



PROJECT AIR FORCE

- CHILDREN AND FAMILIES
- EDUCATION AND THE ARTS
- ENERGY AND ENVIRONMENT
- HEALTH AND HEALTH CARE
- INFRASTRUCTURE AND TRANSPORTATION
- INTERNATIONAL AFFAIRS
- LAW AND BUSINESS
- NATIONAL SECURITY
- POPULATION AND AGING
- PUBLIC SAFETY
- SCIENCE AND TECHNOLOGY
- TERRORISM AND HOMELAND SECURITY

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

This electronic document was made available from www.rand.org as a public service of the RAND Corporation.

Skip all front matter: [Jump to Page 1](#) ▼

Support RAND

[Purchase this document](#)

[Browse Reports & Bookstore](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore [RAND Project AIR FORCE](#)

View [document details](#)

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND electronic documents to a non-RAND website is prohibited. RAND electronic documents are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see [RAND Permissions](#).

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Global Demographic Change and Its Implications for Military Power				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) RAND Corporation, Project AIR FORCE, 1776 Main Street, P.O. Box 2138, Santa Monica, CA, 90407-2138				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

This product is part of the RAND Corporation monograph series. RAND monographs present major research findings that address the challenges facing the public and private sectors. All RAND monographs undergo rigorous peer review to ensure high standards for research quality and objectivity.

Global Demographic Change and Its Implications for Military Power

Martin C. Libicki, Howard J. Shatz, Julie E. Taylor

Prepared for the United States Air Force

Approved for public release; distribution unlimited



PROJECT AIR FORCE

The research described in this report was sponsored by the United States Air Force under Contract FA7014-06-C-0001. Further information may be obtained from the Strategic Planning Division, Directorate of Plans, Hq USAF.

Library of Congress Cataloging-in-Publication Data

Global demographic change and its implications for military power / Martin C. Libicki, Howard J. Shatz, Julie E. Taylor.

p. cm.

Includes bibliographical references.

ISBN 978-0-8330-5177-6 (pbk. : alk. paper)

1. United States—Military policy—Forecasting. 2. Armed Forces—Mobilization—Forecasting. 3. Demographic transition. 4. Manpower policy—United States. 5. Population aging—Economic aspects. 6. Security, International—Economic aspects. 7. War—Forecasting. I. Shatz, Howard J. II. Taylor, Julie E., 1968- III. Title.

UA23.L555 2011
355'.033073—dc23

2011020355

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

Cover image courtesy of iStockphoto.

© Copyright 2011 RAND Corporation

Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Copies may not be duplicated for commercial purposes. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. For information on reprint and linking permissions, please visit the RAND permissions page (<http://www.rand.org/publications/permissions.html>).

Published 2011 by the RAND Corporation

1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

1200 South Hayes Street, Arlington, VA 22202-5050

4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665

RAND URL: <http://www.rand.org>

To order RAND documents or to obtain additional information, contact

Distribution Services: Telephone: (310) 451-7002;

Fax: (310) 451-6915; Email: order@rand.org

Preface

Air Force planners are charged with designing an air force that can fly, fight, and win tomorrow's wars. In doing so, it helps to have a sense of what tomorrow looks like, particularly with respect to how it differs from today. Many of the changes that will take place between today (2011) and, say, 2050 are, for all practical purposes, unpredictable. Nevertheless, there are a few factors for which one can confidently assert that tomorrow will differ in specific ways from today. Technology is one. Demographics—the age and geographic distribution of future populations—are another. Thus, while forecasting, in general, may seem no better than throwing darts, it may be useful to first move the dartboard in the direction of knowable change.

This monograph analyzes the following question: What is the impact of demographics on the prospective production of military power and the causes of war? It addresses this issue by, first, projecting working-age populations; second, assessing the influence of demographics on manpower, national income and expenditures, and human capital; and, third, analyzing how the ability to carry out broad missions is affected by manpower, available national income, and human capital. The monograph also examines some implications of these changes for other aspects of international security.

The research described in this monograph was sponsored by the Director of Strategic Planning, Office of the Deputy Chief of Staff, Strategic Plans and Programs, Headquarters United States Air Force (HQ USAF/A8X). The study was performed within the Strategy and Doctrine Program of RAND Project AIR FORCE.

RAND Project Air Force

RAND Project AIR FORCE (PAF), a division of the RAND Corporation, is the U.S. Air Force's federally funded research and development center for studies and analyses. PAF provides the Air Force with independent analyses of policy alternatives affecting the development, employment, combat readiness, and support of current and future air, space, and cyber forces. Research is conducted in four programs: Force Modernization and Employment; Manpower, Personnel, and Training; Resource Management; and Strategy and Doctrine.

Additional information about PAF is available on our website:
<http://www.rand.org/paf.html>

Contents

Preface	iii
Figures	ix
Tables	xi
Summary	xiii
Acknowledgments	xxv
Abbreviations	xxvii
CHAPTER ONE	
Introduction	1
Organization	3
CHAPTER TWO	
Numbers	7
Fertility Rates	9
Survival Rates	19
Migration	21
Projections	24
Youth Bulges to Come?	38
Projected Muslim Populations	40
Conclusions	44
CHAPTER THREE	
Long-Term Trends in National GDP	47
Forecasts of GDP per Working-Age Population	48
Uncertainties in the Relationship Between Aging and GDP	55
Conclusions	58

CHAPTER FOUR

The Economic Burden of Aging Populations..... 59

Policies Plus People Equals Burden 59

A Profile of the Aging World 61

The Advanced Countries 64

The Developing Countries 66

Medical Expenditures 68

Ambiguities in the Relationship Between Aging and Medical
Expenditures..... 69

Counterevidence That Costs May Rise with Aging..... 72

Summing Up Aging and Medical Costs 74

Pension Expenditures and the Fiscal Burden 75

Implications for the Fiscal Burden, or the Lack Thereof 77

Conclusions 79

CHAPTER FIVE

The Influence of Demographics on the Causes of War 83

CHAPTER SIX

The Impact of Demographic Trends on Military Power

Projection 89

Manpower, Money, and Technical Expertise..... 90

Manpower 91

National Income 93

Technical Expertise..... 94

Other 95

The Contribution of Demographics to Various Military Missions..... 95

Nuclear Coercion 96

Commons Control..... 97

Surveillance..... 99

Conventional Combat..... 100

Raids and Seizures 102

Counterinsurgency 102

Military Operations Other Than War..... 106

Implications..... 107

CHAPTER SEVEN

Implications..... 111
 Findings 111
 Major Themes 113
 The Once and Future Indispensable Nation..... 114
 The Shrinking Zone of War 117
 Lessons for the Air Force..... 119

APPENDIXES

A. Delayed Maternity and Fertility Rates..... 121
B. Trade-Offs Between Fertility Rates and Migration Rates..... 125

Bibliography..... 131

Figures

S.1.	Projected Working-Age Populations of 15 Large Countries Under Medium Variant and Constant-Fertility Variant Projections	xvii
2.1.	Total Fertility Rate Trends by Country—Upper-Income Countries	12
2.2.	Total Fertility Rate Trends by Country—Middle-Income Countries	13
2.3.	Total Fertility Rate Trends by Country—Lower-Income Countries	14
2.4.	Total Fertility Rate Trends by Country—Latin America.....	15
2.5.	Birth Years of Country’s Largest Five-Year Cohort.....	16
2.6.	Current Total Fertility Rate by Country.....	17
2.7.	Expected Changes in Working-Age Populations, 2010–2030.....	35
2.8.	Projected Populations for 15 Large Countries: Medium Variant and Constant-Fertility Variant Forecasts Compared.....	37
2.9.	Working-Age Populations for NATO Countries	38
2.10.	Working-Age Populations for Asia-Pacific Countries	39
2.11.	Percentage of Population Composed of Males Aged 15 to 25—Non-Islamic-Majority Countries.....	40
2.12.	Percentage of Population Composed of Males Aged 15 to 25—Islamic-Majority Countries.....	41
3.1.	Gross National Product per Working-Age Person Relative to U.S. Levels.....	51
3.2.	Demographics or Economics?	55
4.1.	Number of Old-Old People (85+) for Every 100 Working-Age Adults.....	63

x Global Demographic Change and Its Implications for Military Power

A.1.	Long-Term Effects of a One-Time Decision by Women to Have Children Later in Life.....	123
B.1.	Working-Age Population Projection of a Hypothetical Germany-Like Country with Alternative Birth and Migration Rates.....	126
B.2.	Working-Age Population Projection of a Hypothetical Country with ZPG Fertility Rates Under Alternative Future Fertility Rate and Migration Assumptions.....	128

Tables

2.1.	Global Age Distribution, 2010	18
2.2.	Past and Projected Working-Age Population by Country	28
2.3.	Past and Projected Working-Age Population for Selected Regions.....	33
4.1.	Projected Annual Improvements in Mortality Rates for the United States from 2005 to 2050.....	66
4.2.	Age-Specific Medical Expenditures.....	68
A.1.	Percentage of All Childbirths to Women of Succeeding-Age Cohorts.....	122

Summary

It is far easier to notice change marked by singular events—the falling of the Berlin Wall, the attack on the World Trade Center—than change that takes place over time. The latter may initially be hard to detect, but such change can profoundly transform societies, influencing a host of social, economic, and political issues.

Demographic change is almost always slow change, but it is quite powerful and, for the most part, inexorable. Barring catastrophe, we know how many 25-year-olds the world will house in 2030 because they have already been born and have all passed infancy (after which point their prospective survival rates are, in most places, nearly 100 percent). Given the limited numbers and persistent patterns of immigration, we have a fairly good idea how many 25-year-olds every country will house in 2030 as well.

To generalize further, we have a fairly good idea of how many people of working age—herein defined as between 20 and 60—will inhabit each of the world’s nations between now and 2030, and a rough idea of how many will by 2050. Working-age populations are what determine the demographic component of national power. The contribution from those under 20 or over 60 tends to be relatively small and is unlikely to reflect the conclusions drawn from limiting working age to those years.

This monograph analyzes the following question: What is the impact of demographics on the prospective production of military power and the causes of war? It addresses this issue by, first, projecting working-age populations; second, assessing the influence of demo-

graphics on manpower, national income and expenditures, and human capital; and, third, analyzing how the ability to carry out broad missions is affected by manpower, available national income, and human capital. The monograph also examines some implications of these changes for other aspects of international security.

Numbers

So, what do the numbers tell us about the future?

The number of people in the world is completely determined by the number of births and deaths; at the national level, net migration has to be factored in. In general, births are the most important of the three determinants of population, in the sense that birthrates can vary greatly from one decade to the next. Death rates, by contrast, are relatively predictable in timing. As for migration, most countries worth migrating to limit how many newcomers they get, more or less successfully.

Forty years ago, one could confidently assert that the rich got richer and the poor had babies—and lots of them. Women in almost all developing countries averaged four to seven surviving children over their lifetime. Women in developed countries averaged two to three. With too many people on a planet with fixed resources, many prophesized doom.

Since then, fertility rates in the richer countries have continued to fall and now range from just over one child per woman (Hong Kong, South Korea) to just over two children per woman (the United States), and they appear to have stabilized at this level or increased slightly (whether these recent upward blips are only timing effects or foreshadow increases in completed fertility is, so far, unclear).

In Communist and former Communist countries, they have fallen even harder, either from fiat (e.g., China's one-child policy) or from the aftereffects of the collapse of Communist rule. Rates in Russia and Eastern Europe are well below the rate necessary to maintain populations in the long run.

Births in the middle-income lands—Latin America, northern Africa, Turkey, Lebanon, Iran, formerly Soviet Central Asia, southwestern India, and Southeast Asia—have also fallen sharply to somewhat above two per woman or lower (e.g., Thailand).

The swath between Afghanistan, Pakistan, and the Ganges Valley is still adding population; fertility rates average above three and a half children per woman.

Sub-Saharan Africa, between the tropics of Cancer and Capricorn, is adding population even faster. Fertility rates in most of these countries have been generally falling for 30 years, although the declines have stalled in some during the past decade.

The consequence of what has already taken place in the world's maternity wards (so to speak) will unfold over the next 20 years.

First, the United States, alone of all the large affluent nations, will continue to see (modest) increases in its working-age population thanks to replacement-level fertility rates and a likely return to vigorous levels of (mostly legal) immigration. Meanwhile, the working-age populations of Europe, Japan, and the Asian Tigers (South Korea, Taiwan, Singapore, and Hong Kong) are slated to fall by as much as 10 to 15 percent by 2030, and as much as 30 to 40 percent by 2050. The United States will account for a larger percentage of the population of its Atlantic and Pacific alliances; to put it another way, the capacity of traditional alliances to multiply U.S. demographic power is likely to decline, perhaps sharply, through 2050.

Second, India's working-age population is likely to overtake China's by 2030. Today, China's working-age population is just under five times larger than the U.S. working-age population. By 2050, it may be only just over three times larger. Conversely, the ratio of India's working-age population to the U.S. working-age population will evolve in the opposite direction: just over three times larger today, but five times larger in 2050.

Third, the working-age populations of most middle-income developing countries (e.g., Brazil, Indonesia) are likely to reach major inflection, or even deflection, points by or just before 2030.

Fourth, barring catastrophe, many of the world's most populous countries will be in Africa: Nigeria, Ethiopia, Congo, Sudan, and Tanzania.

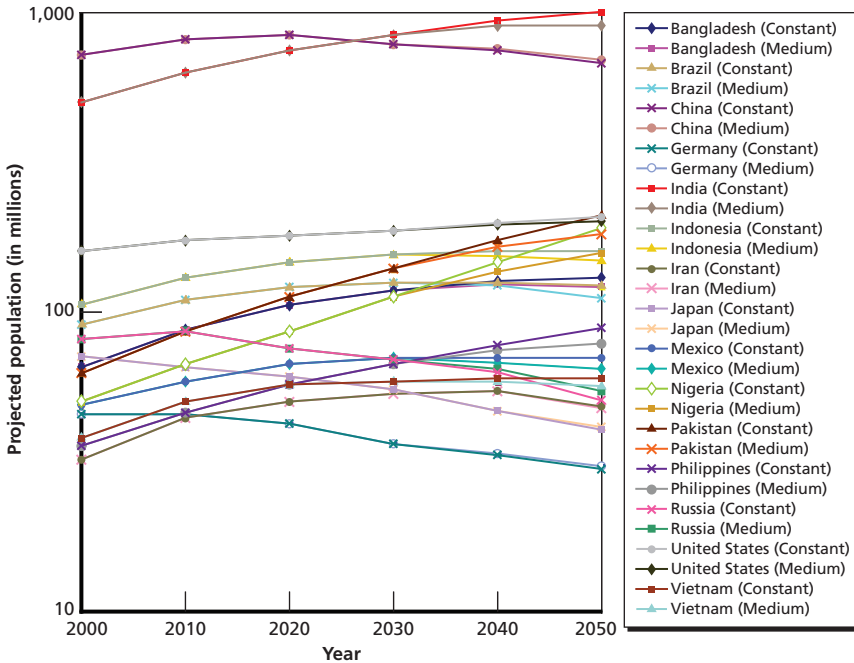
Despite these trends, the prospects that differential birth rates will lead to cross-border conflict are limited. Rarely do the low-birthrate portions of the world abut the high-birthrate portions of the world; typically, they are separated by countries whose fertility rates have only recently fallen to relatively low levels. Furthermore, the countries from which the rich nations have drawn and are still drawing immigrants no longer have high birthrates. Fertility rates are similar on both sides of the Rio Grande. Fertility rates in Algeria are only slightly higher than in France and comparable to those of Turkey. Fertility rates in Central Asia are only slightly higher than on the Islamic side of the Mediterranean but are much higher than in Russia because of the latter's birth dearth.

The inevitability of these demographic changes, certainly through 2030 and to a large extent to 2050, can be gauged by examining two different United Nations projections: One assumes that today's fertility rates stay constant; the other assumes that they converge through 2050 to a universal average of 1.85 babies per woman. Figure S.1 graphs the population (logarithmically) of 15 large countries under both variants. One can see that the two curves diverge after 2030, but never by much—and not enough to alter the underlying trends.

Three factors account for why large plausible differences in birthrates hardly affect working-age populations even 40 years out: (1) The older half of the working-age population has already been born; (2) predicted birthrates do not diverge instantly, but over time; and (3) decades of low birthrates mean that the number of potential mothers is depressed (and the reverse is true after decades of high birthrates).

Two related questions merit note. One is whether developing nations (particularly in the Islamic world) will suffer from a destabilizing youth bulge—specifically, a growing share of the population composed of males between the ages of 15 and 25. The short answer is “no”: This percentage will decline almost everywhere for decades to come, although some countries will see slight upticks in the percentage over one or another five-year period. The second is the prospect of Europe turning into “Eurabia” as the share of its population that is Muslim approaches or exceeds 50 percent. The short answer is “not yet.” If one assumes constant migration rates and that the demographics of

Figure S.1
Projected Working-Age Populations (in millions) of 15 Large Countries
Under Medium Variant and Constant-Fertility Variant Projections



SOURCE: Data from United Nations Population Division, 2009.

RAND MG1091-S.1

Europe's Muslim population resemble those of the countries from which it draws its immigrants, then the Muslim share of France's and Germany's working-age populations reaches roughly 15 and 10 percent, respectively, by 2050. By contrast, Russia's Muslim population could double to reach 30 percent of the total.

Incomes

To the extent that a nation's power depends on its gross domestic product (GDP), it is possible that large, putatively unpredictable differences in economic growth rates from one country to another could swamp the slow but predictable international differences in population growth

rates. If so, population may be quite secondary in evaluating a nation's potential military power.

To determine whether this might be so, the research reported here looked backward at the rate of change in national per capita GDP from 1980 to 2007 for the 37 most populous countries.¹ The numbers indicate that the standard deviation in annual per capita GDP growth rates (1.94 percent) is only 50 percent larger than the prospective standard deviation in the growth of working-age populations from 2010 to 2030 (on average, 1.29 percent). If China and Congo are excluded, the two numbers are closer: 1.46 percent for GDP per capita and 1.24 percent for prospective working-age populations. Although international economic growth variations are larger, they are not overwhelmingly so. Demographic change can be regarded as a separate and important influence on a nation's power. Because the per capita GDP growth of rich countries has been roughly the same since 1980, demographic growth assumes singular importance in making international comparisons among them.

However, past income growth and future population growth (which is to say, past birthrates) are negatively correlated to a modest extent: Every 1-percent difference in the former is associated with a 0.25-percent difference in the latter.

Aging

Nearly every country in the world (and the rural areas of all countries) is aging, and the number of people above working age will rise relative to the number of working-age adults. Today, Brazil has 18 older individuals for every 100 working-age adults; Japan, 53. Accounting for population aging, projections indicate that by 2050 Brazil will have 59 older individuals for every 100 working-age adults; Japan, today and in the future among the most aged countries in the world, will have 109

¹ GDP is measured in purchasing power parity, as measured by the World Bank (World Databank, "World Development Indicators, 2007," accessed December 15, 2010), divided by the working-age population.

older individuals for every 100 working-age adults. Just as the proportion of older adults in general will rise, the proportion of those aged 85 or older, the “old-old,” will rise as well. The number of old-old people in Japan is projected to rise from 6 per 100 working-age adults in 2010 to 24 per 100 working-age adults in 2050.

Population aging carries economic costs. Medical costs, on average, rise at the end of life irrespective of age, so a higher proportion of elderly people in the population means a higher proportion bearing end-of-life costs in the short run.² Severe age-related disabilities may create further cost pressures. Since the elderly rarely work, paying for their health care has become, in many cases, a government expense.

A second economic cost is pensions. Nearly all developed countries use a pay-as-you-go pension system, meaning that the tax revenues from current workers are used to pay the pensions for the current elderly. As the proportion of elderly to workers rises, fewer and fewer workers will support more and more elderly. Most such systems are not financially sustainable with today’s policies.

On the face of it, the demographic trends affecting the end of life—longer life spans and the imminent retirement of the baby boomers in the developed countries—are likely to exacerbate the effect of trends associated with the beginning of life—lower birthrates (although aging increases the dependency ratio and lower birthrates decrease it, the latter is true only in the short run). The growing ranks of the elderly do this by drawing on public resources to fund their pensions and health care, thereby limiting what can be spent on other national ends. Both effects work against the ability of aging societies to defend themselves or contribute to the defense of others.

But there are policy solutions. Public pension systems currently provide incentives for early retirement, and many societies are unreceptive to older workers. Raising retirement ages, changing the terms of pension systems so that pension payouts are greater for people who retire later, and improving training and workplace laws to make labor markets more hospitable to older workers are three measures that can keep older workers in the labor force. This, in turn, can increase tax rev-

² In this monograph, *elderly* is used as a general term for those who are past middle age.

enues and the ability of governments to support pension and medical payouts, along with the ability to spend on defense. However, whether these steps will be taken is a matter of politics, and politics is far harder to predict than demographics.

Demographic Influences on the Tendency Toward War

The academic literature has examined several types of relationships between overall demographic growth and the tendency of nations to go to war; three perspectives have received a good hearing.

The first argues that population pressures and fixed land resources (the quality of which is deteriorating precisely because of population pressures) may combine to create new causes for war. The second argues that young men, particularly in China but also India, will so greatly outnumber young women that a significant share will remain womanless and hence may be prone to gang violence—or, worse, may serve as fodder for future wars by states just as happy to be rid of them. The third argues that an aging world is a peaceful world, mostly because supporting the elderly draws resources from what would otherwise be spent on military endeavors, and, speculatively, because the old are not as hormonally prone to violence as the young. All three may be true, but the last appears most plausible.

Implications for Military Power

A world of states that compete militarily, border one another, and have comparable technologies (but no nuclear weapons) is one in which demographics had a considerable impact on relative national power (e.g., the Franco-Prussian/German rivalry between the mid-1800s and the mid-1900s). Circumstances are different today. Conquest rarely wins riches or even security. The world's rich countries are allies of one another. Rich low-birthrate countries generally do not border high-birthrate countries. Finally, nuclear weapons can be a great equalizer,

keeping poor small nations from being intimidated by larger and richer ones.

But, then, how do demographics correlate to national power today? To address this, we focused on three core resources of military power: manpower, money (GDP), and the supply of very talented individuals for software and systems integration. The size of a nation's working-age population is directly related to all three: trivially in the first case, by multiplication with a nation's productivity in the second case, and through the enlargement of the pool from which technical expertise can be found in the third case.

Many steps separate the raw material of national power from power itself. Each of these three elements has to be converted into military strength. The quantity and quality of warfighters depend on recruitment policies, education and training policies, and cultural factors (e.g., the willingness of people to join the military). The conversion of national income into military expenditures depends on taxes, budget policy, the efficiency of the process by which requirements are formed and converted into product, and the country's access to technology. The ability to exploit technical experts requires that they work on the right problems. Then military power has to be converted into warfighting (or war-detering) effectiveness, which has to be translated somehow into national security and well-being. The chain is long, but it all starts with resources.

The study then assessed the relative importance of each of these three broad resource components of military power to a canonical set of military missions, as follows:

- Demographics are a relatively minor factor in predisposing the outcomes of **nuclear standoffs**, particularly when compared to intangibles, such as determination.
- Apart from the manpower requirements of maintaining an air force or navy, building an effective capability to **control the commons** is largely a matter of having money and technical expertise, rather than manpower.

- The most important factors in enabling **surveillance** systems are money (to pay for the sensors) and technical expertise (to program the sensors and enable systems integration).
- Manpower, money, and, to a growing extent, technical experts are all important components in **conventional warfare**. Over the last 50 years, however, the balance has been shifting away from manpower and toward money and, especially, software.
- **Raids and seizures** require manpower—with an emphasis on quality in the case of raiders and quantity in the case of defenders.
- National institutions to produce highly skilled and worldly wise warfighters are required for many aspects of **counterinsurgency**, especially as the latter becomes a “thinking man’s” war. Money can also be used to purchase command, control, communications, and computers intelligence, surveillance, and reconnaissance (C4ISR) and signals-intelligence equipment (for support of border-keeping as well as gathering intelligence on high-value targets, attack plans, and so on) and logistics (for rapid intervention). Yet, it is no substitute for skilled manpower, the sine qua non of counterinsurgency.
- Manpower, backed by enough money for logistics, is essential for **military operations other than war**.

From this one may infer that a military contest between a smaller rich country and a larger poor one will find each side trying to define the war in terms that each can do well in. What starts off as control over the local commons and the attempt by one to impose surveillance regimes on the other may descend into conventional combat and further descend into an insurgency or low-intensity warfare—and perhaps back again. Asymmetric opponents produce asymmetric wars.

Conclusions

Barring catastrophe, the United States appears likely to have the demographic and economic resources to remain the world’s indispensable

nation through at least 2050.³ Its birthrate and immigration rates are high enough to keep its population rising, albeit in the 0.5 to 1 percent per year range (once the effects of the current recession on immigration rates wear off). The United States, which has 4.7 percent of the world's working-age population, will still have 4.3 percent by 2050.⁴ When the relative flatness of the ratio between U.S. GDP per capita and those of most other nations is factored in, the current share of global GDP accounted for by the U.S. economy is likely to stay quite high.

China is likely to become the most important contender over the next 40 years in terms of national resource base, but its relative GDP has everything to do with how high its per capita productivity gets vis-à-vis the United States. If it achieves Japan-like levels of productivity by 2050, its GDP will be double America's. If, however, it begins to level off as it approaches productivity levels characteristic of South Korea today, then China's economy will be somewhat larger than the American economy. Finally, if the many challenges that China has—pollution, corruption, and financing the elderly—are not met, China may reach an economic inflection point earlier rather than later and fail to surpass U.S. GDP levels. Demographics suggest that if China's economy cannot surpass the United States' by 2050, it might never do so.

Lessons for the Air Force

The effect of international demographics on what the Air Force does over the next four decades reflects potential differences in the components of national power from one country to another.⁵

The relative power of America's traditional allies is falling vis-à-vis both emerging economies and high-growth nations. True, the U.S.

³ This description of the United States became well-known when Secretary of State Madeleine Albright started including it in her speeches.

⁴ If one assumes that the U.S. fertility rate, which, uniquely, is higher than it was in the last generation, stays constant and that illegal immigration continues at rates characteristic of the last ten years, then the U.S. percentage of total world population might not decline at all.

⁵ National demographics—e.g., the geographic, ethnic, and educational composition of the United States—were not examined in this study. Yet, they have profound implications for how the Air Force recruits.

share of the world's power may not be shrinking so quickly, and so the independent capability of the U.S. Air Force (USAF) to carry out global surveillance and global strike may remain. However, to the extent that the success of the USAF depends on its ability to work with others, notably other air forces, the shift in relative power should portend a shift in those countries with which the USAF has to interoperate. It is one thing to accommodate the expansion of the North Atlantic Treaty Organization (NATO) in the sense of having new partners with whom to interoperate, but the new NATO countries have shrinking populations. The harder task for the Air Force is to learn how to interoperate with rising and still-growing countries that have different cultural contexts and value structures. Yet, if the United States and its allies are to retain the same share of global power, then new countries have to be reached out to. Interoperability is likely to be a challenge, but, as with many such challenges, the earlier they are undertaken, the more time is available for working out the kinks. Here, the USAF needs to lean into the future.

The shrinking zone of instability worldwide, for its part, suggests that the current emphasis on counterinsurgency ought not to be confused with the Air Force's long-term future. The easy tendency to associate the Muslim world with rapid population growth is only partially correct. North Africa, Turkey, Iran, formerly Soviet Central Asia, Malaysia, Indonesia, and even Bangladesh have birthrates that are below or no more than 20 percent above zero population growth levels (2.1 births per female). *Muslim* may not equate to *unstable*. If demographic factors explain insurgencies as much as or more than economic factors do, then declining birthrates would, over decades, shrink the number of places heir to insurgencies, irrespective of the future of economic growth. By contrast, issues associated with protecting the air, sea, space, or cyberspace commons or maintaining surveillance are far less dependent on demographic factors and are likely to maintain or even increase their relevance over the next few decades.

Acknowledgments

We wish to acknowledge some of the individuals who assisted us in the preparation of this monograph. Brig Gen Mark Ramsay, our initial project sponsor at HQ USAF/A8X, provided the intellectual context for our efforts and specifically requested this study. David Shlapak (PAF), David Ochmanek (now at the Office of the Secretary of Defense), and Andrew Hoehn (PAF) provided intellectual encouragement for this effort. Aine McCarthy, a research associate, provided us with much of the basic statistical material for our model. Consultations with William Butz and Carl Haub (both from the Population Reference Bureau) and with Richard Jackson (from the Center for Strategic and International Studies) offered us friendly tips on how to approach the demographics problem. We also gratefully acknowledge the help and suggestions offered by our reviewers, Megan Beckett, William Butz, and Ashley Tellis.

Abbreviations

ADL	activities of daily living
AIDS	acquired immune deficiency syndrome
C4	command, control, communications, and computers
CORDS	civil operations and revolutionary development support
GDP	gross domestic product
GNP	gross national product
HCE	health care expenditures
HDI	human development index
IADL	instrumental activities of daily living
ISR	intelligence, surveillance, and reconnaissance
NATO	North Atlantic Treaty Organization
NRC	National Research Council
OECD	Organisation for Economic Co-Operation and Development
OMB	Office of Management and Budget
PAF	Project AIR FORCE
PPP	purchasing power parity

RF	radio frequency
SIPRI	Stockholm International Peace Research Institute
TFR	total fertility rate
TRICARE	health care program serving active-duty military service members, National Guard and Reserve members, retirees, their families, their survivors, and certain former spouses worldwide
UAV	unmanned aerial vehicle
UN	United Nations
USAF	U.S. Air Force
ZPG	zero population growth

Introduction

It is far easier to notice change marked by singular events—the falling of the Berlin Wall, the attack on the World Trade Center—than change that takes place over time. The latter may initially be hard to detect, but such change can profoundly transform societies, influencing a host of social, economic, and political issues. Global warming, industrialization, and the rise of the automobile and the information society have all produced monumental changes, but they did not have memorable before and after dates; their passage is not sharply delineated. While protracted changes are significant in and of themselves, for military and foreign policy planners they are important because they can have both direct and indirect effects on relations among states.

The sooner planners can identify and characterize these slowly unfolding trends, the better they can prepare for possible repercussions and, in some cases, work to reverse adverse trends. Yet, people rarely notice them in their formative stage. Major change often has a large head of steam behind it before it is recognized as such; even then, it can take a long time before a dominant consensus on the trend emerges, if it ever does. These changes may be subtle and their impacts difficult to predict, but their possible effects are too significant to ignore. Because of such uncertainties, it is crucial that institutional planners acquire the ability to grasp the implications of fundamental long-run changes, particularly when such institutions themselves would play a large role in shaping the future.

Demographic change is one such slow and inexorable change, whose political implications have only recently begun to be recog-

nized.¹ Prior to 2000, one heard occasional prophecies that the incessant population growth in the developing world (also known as the poorer countries) would erode the dominant economic and military position of the developed world (also known as the richer countries, or, simply, the West).² Today, such demographic concerns appear closer to the surface and feature prominently in popular and academic writing. Articles about Europe and Japan often refer to aging populations and looming pension crises there. Russia is commonly described as a demographic basket case, with low fertility rates and startlingly short life spans (particularly for men). China's long-term future, otherwise bright, nevertheless induces hand-wringing about a country that will "grow old before it grows rich." And growing concern is expressed about what is characterized as unchecked population growth in sub-Saharan Africa and parts of the Middle East.

Yet, despite greater discussion of demographic issues (in particular, their impact on each country's domestic policy), there is less discussion concerning the implications for international security. The lack of coverage is not surprising, given that the impact on international affairs is often indirect and less obvious, though no less important. To illustrate, for some countries, a spike in population growth (a rare occurrence) could be a "demographic gift": If the government is able to invest in its youth, they could become an engine of future economic growth. Alternatively, if the country simultaneously faced an economic crisis that precluded investments in education and social services, the population spike could spawn internal instability and illegal migration flows that might strain relations with neighbors and even invite intervention by

¹ As examples, see Brian Nichiporuk's pathbreaking *The Security Dynamics of Demographic Factors*, Santa Monica, Calif.: RAND Corporation, MR-1088-WFHF/RF/DLPF/A, 2000; and David E. Bloom, David Canning, and Jaypee Sevilla, *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*, Santa Monica, Calif.: RAND Corporation, MR-1274-WFHF/DLPF/RF/UNPF, 2003. For a later comprehensive treatment, see Richard Jackson and Neil Howe, with Rebecca Strauss and Keisuke Nakashima, *The Graying of the Great Powers: Demography and Geopolitics in the 21st Century*, Washington, D.C.: Center for Strategic and International Studies, 2008.

² See, for instance, Matthew Connelly and Paul Kennedy, "Must It Be the Rest Against the West?" *The Atlantic Monthly*, December 1994.

the international community. As the comparisons show, demographics alone explain very little in international security—but demographics and other factors together may explain a lot. Demographics are just one ingredient in a complex dish,³ and unpredictable events (economic crises, wars, assassinations of powerful leaders, etc.) make any conclusions highly probabilistic. Yet, even though pure chance always plays a big role in determining outcomes, the future is not a random scattering of possibilities. Combining an analysis of demographics (the most predictable long-term change) with other predictable changes (technology, resource depletion, the composition of the atmosphere, and economic growth) can circumscribe a range of possible outcomes. The breadth and the reliability of this range of “futures” will depend on the issue under consideration. In examining national entitlements budgets 20 years hence, predictable demographic change is likely to play a large role. In forecasting the level of terrorism a country will experience, perhaps not so much.

Organization

This monograph analyzes the following question: What is the impact of demographics on the prospective production of military power and the causes of war? It addresses this issue by, first, projecting working-age populations; second, assessing the influence of demographics on manpower, national income and expenditures, and human capital; and, third, by analyzing how the ability to carry out broad missions is affected by manpower, available national income, and human capital. The monograph also examines some implications of these changes for other aspects of international security.

Although the monograph’s many implications for the military context are relevant to the U.S. Air Force (USAF), their scope is

³ For a more technology-oriented view of the components of national power, see Ashley J. Tellis, Janice Bially, Christopher Layne, Melissa McPherson, and Jerry M. Sollinger, *Measuring National Power in the Postindustrial Age*, Santa Monica, Calif.: RAND Corporation, MR-1110-A, 2000, especially Chapter Four, “Toward a Revised View of Measuring National Power.”

broader than that of the Air Force alone. Nevertheless, certain of the warfighting areas in Chapter Six are predominantly relevant for the Air Force and should be understood in that light.

The remainder of this monograph is organized into six chapters and two appendixes.

Chapter Two presents the forecasts on which the monograph is based. We took our numbers (specifically, population by sex and five-year age group) from the United Nations Population Division,⁴ using their medium-fertility-rate and constant-fertility-rate projections through the year 2050. The primary focus for the implications chapter is on the economically and militarily active population (i.e., those between 20 and 60) through 2030—all of whom were already born by 2010—as a way of discerning underlying factors in relative national power.

Chapter Three examines past trends in national income (specifically, gross domestic product [GDP] per working-age individual) to get a sense of how projected international variations in economic growth rates compare with projected international variations in population growth rates. It is motivated by the presumption that national power is a function not only of demographics but also of economics.

Chapter Four takes these data and examines what they may portend for pension and health care costs. The purpose is to test the hypothesis that such costs may crowd out the ability of aging nations to finance military and other security expenditures.

Chapter Five contains a brief review of key arguments that relate the prospects for peace to demographics.

Chapter Six examines some implications of demographic change for a nation's ability to carry out military operations in a world where everyone else's population is changing as well. We look at the foundation of national power in terms of manpower, money, and software—all linked to demographics. We then take a list of broad military missions

⁴ Detailed data can be downloaded by country (five at a time) from the United Nations Population Division, *World Population Prospects: The 2008 Revision Population Database*, last updated March 11, 2009.

to examine to what extent each of them is reliant on one or another of the three supports.

Chapter Seven employs the previous chapter's conclusions to analyze the future trajectory of two important issues: the relative dominance of the United States through 2050 and the ability of the United States or any similar country to intervene overseas.

Numbers

Demographics is a numbers game, and the numbers that matter are births, deaths, and migration. Together, they tell what a nation's population will be—not only in terms of raw numbers, but also with respect to age, sex, and national/ethnic origin. They can also be used to forecast the size of groups (e.g., religions) if trends on affiliation and disaffiliation are taken into account. As will be shown in later chapters, this knowledge can help planners with long-range force planning, force basing, and alliance policies.

Those who forecast demographic trends generally stand on firmer ground than other forecasters do. For instance, if education experts wanted to project the number of college graduates a country might have in 2030, they can extrapolate using a combination of population estimates, educational spending projections, and current graduation rates, but if they make the projection today, their conclusion will be much more tenuous than if they waited to make it in 2026, the year that most 2030 graduates enroll. That is because they will have a less solid, identifiable baseline from which to make the projection. This is the advantage that demographers have over other forecasters: As long as their predictions are limited to the expected lifetime of a cohort which has already been born, they have a clear baseline on which to build their estimates. True, their numbers could be affected downward by unexpected changes in death rates. If one is referring to national populations, changes in migration levels have to be taken into account, but, in general, they vary only within fairly narrow ranges. Thus, if

carefully bounded, demographic projections are probably as close to demographic fact as any forecast can be.

Even higher levels of predictability attend those who focus on working-age populations—those from 20 to 60: Projections of births can be ignored for 20 years, and year-to-year survival rates are already high for those in that age bracket. As it is, the size of a nation's working-age population is what matters to national power—specifically, a nation's ability to raise resources: It supplies the security forces and mans the jobs from whence the nation draws its GDP. The young do not contribute much to national power except prospectively; conversely, raising and educating them consumes resources that, in the short run, draw from resources that could be put to other uses. The old, demographically speaking, also generally subtract from national power;¹ their care, as we explore in Chapter Four, competes for public and private resources.

The precise demarcations of the workforce, entering at 20 and departing at 60, are necessarily arbitrary and approximate. These particular numbers are driven, to some extent, by the tendency of demographic data to be expressed in terms of five-year variables. In rich countries, the combination of college and persistently high youth unemployment means that most 20-year-olds are not in the labor market yet. Some people enter the workforce in their teens; others are being educated or remain unemployed well into their 20s. The contribution of those under 20 to military power is very small, particularly in modern nations. In the United States, for instance, the draft age (between 1948 and 1973) was 18,² but accession usually took place months later at the earliest, and it took months or years of military training, depending on military specialty, before someone became competent as a warfighter. Retirement, for its part, is not necessarily binary (that is, one can partially retire) and does not always happen at

¹ “Generally” because many are still in the labor force and many contribute in many other ways, not least of which is to assist in child-raising. This is distinct from the assets owned by the elderly (in this monograph, *elderly* is used as a general term for those who are past middle age), whose explicit and implicit earnings may contribute to national power.

² Today, 18-year-old males must register for the draft, but there is currently no draft.

60. Some people may be lucky enough to retire early; others, having unluckily lost their jobs while in their 50s, may never again secure full-time employment. Many would like to work but are disabled; if self-employed (e.g., as farmers), they may put in the hours, but their productivity is a fraction of what it would have been if they were healthy. Conversely, it is not uncommon for Americans to keep working into their 60s and beyond (one must be 65 to receive Medicare). By the time European males turn 60, fewer than half hold jobs, and this ratio has been declining since at least 1970.³

All in all, using 20 and 60 as the workforce boundaries is imperfect but not outrageously so.

The rest of the chapter is divided into sections covering (1) recent declines and current trends in fertility rates, (2) trends in death and migration rates, (3) projected working-age populations by country, (4) potential future youth bulges, and (5) Islamic populations.

Fertility Rates

The most prominent feature of demographics over the past few decades has been the sharp fall in almost every country in the world in the fertility rate: technically, in the total fertility rate (TFR), the mean number of births a woman can expect over her lifetime. The pivot of the TFR is the number that, if extended indefinitely, would result in a native-born population that neither grows nor declines—this condition is often referred to as zero population growth (ZPG). Native cohorts with higher fertility rates inevitably grow; those with lower fertility rates inevitably shrink. In rich countries, the break-even fertility rate is 2.1 births for every woman over her lifetime. The difference between

³ Sveinbjorn Blondal and Stefano Scarpetta, “The Retirement Decision in OECD Countries,” OECD Economics Working Papers No. 202, 1999. In Japan, the elderly may “retire” early and transition to life as an independent shop owner of middling productivity. “Companies typically retire workers at 60 and then hire about half of them back, often at 50 to 70 percent of their previous pay. Those who do not get rehired tend to move to a service job such as caretaking or working as a security guard” (“Don’t Go Yet: Why Early Retirement Must Get Later,” *The Economist*, March 25, 2004).

2.1 and what seems like the intuitively correct rate of 2 is caused by two factors. One is the natural tendency for baby boys to outnumber baby girls (the only sex that grows up to become mothers, hence the denominators in the total fertility *ratio*): 1.07 to 1 ratios are typical. The other is the small but nonzero death rate between a woman's birth and adulthood (the great bulk of which is infant mortality⁴). In poor countries, because mortality—especially infant mortality—rates are higher, fertility rates must be correspondingly higher to produce enough women of childbearing age to maintain overall population levels.

In recent years, fertility rates of many countries have fallen below the ZPG rate. The U.S. fertility rate is just at the level that, in the long run, portends ZPG before immigration is factored in. Israel is the only country among the world's affluent nations whose fertility rate is more than high enough to reproduce its population.⁵ All other rich countries will experience inevitable declines in their native cohorts if current fertility rates continue.

Many nonrich countries, notably China, have crossed the ZPG line. China's fertility rate has fallen to below 1.8. Of these children, disproportionately few are female: 47 percent versus the 49 percent that is the biological norm (which means that in 20 years there will be 4 percent fewer women than one would expect based on birthrates alone). China's fertility rate, which is considered quite low for a country in which most people are still poor, is widely considered to be a consequence of its one-child policy, as if to indicate that the lifting of such a policy would result in an immediate rebound in births. Yet, other factors cannot be ruled out. Taiwan and Hong Kong, which, admittedly, are affluent nations but do not have a one-child policy, nevertheless have the world's lowest fertility rates: 1.1 and 1.0, respectively. Neighboring countries in Southeast Asia, such as Vietnam and Thailand, also lack China's one-child policy but have fertility rates at or below ZPG: 2.1 and 1.8, respectively.

⁴ In countries ravaged by the acquired immune deficiency syndrome (AIDS), many women also die before reaching 45.

⁵ That noted, Israel's fertility rate is highest among the two subpopulations that contribute a disproportionately low percentage of their children to the military: Arabs and the Haredim.

The next three graphs illustrate total fertility rates for the world's 55 largest countries (ranked in terms of their projected 2020 population) divided into three groups: upper-, middle-, and lower-income (based on current per capita incomes as measured by the World Bank⁶).

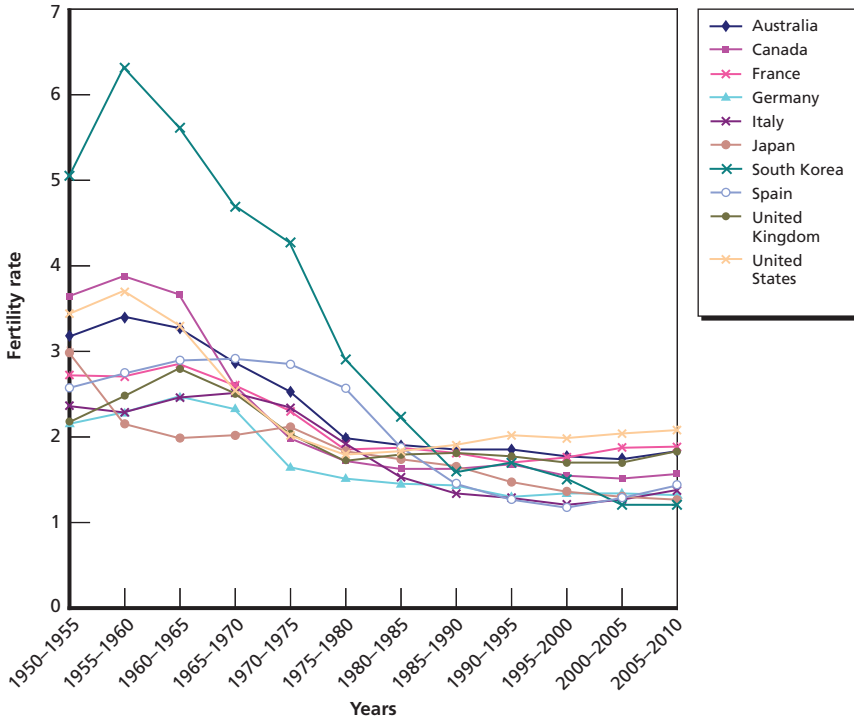
Figure 2.1 depicts ten large rich countries. All of them had, by today's standards, moderately high fertility rates through the early 1960s (South Korea's rate was significantly higher, but it was a poor country then).⁷ By the late 1970s, all but two of them—Spain and South Korea, neither rich at that point—were below ZPG. The U.S. fertility rate bottomed out in the late 1970s and has returned to ZPG level; its fertility rate leads that of the larger rich nations. Every other nation is still below ZPG. One can see some recovery in fertility rates over the last ten or so years. This may represent a slight change in attitudes or decisions by women in their 30s and early 40s to finally have the children they had earlier postponed. Yet, one should not exaggerate the impact of changes in birth timing on fertility rates; Appendix A demonstrates that the effects can be small and temporary. Because rich states have been below ZPG for well over a generation, the size of their child-bearing cohort has been correspondingly reduced, which means that even a return to relatively high fertility rates is unlikely to restore native (i.e., nonimmigrant) population levels anytime soon.

Figure 2.2 depicts the course of fertility for middle-income countries. Although the trends for each country are similar, there are disparities among countries, in large part because today's middle-income countries have been on different development paths. Until 1975, for

⁶ Eric Swanson, *World Development Indicators 2007*, Washington, D.C.: World Bank, April 1, 2004.

⁷ Billari, Kohler, and Myrskylä argue that recent rises in fertility are more than random (or represent babies finally born to women who have postponed childrearing). They point to a systematic positive correlation between a country's fertility levels and its human development index (HDI) once the index crosses a particular level (represented, roughly put, by Eastern Europe). Although their thesis may be proven correct in time, such conclusions may be premature. The number of countries with high HDIs is small, the data points are clumpy (five of the high-HDI countries are Scandinavian and, for that reason, may be expected to be similar), and there are important exceptions (e.g., Japan, Canada) (Francesco Billari, Hans-Peter Kohler, and Mikko Myrskylä, "Advances in Development Reverse Fertility Decline," *Nature*, August 6, 2009, pp. 741–743).

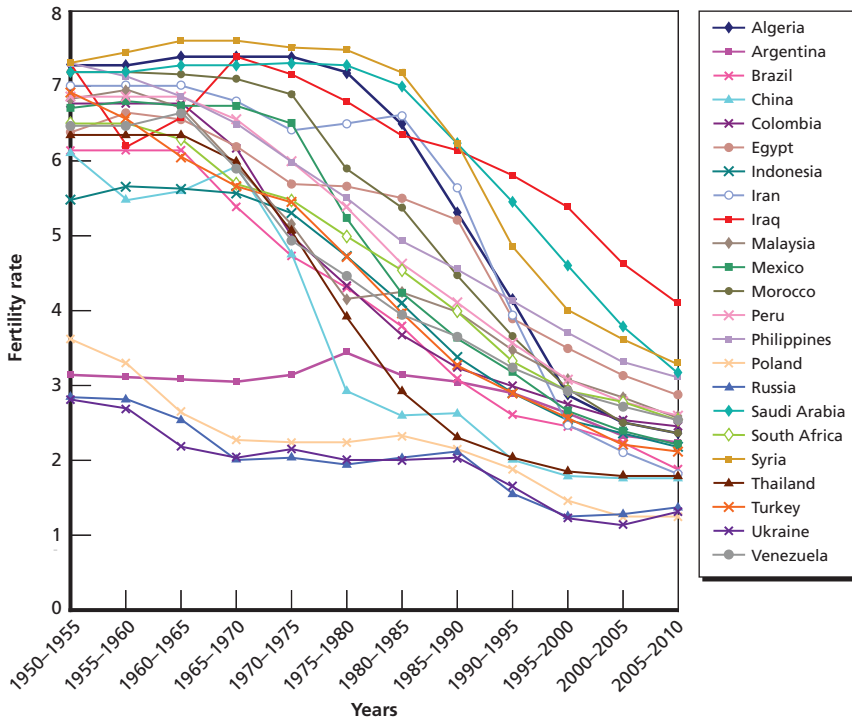
Figure 2.1
Total Fertility Rate Trends by Country—Upper-Income Countries



SOURCE: Data from United Nations Population Division, 2009.
 RAND MG1091-2.1

instance, four medium-fertility-rate countries, Poland, Argentina, Russia, and Ukraine (all at least partially industrialized prior to World War II), stood in high contrast to the 19 high-fertility-rate countries, all of whom had a total fertility rate over 4.5, and some of which were as high as 7.5. Russia, Poland, and Ukraine, in particular, now have very low fertility rates and rapidly aging populations. Starting in the mid-1970s, a substantial decline among China and the other 18 countries set in. The three core Arab countries in the mix, Syria, Iraq, and Saudi Arabia, were late into the fertility decline (Algeria, Egypt, and Iran were almost as late) and, as a consequence, still have rather high fertility levels. Other than those three, the highest fertility rate among middle-income countries is 3.1 (the Philippines), and many middle-

Figure 2.2
Total Fertility Rate Trends by Country—Middle-Income Countries



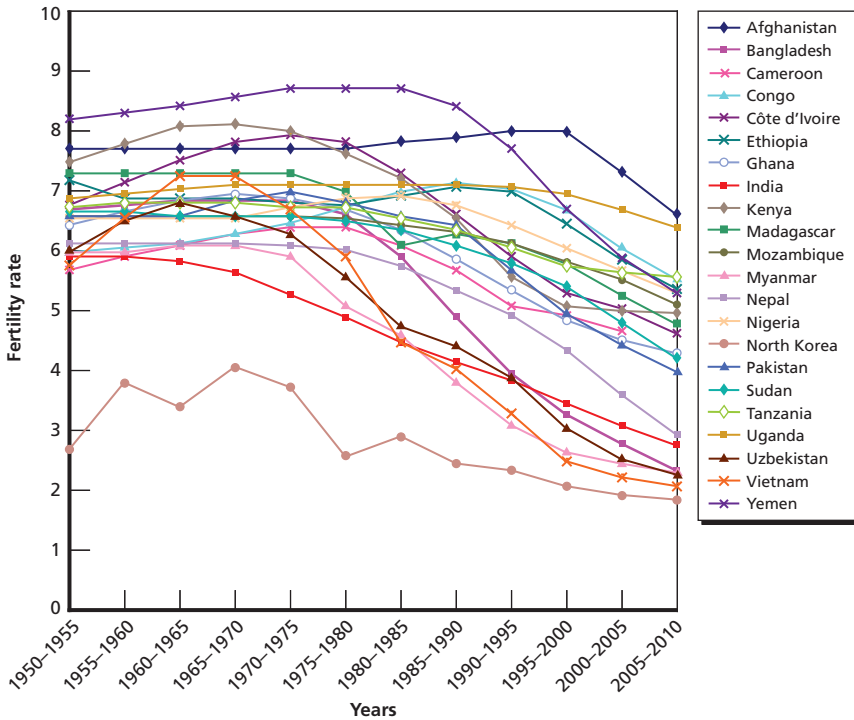
SOURCE: Data from United Nations Population Division, 2009.

RAND MG1091-2.2

income countries (the four long-industrialized nations, plus China, Brazil, Thailand, and Iran) have fertility rates below ZPG levels.

Figure 2.3 depicts lower-income countries. Here, the clustering patterns are different. With the exception of North Korea (semi-industrialized by the end of World War II), all of the large poor countries had fertility rates in excess of five children per woman through the mid-1970s—indeed, on the whole, they were, if anything, rising rather than falling from the early 1950s forward. Since the mid-1970s, and especially since the early 1990s, fertility rates in the poorest countries have all fallen, some more dramatically than others. The most substantial declines were in Asia, notably Vietnam, Myanmar, India, Nepal, and Uzbekistan. Nevertheless, they remain high, with a group of

Figure 2.3
Total Fertility Rate Trends by Country—Lower-Income Countries

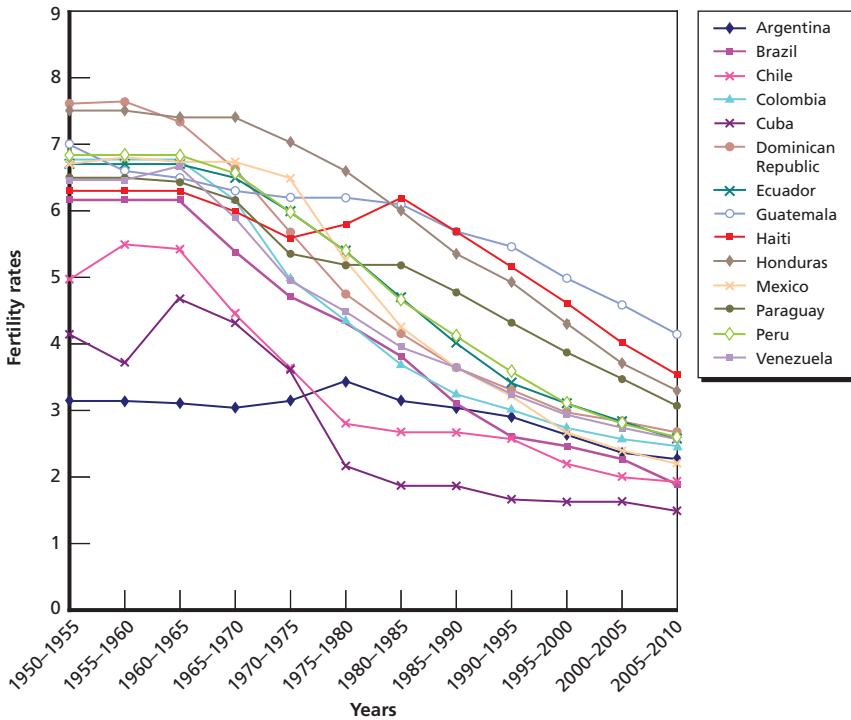


SOURCE: Data from United Nations Population Division, 2009.
 RAND MG1091-2.3

14 countries exhibiting fertility rates clustered between 4 and 5.5 children per female. In general, the world’s poor countries are roughly 20 years behind its middle-income countries in terms of their demographic transition to lower fertility rates.

Finally, Figure 2.4 spotlights the 14 largest countries of Latin America, the region from which the United States draws the major share of its immigrants. The pattern of falling fertility rates recurs but from much higher starting points. Cuba’s fertility rates are similar to those of Western Europe. Guatemala, a poor country, still has very high fertility rates, followed closely by rates in Haiti, a poorer one. Fertility rates in the other countries, however, have, in recent years, fallen toward ZPG within a fairly narrow range, from a TFR just under

Figure 2.4
Total Fertility Rate Trends by Country—Latin America



SOURCE: Data from United Nations Population Division, 2009.

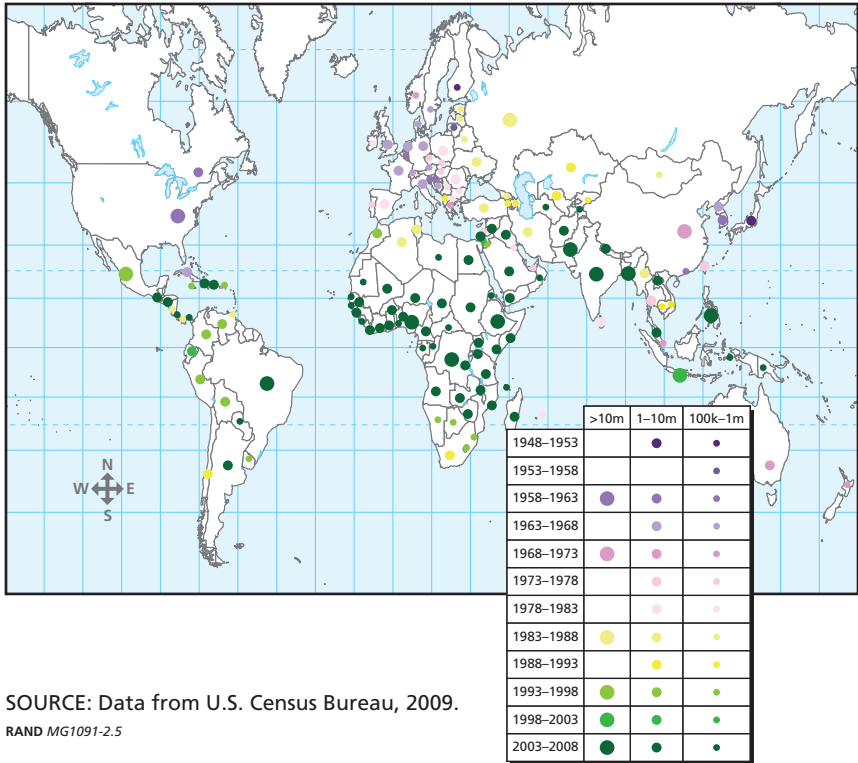
RAND MG1091-2.4

2.0 (Chile and Brazil) to 3.5 (Honduras). The former notion of Latin America as teeming with babies is outdated. Latin American fertility rates as a whole may well hit ZPG between 2015 and 2020.

The fall in birthrates can also be inferred by asking in which years the country's largest (surviving) cohort was born. Figure 2.5 depicts these years.⁸ China's largest cohort, for instance, consists of the population that was born between 1968 and 1973—people who are now in

⁸ The statistics from this chart were taken from the U.S. Census Bureau, *International Data Base (IDB)*, as of September 30, 2009. The reason for departing from the U.S. data is to generate an estimate for 2008 based on cohorts whose age end-points were a multiple of 5 years. Since these are historical data, differences in projections methodologies do not come into play.

Figure 2.5
Birth Years of Country's Largest Five-Year Cohort



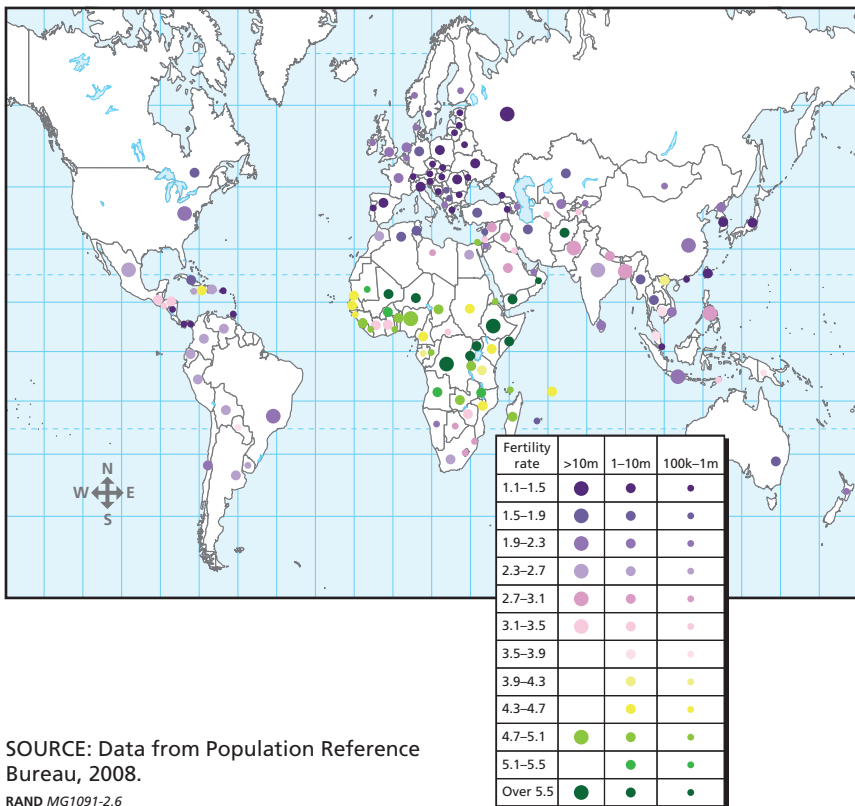
SOURCE: Data from U.S. Census Bureau, 2009.
 RAND MG1091-2.5

their late 30s and early 40s. Every subsequent cohort has been smaller. Even with the United States, which (currently) has a ZPG fertility rate and high levels of net immigration, the largest cohort consists of people born between 1958 and 1963, a group now in their late 40s and early 50s (although if the number of births in 2007—an all-time record—characterizes the next few years, such a graph, drawn five years hence, would show that its most recent cohort is the largest). Nearly 45 percent of all people live in countries whose most recent cohort is their largest—clear indication that their populations are still going up. However, the other 55 percent have, so far, already seen their largest cohort, and many of them may never again see a larger cohort.

Figure 2.6 characterizes all countries by their current total fertility rates.⁹ Note that the legend for both this and the previous figure refers to the size of each country's peak cohort—countries with larger cohorts are denoted by larger circles.

Finally, to make the same point using global statistics, Table 2.1 shows the world's distribution of population by age and sex.¹⁰ Note the inflection point (or deceleration) in the data that occurs in the early 20s

Figure 2.6
Current Total Fertility Rate by Country



SOURCE: Data from Population Reference Bureau, 2008.

RAND MG1091-2.6

⁹ These data were taken from the Population Reference Bureau, “2008 World Population Data Sheet,” Washington, D.C., 2008. The reason for using this source was to get data for 2008. United Nations (UN) data, by contrast, give an estimate/projection for the 2005–2010 interval.

¹⁰ U.S. Census Bureau, 2009.

Table 2.1
Global Age Distribution, 2010
(in millions)

Age	Male	Female	Ratio
0–4	331.7	310.0	1.07
5–9	318.7	297.0	1.07
10–14	312.4	291.7	1.07
15–19	314.4	294.7	1.07
20–24	312.3	296.7	1.05
25–29	282.7	272.2	1.04
30–34	255.8	247.7	1.03
35–39	247.6	241.1	1.03
40–44	231.1	226.8	1.02
45–49	204.4	203.0	1.01
50–54	174.3	175.5	0.99
55–59	151.8	156.0	0.97
60–64	114.5	121.1	0.95
65–69	83.3	92.0	0.91
70–74	65.0	77.4	0.84
75–79	43.6	56.5	0.77
80–84	24.9	37.4	0.67
85–89	10.6	19.5	0.54
90–94	3.1	6.9	0.44
95–99	0.7	2.1	0.32
100+	0.1	0.4	0.24

SOURCE: U.S. Census Bureau, 2009.

cohort, whose total size is 609 million. The most recent cohort—that is, those born a full 20 years later—is only 643 million. When projected residual infant mortality is factored in, one can expect to see no more than 635 million survivors, a growth rate of just over 6 percent in a generation. This is not ZPG, but it is close.¹¹

Survival Rates

Plausible changes in survival rates, barring catastrophe, are unlikely to make much of a difference in projections of the working-age population. As noted, children who reach their first birthday already have a high chance of reaching their sixtieth birthday, except in countries where the AIDS epidemic rages. Males in a typical rich country, such as France, have an 89-percent likelihood; females have a 95-percent likelihood. In a poor (but not AIDS-ridden) country, such as Pakistan, the figure is 82 percent for both sexes. Because most of these deaths among those below 60 take place among those in their 50s, the average number of years that a one-year-old can expect to spend within the working-age population (20 to 60) is close to 40, the theoretical maximum. In France, the average is 38.7 years (male) and 39.4 years (female). In Pakistan, the corresponding numbers are 37.4 years and 37.6 years. Theoretically, if all one-year-olds reached 60, this would only increase France's working-age population by 2.5 percent and Pakistan's workforce by 6 percent. In other words, the upside potential of better health on the size of workforce cohorts is quite small.¹²

¹¹ A little caution is required in reading into these statistics. If a population that previously had four births per woman suddenly becomes one in which three births is the norm, the cohort born when fertility was higher will likely be larger than the subsequent cohort. But if the three-births-per-woman rate does not decline further, population will continue to grow—and so will the size of successive cohorts—until a cohort emerges that is larger than the one born when four births per woman was the norm. Therefore, global cohort figures do not prove that the world's population will settle down to eight or nine billion, but, as noted, fertility rates have continued to fall, and so a depressed population trajectory is possible.

¹² Since we did not model the factors behind productivity, we did not model the effect of better health on the productivity of the workforce. See, for instance, Marc L. Berger, James F. Murray, Judy Xu, and Mark Pauly, "Alternative Valuations of Work Loss and Productiv-

That noted, higher rather than lower survival rates can be expected in coming decades.

Yet, while declines in average survival rates for those under 60 are unlikely, there is far more room for the survival rates of those under 60 to drop than rise. Possible calamities range from global thermonuclear war to lesser scenarios, such as widespread conflict and chaos or new virulent diseases (e.g., a variant of the H5N1 bird flu that could be spread from person to person). Historically, it is a rare event that leaves its mark in demographic statistics. The Black Death killed roughly one in three Europeans, but this was an era in which knowledge of medicine and sanitation was quite primitive. The last large and rapidly contagious disease, the Spanish Flu, killed roughly 2 percent of the world's population. AIDS, so far, has killed around 25 million, or 0.4 percent of the global population. As for man-made catastrophes, World War II killed between 1.5 and 2 percent of the world's population. Large numbers have also died during great internal upheavals, notably China's Great Leap Forward, with its 20 to 40 million dead (around 5 percent of the nation's population at the time).

We assume that with modern health technology, ubiquitous communications and transportation infrastructures (which facilitate the detection of disaster and the subsequent distribution of food and medicine worldwide), and the growing ranks of the middle class¹³ (a factor that should work against war and upheaval), such catastrophes are becoming less likely. Even with AIDS, a disease mostly prevalent in the world's poorest countries, the population of HIV-infected individuals appears to have reached an inflection point circa 2002, with the number of AIDS-infected people growing no more than 2 percent per

ity," *Journal of Occupational and Environmental Medicine*, January 2001, for an entry into the topic for developed countries and Peter Hotez, "The Neglected Tropical Diseases and Their Devastating Health and Economic Impact on the Member Nations of the Organization of the Islamic Conference," *PLoS Neglected Tropical Diseases*, Vol. 3, No. 10, October 2009, for a discussion of developing countries.

¹³ See John Parker, "Burgeoning Bourgeoisie," *The Economist*, February 12, 2009.

year since then.¹⁴ If so, then the death rates that ensue between now and 2030 or even 2050 are likely to be close to projections.

Migration

Migration data lack the solid foundation and long-term stability of birth and death data when factored into population projections. A crisis can unleash waves of refugees; a depression in rich countries would squelch expected migration from poor countries. Yet, the influence of migration is limited by two circumstances. First, with the exception of some small Gulf States, any year's migrants tend to be a small fraction of a country's population, in every case smaller than the number of births. Second, basic trends—poor countries send people to rich countries—are unlikely to change.

Current levels of migration are not necessarily known. Illegal immigration into the United States, for instance, is said to be large, with total populations near or over 10 million.¹⁵ Furthermore, while illegal immigrants may not be registered in any one year's migration counts, sooner or later they could show up in the census. One way to measure net immigration—legal and illegal together—is to look at the difference in cohorts from one interval to the next. For instance, if in 2000 a country had 9 million people who were born between 1975 and 1980 (that is, in the 20–24 age range) and in 2005 it had 10 million people born those years (that is, in the 25–29 age range), net immigration over the five-year period was almost certainly just over a million,¹⁶ whether or not it was counted as such in annual migration statistics.

¹⁴ Joint United Nations Programme on HIV/AIDS, "2009 AIDS Epidemic Update," accessed December 2007.

¹⁵ See Julia Preston, "Decline Seen in Numbers of People Here Illegally," *New York Times*, July 31, 2009, and Michael Hofer, Nancy Rytina, and Christopher Campbell, *Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2006*, Washington, D.C.: United States Department of Homeland Security, Office of Immigration Statistics, Policy Directorate, Population Estimates, August 2007.

¹⁶ The phrase *just over* takes into account the small number of those aged 20 to 24 who did not survive to be in the 25- to 29-year-old population five years later.

In terms of immigration, there are net gainers and losers (although every country has both immigrants and emigrants). The United States is the largest net gainer, with roughly 1.6 million migrants a year.¹⁷ Indeed, the United States accounts for 40 percent of all net immigration worldwide; the other countries that receive more than 100,000 net immigrants a year are Canada, Australia, Britain, Germany, and Italy. The largest country of net emigration is Mexico (whose 400,000 emigrants correspond only to a quarter of all U.S. net immigrants). Other countries with large numbers of net emigrants include China, India, Indonesia, the Philippines, Pakistan, Bangladesh, Peru, Iraq, Kazakhstan, and Morocco.

Immigration remains a highly volatile indicator, and the accuracy of any straight-line predictions may well depend on what happens to the global and national economies.¹⁸ If the recovery from the 2008 recession is vigorous, then the pattern of immigration that characterized the period from 1996 to 2006 is likely to return—and vice versa. In the 1930s, when U.S. unemployment rates were higher than Europe's, more people left the United States than entered it. Immigration to the United States from Latin America, which used to be a major

¹⁷ For most countries we used the rates specified by the Population Reference Bureau, 2008. For the rest (Australia, Belarus, Canada, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Kazakhstan, Mexico, Russia, Saudi Arabia, Singapore, Spain, the United Kingdom, and the United States), we estimated migration rates by comparing the nation's population in each cohort in 1996 (multiplied by its ten-year survival rate) to the corresponding cohort in 2006 (e.g., comparing the number of 10- to 14-year-olds in 1996 with the number of 20- to-24-year-olds in 2006).

¹⁸ Immigrants, notably recent immigrants, and guest workers send nearly \$300 billion a year back to their home countries, a figure that not only exceeds official development assistance and foreign direct investment but is much more stable from one year to the next. Such flows provide a substantial boost to poor countries. Their effect on the propensity of developing countries to generate would-be migrants and guest workers or, more importantly, on the willingness of developed countries to receive them is less clear. As a general rule, political objections to immigration rarely dwell on the likelihood that remittances constitute a source of currency outflows. For a broader treatment of migration and remittances, see Dilip Ratha, "Workers' Remittances: An Important and Stable Source of External Development Finance," in *Global Development Finance: Striving for Stability in Development Finance*, Washington, D.C.: World Bank, 2003, pp. 157–175, or Dilip Ratha and William Shaw, "South-South Migration and Remittances," Washington, D.C.: World Bank, January 19, 2007.

source of construction workers, slowed considerably in 2008 and thereafter as unemployment rates in construction rose.¹⁹ Other anecdotal evidence suggests that Polish immigration to the United Kingdom and South Asian immigration to Persian Gulf states also slowed.

Countries experiencing new immigration tend to be rich. With the exception of the United States and Israel, rich countries have low fertility rates and, in a sense, may need more people. This raises the question of whether immigration can substitute for low fertility rates in maintaining a country's population. To be sure, they are not one-for-one substitutes. Today's babies do not become tomorrow's workforce for two decades or so. Conversely, the average immigrant is already 20 years old. Appendix B develops some numbers on immigration as a substitute for births.

If the recovery stalls and immigration is quelled, then the broad trends favoring faster population growth in poor countries than in rich countries would be reinforced. Immigration normally tends to muffle such differences by distributing people from countries with more youths (relative to opportunities) in favor of countries with fewer youths.

Immigration also takes place among developing countries—typically from low-income countries (e.g., Guatemala) to middle-income countries (e.g., Mexico). Roughly 1.5 million citizens of Zimbabwe, for instance, now live in South Africa.²⁰ Migration within the developing world may assume a rising importance. Not only will countries continue to develop at different rates, but advances in communications will allow potential migrants to learn of opportunities in middle-income developing countries—and the burgeoning of infrastructure will facilitate their getting there (and returning home for visits). Some of the economic, cultural, and political pressures and problems asso-

¹⁹ For instance, see Miriam Jordan, "Illegal Immigration from Mexico Hits Lowest Level in Decade," *Wall Street Journal*, July 23, 2009. Unexpectedly, however, such immigrants were not returning home in large numbers either. See also Conor Dougherty and Miriam Jordan, "Recession Hits Immigrants Hard: Survey Shows First Decline in Foreign-Born U.S. Residents in Nearly 40 Years," *Wall Street Journal*, September 23, 2009. See also the demographic work of the Pew Hispanic Center (Pew Hispanic Center home page, 2011).

²⁰ It remains to be seen how many may move back or will be moved back once Zimbabwe's current president, Robert Mugabe, leaves office.

ciated with migration to developed countries will likely characterize migration to the better-off developing countries as well. Harder to predict is the tolerance of recipient countries for such migrants: Mexico, which is sensitive to U.S. border controls, is contemplating erecting barriers on its border with Guatemala.²¹ Presumably, the UN statistics on which this monograph is based reflect such trends. That said, such trends are volatile. Not only are the relative long-term growth rates of developing countries hard to predict (growth rates in Africa, for instance, which turned negative in the 1990s, were quite positive over the subsequent decade), but emigration is also often driven by political conditions (e.g., war, dictatorship) that are even more unpredictable.

Projections

The following projections come from the United Nations Population Division.²² They prepare four variants of projections in their forecasts: high, medium, low, and constant-fertility. The medium projection assumes that fertility rates around the world will converge toward a global average of 1.85 children per woman: That is, women in today's high-fertility-rate (and predominantly lower-income) countries will produce successively fewer and fewer children,²³ while today's low-

²¹ Similarly, Hong Kong, which has only been developed for a few decades, instituted fairly rigorous controls over illegal Vietnamese migrants in their midst during the 1980s and early 1990s.

²² UN numbers are considered to be the "gold standard" in the world of demographic projections. According to the National Research Council's (NRC's) *Beyond Six Billion*, Washington, D.C.: National Academy Press, 2000, UN projections for year 2000 population have been at no time off by much more than 7 percent, even going as far back as 1957 (see "The Accuracy of Past Projections," in NRC, 2000, pp. 37–52). That noted, these projections have systematically overestimated fertility rates and mortality rates. Thus, fewer babies were born, but fewer older people died than forecast—which, combined, means that UN projections generally failed to predict how quickly the world's population would age.

²³ Many of the high-fertility-rate countries (e.g., in Africa) approach but do not hit the convergence fertility rate. Most other countries, the UN model assumes, do hit it exactly. NRC, 2000, p. 55, observed, ". . . once fertility decline has started (the usual criterion being a 10-percent fall) it continues until moderate or low levels of childbearing are reached."

fertility-rate (and, largely, upper- and middle-income) countries will see some recovery in their fertility rates. The high projection looks for a convergence at 2.35 children; the low projection, 1.35 children. The constant-fertility model assumes that the fertility rate of the 2005–2010 period persists indefinitely.

The difference between the three convergence projections and the constant-fertility projection is quite relevant for the questions in this work. Note that, while the different convergence points allow forecasters to bracket the implications of population change for many public policy issues (e.g., the human impact on the environment), the very assumption of convergence itself tends to tamp down the implications of demographic change for the relative power of potentially competing states. This effect occurs because all countries are projected to eventually grow or shrink at the same rates. This is true whether the convergence point is high, medium, or low. By contrast, the constant-fertility assumption supports the broad contention that there will be differences in population growth from one country (or, more generally, from one type of country) to the next.²⁴ The constant-fertility projection implies a greater amount of power shuffling among states.

All four projections produce the same forecasts for working-age populations (those aged 20 to 60) through the year 2030 because every working-age individual of 2030 has been born.²⁵ As demonstrated in Figure 2.8, there are only modest differences in forecasts of working-age populations between two projections: the medium convergence projection and the constant-fertility projection.

Of more immediate import are projections in net migration rates, which can be quite variable from one year to the next. In general, the UN projections for migration follow patterns that characterized the period from 1995 through 2005, but with important exceptions. The U.S. immigration rate, which was about 1.5 million a year, is projected

²⁴ NRC, 2000, p. 197, notes that mean-country-error in projections—an average of 14 percent for projections 25 years hence—is substantially higher than the error in world projections, which is just over 1 percent.

²⁵ The UN model uses the same fertility rate for births in the 2005–2010 half-decade in all four variants.

to be no more than 1.0 million a year (which is roughly the maximum allowed by law, or roughly 3.5 per thousand per year).²⁶ Australia's rate similarly falls short of historic inflows. Projections for Italy and Spain are considerably higher than past trends. For the rest of Europe, projections run close to past experience: 100,000 for France and Germany (roughly 1.5 per thousand per year) and 170,000 for the United Kingdom (roughly 2.5 per thousand per year). Russia and Japan are projected to have net inflows (roughly 50,000 a year, or roughly 0.3 per thousand per year).

As one looks out from 2030 to 2050, the influence of unpredicted, perhaps unpredictable, changes in fertility rates becomes the major determinant, absent catastrophe, of whether such projections are realized. To be sure, predicting fertility rates is notoriously difficult. Nicholas Eberstadt has observed, ". . . demographers were unable to foresee either the transnational postwar 'baby boom' or the subsequent Organisation for Economic Co-operation and Development (OECD)-wide shift to an under-replacement fertility regime. As for developing countries, demographers have been unable to forecast either the onset of fertility decline or the trajectory that fertility change follows once it begins."²⁷ Some of the more sensitive indicators suggest that fertility rates throughout Western Europe have crept upward since 1998. Nevertheless, ancillary indicators suggest against a broad-scale revival of fertility rates in either rich or poor countries. In rich countries, polls report that the "ideal family size" has fallen substantially.²⁸ In poor countries, the percentage of women who have access to birth control

²⁶ If one assumes that the legal immigration quota is completely filled, this estimate implies that net illegal immigration is less than emigration.

²⁷ Nicholas Eberstadt, "What If It's a World Population Implosion? Speculations About Global De-Population," Cambridge, Mass.: Harvard Center for Population and Development Studies, Working Paper 98.04, March 1998.

²⁸ In Germany, the figure is 1.7; in Austria, 16 percent of women of child-bearing age answered "zero" to the ideal number of children. Both are historically unprecedented. See Jonathan Grant and Stijn Hoorens, "The New Pronatalism?" *Public Policy Research*, March–May 2006.

has increased steadily over the last few decades, and unmet needs for contraception have correspondingly fallen.²⁹

Table 2.2 displays past and projected working-age populations by country (ranked in terms of their projected 2020 working-age population) from 2000 through 2050 using the medium-fertility variant projection. For 2040 and 2050, the numbers in parentheses are the constant-fertility variant.

We now review the trends for the larger countries.

China's working-age population, due largely to a generation of one-child policies, is to peak within ten years (2020). After 2020, their numbers will start to decline, at first slowly and then with greater speed. China's working-age populations will be surpassed by India's just after 2025. After 2025, China's population shrinks at a rate of almost 1 percent a year.³⁰ China, which has a working-age population 4.7 times higher than the United States, is likely to have a working-age population that is only 3.3 three times larger by 2050.

India's working-age population is likely to grow at roughly 1.5 percent a year, due to a total fertility rate of just over three per woman. Pakistan and Bangladesh, India's western and eastern neighbors, have working-age populations that will grow somewhat faster, especially Pakistan's. In 2008, the ratio between India's working-age populations and the other two countries combined was 3.7 to 1. By 2030, it will be 3.3 to 1, and by 2050, 3.0 to 1. These differences are real but prob-

²⁹ Bloom, Canning, and Sevilla, 2003, p. 72.

³⁰ To the extent that China's current low fertility rate reflects the effects of its one-child policy, China's demographic "problem" (too few youths to support old folks) might seem easily "corrected." But this might not be the case; current low fertility rates may be the new normal. Current data suggest that urban Chinese simply do not want to have many children. Hong Kong, which is not covered by the one-child policy, has a TFR of roughly 1. The same is true inside China, as Richard Jackson, Keisuke Nakashima, and Neil Howe, with contributions by Jiangong Zhou, *China's Long March to Retirement Reform: The Graying of the Middle Kingdom Revisited*, Washington, D.C.: Center for Strategic and International Studies, 2009, p. 9, notes: "In Beijing and Shanghai, it [fertility] has now dipped below 1.0." See also Ariana Eunjung Cha, "In Aging China, a Change in Course: Looming Population Crisis Forces Officials to Rethink One-Child Policy but Couples Hesitate," *Washington Post*, December 2, 2009, p. A8. This phenomenon may limit the success of the new strong pronatalist policies, such as those announced in South Korea and Iran.

Table 2.2
Past and Projected Working-Age Population by Country (in millions)

Country	2000	2010	2020	2030	2040	2050
China	712.5	812.1	836.9	782.6	751.3 (746.3)	687.2 (674.2)
India	501.4	627.4	744.6	841.0	899.3 (934.9)	903.6 (1,017.1)
United States	158.8	173.2	179.9	186.6	196.3 (198.6)	201.1 (208.3)
Indonesia	106.1	129.2	145.5	154.5	153.6 (158.2)	148.6 (159.7)
Brazil	90.3	109.3	120.7	125.5	121.5 (125.6)	111.2 (121.5)
Pakistan	62.5	85.8	112.2	139.1	165.4 (173.4)	182.0 (210.9)
Bangladesh	65.2	86.8	105.4	118.2	122.9 (125.9)	121.0 (129.6)
Nigeria	50.4	66.5	86.3	111.5	136.6 (145.4)	156.9 (191.2)
Russia	80.9	85.8	75.4	69.3	64.3 (62.7)	54.5 (50.8)
Mexico	49.0	58.9	66.9	70.3	67.7 (69.9)	64.3 (69.8)
Japan	71.1	65.5	61.0	55.5	46.8 (46.6)	41.3 (40.4)
Vietnam	37.9	49.9	57.3	58.4	58.3 (59.7)	56.8 (59.9)
Philippines	35.8	46.3	57.0	66.5	74.2 (77.1)	78.6 (87.8)
Egypt	31.8	43.0	51.6	60.3	67.2 (69.4)	68.8 (75.6)
Iran	32.0	44.6	50.1	53.4	54.4 (54.8)	47.6 (48.1)
Turkey	34.0	42.1	48.4	51.5	51.7 (52.5)	50.6 (53.0)
Ethiopia	25.7	34.4	47.7	63.4	80.6 (86.2)	96.0 (117.6)
Germany	45.6	45.5	42.4	36.4	33.7 (33.4)	30.7 (29.8)
Thailand	35.3	40.3	40.6	39.2	38.1 (37.9)	37.0 (36.6)
Congo	18.9	26.0	36.4	49.7	64.9 (68.9)	79.7 (96.6)
United Kingdom	31.8	33.1	34.4	33.9	35.0 (35.0)	35.6 (35.4)
France	31.8	32.9	32.0	31.5	31.2 (31.4)	30.9 (31.2)
Italy	32.0	32.7	31.6	28.7	25.7 (25.5)	24.5 (23.9)
Myanmar	24.0	28.4	31.4	33.5	34.0 (34.6)	33.1 (35.0)
South Korea	27.8	29.6	29.2	25.5	22.0 (21.7)	19.2 (18.5)
Colombia	20.0	24.6	28.3	30.7	32.4 (33.1)	32.8 (35.2)
South Africa	22.4	26.5	27.5	29.3	30.9 (31.7)	31.4 (33.7)
Spain	23.0	26.2	26.6	25.2	23.0 (22.5)	22.0 (20.8)

Table 2.2—Continued

Country	2000	2010	2020	2030	2040	2050
Sudan	14.7	19.3	25.6	31.8	37.2 (39.5)	41.6 (49.3)
Tanzania	13.6	17.9	24.2	33.3	44.6 (46.3)	56.0 (64.7)
Ukraine	26.3	26.8	23.8	21.2	19.2 (18.5)	16.2 (14.5)
Argentina	18.4	21.1	23.5	25.4	26.2 (26.6)	26.2 (27.6)
Algeria	14.5	19.9	23.2	25.3	26.5 (27.0)	25.6 (27.2)
Kenya	12.5	17.3	22.7	30.3	38.2 (40.2)	45.0 (52.9)
Poland	21.3	22.6	20.7	19.4	17.3 (17.2)	14.4 (13.9)
Canada	17.6	19.4	20.0	20.0	20.6 (20.4)	21.0 (20.3)
Morocco	13.7	17.5	19.9	21.6	22.7 (23.2)	22.2 (23.6)
Iraq	10.2	13.8	19.6	25.5	30.6 (32.4)	35.1 (41.4)
Nepal	10.4	14.0	18.4	22.2	25.3 (26.4)	27.3 (30.5)
Uganda	8.7	12.2	18.0	26.1	36.2 (38.1)	47.0 (55.8)
Venezuela	12.0	15.2	17.9	20.1	21.7 (22.2)	22.2 (23.9)
Saudi Arabia	10.1	14.1	17.8	20.7	22.9 (23.9)	24.5 (27.8)
Peru	12.6	15.2	17.8	19.9	20.9 (21.6)	21.0 (23.2)
Uzbekistan	11.2	14.9	17.8	19.2	20.3 (20.7)	19.7 (20.9)
Malaysia	11.7	15.0	17.6	19.6	21.0 (21.8)	21.1 (23.5)
Afghanistan	7.9	11.4	16.4	22.1	29.3 (30.3)	37.6 (42.5)
North Korea	12.5	13.4	14.7	14.0	13.6 (13.6)	13.0 (13.1)
Yemen	6.7	9.9	14.2	19.3	25.0 (26.8)	29.7 (36.4)
Ghana	8.3	11.0	14.2	17.6	21.0 (23.4)	23.9 (33.2)
Syria	6.9	11.3	13.7	17.0	19.3 (20.3)	20.1 (23.2)
Australia	10.7	11.8	12.4	12.8	13.4 (13.3)	13.8 (13.8)
Côte d'Ivoire	7.3	9.2	12.3	16.2	20.1 (21.3)	23.6 (27.9)
Mozambique	7.4	9.5	12.1	15.8	19.7 (21.0)	23.4 (28.4)
Madagascar	6.2	8.4	11.7	15.4	19.3 (20.5)	23.1 (27.6)
Cameroon	6.4	8.6	11.1	14.2	17.4 (18.4)	19.8 (23.6)

SOURCE: Data from United Nations Population Division, 2009.

ably not enough to alter India's dynamics with its neighbors. Of greater relevance may be differences within India across a line separating six southwestern states (Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh) from the rest. This southwestern region has roughly a third of the country's population and produces just over a fifth of its infants but enjoys almost half of its GDP.³¹ One might expect that migration from the poorer to the richer parts would counteract the differences in fertility rates between the two parts, but language differences may inhibit internal migration. Similar observations could have been made about China over the past 30 years—contrasting south-east coastal China (Guangdong, Fujian, Zhejiang, and Shanghai) with China's interior. With China's rapid economic growth, this distinction is made less frequently these days.

The United States working-age population is projected to keep growing, but at a relatively modest rate of just under 0.5 percent a year (less if the 2008 recession persists and illegal migration falls off or reverses itself). Despite having the highest fertility rate among the rich countries and a history of substantial immigration flows, the child-bearing cohorts of the new century were born in the birth-death years of the 1970s and early 1980s. Thus, total birth levels are somewhat depressed, and workforce growth through 2030 is likely to be similarly depressed. Overall, the size of the U.S. working-age population keeps increasing at roughly 6 percent every ten years,³² nearly all of which is immigration (and if U.S. immigration figures exceed those of the UN projections, this increase will be larger yet).³³

The working-age populations of Indonesia and Brazil are expected to grow vigorously—roughly 1 percent a year—through 2025 but will not catch up to U.S. totals. By 2025, both countries will be near an

³¹ The source for fertility rates by Indian states is Census of India, *Sample Registration System: Statistical Report*, 2005; incomes estimates are from Massimiliano Cali, "Urbanization, Inequality and Economic Growth: Evidence from Indian States," World Bank, preliminary findings of a paper prepared for the World Development Report 2009, November 2007.

³² This is in the constant-fertility projection, which is actually a ZPG rate.

³³ Canada's cohorts should grow roughly as fast as U.S. cohorts through 2020, although with more immigrants and fewer births; after 2020, it reaches a plateau and thereafter grows at half the U.S. rate.

inflection (deceleration) point in their working-size cohorts, a result of near-ZPG fertility rates today. The same can be said for Mexico. A great deal depends on when the U.S. economy recovers and how vigorously—the more vigor, the greater the out-migration and the sooner Mexico’s inflection point arrives. The working-age populations of Indonesia, Brazil, and Mexico all reach a plateau after 2030 under constant-fertility assumptions; in the medium projection, these working-age populations fall.

Africa’s numbers follow from their high birthrates.³⁴ Nigeria’s cohorts are likely to grow at very fast rates—over 3 percent a year—through 2030, barring catastrophe. The same holds for Ethiopia, and even more so for Congo, whose cohorts are likely to grow by closer to 4 percent a year. Sudan and Tanzania are on the same growth track as Nigeria. South Africa is the major exception, as working-age population totals meet an inflection point in the near future, with slow growth thereafter.

Russia loses 20 percent of its working-age populations by 2030, something which has been long foreseen.³⁵ More recently, Admiral Dennis Blair, the Director of National Intelligence, predicted that Russia would have half as many eligible military recruits in 2018 as it had in 2005 (although most of that drop is associated with the poor health of Russia’s youth).³⁶ By 2050, Russia’s working-age population is just 60 percent of what it is now; Ukraine’s decline is almost as steep.

The Philippines workforce grows quickly at roughly 2 percent a year, the highest rate for all the large East Asian countries; thereafter it rises at a more measured rate, and any inflection point lies beyond

³⁴ However, one cannot rule out large waves of migration within Africa that result from war, calamity, or misgovernment. For instance, 1.5 million citizens of Zimbabwe now live in South Africa.

³⁵ See Julie DaVanzo and Clifford Grammich, *Dire Demographics: Population Trends in the Russian Federation*, Santa Monica, Calif.: RAND Corporation, MR-1273-WFHF/DLPE/RF, 2001. See also Murray Feshbach, *Russia’s Demographic and Health Meltdown*, United States Congress, Joint Economic Committee, *Russia’s Uncertain Economic Future*, 107th Congress, 1st Session, Washington, D.C.: Government Printing Office, December 2001.

³⁶ Walter Pincus, “From New DNI, Moderate View on North Korea and Warning About Iran’s Role in Afghanistan,” *Washington Post*, February 16, 2009, p. A13.

2030. By contrast, Vietnam's working-age population peaks in 2025. Thailand's is already close to peaking, and decline is likely within ten to 20 years. Burma and Vietnam also reach population plateaus 20 to 30 years hence.

The size of Japan's working-age populations will drop at rates close to 1 percent a year, declining 15 percent by 2030 and 40 percent by 2050. In 2009, the population of Japan—a country with little immigration—registered its first absolute decline.

Egypt's cohorts grow somewhat faster than 1 percent a year without a near-term inflection point. North African countries, such as Morocco and Algeria, both hit inflection points at 2015 and grow at less than 1 percent a year thereafter toward a plateau in the 2030–2040 time frame. Iran's working-age population is expected to increase vigorously until 2015 and then hits an inflection point, after which cohorts begin to fall sharply (recently announced pronatalist policies notwithstanding). Turkey's working-age population, similarly, continues to grow until it, too, is expected to reach a plateau after 2020 and then slip.

In 2005, Germany had the twelfth largest working-age population; in 2030, with 12 percent fewer, it is projected to have the twentieth largest, even though it receives net immigration. By 2050, its population will be down by a third. The story in the other large middle-European countries is similar, whether one is talking about Italy (dropping 6 percent every ten years), Poland (a 14-percent drop by 2030 and a 40-percent drop by 2050), or France (a 5-percent drop followed by a leveling off). Spain manages to retain the size of its working-age population at first, only because of expected high immigration levels, but then falls by 20 percent after 2030. The United Kingdom, the exception, may even eke out a small increase over that period.

Finally, the South Korean working cohorts are expected to stay constant for ten years and then start to shrink sharply by a third through 2050; the same is true for Taiwan's.³⁷

³⁷ The UN does not publish such information for Taiwan. Our estimate is derived from data maintained by the International Division of the U.S. Census Bureau, 2009, and by the Population Reference Bureau, 2008.

Another way to examine these numbers, especially for regions for which there is no one dominant country, is to look at aggregates, as Table 2.3 does.

One such aggregate is the core Arab world (the region bordered by Turkey, Iran, Israel, and various seas). In 2005, its working-age population was 55 million; by 2030 it is expected to be 105 million—exhibiting growth rates seen nowhere else but Africa. Total numbers are expected to be three times larger in 2050 than they are today. Some of that represents migration, notably into the Gulf States, and one might argue that with oil prices down, immigration will also be down, perhaps even negative. But immigration is only expected to be 100,000

Table 2.3
Past and Projected Working-Age Population for Selected Regions
(in millions)

Region	2000	2010	2020	2030	2040	2050
Core Arab world	44.7	65.2	85.1	105.3	122.7 (116.5)	135.7 (142.8)
Scandinavia	13.2	13.3	13.4	13.2	13.2 (13.2)	13.4 (13.4)
Eastern Europe	104.5	107.6	98.9	91.2	81.6 (80.3)	69.1 (68.1)
Central Asia	25.8	33.0	38.0	41.0	43.8 (45.0)	42.8 (46.4)
Spanish South America	84.8	102.2	117.6	128.7	135.7 (139.3)	137.1 (148.3)
Central America	15.3	19.7	25.1	30.1	34.5 (36.1)	37.1 (42.4)
Caribbean	19.3	22.0	24.1	24.7	26.5 (25.3)	26.7 (24.8)

SOURCE: Data from United Nations Population Division, 2009.

NOTE: The core Arab world consists of Bahrain, Iraq, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen, and Jordan. Scandinavia is Denmark, Finland, Iceland, Norway, and Sweden. Eastern Europe is Albania, Belarus, Bosnia, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, and Ukraine. Spanish South America excludes Brazil and the Guyanas. The Caribbean is comprised of Aruba, Bahamas, Barbados, Cuba, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Netherlands Antilles, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, and the United States Virgin Islands. Central Asia consists of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

a year, or no more than 5 percent of the total growth. In other words, barring catastrophe, these growth rates are locked in—plus or minus 5 percent.

Scandinavia is of interest, even though its numbers are small, because its fertility has bucked the trend otherwise pervasive in middle Europe. Its working-age population is expected to stay steady through 2050.

The workforces of Eastern Europe,³⁸ by contrast, are expected to decline in much the same way as Russia's, even though these countries do not have Russia's health crises. A working-age population of 110 million in 2010 shrinks to below 90 million by 2030 and 70 million in 2050, with almost all countries experiencing a decline.

Largely Islamic Central Asia reaches an inflection point in 2020; working-age populations grow a further 10 percent through 2030, peaking in 2040.

Spanish South America (i.e., excluding Brazil, Guyana, Surinam, and Guyane) is expected to see its working-age population rise from 94 to 125 million, but with an inflection point by 2040. Central America's cohorts are likely to grow substantially faster (from 17 to 30 million) but with a modest inflection point in 2030. The Caribbean nations vary greatly from one country to another demographically; they range from Cuba, whose fertility rates have been below ZPG for several decades, to Haiti, whose fertility rates are quite high. Haiti's citizens, who constitute 21 percent of the Caribbean's working-age population, will account for 28 percent by 2030 (and roughly 34 percent by 2050).

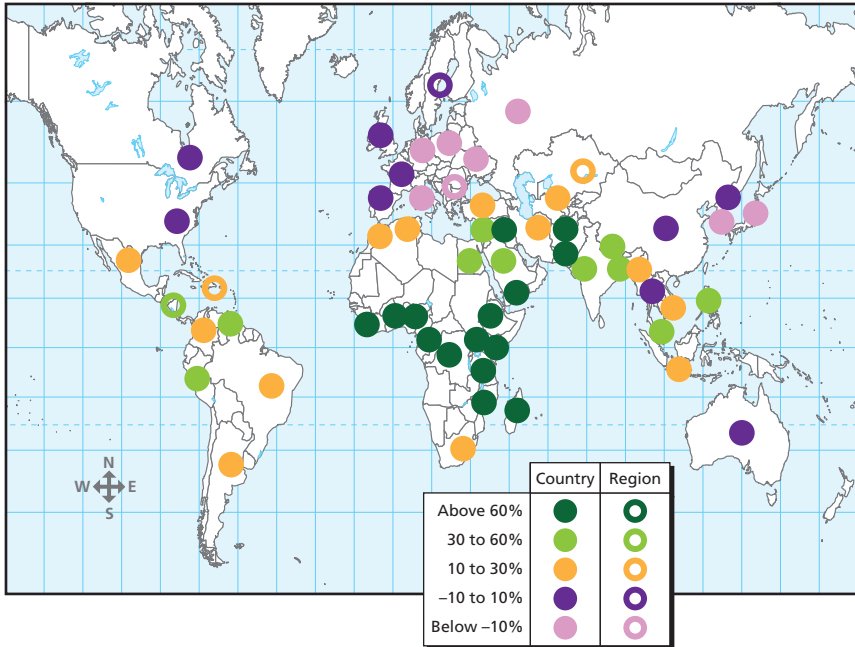
These trends are illustrated for the larger countries and for selected regions in Figure 2.7, which illustrates the expected expansion in the working-age population from 2010 to 2030.

Figure 2.7 suggests that the world's countries can be grouped as follows:

- an industrialized swath from Portugal to Russia and Japan, whose working-age populations are likely to decline by 1 percent a year

³⁸ Formerly Communist countries except the former East Germany, plus the Baltic countries, Belarus, and Moldova.

Figure 2.7
Expected Changes in Working-Age Populations, 2010–2030



SOURCE: Data from United Nations Population Division, 2009.

RAND MG1091-2.7

- a northern swath that includes the United States, Canada, Britain, France, and Scandinavia, which tends to be immigrant-tolerant and whose cohorts should remain steady or rise slowly throughout the period
- middle-income countries (China, South Korea, Southeast Asia, Iran, Turkey, and the Maghreb) that will see modest increases in their working-age populations, but with noticeable inflection points (or in the case of East Asia, deflection points) circa 2025
- Latin America and Central America, whose population statistics will show similar patterns—growth followed by inflection circa 2025—with the latter growing somewhat faster
- a South Asian swath, including the Ganges and Indus river valleys, where population growth is steady at 2 percent a year (decel-

erating to 1 percent a year after 2030 if global fertility rates converge). Note that this does not include the southern third of India, which is demographically similar to Southeast Asia.

- two regions—sub-Saharan Africa and the core Arab states—that will continue to see vigorous growth in their working-age populations.

These generalizations are quite robust over the plausible variations in fertility rates. The difference between two very different fertility rate projections turns out to be quite modest, even 40 years out. Figure 2.8 illustrates as much by charting the trajectory of working-age populations from the 15 largest countries under both the medium-fertility and constant-fertility variants. Many of the line pairs look like one (e.g., China's); others show slight differences as one gets beyond 2030.³⁹

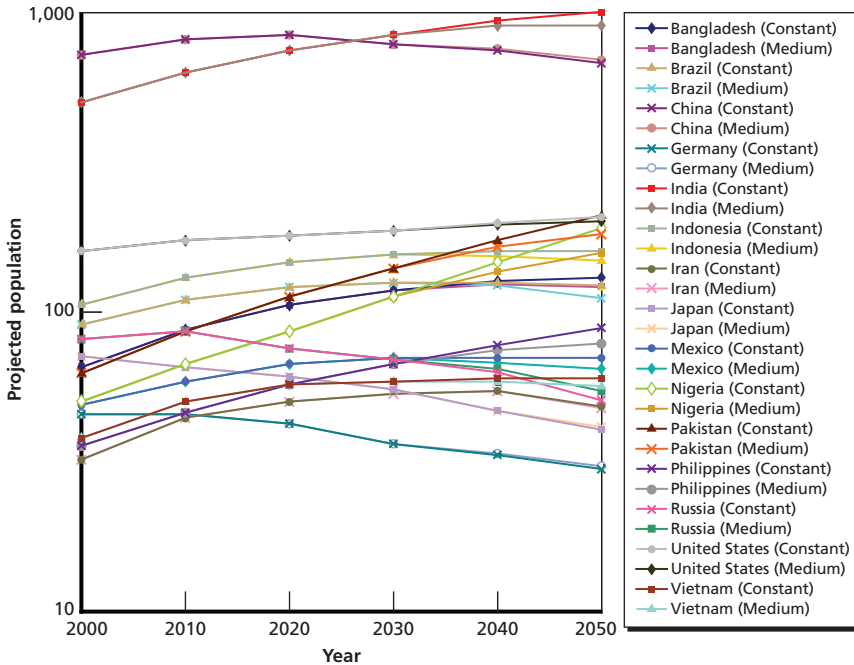
The closeness of the constant-fertility and medium-fertility lines suggests that the projections of working-age populations by country by 2050 can be considered fairly solid, regardless of plausible variations in fertility rates, as long as the basic factors underlying migration—notably the search for economic opportunity and national variations in the acceptability of immigrants—do not change much. These numbers cannot be wished away on the theory that the world may turn out differently because there is very little wiggle room in these numbers.

Figures 2.9 and 2.10 look at the relative sizes of working-age populations in two theaters strategic to the United States: first the Atlantic and then the Pacific.

A few quick observations follow. Total working-age populations are shrinking, but the U.S. (and for a while, Turkish) working-age populations are growing. Cohorts in the United Kingdom and

³⁹ Why are the lines so close together even 40 years out? First, the difference between birthrates in both models takes time to emerge fully; after all, fertility rates do not jump up or down radically from one year to the next. Second, the graphs measure those over 20 and thus reflect only births that take place by 2030; therefore, differences in birthrates after that date do not matter. Third, demographic projections have a built-in momentum: Many countries with low (or, conversely, high) fertility rates in prior decades will have female cohorts of childbearing age whose ranks are low (or, conversely, high) relative to the population as a whole; thus, the number of children they would have would be correspondingly reduced.

Figure 2.8
Projected Populations for 15 Large Countries: Medium Variant and
Constant-Fertility Variant Forecasts Compared



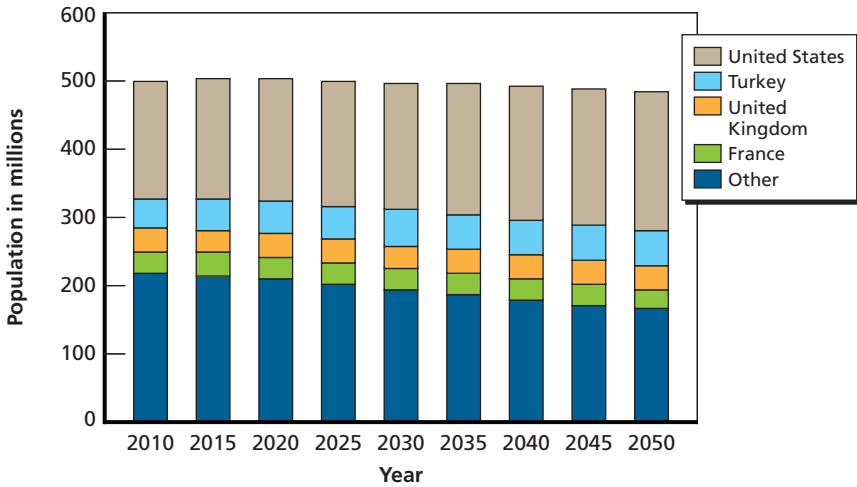
SOURCE: Data from United Nations Population Division, 2009.

RAND MG1091-2.8

France remain constant. Thus, the cohorts generated by everyone else are shrinking even faster than the overall totals. In 2008, everyone else's cohorts outnumbered U.S. cohorts by a ratio of 1.9 to 1 (without Turkey: 1.65). By 2050, this ratio should shrink to just over 1.4 to 1 (without Turkey: 1.15). Although such numbers suggest that Europe's ability to generate military power is not keeping up, the key question is: keeping up with whom? If the answer is Russia, for instance, note that the ratio of working-age populations between the North Atlantic Treaty Organization (NATO) and Russia rises from 5.9 today to 8.9 in 2050 (medium projection).

Demographically, the United States plays a smaller role in the Pacific, and China, of course, plays the larger role; it accounts for

Figure 2.9
Working-Age Populations for NATO Countries (in millions)



SOURCE: Data from United Nations Population Division, 2009.

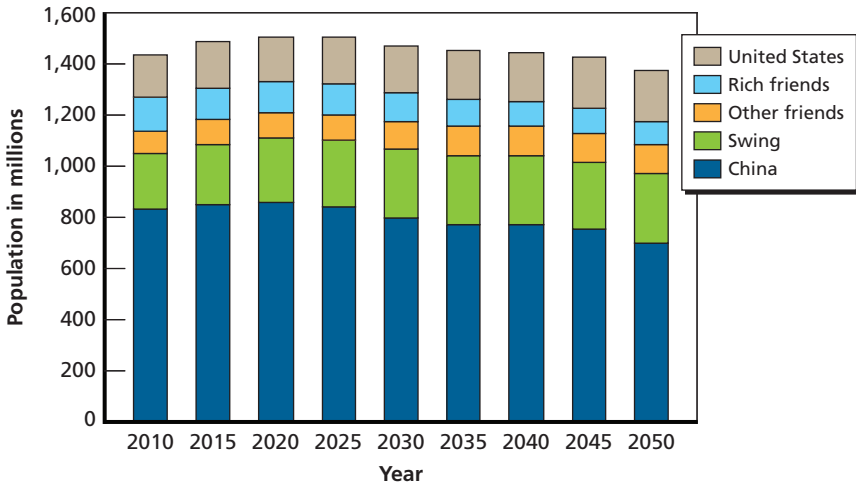
RAND MG1091-2.9

roughly 58 percent of the total working-age population. By 2050, China's share will have shrunk to 51 percent (in the medium variant; 49.5 percent for the constant-fertility variant). The U.S. share is expected to stay relatively constant at 12 percent through 2025, whereupon it jumps to 15 percent by 2050. The traditional affluent U.S. allies in the region—e.g., South Korea, Taiwan, Japan—are facing declining working-age populations: Their share is expected to fall from nearly 9 to closer to 6 percent. The difference is made up by Southeast Asia, notably the Philippines, but also Indonesia to some extent.

Youth Bulges to Come?

Concerns have been expressed that, “Over the next few decades . . . dramatic demographic trends in developing nations . . . [such as] resur-

Figure 2.10
Working-Age Populations for Asia-Pacific Countries (in millions)



SOURCE: Data from United Nations Population Division, 2009.

NOTES: China includes Hong Kong and Macao and adds North Korea. The swing states are Brunei, Cambodia, Indonesia, Laos, Myanmar, Papua New Guinea, and Vietnam. Other friends are Thailand and the Philippines. The rich friends are Australia, Japan, New Zealand, South Korea, Singapore, and Taiwan.

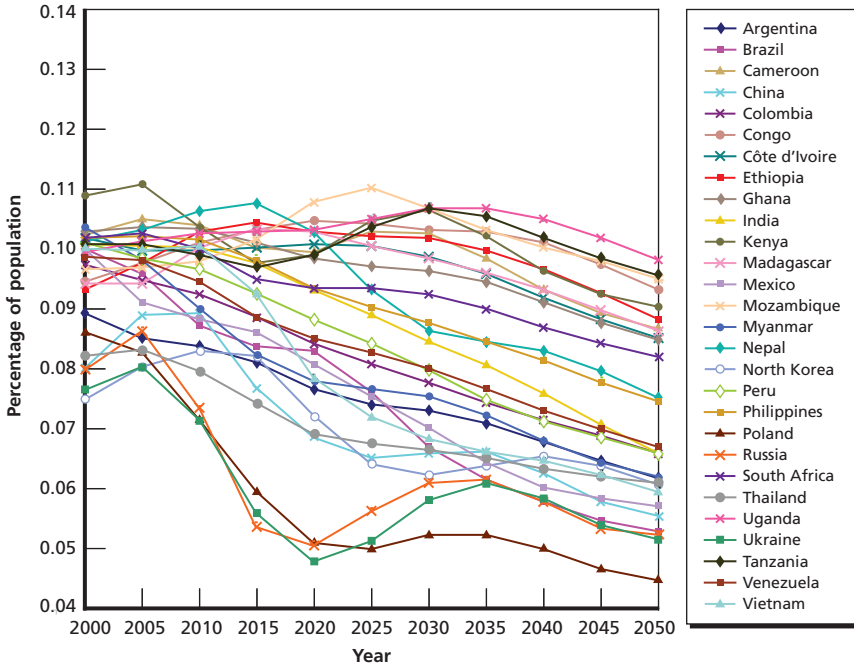
RAND MG1091-2.10

gent youth booms in the Muslim world . . . will give rise to dangerous new security threats.”⁴⁰

Figures 2.11 and 2.12 examine the prospects by charting the percentage of the total population consisting of males between the ages of 15 and 25 for the 45 middle- and lower-income countries included in Figures 2.2 and 2.3. Figure 2.12 charts Islamic-majority countries; Figure 2.11 charts the rest. Numbers for 2000 and 2005 are estimated; those for 2010 and forward are projected. Those prior to 2025 are solid, to the extent that these youths have already been born. Numbers for 2030 and beyond depend, to some extent, on future fluctuations in fertility rates (the graphs use the medium-fertility variant). As the figures illustrate, any youth bulge is likely to be small and, in most cases,

⁴⁰ Neil Howe and Richard Jackson, “Battle of the (Youth) Bulge,” *The National Interest*, July/August 2008, pp. 33–40.

Figure 2.11
Percentage of Population Composed of Males Aged 15 to 25—Non-Islamic-Majority Countries



SOURCE: Data from United Nations Population Division, 2009.

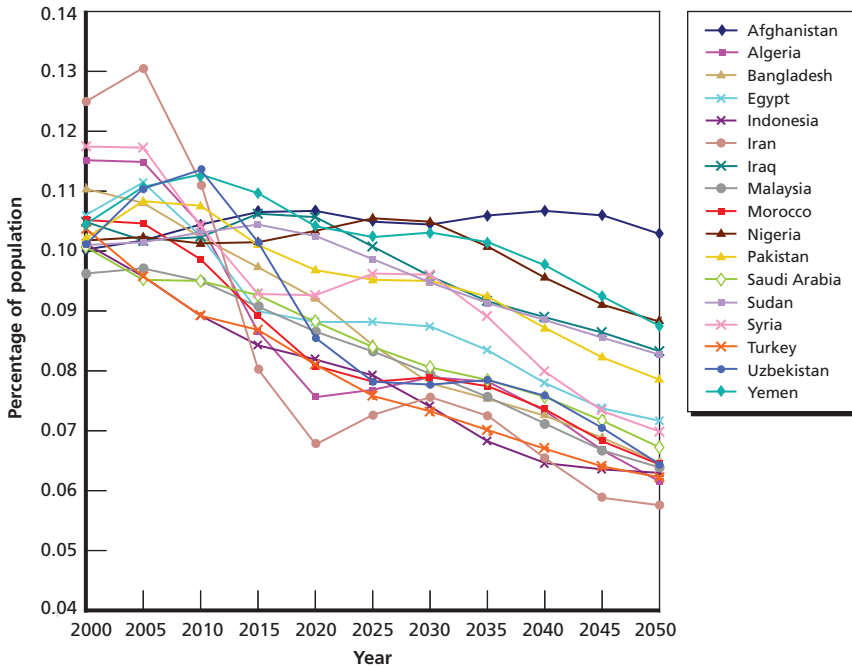
RAND MG1091-2.11

negative: The percentage of the population composed of young men is likely to shrink rather than grow.

Projected Muslim Populations

The world’s Islamic population tends to be geographically concentrated. Although Muslims account for 23 percent of the world’s population, up to 69 percent of the world’s Islamic population lives in countries that are more than 87 percent Islamic. This means that the size of the Islamic population is closely tied to the size of predominantly Islamic states, thereby limiting the impact of uncertainties over whether Islamic populations within countries have been counted cor-

Figure 2.12
Percentage of Population Composed of Males Aged 15 to 25—Islamic-Majority Countries



SOURCE: Data from United Nations Population Division, 2009.

RAND MG1091-2.12

rectly. Many other Muslims live in countries in which their populations are geographically concentrated—e.g., the northern half of Nigeria and the northern two-thirds of Sudan. Of the 21 percent of the world's Islamic population that does not live in Islamic-majority countries, almost half live in India.

Because Islamic-majority countries tend to have high fertility rates (although not all do—e.g., Iran), their populations tend to be young. The percentage of the world's working-age populations who are Islamic is, thus, at 24.4 percent in 2010, somewhat lower than its

share of the overall population (25.6 percent). By 2030, the percentage is expected to be 28.2 percent and by 2050, 30.7 percent.⁴¹

Considerable attention is given to the Eurabia question:⁴² What share of Europe will be Muslim? One problem is that estimates of today's Muslim population are, in many countries, only that: estimates. Neither France nor the United States allows their national census to ask such a question. Estimates of age distributions or fertility rates are on an even less firm basis. Nevertheless, one can make an attempt at an estimate that is contingent on several assumptions.⁴³

Consider France, whose Muslim population has been estimated at 8.5 percent of the national total. Assume that, because Algeria has been the most important source of Muslim immigrants in the post-World War II period, the Islamic population's fertility rate and age distribution are the same as Algeria's today,⁴⁴ but with survival rates the same as France as a whole. Assume further that two-thirds of all

⁴¹ This assumes medium-variant projections; the percentage is 31.6 percent under constant-fertility projections.

⁴² This attention is ironic, however, because only a small percentage of the world's Muslim population resides in Europe or is expected to, even by 2050. The term *Eurabia* was popularized by Niall Ferguson's "The Way We Live Now: Eurabia?" *New York Times Sunday Magazine*, April 4, 2004. See also Christopher Caldwell, *Reflections on the Revolution in Europe: Immigration, Islam, and the West*, New York: Doubleday, 2009.

⁴³ In making our projections, we have to assume several things that make sense only in aggregate. First, the offspring of Islamic parents are Islamic (statistically speaking, one has to assume something similarly proportional from mixed marriages). Second, Islam as a category is nominal and binary (one is or one is not Muslim—religiosity is not a variable). Third, the net "migration" (conversion) into and out of Islam is zero, or at least statistically negligible, everywhere. We begin our analysis with a fourth assumption that the age distribution, fertility rate, and death rate of the Islamic population in any country are the same as the non-Islamic population of the country (there have been countries in which the percent of the population that is Islamic has grown for reasons having little to do with migration—e.g., Lebanon and Serbia/Yugoslavia). Later, we explore alternative assumptions for each country.

⁴⁴ Although NRC, 2000, p. 173, observes that "... migrants have fertility levels in between those of their countries of origin and destination," Charles F. Westoff and Tomas Frejka, "Religiousness and Fertility Among European Muslims," *Population and Development Review*, Vol. 33, No. 4, 2007, pp. 785–809, suggests that Muslim birthrates, while still higher than native European ones, are on par with birthrates that prevail in the countries from which they came.

net immigrants into France are Muslim. If so, the Muslim working-age population rises from 9 percent of France's total today to 13 percent in 2025, reaching 17 percent by 2050.⁴⁵ The numbers are somewhat lower when immigration is zeroed out: 12 percent in 2025, but only 13.5 percent in 2040–2050 at its plateau. Raise the fertility rate to a constant 2.5—despite the fact that Algeria's fertility rate now is only somewhat higher than France's—and one gets to 19 percent, much higher.

A similar exercise can be run for Germany but with two changes in assumptions: first, that Muslims account for a third of all net immigration (many immigrants into Germany are ancestral Germans drawn from countries to its east and south), and, second, that Turkey is the reference model for its Muslim immigrants. Similar numbers result: The percentage of Germany's working-age population of Islamic ancestry rises from 4 percent today to 6 percent in 2025, 9 percent in 2040, and 11 percent in 2050. Zero out immigration, and the percentage circa 2050 is only 7.5 percent. Raise the fertility to 2.5, and the percentage rises to 12 percent.

Russia, which is roughly one-eighth Islamic today, is likely to become increasingly Islamic for similar reasons: Its Islamic populations are young, they tend to have more children than native Russians, and they have relatives back home who would like to join them (Russia currently has zero net migration, but its emigrants are rarely Muslim). Russia's Islamic population is quite heterogeneous, a mixture of well-integrated Tatars, increasingly disintegrated populations in the Caucasus, and unintegrated migrants, most notably from Tajikistan. If the age distribution and fertility rate (3.45 per woman) of Tajikistan typify Russia's Islamic working-age population, then, absent further net Muslim immigration, the Islamic working-age population, which constitutes 9.6 percent of the whole, rises to 17 percent in 2025, 26 percent in 2040, and 35 percent in 2050. If one adds Muslim immigration at a rate of 40,000 per year (by contrast, the overall U.S. rate is 1.0 to 1.5 million per year), the percentage goes to 18 percent in 2025,

⁴⁵ If France's Islamic population is like Algeria's, its youth cohort is disproportionately large compared to France's, but its elderly cohort is even more disproportionately small. Thus, the working-age population is roughly the same percentage of the population.

27 percent in 2040, and 38 percent in 2050. Conversely, if one assumes a lower fertility rate—2.5 rather than 3.45—and zero immigration, then the 2050 share is still 31 percent.

It should be no surprise to learn that young populations with high (albeit declining) fertility rates and who were recently drawn from countries with a high propensity to send more immigrants have a great deal of demographic momentum compared with mature populations with low fertility rates.

Conclusions

Two overall observations may be warranted.

First, the numbers are changing. The old image of global population rising out of control started to become obsolete in the 1970s (just about the time that best-selling books were being written about the disaster to come).⁴⁶ The newer, but still old, image of declining rich countries and still-burgeoning poor countries needs modification. With a few exceptions, large swaths of poor countries have reduced their fertility rates to the point where they are approaching or, in many cases (e.g., China, Brazil, Thailand), have passed ZPG rates on the way down. As a result, working-age populations there are expected to peak or at least reach a major inflection point somewhere between 2020 and 2030. Notable exceptions are the core Arab world and sub-Saharan Africa (South Africa excluded), where fertility rates are still quite high.

Second, what trends exist suggest that projections of working-age populations—even as far out as 2050—are relatively stable against a plausible range of contingencies. Migration is the largest swing factor, but there is no reason to believe that affluent countries will not attract as many immigrants as they want and can employ (and then some). The current global recession may dampen fertility rates and migration levels, but only as long as it lasts. Otherwise, plausible changes in fertil-

⁴⁶ For instance, Paul Erlich, *The Population Bomb*, New York: Ballantine, 1971, and Donella H. Meadows, Jorgen Randers, Dennis L. Meadows, and William W. Behrens, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, New York: Universe Books, 1973.

ity rates, up to and including a global convergence to a uniform level worldwide, are unlikely to change the numbers very much.

Thus, for all practical planning purposes, the demographic future is here; it will just take a few decades to make itself clear.

Long-Term Trends in National GDP

The resources from which a state can create military power include more than demographics. Key among them is national income, the wherewithal for military expenditure. According to neoclassical economics, national income is almost a direct function of (working-age) population—“almost” because the influence of numbers and growth rates on productivity is complicated and controversial.¹

In this chapter, we use historical information to characterize the economic growth of large countries and thereby establish some bounds for predicting economic growth over the next 20 to 40 years. Our goal, however, is not to forecast such growth on a nation-by-nation basis. This would require a different level of analysis, and such an exercise lacks the certainties and near-certainties that lend credibility to demographic projections. Nevertheless, it would be useful to understand two things:

¹ There are several factors at work at both the static level (the size of the population) and the dynamic level (the growth of the population). Neoclassical economics generally holds that more people and fixed land and capital mean lower per capita income. More recent observers, such as William Alonso and Julian Simon, have focused on network effects and concluded that more people means more ideas and hence higher per capita income. Similarly, economics would hold that higher population growth rates require perhaps an unobtainable level of investment to create the requisite jobs, absent which per capita income falls. Others would argue that globalized capital markets mean that high-population-growth economies attract proportionally more capital from abroad, leading such countries to have a newer and hence more productive capital stock than their low-population-growth counterparts.

- whether or not international variations in economic growth rates would swamp international variations in population growth rates
- whatever relationship exists between population and economic growth rates.²

Forecasts of GDP per Working-Age Population

A nation's GDP is a function of its workforce productivity, the size of the workforce (which in turn reflects the percentage of its working-age population that is actually working), and, in some respects, its terms of trade.³ Of the three, workforce productivity is the most indicative of the long-run prosperity of a nation's citizens. Over the long run, productivity tends to reflect the knowledge, skills, and attitude (cf., aptitude) of its workforce; its endowments of capital (both hardware and human capital) and land; and the sectors in which its export economy is concentrated. Such factors do not fluctuate very much from one year to the next—although they may have stronger or weaker growth factors built into them. By contrast, the percentage of a country's workforce that is working reflects year-to-year macroeconomic fluctuations as well as longer-term trends in labor force participation rates, such as whether mothers work or when people retire. Similarly, a nation's terms of trade reflect year-to-year fluctuations in commodity prices and exchange rates.

We look at GDP in terms of per capita GDP⁴—more particularly, for our purposes, national income divided by the working-age population (by such a metric, Luxembourg and France look similar even

² For instance, if the two are strongly negatively correlated, then perhaps demographics can be ignored altogether in forecasting national military power, since what may be gained by having more babies is lost because per capita GDP is correspondingly reduced.

³ This is particularly true for economies that depend on exporting commodities, such as oil. Rising prices for such commodities can lead to rising standards of living even without changes in productivity. Yet, what goes up . . .

⁴ Perhaps needless to add, if one can forecast per capita GDP and population (more pertinently, GDP per working-age population and working-age population), one can forecast GDP, and vice versa.

though the latter has roughly 200 times the GDP). We have also chosen to define GDP in terms of purchasing power parity (PPP), which measures national income in terms of goods and services as they are purchased by the people, rather than exchange-rate GDP, which measures what a nation can buy in international markets. True, exchange-rate GDP measures are less ambiguous; using them avoids having to wrestle with such PPP questions as the value of a visit to a Chinese dentist compared with the value of a visit to a U.S. dentist. However, using exchange-rate measures introduces near-meaningless year-to-year fluctuations in national incomes that result from corresponding fluctuations in currency levels. Eliminating such year-to-year variation makes it easier to see changes over time.

As a general rule, the exchange-rate GDP of a poor country is significantly below its PPP GDP (measured against rich-country currencies). Two-to-one ratios are typical (e.g., Thailand) and three-to-one ratios not unknown (e.g., Pakistan). The basic reason for this is simple: A person's standard of living is composed of the goods and services he or she can buy. The price of goods reflects the manufacturing price of the item plus the services required to bring goods to market. Manufacturing prices tend to converge globally in hard currency terms. Most services, however, are provided locally; thus, there is little force prices to converge internationally. So, the price of services reflects the cost of labor and the productivity of labor in producing services. Because labor productivity in many service sectors (e.g., retail, custodial, or repair services) is not much lower in poor countries than in rich ones, the cost of such services primarily reflects wages in the service sector, which follow wages throughout the economy. Thus, poor countries are characterized by inexpensive services. A dollar, so to speak, goes further there.⁵

⁵ To illustrate as much, a person in a rich country may earn \$40,000, which buys 15,000 units of goods and 25,000 units of services (every unit of goods and services costs a dollar). A person in a poor country may earn \$2,000, which buys 1,500 units of goods (every unit of goods costs a dollar) with the first \$1,500 and 2,500 units of services (here, every unit of services costs 20 cents) with the remaining \$500. Thus, the person in a poor country buys 4,000 units. In exchange rate (dollar) terms, the rich country citizen earns 20 times as much as the poor country citizen (\$40,000 versus \$2,000). In PPP terms, the rich country citizen earns ten times as much as the poor country citizen (40,000 units versus 4,000 units). Hence,

The difference between exchange-rate and PPP GDP, however, is more than a statistical quibble when it comes to measuring the relative resources nations have for building military power.⁶ If a country can supply its own weaponry and can build it less expensively (by dint of having lower wage rates), then PPP is the more important indicator. If, however, a country has to purchase weaponry (or at least licenses to manufacture its own weaponry), then exchange-rate GDP becomes relevant. As it is, the percentage of any country's defense expenditures spent on imported military hardware (or licenses) tends to be fairly low (rich but unindustrialized countries may be an exception), and so PPP GDP tends to be more relevant than exchange-rate GDP for estimating a country's warfighting potential. In addition, regardless of where they buy their weapons, most countries acquire their military personnel locally at local rates. All this ignores the question of quality—for example, the comparative warfighting value of a highly educated, well-trained, highly motivated U.S. soldier versus a poorly educated and indifferent soldier of a poor country—but this is a consideration beyond mere economics.

Figure 3.1 compares, for 37 large countries,⁷ the gross national product (GNP) divided by its working-age population in PPP terms in comparison to the United States (which means that the U.S. data are represented as a straight line).⁸ The years covered range from 1980 to 2007, based on World Bank data, where such data exist. Rising lines

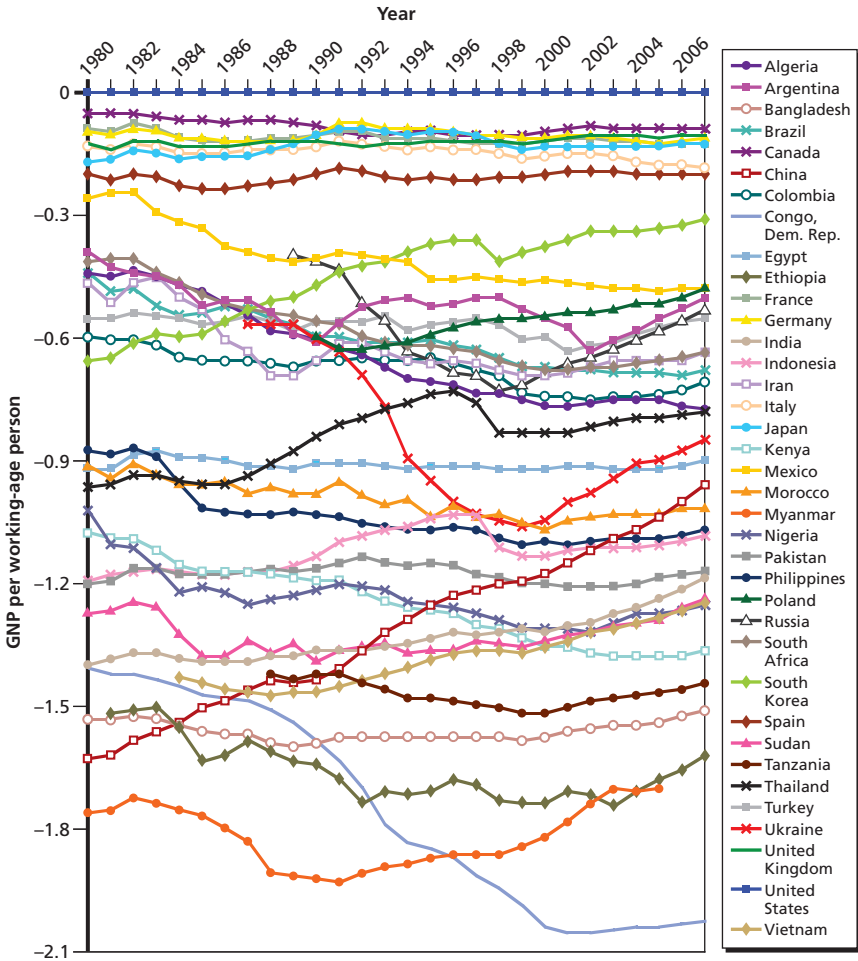
in PPP terms, the poor country's GDP per capita is 10 percent that of the rich country; in exchange-rate terms, 5 percent—the aforementioned 2:1 ratio.

⁶ This is not a universal view. The Stockholm International Peace Research Institute (SIPRI) tracks arms expenditures but uses exchange rates rather than PPP estimates. This is explained by their reluctance to use estimates in place of facts (for similar reasons, if they lack facts on a particular expenditure, they leave it blank). See SIPRI, SIPRI Military Expenditure Database, undated.

⁷ The largest 37 countries were defined in terms of the size of their working-age population in 2020. We use 37 rather than 55 to avoid cluttering the graph and because going past 37 would quickly involve such countries as Iraq and Afghanistan, numbers for which are questionable.

⁸ GDP per capita data from the World Bank were divided by UN data on the ratio of the working-age population to the whole population. The resulting data were then divided by that year's figure for the United States.

Figure 3.1
Gross National Product per Working-Age Person Relative to U.S. Levels
(logarithmic scale)



SOURCE: World Databank, "World Development Indicators, 2007," accessed December 15, 2010.
 RAND MG1091-3.1

mean that a nation's GDP per capita is growing faster than the U.S. rate. Declining lines mean that it is growing more slowly, although it could still be rising in absolute terms. Note that, for clarity, the figure

shows the logarithm of the ratio rather than the ratio itself; thus, the U.S. line equals zero (the natural logarithm of one).

What is notable about this graph is the stability of the various per capita GDPs vis-à-vis each other over such a long period.⁹ Consider, first, six rich countries: Japan, Germany, France, the United Kingdom, Italy, and Spain. All of them (other than Spain) start roughly a quarter less affluent than the United States, and all of them (now including Spain) end up there as well. Indeed, Japan, whose per capita GDP reached 85 percent in the 1980s, is now closer to 75 percent. Canada stays in the 80- to 90-percent range throughout. Following several decades of economic convergence after World War II ended, there has been little further convergence since 1980 in these numbers.¹⁰ If past is prologue, there is no reason to believe that these ratios will change much over the next 40 years.

After the rich countries comes a fairly large gap around the -0.5 level (roughly a third of U.S. GDP per capita). The gap is crossed by three countries: Mexico (whose income circa 1980 reflected the elevated price of crude oil and thus fell with crude oil prices in the early 1980s), Russia (whose GDP collapsed in the first five years after Communism ended), and South Korea—the only country that has moved from the middle-income band to the affluent band (albeit at the bottom of the band) over the last quarter-century.

Next examine the middle-income countries whose 2007 GDP per capita on the graph lies between -0.45 (36 percent of U.S. levels) and -0.85 (12 percent of U.S. levels). They include, from most to least affluent, Poland, Mexico, Argentina, Russia, Turkey, South Africa, Iran, Brazil, Colombia, Thailand, Algeria, and Ukraine. The overlap between this group and the 1980 version of the middle-income group is high. South Korea left that group going up, and Thailand entered that

⁹ Bear in mind that the display—in portrait rather than landscape form and with the legend on the side—exaggerates the vertical dimension.

¹⁰ Per capita GDP in Singapore (not shown), having nearly reached U.S. levels just before the Asian financial crisis in 1998, did surpass U.S. levels in 2005 and is still rising. Hong Kong levels may also surpass U.S. levels within the next few years, based on recent trends. Data for Taiwan are unavailable. Incidentally, the impact of the 1998 financial crisis, as judged by the data, was quite substantial and persistent.

group going up. Per capita incomes in Poland, Russia, and Ukraine may or may not have been higher in 1980 (under Communism) than the group's range, but when their incomes were first measured in the late 1980s, they were part of or just above that cluster. Every other country in that cluster started there and stayed there. To be sure, if one looks back only to 2002 (or 2000, if Argentina is excluded), all 13 countries have been growing more rapidly, per capita, than the United States¹¹ has—but the same cannot be said if one looks back to 1980.

The last group consists of poor countries, countries whose per capita income ranges from 12 percent of U.S. levels (Egypt and China) down to 0.7 percent (Congo, a war-torn outlier). Every member of that group today was a member back in 1980. Only three countries in that group have experienced a steadily rising GDP per capita (relative to U.S. levels): China,¹² Vietnam, and, starting later and to a lesser extent, India. Every other country seems to have drifted (again, in relative terms), and some of them have fallen: notably Congo, but also Ethiopia and Kenya. As with the middle-income group, if one looks back only five years, growth rates in all instances have been faster than U.S. levels.

China and India bear special attention. In all likelihood, if this monograph were to be written a few years from now, China would sit squarely within the middle-income countries. Similarly, if one takes India's growth rate from 2000 to 2007 as the new norm, one could

¹¹ U.S. per capita GDP growth was 2.16 percent from 1980 to 2000 but only 1.48 percent from 2000 to 2007. Thus, part of the reason for everyone else's faster relative growth was the slower absolute growth of the United States. That noted, of the 27 middle-income and lower-income countries, two (Mexico and Congo) grew ever-so-slightly more slowly than the United States over the seven-year period. Had U.S. growth after 2000 been the same as U.S. growth over the 20 years prior, two more countries (Brazil and Kenya) would have been registered as having grown more slowly. That leaves 23 countries that would have grown more quickly even if U.S. growth had not decelerated.

¹² In the previous chapter, China was grouped with middle-income countries for the purpose of displaying its fertility rate.

envison India reaching middle-income status by 2028 in relative terms.¹³

We end this discussion by considering whether variations between one country and the next in demographics (working-age population) are more or less of an influence on overall national GDP than are variations between one country and the next in economics (GDP per working-age person). To do so, we compare across 37 nations the variation in a nation's prospective (2010–2030) working-age population to the variation in its retrospective (1980–2007) GDP per capita.¹⁴

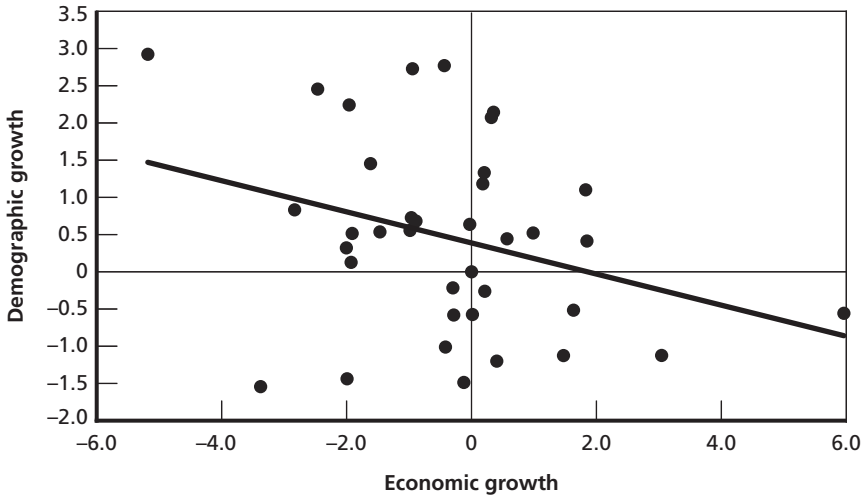
The results are plotted in Figure 3.2, where the horizontal axis represents annual growth in GDP per working-age person (1980 to 2007) and the vertical axis represents annual growth in working-age population (2010 to 2030). When all 37 countries are considered, the standard deviation in retrospective GDP per capita growth rates of 1.94 is clearly higher than the standard deviation in prospective working-age population growth rates of 1.29. One may infer that when projecting future GDP, hard-to-predict variations in economic growth are more important than easier-to-predict variations in demographic growth. However, if one can eliminate two economic growth rate outliers—high-growth but aging China and war-torn but high-fertility Congo—then the dominance of economic growth is not so pronounced. The standard deviation of economic growth falls to 1.46, while the standard deviation for population growth is 1.24. Country-to-country variations in economic growth rates are only slightly more important components than country-to-country variations in demographic growth rates in terms of forecasting GDP.

Prior economic growth and prospective growth in the working-age population—which is actually a proxy for prior fertility rates—appear to be somewhat negatively correlated. Every percentage-point rise in the annual demographic growth rate is associated with just

¹³ India's GDP per working-age person will hit 12 percent of current U.S. levels by 2023 at these rates.

¹⁴ We take into account the fact that the relevant span is shorter for those countries for which 1980 figures are not reported or the one country (Myanmar) for which 2007 figures are not reported.

Figure 3.2
Demographics or Economics?



SOURCE: Economic growth data (horizontal axis) are from World Databank, 2010. Demographic growth data (vertical axis) are from United Nations Population Division, 2009.

RAND MG1091-3.2

below a quarter-point decline in the economic growth rate. It is not clear which is cause and which is effect (e.g., is it more important that countries growing richer therefore have fewer babies or that having fewer babies provides a “demographic dividend”?).

Uncertainties in the Relationship Between Aging and GDP

The globe’s population is aging as it never has before. Yet, the effect that aging will have on GDP growth is quite uncertain. One key sub-issue is the effect of a nation’s having a declining labor force. All else equal—including labor force participation rates and retirement ages—an aging population means a smaller labor force relative to the population and potentially less aggregate income relative to the population (a

lower GDP per capita). Labor force participation of all adults, including the elderly, is forecast to decline in more countries than it is forecast to rise.¹⁵

This could have negative consequences. One estimate holds that if labor force participation rates remain unchanged and if labor productivity follows the same trend as it did between 1970 and 2000, then per capita GDP growth in the OECD (the world's rich but aging countries) will decline to 1.7 percent annually for three decades through about 2030, compared to 2.5 percent in the three decades prior to 2000.¹⁶ Since the United States is aging more slowly than its rich counterparts, demographics are a force that may widen the gap between the size of the U.S. economy and the economies of other developed countries in terms of both aggregate GDP and GDP per capita.

However, labor force participation among the working-age population may not be the right measure for thinking about the economy in an era of aging. The aging of populations has been accompanied by lower fertility rates, meaning fewer children. While the proportion of adults working may fall, the proportion of the entire population working need not fall. In fact, the ratio of labor force to population for 174 countries rose between 1960 and 2000 from 42.5 to 46.5 percent, at the same time that labor force participation among adults fell. The labor force to population ratio is further projected to keep rising to 48.6 percent by 2040.¹⁷ This rise in labor force relative to population means that there will be very little effect on global GDP through 2040. Even so, those countries aging most rapidly are likely to have modest slowdowns of growth.

Changes in labor productivity also raise uncertainties about the effects of aging on economic performance. As noted above, labor productivity is an important indicator of long-run growth. How productive will an older workforce be? No one really knows. In part, this is

¹⁵ David E. Bloom, David Canning, and Günther Fink, "Population Aging and Economic Growth," Cambridge, Mass.: Harvard Initiative for Global Health, Program on the Global Demography of Aging, Working Paper No. 31, April 2008.

¹⁶ OECD, "Live Longer, Work Longer," *DELSA Newsletter*, Issue 2, 2006, pp. 2–3.

¹⁷ Bloom, Canning, and Fink, 2008.

because there are no reliable data on age-specific labor productivity.¹⁸ If older workers are trainable, are inventive, and can absorb new technology and methods, labor productivity trends could continue along the same path as before. If they are not, economic growth may suffer.

Another uncertainty stems from how the economy will transition to the different demand patterns and labor supply patterns that aging will bring about. The composition of older people's consumption is different from that of younger people. The older consume more from the health and hygiene sector, for example, and less from the transportation and communication sector and clothing and shoes sector.¹⁹ At the same time as demand is changing, thus changing demand for labor by sector, the supply of labor will be changing as well, in the form of an aging workforce. This could have large, as yet poorly understood economic effects.²⁰ These effects are most likely to be seen at the sectoral level.

A final uncertainty involves the savings-investment balance. Global capital markets are open—and are likely to stay so despite the financial crisis that started in 2008—but, for most countries, the source of investment has remained national savings. As populations age, older people will presumably draw on their savings, reducing the amount of money available for investment.

Two trends militate against this being a problem. First, although savings rates appear to decline as a population ages,²¹ there is no observed dissaving—older people continue to save on an aggregate basis.²² There may, in fact, be less new money available for investment, but an aging population may not draw down whatever capital is already present. Second, there will be fewer workers over which to spread investment.

¹⁸ Axel Börsch-Supan, "Global Aging: Issues, Answers, More Questions," University of Michigan Retirement Research Center Working Paper 2004-084, June 2004.

¹⁹ Börsch-Supan, 2004.

²⁰ David N. Weil, "Population Aging," Cambridge, Mass.: National Bureau of Economic Research, Working Paper 12147, March 2006.

²¹ Barry P. Bosworth, Ralph C. Bryant, and Gary Burtless, *The Impact of Aging on Financial Markets and the Economy: A Survey*, Washington, D.C.: The Brookings Institution, 2004.

²² Börsch-Supan, 2004.

In fact, the demand for new investment may decline faster than available new savings.

Conclusions

A nation's future GDP is the product of its easy-to-predict future working-age population and its hard-to-predict future GDP per working-age person. The latter has historically been bounded in the sense that growth rates for other countries have, so far, not been radically different than growth rates for the United States. More broadly, country-to-country variations in economic growth rate have been comparable to similar variations in population.

Furthermore, there is no reason to believe, at this point, that population aging is likely to flatten economic growth rates. The elderly, because they consume but are rarely employed, tend to be a net drain in GDP accounts. Conversely, as a class, they can bring into retirement more assets than they consume over the course of their retirement and are therefore a net gain for investment. Aging countries can well be net capital exporters.

All this suggests that demographic change can be understood as an independent and significant contributor to a nation's ability to generate resources, notably—as Chapter Five discusses—for military power.

The Economic Burden of Aging Populations

Chapter Three discussed economic growth trends with respect to a country's income, but the financial resources that a country can commit toward enhancing its power projection also depend on the size and allocation of its expenditures. There are many expenses—such as debt payments, infrastructure costs, and government operating expenditures—that come out of the same pot of money that funds the military. This monograph cannot hope to explore all of these competing financial priorities, but it can provide insights into those expenditures most determined by demographic trends: social security and medical expenses. Even though this exploration is limited, it will be useful for our purposes because social benefit outlays tend to be defense budgets' biggest competitors. The global average for government health expenditures in 2006 was 14 percent of total government expenditures.¹ This chapter will examine how the aging of a nation's population affects the costs of social welfare spending and ultimately impacts the resources available to support military operations.

Policies Plus People Equals Burden

The burden of an aging population is not simply a reflection of the number of elderly citizens; it is also the result of national policies. Chief

¹ World Health Organization, "General Government Expenditure on Health as Percent of Total Government Expenditure 2006," in World Health Organization, *World Health Statistics 2009*, Part II, "Health Expenditure," Geneva, 2009, Table 7, pp. 107–117.

among these are public pension rules that provide incentives to retiring early and penalize retiring later. Such incentives for retiring early could include low mandatory retirement ages or disability rules that result in pension payments for workers with modest disabilities who could actually still hold productive employment, although perhaps not in their preferred profession. Penalties for retiring later would include pension benefits that were no higher if a worker were to retire past some target age.

As in many middle-income and advanced countries, policy choices weigh heavily on U.S. public retirement systems.² Social Security projections as of late spring 2009 estimated that program costs would exceed tax revenues in 2016 and the trust funds underlying the system would be depleted by 2037³—after which point, assuming no change in laws, full benefits for old age and disability could not be paid for. However, in a prior analysis (with the costs exceeding revenues in 2019 and the trust funds being depleted in 2044), the Congressional Budget Office found that changing how benefits are indexed, the benefits formula, the retirement age, and tax provisions could extend the life of the trust fund by decades, and even indefinitely.⁴

Not solving these budget pressures could have deleterious effects on other functions of government. In 2007, U.S. government expenditures were 21 percent of GDP, social benefits were 9 percent, and borrowing was 2 percent. The U.S. Office of Management and Budget

² A number of countries in the OECD—an organization that includes all economically advanced and several middle-income countries—have challenging budget situations caused by aging. Among countries with low labor-force participation rates among people aged 50 to 64, Austria and Hungary are likely to have large increases in their old-age dependency ratios through 2050, while Greece, Italy, Poland, the Slovak Republic, and Spain are anticipated to have very large changes. Of these countries, Hungary, Poland, and the Slovak Republic had per capita GDPs less than half those of the other four countries, and of the three poorer countries, Hungary had the slowest growth of per capita GDP from 2004 to 2008 (World Databank, 2010).

³ Federal Old-Age and Survivors Insurance and Federal Disability Trust Funds, *The 2009 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Trust Funds*, Washington, D.C., May 12, 2009.

⁴ Congressional Budget Office, *Projected Effects of Various Provisions on Social Security's Financial and Distributional Outcomes*, Washington, D.C., May 25, 2005.

(OMB) projected that by 2040, payments for Social Security, Medicare, and Medicaid will rise to 13 percent of GDP, compared with 7 percent in 2000. If the percentage of the GDP going to the federal government maintains its historic rate of 20 percent, this leaves only 7 percent of GDP for all other functions of government, including interest payments and national defense.⁵

Keeping in mind that the burden of an aging world is an issue of both population and policy, we first take a closer look at what that world looks like today and how populations, as a whole, are expected to age over the next 20 to 40 years. We then discuss the potential effect of aging on pension costs and medical costs, concluding with policy implications.

A Profile of the Aging World

As shown in Chapter Two, the percentage of the population over 60 is rising in nearly all countries. Correspondingly, the ratio of older people to those of working age (20 through 60) would also rise. This figure, known as the *aged dependency rate*, already shows wide variation for countries for which good data are available. Taking the 2010 projection for nine major countries as a proxy for current (2010) statistics, Brazil has the lowest aged dependency rate, with fewer than 18 senior citizens for every 100 working-age adults; Japan has the highest, with 53.

The figures may understate the burden of support that workers must provide because they do not take account of labor force participation. Just because Brazil has 18 older individuals for every 100 *working-age adults* does not mean that it has 18 older adults for every 100 *workers*. In 2007, among ten economically advanced countries, the ratio of civilian employment to the civilian working-age population averaged

⁵ OMB, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009*, Washington, D.C.: U.S. Government Printing Office, 2008, Table 13-2.

58.4 percent.⁶ Assume, therefore, that, on average, only 60 percent of all working-age people can be considered potential *workers*.⁷

When one whittles down the working-age population to a number that more closely approximates the number of actual workers, Brazil has 30 older people for every 100 potential workers, whereas Japan has almost 90. Italy, Germany, and France are not so far behind, with roughly 80. And all these figures are projected to rise, in some cases dramatically. The biggest increase is projected for Brazil, from 30 to nearly 100 by 2050. The smallest increase is expected in the United States, from 55 to 90.

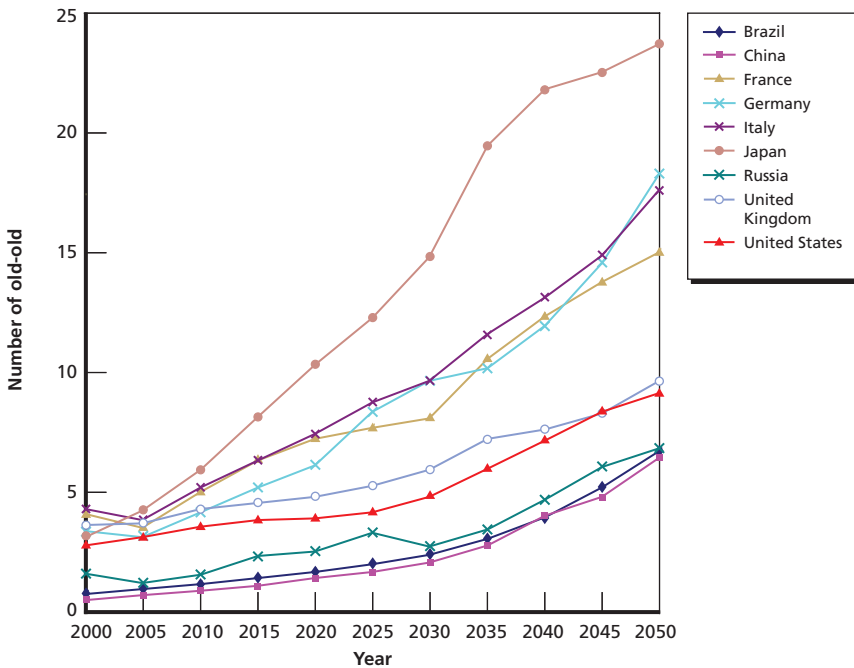
Conversely, because people can work past 60, assuming that they are net resource users may overstate some of the pressures of aging. The old-old, those over 85 and thus likely to have serious medical expenses, may be the heart of the burden. It helps to consider the ratio between the old-old and the working-age population, as we do in Figure 4.1.

The rapid rise of the old-old is particularly striking in Japan, but their proportion also rises quickly in Europe. It rises most slowly in the developing world, and particularly slowly in China. In Japan, the proportion of old-old to working-age adults rises from 6 to 22 percent in 2040 and 24 percent in 2050—or greater than the proportion of old (60+) to working-age adults today in Brazil. The proportion of old-old relative to working-age adults in Italy is expected to rise from 5 percent today to almost 18 percent in 2050. By contrast, it is expected to rise in China from below 1 percent today to around 6 percent in 2050.

⁶ United States Bureau of Labor Statistics, Division of Foreign Labor Force Statistics, *International Comparisons of Annual Labor Force Statistics: 10 Countries, 1960–2007*, Washington, D.C., October 21, 2008. The ten countries are Australia, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, the United Kingdom, and the United States.

⁷ This 60 percent reflects roughly 80 percent among men and roughly 40 percent among women. The former is consistent from one country to the next, but the latter varies from one to another country for many reasons, such as cultural factors. We discuss estimates of older people relative both to working-age people and the approximate number of workers because the number of workers can change, depending on policy and other circumstances, whereas the number of working-age people can give a better idea of the approximate upper bound of the number of people supporting nonworkers. The definition of working age can change as well, suggesting that using the total number of working-age people does not provide a fixed upper bound but rather suggests an order of magnitude.

Figure 4.1
Number of Old-Old People (85+) for Every 100 Working-Age Adults



SOURCE: Data from United Nations Population Division, 2009.

RAND MG1091-4.1

Reintroducing the earlier basis of comparison, China remains the country, among those assessed, with the lowest proportion of old-old relative to potential workers, while Japan clearly has the greatest. The proportions for France, Germany, Italy, and the United Kingdom also rise to the double digits, but those for Brazil, Russia, and the United States stay below 10. We now explore these figures in more detail to explore the extent to which demographic changes affect national power. Countries that are similar today may face very different futures, particularly if they have no good way other than taxation to support those who cannot work but who, on average, face high health care requirements.

The Advanced Countries

As noted, our projections for the older population encompass France, Germany, Italy, Japan, the United Kingdom, and the United States. These are among the richest countries in the world and together constituted 53 percent of the world economy in 2007, when measured at market exchange rates.⁸ The fact that they have populations that are older than those of many other countries, at least in the case of the first four, can be credited to lower total fertility ratios among women of childbearing age and higher survival rates among older residents. The United States and the United Kingdom have slower-aging populations than the other four. In the case of the United States, its fertility rate is the highest of the six, while its survival rates (the number of people of a given age who survive until the next year as a percentage of all people of a given age) for those older than age 60 are relatively low. For the United Kingdom, even though its fertility rate is closer to the average for the entire group, it has lower survival rates for most age groups above age 70.

Chapter One discussed variations in total fertility rates and how those might change. This section takes an alternative look at how populations age by considering changes in survival rates. The possibility of such changes is not far-fetched. Humans have undergone astounding physical and longevity changes in the past 300 years.⁹ These include an increase in average body size by more than 50 percent, more than a doubling of average longevity, and improvements in “the robustness and capacity of vital organ systems.”¹⁰ Even beyond these longer-term changes in longevity, recent research suggests that longevity could be malleable even in the short term: Current conditions and behav-

⁸ World Databank, 2010.

⁹ Robert W. Fogel and Dora L. Costa, “A Theory of Technophysio Evolution, with Some Implications for Forecasting Population, Health Care Costs, and Pension Costs,” *Demography*, Vol. 34, No. 1, February 1997, pp. 49–66.

¹⁰ Fogel and Costa, 1997, p. 49.

iors strongly influence age-specific death rates, and interventions can increase longevity even in the very old.¹¹

Survival rates can be thought of in terms of the number of people of a certain age who survive each year out of 1,000 people of the same age. For the economically advanced countries of France, Germany, Italy, Japan, the United Kingdom, and the United States, these numbers average 992 for people aged 55 to 60 and 700 for people aged 95 to 100. Among these countries, only Japan has survival rates that are better than average for every age group between 55 and the end of life, for both men and women. The United States is at least one standard deviation worse than average for most younger-old age groups (men through age 75 and women through age 80) but is better than average for all older age groups.

It is worth noting that the growth in the percentage of these nations' old and old-old populations comes, in part, from the assumption that survival rates will continue to advance. Table 4.1 portrays the year-to-year decline in mortality rates—the opposite of survival rates—inferred from UN statistics.¹² Yet, these are conservative assumptions; over the last 20 years, mortality rates in the United States for those over 80 have improved at 1.5 percent a year for men and 1.0 percent a year for women. If these numbers (see Table 4.1) are plugged into the UN population projection model, the ratio of the old to the working-age population is 58 percent rather than 54 percent, and the ratio of old-old to the working-age population would be 11.5 percent rather than 9 percent. Conversely, were there no improvements in survival rates, the ratio of old to working-age would be 49 percent (rather than 54 percent), and the ratio of old-old to working-age would be 6.5 percent (rather than 9 percent).

¹¹ James W. Vaupel, James R. Carey, and Kaare Christensen, "Aging: It's Never Too Late," *Science*, Vol. 301, No. 5640, September 19, 2003, pp. 1679–1681.

¹² The inference assumes that net immigration for those older than 60 is zero—an assumption that tracks well with actual historical statistics.

Table 4.1
Projected Annual Improvements
in Mortality Rates for the United
States from 2005 to 2050

Age Group	Men	Women
60–64	1.014 ^a	1.013
65–69	1.012	1.011
70–74	1.010	1.011
75–79	1.008	1.009
80–84	1.007	1.009
85–89	1.006	1.008
90–94	1.005	1.006
95–99	1.003	1.005
100+	1.001	1.002

SOURCE: Calculations based on data from United Nations Population Division, 2009.

^a As an example of the derivation, the estimated annual mortality rate for a 60-year-old man in the United States was 1.03 percent in 2005, and the projected annual mortality rate for a 60-year-old man in 2050 was 0.46 percent—an annual improvement of 1.4 percent (shown as 1.014 in the table).

The Developing Countries

Reliable survival rate data for those over 85 are available for only a few developing countries. We focus on Brazil, China, and Russia. It may seem surprising to include Russia in a list of developing countries, but once you strip away Russia's macroeconomic indicators, its social development picture looks more like Asia than Europe, especially for its large population of pensioners. Survival rates in these three countries are far worse than the average rates in the economically advanced countries.

Russia suffers from notoriously bad health indicators, but survival rates in China are also quite poor relative to those in the advanced countries. For example, in the six advanced countries discussed above, the survival rate for people aged 65 to 70 averages 982 out of 1,000, but in China it measured 933 out of 1,000, and in Russia it measured 945 out of 1,000 (put another way, a 65-year-old has four times the likelihood in China and three times the likelihood in Russia of dying in the year compared to his or her chances in the West). In general, developing countries can expect to have far fewer older people relative to working-age people compared with advanced countries. An exception may be Russia, but this is due to low fertility rates and high death rates among the working-age cohorts.

As of 2010, the number of people aged 60 and over relative to the working-age population was lower in all three countries than in any of the advanced countries (except that Russia's ratio was higher than the U.S. ratio). The number in Brazil and China in 2050 is projected to be below that of all advanced countries in 2010, except for that of the United States. Even with declining survival rates, the number of people aged 60 and over relative to 100 working-age people would be lower in Brazil and China in 2050 than in France, Germany, Italy, and Japan today. Brazil and China will remain younger societies than Europe and Japan.

In Russia, by contrast, the number of people over 60 for every 100 working-age people is only three below that of the United States now. According to UN projections, Russia will surpass the United States just after 2040 (both as projected and if survival rates in both countries improve by 1.5 percent a year). If survival rates were to stop improving, Russia's ratio will not surpass the U.S. ratio before 2050.

The old-old in these three countries are likely to remain a small percentage of the population—roughly 6 percent in all three countries by 2050.

Medical Expenditures

Population aging carries economic costs that reflect the extent to which the elderly need more medical care than the young. With all else constant—such as medical technology, the cost of treatment, and the incidence of disease—a society with more elderly people will have higher medical costs. Since the elderly rarely work, paying for their health care has become, in many cases, a government expense.

Recent research on the lifetime distribution of health care costs illustrates this issue (Table 4.2). Alemayehu and Warner calculated that if age-specific medical costs and mortality rates in the late 1990s stayed the same over the lifetimes of people born in any given year, then a newborn would expect to incur \$316,600 in medical costs throughout his or her life.¹³ Six percent of a person's costs would be incurred prior to reaching the age of 20. A person who survived until 85 would expect to pay \$113,700 over the years remaining, or more than one-third of his or her total lifetime medical expenditures.¹⁴

Table 4.2
Age-Specific Medical Expenditures (constant 2000 dollars)

Age	Annual Per Capita Expenditure	Lifetime Per Capita Expenditure Yet to Be Paid	Relative Lifetime Expenditure (%)
0	2,920	316,579	100.0
20	1,255	296,363	93.6
40	1,929	262,124	82.8
65	7,702	188,658	59.6
85	7,688	113,685	35.9

SOURCE: Alemayehu and Warner, 2004, Tables 3 and 4.

¹³ Berhanu Alemayehu and Kenneth E. Warner, "The Lifetime Distribution of Health Care Costs," *Health Services Research*, Vol. 39, No. 3, June 2004, pp. 627–642.

¹⁴ Expenses include facility services (hospitalization and nursing home stays), professional services, drugs, dental services, and vision and hearing services.

The researchers observed that lifetime lengths had a nontrivial effect on medical costs. In part, because women lived almost six years longer than men, 79.4 years versus 73.6 years (as of the late 1990s), their lifetime medical costs are higher under the researchers' assumptions: \$361,200 versus \$268,700. If men lived as long as women, their lifetime medical costs would rise by \$36,600; likewise, if women's lifespans were as short as men's, their lifetime medical costs would fall by \$43,900.

The work by Alemayehu and Warner demonstrated a pure age effect on health care expenditures (HCE). Notwithstanding any other factor, the changing age distribution of the U.S. population would raise per capita health expenditures by 20 percent between 2000 and 2030. But one cannot ignore these "other factors."

Ambiguities in the Relationship Between Aging and Medical Expenditures

If aging and medical expenditures were strictly related, then countries with older populations would exhibit higher medical expenditures. Yet, few cross-country studies find much relationship between age and medical expenditures after taking account of the effects of income, lifestyle factors, and environmental factors.¹⁵ One reason is that while populations age, other changes take place that could alter health costs: e.g., changes in disease patterns, social and economic changes, greater public entitlements to medical treatment, and technological change.¹⁶

¹⁵ Meena Seshamani and Alastair M. Gray, "A Longitudinal Study of the Effects of Age and Time to Death on Hospital Costs," *Journal of Health Economics*, Vol. 23, No. 2, March 2004, pp. 217–235; Dov Chernichovsky and Sara Markowitz, "Aging and Aggregate Costs of Medical Care: Conceptual and Policy Issues," *Health Economics*, Vol. 13, No. 6, June 2004, pp. 543–562; Peter Zweifel, Stefan Felder, and Markus Meiers, "Ageing of Population and Health Care Expenditure: A Red Herring?" *Health Economics*, Vol. 8, No. 6, September 1999, pp. 485–496.

¹⁶ Chernichovsky and Markowitz, 2004.

According to three different analyses,¹⁷ technology-related changes in medical practices accounted for between 38 percent and 65 percent of the growth in real health care spending per capita in the United States between 1940 and 1990. Administrative costs, changes in systems of third-party payment (e.g., Medicare and Medicaid), and rising prices contributed much of the rest.¹⁸ All this makes untangling the relationship between aging and medical expenditures difficult.

Longitudinal studies suggest that there may well be individual-level aging-related increases in costs;¹⁹ more importantly, costs, on average, rise at the end of someone's life, irrespective of his or her age. Since older people tend to be closer to the end of life, aging populations have higher medical costs—but this does not mean that the trend toward longer lifetimes is a trend toward greater individual annual expenditures on health. Each of us will be at the last year of our life once and only once.

A study of medical expenses in Israel suggests that aging had little effect on individual-level costs; other factors mattered more. Between 1966 and 1998, the median age of the population had no statistically significant relationship with health spending, yet other factors did. It appeared that higher education levels tended to be associated with lower health costs, while GNP per capita was associated with higher individual costs.²⁰

Household-level data indicated that aging was related to the distribution of health care expenses. People over 65 had more doctor and nurse visits, but no more specialist visits, than those aged 45 to 65. Education and a measure of income had the same effects in the household-level data as in the population-level data. Once a person reached 65, the number of visits did not necessarily rise continuously as a person aged. Although people aged 75 and higher tended to have more doctor

¹⁷ Summarized in Congressional Budget Office, *Technological Change and the Growth of Health Care Spending*, Washington, D.C., January 2008.

¹⁸ Congressional Budget Office, 2008.

¹⁹ Longitudinal studies follow one country or one population through time to account for different developments in technology, lifestyle, and other factors.

²⁰ Chernichovsky and Markowitz, 2004, Table 4, p. 552.

and nurse visits than those aged 65 to 74, older people within the 65 to 74 age group did not tend to have more visits than younger people in that age group, and older people in the 75-plus age group did not tend to have more visits than younger people in that age group. In fact, the number of specialist visits declined as aging continued past age 75.²¹ In other words, if the data from Israel on which these findings are based can be generalized, once countries develop to the point where there is a large cohort over age 75, additional longevity has little further influence on national primary medical costs. We note, however, that this analysis did not include expenditures on other health-related costs, such as nursing home care.²²

By focusing on utilization rather than expenditures, the Israel study went only partway toward answering whether aging and medical costs are related. Two other studies, one using Swiss data from 1983 to 1992 and the other using data on patients in England from 1970 to 1999, looked at expenditures directly.

The Swiss study found that annual HCE were concentrated only at the last two years of life, regardless of age, for those 65 and older.²³ As such, a 90-year-old healthy person would actually incur lower quarterly costs than a 66-year-old person who was within a year of death. In addition, quarterly expenditures rose steadily within that final two-year period, and 40 to 50 percent of all spending during the last year of life took place in the last quarter. Similarly, about 60 percent of Medicare spending during the last year of life takes place in the last

²¹ Chernichovsky and Markowitz, 2004; Tables 7, 8, and 9; pp. 556–558.

²² Zweifel, Felder, and Meiers, 1999, add “another point of criticism could be that this study accounts for HCE in the terminal two years of life only, rather than also considering HCE due to early deterioration of an individual’s health, resulting in chronic diseases. It can be argued that as chronic diseases are positively correlated with calendar age, an increase in the elderly’s share of total population will result in an increasing demand for long-term care services. However, empirical evidence suggests that if a person falls chronically ill, her remaining life expectancy markedly falls (see S. Felder, “Multiple Risks and the Demand for Insurance: The Case of Longevity and Long-Term Care Risks,” *The Geneva Papers on Risk and Insurance, Issues and Practice*, 2000). Hence, it again appears likely that the high share of chronically ill persons among elderly cohorts is caused by the closeness to the time of death rather than by high calendar age.”

²³ Zweifel, Felder, and Meiers, 1999.

quarter. The high cost-loading in the final quarter generally reflected the tendency of most older people to die in the hospital.²⁴

Although the English study found that hospital costs were concentrated in the immediate period before death (rather than correlating simply with age), these costs started rising well before the two years prior to death; the rise actually started 15 years prior. Nevertheless, half of these costs were incurred in the last year of life, and almost three-quarters were incurred in the last five years.²⁵ Hospital costs in the final year of life did vary with age, but not linearly. They rose into the 80s and then fell, so that costs for people aged 90 and above in their last year of life were actually lower than for people aged 80 or 85.

Counterevidence That Costs May Rise with Aging

Conclusions drawn from these studies must be tempered by the fact that costs, in nearly every health care system, are controlled in one way or another—e.g., by limiting what doctors can charge or what conditions are covered. In addition, the studies may not cover every health cost related to aging. A study focusing on the incidence of disability among the aged shows that aging may well cause individual health spending to increase with greater age.²⁶

The aged as a whole are getting healthier. From 1984 through 1999, the percentage of the U.S. population over 65 with a chronic disability fell by 2.4 percent;²⁷ similarly, the percentage receiving human help with chronic disability fell by 3.8 percent. In 1984, 73 percent of this population was free of any disability, not just chronic disability, and by 1999 that proportion had risen to 74.7 percent.²⁸

²⁴ Zweifel, Felder, and Meiers, 1999, pp. 488–489.

²⁵ Seshamani and Gray, 2004, Table 3, p. 224.

²⁶ Brenda C. Spillman, “Changes in Elderly Disability Rates and the Implications for Health Care Utilization and Costs,” *The Milbank Quarterly*, Vol. 82, No. 1, 2004, pp. 157–194.

²⁷ Spillman, 2004.

²⁸ Spillman, 2004, Table 1, p. 164.

However, most of the decline took place among what are known as instrumental activities of daily living (IADLs), less-serious types of disability. Furthermore, this statistic should be understood in the context of accommodations that have been innovated to compensate for such disabilities, such as the ability to shop more easily or the switch from mailing Social Security checks to direct deposit, thereby reducing money-handling challenges.²⁹

There was no decline over the 15-year period in the proportion of chronically disabled who were institutional residents or those receiving human help outside of residing in an institution for the more serious activities of daily living (ADLs). In addition, the proportion receiving equipment help for ADLs actually rose.³⁰

Although there was a 6.5-percentage-point decline in disability among the population aged 85 and older, the total proportion of people aged 85 and over with chronic disability was far higher than the proportion of those aged 65 to 85 throughout the period, starting at 62 percent in 1984 and ending at 55.5 percent in 1999. In addition, as with the general older population, most of the declines took place in IADLs.³¹

Extrapolating from U.S. results to global trends implies that old people are getting healthier while at the same time their life spans are increasing. To wit, the relative proportion or absolute level of time spent in chronic poor health falls as life expectancy increases.³² This suggests that older people will increasingly be able to stay economically active (if they so choose) or have lower-than-projected health costs. Yet, it is the severe rather than the mild disabilities that drive costs, and serious disabilities (as a function of age) are not declining. Furthermore, older people tend to have more-serious disabilities. Technology and

²⁹ Spillman, 2004, p. 176.

³⁰ IADLs include doing light housework, doing laundry, preparing meals, shopping for groceries, getting around outside, taking medications, managing money, and using the telephone. ADLs include eating, getting in and out of bed, getting around inside, going to the toilet, bathing, and dressing. See Spillman, 2004, p. 160.

³¹ Spillman, 2004, Table 2, pp. 167–168.

³² Bloom, Canning, and Fink, 2008.

other accommodations can ease the burden of disabilities (as shown by declines in the percentages of those receiving help for certain IADLs), but with uncertain cost effects.

Summing Up Aging and Medical Costs

Aging populations will likely mean higher overall health care spending, because most of the spending takes place near death.³³ However, it is less clear that annual average health care spending on an individual basis will rise dramatically, if for no other reason than because so many other cost-related factors are at work. A recent OECD report on aging noted that “the bulk of the rise in health expenditures is likely to come from a continuation of the long-term trends towards a rising share of GDP being devoted to health independently of demographic trends—partly reflecting the introduction of expensive new drugs and new types of medical interventions and techniques.”³⁴

In countries where people must pay for their own health care, spending levels may depend on the drawdown of personal savings, support from family members, and continued employment or engagement in household production for market. Where governments pay the bulk of the expenses, spending levels may depend on what such governments can afford. If governments respond to budget pressures by cutting benefits, the aforementioned personal sources would come into greater play. However, if governments decide that cutting benefits is not their preferred policy, then cuts must come from other areas, including defense-related spending.

The potential rise in total health care costs in the United States may also have direct implications for the U.S. military, because the military pays for health care for active-duty personnel, retirees, and

³³ Lower death rates per year among the elderly mean that a lower percentage of the population is dying each year if fertility rates are held constant. A country with a long-term ZPG fertility rate will, over time, have a death rate that is inversely proportional to the average life span. Thus, if people can expect to live until 80, 1.25 percent of the population will die each year; if they can expect to live until 100, only 1 percent of the population will die every year.

³⁴ OECD, 2006, p. 26, note 4.

dependents of both. Known as TRICARE, the military health system provides health care through military treatment facilities and private providers.³⁵ Since the mid-1990s, TRICARE benefits have improved at the same time that private-sector, employer-provided insurance has become less generous; in addition, eligibility for participation has expanded, and people have shifted out of employer-provided insurance into TRICARE for the more-generous benefits.³⁶ Although controlling future TRICARE costs will have little effect on the overall federal health care budget, growth of TRICARE may constrain defense spending in other areas.³⁷ This is especially true if Congress tries to keep overall defense spending stable or even cut back. As a result, reforms in benefits, eligibility, and required payments by beneficiaries might be necessary.

That noted, when it comes to the elderly, governments—the U.S. government, notably, aside—tend to spend less money on health care than on pensions, a subject to which we now turn.

Pension Expenditures and the Fiscal Burden

In 1980, Medicare, Medicaid, and Social Security (the three largest entitlement programs) comprised 30 percent of non-interest federal spending. By 2008, they had risen to 44 percent. They are projected to rise to 60 percent by 2030 and 70 percent by 2080. Medicare alone amounted to 1.1 percent of GDP in 1980 but is projected to amount to 9.6 percent in 2080. Those figures for Medicaid are 0.5 percent and 3.3 percent; for Social Security, they are 4.3 percent and 6.0 percent.³⁸

³⁵ Don J. Jansen, “Military Medical Care: Questions and Answers,” Washington, D.C.: Congressional Research Service, CRS Report for Congress RL 33537, May 14, 2009.

³⁶ Susan D. Hosek, “Leveraging Other Federal Health Systems,” in Alice M. Rivlin and Joseph R. Antos, eds., *Restoring Fiscal Sanity 2007: The Health Spending Challenge*, Washington, D.C.: Brookings Institution Press, 2007.

³⁷ Hosek, 2007.

³⁸ OMB, 2009.

However, for most other developed countries, the government-funded pension system presents a more serious problem. Nearly all developed countries use a pay-as-you-go pension system, meaning that the payments of current workers are used as pensions for the current elderly. As the proportion of elderly to workers rises, fewer and fewer workers are supporting more and more elderly. The problem is exacerbated by increasing longevity and trends towards earlier retirement. Most such systems are not financially sustainable.³⁹

The systems of France, Germany, and Japan provide examples. An analysis from the late 1990s showed that their public spending on pensions amounted to 11 percent in France and Germany and 9 percent in Japan in 1995. By 2010, they were projected to rise to 13 percent, 12 percent, and 14 percent, respectively. By 2030, those figures were forecast to become 17 percent, 14 percent, and 16 percent. Holding all else equal, France's unfunded public pension liabilities—meaning pension obligations against which the country has not set aside any money with which to pay them—amounted to 115 percent of GDP, Germany's amounted to 110 percent, and Japan's amounted to 105 percent at the time of the analysis.⁴⁰

Burdens are, in many cases, exacerbated by policy choices. An analysis of 12 developed countries showed that many systems provide benefits before what their societies consider a normal retirement age, thereby encouraging early retirement. For example, 65 is considered a normal retirement age in Germany, the Netherlands, Sweden, the United Kingdom, and the United States, but the age of first eligibility for retirement ranged from 53 to 62 among the countries in the study, with the eligibility age being 62 in the United States. Because many systems do not reward people for continuing to work past the age when benefits can first be collected, those who do work longer actually have lower present values of benefits. Some European countries have dis-

³⁹ Jonathan Gruber and David A. Wise, "Social Security Programs and Retirement Around the World: Fiscal Implications; Introduction and Summary," Cambridge, Mass.: National Bureau of Economic Research, Working Paper 11290, April 2005.

⁴⁰ Barry P. Bosworth and Gary Burtless, "Budget Crunch: Population Aging in Rich Countries," Washington, D.C.: The Brookings Institution, Summer 1997.

ability and special unemployment programs that operate as early retirement programs until the actual retirement benefits are available. As of 2005, in Germany, many employees were using a disability program to retire as early as age 57. Hence, there were fewer workers putting into the pension system, and more retirees drawing from it.⁴¹

Although developing countries are aging as well, many do not face the same budgetary challenges because they do not offer government-provided pensions. India has no populationwide government pension system. Yet, developing countries with public pension systems face the same problems rich countries do: China's system covers only about one-sixth of workers, but as of 2006 its unfunded liabilities already exceed its GDP.⁴²

Implications for the Fiscal Burden, or the Lack Thereof

Countries with public pensions face serious choices, moderated by the tendency for societies with many older citizens to have fewer school-age citizens and thus lower education and related expenses.⁴³ Furthermore, the old provide resources that the young do not. Even though per capita government expenditures on the old in Canada (C\$25,039 for those over 65), for example, are more than twice those on the young (C\$11,799 for those age 0 to 14), the old provide much more government revenue (C\$12,805 versus C\$2,584).⁴⁴ As a result, the fiscal burden of the entire dependent population—young and old—for the supporting population on a per-person basis is projected to rise only

⁴¹ Gruber and Wise, 2005.

⁴² Nicholas Eberstadt, "Growing Old the Hard Way: China, Russia, India," *Policy Review*, No. 136, April/May 2006. Cuba provides a recent example of such action in a developing nation. Faced with an aging population and a law making women eligible for pensions at age 55 and men at age 60, Cuba raised those ages to 60 and 65, respectively, in December 2008 (Jorge I. Domínguez, "Hello from Havana: Nuanced but Unmistakable Stirrings of Change in Cuba," *Harvard Magazine*, July–August 2009, pp. 24–27).

⁴³ Joe Ruggeri and Yang Zou, "The Fiscal Burden of Rising Dependency Ratios," *Population Research and Policy Review*, Volume 26, 2007, pp. 185–201.

⁴⁴ Ruggeri and Zou, 2007, Table 1, p. 188.

about 2 percent per year between 2004 and 2026 versus the 6.3-percent annual rise in the burden between 1989 and 2001.

Governments in the developed world that experience more-rapid increases will face a choice between cutting benefits, increasing taxes, delaying the retirement age, or other measures.⁴⁵ Yet, as the population ages, there will also be more of the older voters who do not want benefit cuts or delays to the retirement age. Older populations tend to be more politically active; in 2001, those over 65 constituted 16.6 percent of the U.S. voting-age population but 20.5 percent of those actually voting in November 2000. That share is expected to reach 30.5 percent by 2030.⁴⁶

This still leaves the 70 percent of voters who have to bear a higher potential burden to support the elderly and who may have different perspectives on the affordability of pensions and health care costs. A study focusing on social transfers, of which the largest was Social Security, in the United States and 12 European countries between 1965 and 1992 found a negative relationship between the dependency ratio and the generosity of social transfers. Adjusting for other factors that could influence social transfers, a higher dependency ratio was associated with a lower labor tax rate and lower social transfers in the form of Social Security, unemployment, and disability payments.⁴⁷

Unless future benefits are reduced, the fiscal stability of the public pension system would depend on the ability of the government to tax workers. Perhaps the presence of retirees with large savings would mean high capital-to-labor ratios, implying higher labor productivity, higher real wages, and, so, higher tax receipts per worker to pay for such pensions. However, higher payroll taxes would probably still be necessary, leaving workers—who would still outnumber retirees—with less to

⁴⁵ Bosworth and Burtless, 1997; Gruber and Wise, 2005; Dimitri B. Papadimitriou, “Economic Perspectives on Aging,” Annandale-on-Hudson, New York: The Levy Economics Institute of Bard College, Working Paper No. 500, May 2007.

⁴⁶ Henning Bohn, “Will Social Security and Medicare Remain Viable as the U.S. Population Is Aging? An Update,” Munich: CESifo Group, CESifo Working Paper No. 1062, October 2003.

⁴⁷ Assaf Razin, Efraim Sadka, and Phillip Swagel, “The Aging Population and the Size of the Welfare State,” *Journal of Political Economy*, Vol. 110, No. 4, 2002, pp. 900–918.

save and thus less capital formation in the economy. One simulation suggests that, on balance, the lowered savings by workers would outweigh the higher savings of the retired and result in scarcer capital and falling real wages, leaving that generation of workers far worse off.⁴⁸

Conclusions

On the face of it, the demographic trends affecting the end of life—longer life spans and the imminent retirement of the baby boomers—are likely to exacerbate the effect of trends associated with the beginning of life—lower fertility rates. The growing ranks of the elderly do this by drawing on public resources to fund their pensions and health care, thereby limiting what can be spent on other national ends. Both effects make it more difficult for aging societies to defend themselves or contribute to the defense of others, suggesting that aging of societies may present a serious concern for their defense planners.

The reality is a great deal more ambiguous. First, all societies are aging, and thus the rapid aging of Europe and Japan, as important instances, is less consequential in global terms than if they alone were aging. Power, after all, is relative. Second, an aging population is not necessarily one that would *ipso facto* spend more money on (publicly financed) health care. To the extent that major medical expenditures characterize the last two years of a person's life, the fact that any one person only goes through these last two years once means that extended life spans for the elderly do not necessarily translate into higher annual individual medical costs, holding all else—such as technology, pharmaceuticals, and financing systems—equal.⁴⁹ Third, while people are

⁴⁸ Laurence J. Kotlikoff, Kent Smetters, and Jan Walliser, "Finding a Way Out of America's Demographic Dilemma," Cambridge, Mass.: National Bureau of Economic Research, Working Paper No. 8258, April 2001.

⁴⁹ One additional wild card in health spending that raises a note of caution is the trend of rising obesity worldwide. Obesity can be described as a body mass index, measured as weight in kilograms divided by the square of the height in meters, of more than 30 (Peter G. Kopelman, "Obesity as a Medical Problem," *Nature*, Vol. 404, April 6, 2000, pp. 635–643). This amount of relative weight is associated with a number of medical conditions, including dia-

dying later, they are also staying healthier longer. They could thus work longer, if they chose, and, more importantly, if the incentives for their doing so existed—which they often do not.

There is no reason to think that current trends in labor-force participation or retirement will necessarily continue. A long-term 12-country study showed that national retirement policies had powerful effects on retirement ages and thus pension liabilities and national budgets.⁵⁰ Increasing the retirement age by three years across these countries would reduce the net cost of social security by 27 percent. Removing the reward for early retirement (and the penalty for continuing to work) would reduce the net cost of social security in five of the 12 countries by 40 percent.⁵¹ Both of these measures, along with ensuring the removal of other barriers to older workers staying in the labor force, would increase the labor-force participation rate of older workers and could dramatically improve economic performance.⁵² To be sure, dire forecasts are easy to generate. An aging population puts a greater burden on its working-age population, saddling them with taxes that spoil their incentives to work (and further reduce their ability to afford children). The state-supported aged, meanwhile, comprise a growing share of the electorate and form a strong lobbying group in favor of retaining a full array of old-age benefits. When countries can no longer generate the taxes to maintain the lifestyle of their early-retiring aged, they have the option of borrowing overseas, thereby levy-

betes mellitus, coronary heart disease, and some cancers (Kopelman, 2000). Although it is most notable in the United States, it is also present and growing in many other countries, both developed and developing, including Australia, Brazil, and China (Kopelman, 2000; Yang Lu and Dana Goldman, “The Effects of Relative Food Prices on Obesity—Evidence from China: 1991–2006,” Cambridge, Mass.: National Bureau of Economic Research, Working Paper 15720, 2010). This has come at a cost to both overall national health expenditures and public expenditures on health (David Thompson and Anne M. Wolf, “The Medical-Care Cost Burden of Obesity,” *Obesity Reviews*, Vol. 2, 2001, pp. 189–197; Eric A. Finkelstein, Christopher J. Ruhm, and Katherine M. Kosa, “Economic Causes and Consequences of Obesity,” *Annual Review of Public Health*, Vol. 26, 2005, pp. 239–257).

⁵⁰ Gruber and Wise, 2005.

⁵¹ Gruber and Wise, 2005, p. 33.

⁵² Gruber and Wise, 2005; Bloom, Canning, and Fink, 2008; OECD, 2006.

ing future obligations on the children of the working-age populations. But choosing this option would leave them fiscally exhausted and prey to the younger and hungrier denizens of the planet.

Conversely, humans have proven themselves resilient over time and possess at least a rudimentary capability to foresee and forestall disaster. Even the aged can intuit trouble if their needs are unaffordable at some basic level and accommodate attempts to rebalance the nation's ends and its means. The difference between the sad and happy future is politics—something, alas, that is even more difficult to predict than demographics and economics.

With this combination of near-certainties and guesses, we now use the baselines to say something useful about their effect on the propensity for war to arise and the differential abilities of various states to wage war between now and 2050.

The Influence of Demographics on the Causes of War

The academic literature has mooted several types of relationships between overall demographic growth and the tendency of nations to go to war;¹ three perspectives have received a good hearing.²

One is that population growth leads to environmental degradation, which in turn is a source of conflict.³ This relationship has been on display in Africa's Great Lakes region, where ethnic strife in Rwanda managed, after several iterations, to create a maelstrom on the eastern Congo, leading, directly or indirectly, to several million dead. Outside those areas, examples are harder to come by (e.g., the north Bangladesh-Assam area has seen tensions but no outright war; Yemen is another possible example⁴). Ultimately, however, this is an argument about the world's poorest regions and about environmental degrada-

¹ The relationship between the differential growth of ethnic groups within a country and its propensity for civil war—of which Lebanon is the oft-cited example—is a different topic.

² For a good general treatment, see Ronald R. Krebs and Jack S. Levy, "Demographic Change and the Sources of International Conflict," in Myron Weiner and Sharon S. Russell, eds., *Demography and National Security*, New York: Berghahn Books, 2001, pp. 62–105.

³ See Laura Kasinof, "Water Crisis at Heart of Yemen's Conflicts," *Christian Science Monitor*, November 9, 2009; Thomas Homer-Dixon, "Environmental Scarcities and Violent Conflict: Evidence from Cases," *International Security*, Vol. 19, No. 1, Summer 1994, pp. 5–40; and Thomas Homer-Dixon, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International Security*, Vol. 16, No. 2, Fall 1991, pp. 76–116.

⁴ See Kasinof, 2009.

tion. True, both India and China are running out of water,⁵ but both countries are also rapidly industrializing, urbanizing, and globalizing. It is quite plausible that today's peasants, if pushed off the land, can become tomorrow's urban proletariat, producing goods that can be traded for food grown by others. The deceleration of global fertility rates may make this a receding threat, albeit still relevant for Africa.

A second is that a preference for baby boys in Asia—notably China, but to some extent India—means that 20 years later such countries will contain many men unable to marry. Left unrestrained, they might form large gangs and thereby present governments with the unpalatable choice between facing extreme instability or drafting them into an army and making other countries unstable.⁶ Without arguing that such a scenario is impossible, suffice it to say that its scope is limited to a few, albeit large, Asian countries. Such problems tend to be self-correcting over a generation (if being a boy is a ticket to misery, people are less apt to preferentially favor baby boys), and the inability of states to channel an excess of males into something other than internal or external war bespeaks state failure more than demographic forces at work.

A third argues, conversely, that aging populations—and all countries, even rapidly growing ones, are aging—are likely to be peaceful

⁵ For India, see John Briscoe, *India's Water Economy: Bracing for a Turbulent Future*, Washington, D.C.: World Bank, 2006. For China, see Jian Xie, Andres Liebenthal, Jeremy J. Warford, John A. Dixon, Manchuan Wang, Shiji Gao, Shuilin Wang, Yong Jiang, and Zhong Ma, *Addressing China's Water Scarcity: Recommendations for Selected Water Resource Management Issues*, Washington, D.C.: World Bank, 2009.

⁶ Valerie Hudson and Andrea Den Boer, "A Surplus of Men, a Deficit of Peace," *International Security*, Vol. 26, No. 4, Spring 2002, pp. 5–38. An oft-cited quote is: "The worst-case scenario implies that China may have close to 40 million young adult bare branches to spare in twenty years, and that the government may at that point ardently wish to see them give their lives in pursuit of a national interest. The alternative is to allow them to remain a threat to national interest which may increasingly be seen as an untenable policy position by the government." The article does not moot alternatives, such as polygamy or encouraging widespread emigration (although the latter requires identifying other countries amenable to high levels of immigration).

by default.⁷ As populations age, the influence of youthful hormones on foreign policy fades. Furthermore, because so much money will have to be devoted to looking after the needs of the elderly, as Chapter Four relates, they will have less money to put into war. To this one can add the (questionable) argument that countries with low fertility rates are less interested in putting their children at risk than are those with large families and thus surplus sons.⁸ This logic is a fairly good description of formerly warrior states that have become rich, middle-aged, and, effectively, pacifist, such as Germany, Japan, and Italy. But such states have been essentially pacifist since World War II ended. This logic may not necessarily apply to countries with growing populations (e.g., India) or to states that can ignore the costs of caring for the elderly (many of the poorer countries).

A strong, albeit indirect, relationship exists between a nation's fertility rates and its tendency to be involved in wars, either internal or external. Clearly, sub-Saharan Africa produces many babies and many wars. So do the Arab heartland and Afghanistan. South Asia (north-east of India's Deccan plateau) has moderately high fertility rates and considerable instability (India as a whole may be stable, but it hosts three full-fledged insurgencies: in Kashmir, in its far northeast provinces, and with the Naxalites). Within the Americas, Haiti and Central America have the highest fertility rates and the greatest instability—but also the most poverty (which may be the better explanatory variable). Conversely, the countries of North Africa and Southeast Asia—none of them rich, but all of them with fertility rates falling toward or below ZPG—are zones of relative peace (despite lingering insurgent movements in Algeria and the Western Sahara). But the Philippines,

⁷ Mark L. Haas, "A Geriatric Peace?" *International Security*, Vol. 32, No. 1, Summer 2007, pp. 112–147.

⁸ Edward Luttwak, "Post-Heroic Warfare," *Foreign Affairs*, Vol. 74, No. 3, May/June 1995, pp. 109–122. Krebs and Levy, 2001, p. 76, disparages the argument with the following claims: (1) that parental love per child declines as the number of children grows is utterly implausible, (2) Europe's declining fertility rates prior to 1945 did not prevent two bloody wars, nor did the postwar baby boom make Europe more bellicose, and (3) publics rarely control the decision to go to war even in democracies.

which has the highest fertility rate in Southeast Asia, houses several insurgencies.

But is correlation causation? Poverty tends to be correlated with both war (mostly internal war) and high fertility rates. Thus, to forecast declining fertility rates without forecasting corresponding reductions in poverty is to test the following hypothesis: If fertility rates are the dominant influence on the tendency for war, then the prospects for peace will be good; less so if poverty is dominant.⁹ Another way to tease apart the relationship is to look for middle-income countries with high fertility rates or low-income countries with low fertility rates. The former include the core Arab states (although oil wealth means that high incomes and low development levels may coexist). The latter notably includes Sri Lanka, which has had low fertility rates for a while—and until the spring of 2009 was locked in a very long civil war.

Left unmentioned are *new* forms of conflict that may be occasioned by the historically unprecedented emergence of societies with a dearth of young working-age people. One form of conflict builds on the increasing disparity between the still-impressive wealth of rich countries—bulked by investment income on overseas property—and the declining cohorts of those able to serve in their militaries, which may also be starved for money as governments spend on the elderly. Undefended wealth would be a target for pressure, coercion, and threats from countries that are growing in population but are decidedly less well-off per capita. The rich countries—assume them unmoored from U.S. guarantees—could reason that concession is wiser than outright opposition, but, as in all such relationships, the process of converting coercion into transferred assets would not go smoothly. Some in the rich countries would resent having to pay off threats; some in the poor countries would get greedy. Tensions would then develop, with one or

⁹ Further tests of the distinction may arise if the current recession lasts long enough to depress global growth rates and fertility rates at the same time. If violence falls, the fertility rate hypothesis looks better; if it rises, the poverty hypothesis looks better.

another poor country having convinced itself that it needs to demonstrate its ability to make life difficult for the rich country.¹⁰

Demographic pressures, particularly working through economic motives and strong states, nevertheless, do not provide a very plausible set of *casus belli*. Most recent quarrels have arisen from the dysfunctions of weak states. Even for them, the link between economic or material motives and war is less important than unresolved differences over ethnic or religious identity. At this point, it appears more likely that demographics—relative differences in population and wealth—will influence *how* states respond to military challenges rather than influence which military challenges states will have to respond to.

¹⁰ Israel is one such small rich country among larger poorer countries. Singapore—which has a formidable military—is another country conscious of the risks to its survival.

The Impact of Demographic Trends on Military Power Projection

Inexorable demographic changes create problems and opportunities for the nations that experience them. This chapter assesses the potential influence of such changes on the ability of one or another country to undertake various military missions vis-à-vis other countries. As noted, although the monograph's many implications for the military context are relevant to the USAF, their scope is broader than that of the Air Force alone.

To presage the conclusion, numbers matter—having more people is generally better for national power than having fewer—but how much better will vary depending on what militaries are asked to do. Demographics matter more for some missions than others. Correspondingly, states may want to tailor their overall politico-military strategies with an eye toward their demographic realities.

Manpower, Money, and Technical Expertise¹

What makes a nation militarily strong?² Classically, armies were strong in direct proportion to their size as measured by the number of fighters.³ With the industrial revolution, the quality of equipment became a critical factor.⁴ As militaries enter the information age, the quality of information and information-processing/communications systems—software and systems integration skills and the technical experts that have them—that go into warfighting started to become an independent factor in assessing the strength of a military.

The impact of demographic factors can be both direct and indirect. The more direct impact is that larger countries can raise proportionally more fighters. The indirect impact is that demographic trends affect economic growth and, thus, the ability to raise resources for military expenditures—although, as noted, the relationship is not one-for-one, since faster population growth is somewhat correlated with slower increases in per-worker income. Finally, if, as will be argued, some aspects of war benefit from the contributions of a small number

¹ While the odds tend to favor countries that have the resources to devote to their militaries, that does not make big countries automatic victors. Imperial China lost a chunk of their country to the Khitans circa 960, half of their country to the Jurchens circa 1140, all of their country to the Mongols circa 1280, and then all of it again to the Manchus circa 1644—despite the fact that its population was always 20 to 100 times larger than any of them.

² A. F. K. Organski and Jacek Kugler, *The War Ledger*, Chicago: University of Chicago Press, 1980, have expressed the matter as follows (p. 8): “To know a nation’s strength, one must look at its capacity to generate the resources that represent the major source of any nation’s might. Three extremely large and complex factors are primarily involved: (1) the number of people in a nation who can work and fight, (2) the skills and productivity of the active population, and (3) the capacity of the governmental system to mobilize the human and material resources at its disposal and devote them to national goals.”

³ Even then, money was relevant. With the emergence of professional warriors came the requirement for a reliable way to pay them. Some countries, such as Spain during the reign of Philip II, maintained their military power by recruiting foreigners (notably, Germans) into their militaries; that also took money.

⁴ This is not to say that equipment was of no importance before the industrial revolution. Hence the relevance of *iron* in the term *iron age* to describe civilizations. Hence, too, the English longbow, Mongolian ponies, the musketry of the conquistadors, and the superiority of the mounted knight in their contexts.

of highly skilled individuals—e.g., the Manhattan Project or Bletchley Park—the greater a country’s population, the greater the availability of technical experts. Again, this availability is subject to many factors, such as educational opportunities.

Consider each of the three factors—manpower, money, and technical experts—in greater depth. Note that manpower, money, and technical expertise are not independent vectors of power; relationships among them mean that they cannot be treated as discrete alternatives, and their presence in the analysis should be viewed heuristically.

Manpower

A country’s recruitment base is proportional to the size of its young (mostly) male cohorts and in the long run cannot escape those constraints. Yet, multiple qualifying parameters need to be taken into account when considering population as an indicator of how large a military can be. One is recruitment policies: Militaries that limit the positions in which women can serve (or reject women altogether), discriminate against national minorities, reject gay and lesbian individuals, and maintain maximum age requirements for billets that do not need such restrictions will have a smaller pool from which to fill their requirements.⁵ Countries with more applications for immigration than they normally want can dangle the prospect of jumping the queue to those who would volunteer in their armed services.⁶ A second mitigating factor is health; many young men (and women) are fit enough to fight, but some are not.⁷ Youth cohorts in rich countries are more likely

⁵ George H. Quester, “Demographic Trends and Military Recruitment: Surprising Possibilities,” *Parameters*, Vol. 35, No. 1, Spring 2005, p. 28: “[O]ne distinct possibility for the future would thus be that military careers would have to be lengthened, and retirement delayed, with a slowing of the process of promotion to accompany this.” See, for instance, Martin Binkin, *Who Will Fight the Next War?* Washington, D.C.: The Brookings Institution, 1996.

⁶ Quester, 2005, pp. 31–33.

⁷ Although young men in rich countries tend to be healthier than their counterparts in poor countries, trends in obesity may reduce the effective advantage of rich countries. The proportion of U.S. 18-year-old military applicants who were overweight rose from 26 percent in 1993 to 34 percent in 2006 (see Lucy L. Hsu, Remington Nevin, Steven K. Tobler,

to be free of debilitation (physical disabilities and infectious diseases) than their counterparts in poor countries. A third is education and training: The more advanced the military, the greater the need for a skilled, and even educated, military workforce.⁸ Such warfighters are more likely to maintain equipments well, use them correctly, and even find innovative ways to wring value from them. Fourth is, for lack of a better phrase, the willingness to serve (and the willingness to learn how to fight⁹): Nations that depend on volunteers can only acquire as

and Mark V. Ruberton, "Trends in Overweight and Obesity Among 18-Year-Old Applicants to the United States Military, 1993–2006," *Journal of Adolescent Health*, Vol. 41, No. 6, pp. 610–612). Applicants who met obesity thresholds more than doubled in the same interval. There is also a greater prevalence of diabetes and hypertension among overweight young people, which could affect their eligibility to serve.

⁸ Fully 95 percent of Union army soldiers were basic riflemen or in associated combat units. By 1985, only 16 percent of military enlisted personnel could be classified as having general military skills; the remainder were white-collar workers, craftsmen, or service and supply workers; see Martin Binkin, *Military Technology and Defense Manpower*, Washington, D.C.: The Brookings Institution, 1986, p. 6. Indeed, a large percentage of the manpower exists to maintain the machinery, so to speak, and thus a declining share of the manpower is required for "trigger"-pulling. Therefore, a capital-intensive military (the need for which is mission-related) could run out of resources to build the machinery well before running out of the manpower to maintain it—and thus overall manpower may never be a constraint. Furthermore, to the extent that on-scene repair can, with modularization, be converted to depot-level and thus stateside repair, such personnel do not have to be recruited into the military but could instead be paid for directly. Despite concerns that U.S. education standards are slipping, international rankings suggest that achievement scores by fourth and eighth grades in the United States are on par with Western Europe. They are slightly behind Eastern Europe and significantly behind Japan, South Korea, and the smaller East Asian countries. They remain far ahead of most of the developing world. See Patrick Gonzales, Trevor Williams, Leslie Jocelyn, Stephen Roey, David Kastberg, and Summer Brenwald, *Highlights From TIMSS 2007: Mathematics and Science Achievement of U.S. Fourth and Eighth-Grade Students in an International Context*, Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, NCES 2009-001 Revised, September 2009.

⁹ One of the themes that emerges by comparing the military effectiveness of one nation's forces to another's is that operationally successful nations (e.g., Germany) have soldiers who value the ability to fight intelligently, while the less successful nations (e.g., Italy) seem to have great difficulty in learning the operational art of war. See Allan R. Millett and Williamson Murray, eds., *Military Effectiveness: Vol. 3, The Second World War*, New York: Cambridge University Press, 2010.

many warfighters as want to join the military.¹⁰ Although the numbers supplied can be altered by incentives (e.g., pay), or the numbers needed can be pared down by outsourcing, the willingness to serve is important. Armed forces that are based on those who want to make serving a career rather than an interlude correspondingly do not have to recruit as high a percentage of the eligible population (e.g., of 19-year-olds) as those that suffer from rapid turnover.

National Income

Historical work by Azar Gat suggests that the best measure of a great power's military power is provided by the product of a nation's GDP with the square or third root of its GDP per capita;¹¹ in other words, if two countries—one small and rich, the other large and poor—have the same GDP, the small rich country is likely to have more potential for military power.¹² As with demographics, however, the “conversion rate” between a nation's GDP and its ability to buy military power is subject to several factors. One is how much effort a country puts into defense, something that would seem to depend on its strategic posture, alternative claims on its resources (e.g., the need to support the elderly), and where it gets its revenues (taking money from state sources, such as oil revenues or state-owned enterprises, is easier than raising it from taxes). Converting money into military power efficiently is not an automatic process. At a minimum, it entails avoiding foolishness—e.g., buying weapons for prestige value, overspecifying their requirements, putting them in the hands of those untrained to use or maintain them, or allowing bribery or political pressure to force bad decisions. Equipments, correspondingly, must be matched for the missions that a coun-

¹⁰ Binkin, 1986, points out that the time when the U.S. military had the hardest time recruiting and thus had to lower its standards the most—the late 1970s—were the very years when the ratio of military-age males to the general population were the highest levels ever attained in the postwar period.

¹¹ Azar Gat, *War in Human Civilization*, Oxford: Oxford University Press, 2006, p. 780.

¹² Whether GDP is measured in terms of PPP or international exchange rates may also make a difference. As noted in Chapter Two, PPP is a better indicator of a country's ability to resource military expenditures in general, while exchange-range GDP is a better indicator of a country's ability to acquire equipment, services, and loans from overseas.

try's military is prepared to undertake. Finally, defense firms differ greatly in their ability to convert money into military capability. Those countries who house good firms can count on getting the best versions for their money, but those who must import may be unable to buy certain products, and what products they do buy may come without the "secret sauce" (e.g., classified electronic countermeasures) and may not be optimized for their requirements. They may also have to pay a premium for the privilege.

Technical Expertise

Software, systems integration, and management skills have been important to building war machines since at least World War II. In the near future, the product of such skills (which also include related techniques of electronic warfare and cyber-warfare) may become important separate from machinery. One example could be an integrated surveillance regime that could look for targets on the battlefield (the limiting constraint for militaries whose weapons can destroy anything they can get coordinates on) or, alternatively, that could accurately detect and characterize suspect individuals against the background of everyday life. A nation's supply of technical experts arises from more than just having a large demographics base from which to choose. Education matters. So, too, does the propensity of young individuals to devote themselves to solving problems of a technical or quasitechnical level. Nations that attract immigrants (and do not bar them from national security-related work) have certain advantages. The work of technical experts must be correctly organized, which requires negotiating the tension between liberating their creative impulses and encouraging them to work as a team. Finally, culture is important; Japan, despite its wealth and the high education level of its workers, lags in large-scale systems integration and the production of packaged software.¹³ Israel, perhaps because of its disproportionate defense spending, has considerable expertise in software, especially for military electronics.

¹³ Japan does, however, have strengths in fuzzy logic, robotics, and certain types of electronic games.

Other

A nation's resources predispose its ability to build a successful military, but they hardly guarantee it. Steven Biddle has argued that mastering the techniques of modern warfare—notably the art of being able to maneuver using cover, concealment, and deception—offers a better explanation of success at conventional warfare than concentration on resource endowments alone.¹⁴ His work emphasizes the military prowess of the Germans in both world wars, an emphasis that inadvertently illustrates that strategic wisdom (not to mention luck) is also relevant to predicting outcomes.

The Contribution of Demographics to Various Military Missions

The use of a military to preserve order or create a new one draws on different capabilities. The ability of various states to generate such capabilities, in turn, depends on their endowments of people, money, and technical expertise in various combinations.

Accordingly, the rest of the chapter will discuss a range of military challenges and the mix of endowments that would allow states to meet such challenges successfully, as follows:

- nuclear coercion
- controlling the commons
- surveillance/enforcement
- conventional combat
- raids and seizures
- counterinsurgency
- military operations other than war.

Again, we note that separating military operations into seven categories is a heuristic device. Countries are not necessarily at liberty to

¹⁴ Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle*, Princeton, N.J.: Princeton University Press, 2004.

specialize in some but not other missions; their foes will see to that. Furthermore, some of these missions are interdependent. Controlling the commons affects a country's ability to carry out conventional conflict. Similarly, escalation dominance may require simultaneous competence at counterinsurgency, conventional combat, and nuclear coercion.

Nuclear Coercion

The simultaneous relevance and irrelevance of demographic factors is well illustrated in the realm of nuclear war. In the early 1940s, perhaps only the United States had the GDP required to invent nuclear weapons, but much of the intellectual background for the bomb was provided by a handful of clever immigrants. These days a country need only be sufficiently determined. Israel became a nuclear power in the late 1960s before its population exceeded 3 million. North Korea built a successful nuclear weapons program while poor and starving.

Can demographics influence whether a country can prevail in a nuclear confrontation? During the 1950s and 1960s, Mao Zedong dismissed nuclear weapons as paper tigers, arguing that China's vast demographic endowments meant that the surviving populations after such a conflict would likely be Chinese¹⁵—but such a proposition was regarded as bravado. The closest the world has ever come to an outright nuclear confrontation—the 1962 Cuban Missile Crisis—was not decided on the basis of who would have more survivors (the Soviet Union had the advantage of a larger population, greater territory, and lower rates of urbanization—but the United States had more weapons and better delivery systems). Instead, events hinged on who would have to escalate to nuclear war first—which would likely have been the Soviet Union, since the United States was more powerful in and around Cuba. Conversely, the outcomes of the many crises over Berlin, notably after the Wall was built in 1961, were strongly influenced by the fact that the Soviet Union had more local control—thus placing the onus on the United States to escalate if it went to war.

¹⁵ From Organski and Kugler, 1980, p. 158: Mao is reported to have suggested that China could survive the loss of 300 million Chinese because there would still be another 300 million left to carry on.

The more important effect of nuclear weapons is to greatly mitigate the fear of defeat via general war. Indeed, a country at risk of defeat and occupation may, for that reason, hold the upper hand in a nuclear confrontation because it visibly has more at stake than the state that has won at the conventional level. A nation may lose the demographic contest—and thereby lose the GDP competition—and yet rest assured in its sovereignty if it has nuclear weapons (especially if the other side does not).¹⁶

Conclusion: *Demographics are a relatively minor factor in predisposing the outcomes of nuclear standoffs, particularly when compared to intangibles, such as determination.*

Commons Control

To control the commons—the seas, the air, space, the radio frequency (RF) spectrum, and cyberspace (granted, far different media)—means having the freedom of action in a medium while denying it to others.¹⁷ It can be total control, in the sense that no one gets to use it, or standby control, which means that they use it with the approval of its controller. In the 19th century, the British controlled the world's oceans, in the sense that they could use them and so could others, unless they were (1) at war with Britain or (2) engaged in the slave trade. Today, the United States can claim at least some control over the commons, in the

¹⁶ An open question is whether the conventionally dominant side can create an increasingly more hostile environment through a series of salami tactics, to the point where the nuclear-armed but otherwise weaker state never has a good opportunity to push back with nuclear threats and eventually collapses from the cumulative pressure. Readers may immediately leap to the Soviet Union as an example, but this is a stretch: Few, if any, in the U.S. government foresaw a Soviet collapse until well after the United States took the pressure off (which was before President Reagan left office).

¹⁷ Barry Posen, "Command of the Commons: The Military Foundation of U.S. Hegemony," *International Security*, Vol. 28, No. 1, Summer 2003, pp. 5–46. Control over the commons has a great deal to do with how internationalized the various parts are: A great ocean fleet cannot, itself, control what happens on a landlocked lake. Similarly, air control gets weaker as the contested ground sits at further remove from relevant air bases. Space is global, but its use can be constrained by ground-based operations. Spectrum control is subject to one-over-distance-squared power rules (making it hard for faraway RF energy sources to overpower close-at-hand RF energy sources). Much of cyberspace consists of communities surrounded by fences of varied permeability.

sense that others can use it unless they are (1) at war with the United States or (2) engaged in terrorism.

Air and sea control require air and naval forces; both require machines. Machines, in turn, require money, although maintaining them can also be manpower-intensive. The scope for substituting manpower for machines in either service is quite limited. What makes modern equipment successful in combat is a combination of weapons, sensors, communications, and maneuverability, and none of these are factors for which adding raw manpower makes much of a positive difference. Crew sizes are growing smaller rather than larger.¹⁸ There is little serious scope for successfully countering expensive platforms with many inexpensive manned platforms, thereby making large poor countries militarily competitive with small but rich ones.¹⁹ Furthermore, it is characteristic of high-end combat that modest differences in man/machine performance make enormous differences in casualty exchange ratios.

To the extent that really good pilots make a difference, they are akin to technical experts in the sense that a large population increases the manpower pool from which they can be sought, but selection and self-selection methods tend to be more important.²⁰ Furthermore, countries that want air and sea power are likely to run out of money

¹⁸ In fact, trends are moving toward ever-reduced manning on ships. See, for instance, Ronald O'Rourke, *Navy CVNX Aircraft Carrier Program: Background and Issues for Congress*, Congressional Research Service, RS20643, updated February 19, 2002; and James B. Hinkle and Terry L. Glover, *Reduced Manning in DDG 51 Class Warships: Challenges, Opportunities and the Way Ahead for Reduced Manning on All United States Navy Ships*, conference paper, Arlington, Va.: Anteon Corporation, March 18, 2004.

¹⁹ There may be specialized circumstances under which a swarm of inexpensive manned platforms may take on an expensive manned platform. Examples may be multiple inflatable vessels taking on a regular ship operating under restrictive rules of engagement or a swarm of aircraft combating a sophisticated jet that has run out of weapons. But how much does the pursuit of such circumstances affect the military planning of other countries?

²⁰ In the 1960s, Israel generated a highly skilled set of pilots even though its overall population was low. Interestingly, a disproportionate number of jet pilots were raised on collective farms (kibbutzim), which collectively accounted for only a few percentage points of the total population.

before they run out of people.²¹ By 2050, even many of the functions performed by pilots (or elsewhere, such as under water) are likely to be carried out in an unmanned fashion.

As for the other three commons, two—the spectrum and space—are the province of equipment. Cyberspace control (insofar as it is meaningful) is almost entirely a matter of having technical experts.

It is in the nature of global commons control that only one state (or one state-led bloc), at most, can control it. Therefore, in all likelihood, the contest over its control would pit the United States against nameless others—who do not want anyone to control it—or China—who may want the control itself. A contest over controlling the commons that does not involve the United States is hard to foresee.

Conclusion: Apart from the manpower requirements of maintaining an air force or a navy, building an effective capability to control the commons is largely a matter of having money and technical expertise, rather than manpower.

Surveillance

Surveillance is the ability to extract and collect information from within a state, sometimes with its cooperation, but frequently against its wishes. The purpose of imposing surveillance on another state can be for intelligence purposes, for indications and warning, to prepare the battlefield, or to dissuade such a state from certain activities. One state can also set up a surveillance network within a cooperating state to facilitate counterinsurgency or other stabilization efforts.

The instruments of surveillance are similar to those of commons control: floating, flying, or orbiting sensors; listening posts; and implanted monitors for cyberspace. To these we can also add ground-based sensors and perhaps the most ubiquitous sensor of all—cell phones in the hands of a supportive and alert citizenry.²² The latter can

²¹ In World War II, the Japanese ran out of skilled pilots before they ran out of aircraft. See Steve Lange, “The Imperial Japanese Navy Air Force in the Pacific War,” 1996. These days, however, although the amount of training required for a skilled pilot is greater, the cost of a single fighter aircraft is far higher than it was in World War II.

²² Martin C. Libicki, David C. Gompert, David R. Frelinger, and Raymond Smith, *Byting Back: Regaining Information Superiority Against 21st-Century Insurgents*, Santa Monica,

be manpower-intensive, but such manpower would be that of the host country (so, countries with higher populations can keep themselves under surveillance for roughly the same percentage of their income as countries with fewer people can).

If pattern recognition is automated, then the balance of requirements shifts to software rather than manpower. If pattern recognition is not automated, there may be large manpower requirements for monitoring the sensor outputs, but if the necessary manpower can be outsourced to a low-wage country, then creating such a capability is more a matter of money than manpower.

Conclusion: *The most important factors in enabling surveillance systems are money (to pay for the sensors) and technical experts (to program the sensors and manage systems integration).*

Conventional Combat

As the Israelis demonstrated in the Six-Day War of 1967,²³ the United States proved in 2003 that a relatively small high-tech force can rout a larger low-tech force in straight-on combat.²⁴ That these battles were routs suggested that an even smaller force may have prevailed, albeit perhaps by taking more time and bearing more casualties. Nevertheless, for the United States—and with a lag for other rich countries—forces for conventional war will require a mix of manpower, money, and technical expertise, with manpower declining in importance and the need for technical expertise rising. Poorer countries, being unable to afford the hardware, are likely to field somewhat lighter forces; these are likely to do well only against similarly light forces.

Over the next 40 years there is likely to be continued substitution of money for manpower in modern militaries. Individual soldiers

Calif.: RAND Corporation, MG-595/1-OSD, 2007, pp. 43–78.

²³ The Six-Day War was a conflict between Israel and Egypt, Jordan, and Syria. The war lasted six days and ended with the Israeli conquest of Gaza and the Sinai (from Egypt), the West Bank (from Jordan), and the Golan Heights (from Syria).

²⁴ As per Thomas Ricks, *Fiasco*, New York: Penguin Press, 2006, p. 117, “The entire ground invasion force amounted to 145,000 troops including the British contribution . . . attacking a weakened Iraqi military . . . which still fielded about 400,000 troops . . .”

are likely to have better body armor, uniform-mounted sensors, and portable (perhaps heads-up) electronic displays. Robots have started to appear in U.S. militaries; today's models can be assigned to limited reconnaissance and fire roles, with improvements likely in sensor capabilities and perhaps reasoning over the next decades.²⁵ Many platforms can now manage themselves better (without human help), and some of their missions are being transferred from manned to unmanned platforms. The days of being able to accurately strike a target represented only by a moving dot on a map are approaching. Information technology in general means that modern militaries need commit fewer people into battle itself—perhaps only to supply eyeballs (and other senses) and quick-reaction intuition; the rest can contribute from the rear. Software—in the sense of adroit and flexible systems integration among warfighting machines—will also play a larger role. Thus, apart from vulnerabilities (e.g., RF links) and the possibility that finicky systems will require large maintenance cadres, the edge in conventional combat is likely to continue to drift from those who can raise the manpower to those who can raise the money. This edge, however, will not appear everywhere to the same degree. Such factors as terrain (clutter, especially urban clutter, predisposes manpower over money), strategies (whether the rich country is on the offensive or the defensive against the poor country), and rules of engagement (the stricter the rules, the more manpower is required to operate within such rules or to see whether others are meeting them) will affect the optimal balance among manpower, money, and technical expertise.

Size is no guarantee of conventional outcomes. Iraq held off Iran (both at similar stages of development) for most of the 1980s despite having only a third the population; Ethiopia bested Eritrea, less than 10 percent its size, but only with difficulty.

Conclusion: *Manpower, money, and technical expertise are all important components in conventional warfare. Over the last 50 years, however, the balance has been shifting away from manpower and toward money and, especially, software.*

²⁵ Peter Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, New York: Penguin, 2009.

Raids and Seizures

Raids are short-term invasions carried out primarily for punishment and are not necessarily a precursor to more permanent military action. U.S. action against Libya in 1986 was a raid. Countries can carry out raids to the extent that they can introduce and withdraw sufficient force quickly. This does not require a mass army; indeed, the premium on rapid movement may make this a military mission for elite warriors. Hence, demographics per se are not much of an independent influence on a state's capabilities in this area.

A country's ability to break a raid is related to its ability to keep raiders out or to mobilize countervailing forces quickly. Border defenses may be important. So, too, in the case of a ground raid (rather than an air raid), is a military large enough and mobile enough to move sufficient forces to unexpected locations quickly. Thus, demographic factors are likely to be more relevant to defending against raids than they are to carrying raids out. A seizure, by contrast, is meant to take and hold real property (for this definition, we assume that the property is lightly populated or unpopulated)—e.g., China's seizure of the Spratly Islands. Seizures are like raids unless and until the defending state decides to contest the seizure and recover territory—at which point the contest looks more like conventional warfare.

Conclusion: *Raids require manpower—with an emphasis on quality in the case of raiders and quantity in the case of defenders.*

Counterinsurgency

To what extent do the demographics—which is to say, the size—of the intervening country permit it to prevail in helping to counter insurgency in another country?²⁶ A great deal depends on how the insur-

²⁶ We could presume that a state's ability to defeat an internal insurgency would be unrelated to the state's population, since the size of its armed forces and the size of the insurgent forces should be proportionate. But is this necessarily so? Assume that an insurgency grows from a small group (true for 54 out of the 89 insurgencies examined in David Gompert, John Gordon IV, Adam Grissom, David R. Frelinger, Seth G. Jones, Martin C. Libicki, Edward O'Connell, Brooke Stearns Lawson, and Robert E. Hunter, *War by Other Means: Building Complete and Balanced Capabilities for Counterinsurgency*, Santa Monica, Calif.: RAND Corporation, MG-595/2-OSD, 2008, Appendix A). Perhaps the number of such groups is proportional to the population of the country, but there is no reason for the initial

gents choose to fight and, even more so, on how the counterinsurgency effort is conducted.

The primary techniques of insurgency—such as building local organizations and attacking individuals or small groups that are part of the state security forces—are fairly universal. Yet, the desire and ability of insurgent groups to attack force concentrations or to storm and hold fortified points varies. If insurgents mount conventional operations (e.g., take over police stations), then the ability of the intervening states to defeat such operations (e.g., through rapid maneuver of forces) can be inferred from the latter's ability to mount conventional operations—or to counter raids—in general.

However, pure counterinsurgency—the struggle for the hearts and minds of the affected population—calls for a different set of skills and a mix of strategies and, hence, resource endowments. For example, if the insurgency is supported by outside states, especially if they provide sanctuary to insurgents, the counterinsurgent may choose to pressure sanctuary/support states or at least try to prevent movement from the sanctuary state. Barring outright invasion, the military leverage of the counterinsurgent may be exercised in terms of raids, air attacks (e.g., by unmanned aerial vehicles [UAVs]), or some sort of blockade—capabilities that mostly require money. Conversely, if the sanctuary/support problem is addressed by border controls, the intervening state can use a mix of manpower and sensors (e.g., UAVs). Sensors, to date, have proven partially effective in limited cases, but only if they are backed up by physical barriers (as in Israel) or mobile border patrols (as in the U.S.-Mexican border). Guarding long cluttered borders (e.g., Afghanistan, Vietnam) tends to be manpower-intensive in terms of both deployed forces and the infrastructure required to support them. It is beyond the purview of a state that cannot raise a large military.

size of insurgent groups to be larger in large countries than in small ones. In large countries, such groups may have to grow for longer periods before they are big enough to contend with government forces. If the size at which they attract serious attention to themselves is the same in large countries as in small ones, then large countries have more time to bring serious resources to bear against insurgents than small countries do. If so, large countries are likely to do better against insurgencies.

If the leadership cadre, or, more to the point, a charismatic leader, is deemed critical to the success of an insurgency, then the intervening state can focus its efforts on capturing or neutralizing the leader and other “high-value targets.” If spotting such targets requires information from a population that is willing to talk only if it feels protected, then such protection will require adequate policing manpower. Thus, the protectors have to have the demographics required to place enough boots on the street.

If the insurgency appears to arise from economic woes (or if the population can be won over with material incentives), then the focus might be on economic development. The resources required for an economic development program are money and manpower—but not much manpower (for technical assistance and on-site auditing). The U.S. aid program in South Vietnam peaked at 2,000 civilian employees,²⁷ although the civil operations and revolutionary development support (CORDS) program overall involved, variously, from 5,000 to 16,000 advisers when military personnel are included.²⁸ These days, there is also a large infrastructure of nongovernmental organizations that can substitute for U.S. workers. However, three caveats need to be noted: First, it is unclear whether even the U.S. effort in South Vietnam was big enough to make a substantial difference to the war’s outcome; second, aid workers need protection, which reintroduces the need for ground forces; and third, to achieve permanent improvement, one must also prevent insurgents from destroying the infrastructure provided as part of the aid effort—and that also takes manpower.

If the insurgency has potential fissures, then efforts to split off a large chunk of the insurgency and turn it against the remainder of the insurgency may prove worthwhile.²⁹ Here it helps to be, in Bing West’s

²⁷ Matt Steinglass, “The Pitfalls of Pacification,” *GlobalPost*, Boston, Mass., March 30, 2009.

²⁸ Christopher Fisher, “The Illusion of Progress: CORDS and the Modernization in South Vietnam, 1965–1968,” *Pacific Historical Review*, Vol. 75, No. 1, May 2006, p. 43; and Frank L. Jones, “Blowtorch: Robert Komer and the Making of Vietnam Pacification Policy,” *Parameters*, Autumn 2005, pp. 103–118.

²⁹ Defections proved to be crucial in U.S. efforts against al Qaeda in Iraq’s Anbar province and may have played a strong supporting role in Sri Lanka’s campaign against the Tamil

words,³⁰ “the strongest tribe” in the first place, which means that a splintering strategy can play only an adjunct role, albeit a large one.

This leaves the basic approach to counterinsurgency, which is providing security for the population.³¹ As noted, it undergirds all but one (sanctuary-busting) of the other approaches: eliciting intelligence (for high-value targeting), protecting aid workers and their products, and fomenting insurgent splits. As experience with the 2007 surge of forces in Iraq indicated, protecting the population is a manpower-intensive operation.³² Countries that aim to do this seriously either need large populations or populations in which the propensity of good people to join the military is sufficiently high.

Training is another important aspect of counterinsurgency. It, too, is basically a matter of manpower—not because the number required is so high, but because it may take a large population (or a very willing population) from which one can select enough good people to become effective trainers.

Finally, counterinsurgency forces may also have to intervene rapidly to respond to crises (e.g., police stations under attack). Again, this is a question of manpower, but money also becomes very important if it can buy logistics and intelligence, surveillance, and reconnaissance (ISR), which thereby allow more widely dispersed units to respond more quickly to emergencies. Incidentally, under some circumstances, the requirements for a rapid show of force need not be that stressful.

Tigers. See “LTTE’s Days Numbered—Karuna,” *BBC News*, March 1, 2009.

³⁰ Bing West, *The Strongest Tribe: War, Politics, and the Endgame in Iraq*, New York: Random House, 2008.

³¹ This was the theme of the 2006 *Field Manual on Counterinsurgency* (FM 3-24) (Headquarters, Department of the Army, 2006 *Field Manual on Counterinsurgency* [FM 3-24], December 2006). More recently, see Andrew M. Exum, Nathaniel C. Fick, Ahmed A. Humayun, and David J. Kilcullen, *Triage: The Next Twelve Months in Afghanistan and Pakistan*, Washington, D.C.: Center for a New American Security, June 11, 2009.

³² In nonurban settings, helicopters can be the most important asset—one, ironically, that is extremely manpower-intensive in terms of maintenance. By one estimate, four man-hours of maintenance is required for every hour of flight time. See Herbert Howe, “Lessons of Liberia: ECOMOG and Regional Peacekeeping,” *International Security*, Vol. 21, No. 3, Winter 1996/1997, p. 168; see also “Getting Boots Off the Ground,” *The Economist*, January 24, 2008.

The rapid intervention of no more than 2,000 elite British forces into Sierra Leone (and a smaller number of mercenaries from Executive Outcomes) essentially defeated the notorious Revolutionary United Front insurgents, whose numbers were greater.

Conclusions: *National institutions to produce highly skilled and worldly wise warfighters are required for many aspects of counterinsurgency, especially as the latter becomes a “thinking man’s” war.*³³ *Money can also be used to purchase C4ISR/signals-intelligence equipment (for support of border-keeping, as well as gathering intelligence on high-value targets, attack plans, and so on) and logistics (for rapid intervention). Yet, it is no substitute for skilled manpower, the sine qua non of counterinsurgency.*

Military Operations Other Than War

Military operations other than war tend to be very manpower-intensive. Since opposition is either nonexistent or, more likely, unorganized, questions of sanctuary are moot, and the importance of high-value targeting is reduced. Compared to the counterinsurgency mission, this operation is lighter: Less force protection is needed, border patrol is relatively less important, and rapid intervention is generally unnecessary. The ability to be everywhere at once is helpful, but in most such operations, the knowledge required to sort out the most dangerous individuals from the others does not come readily to those dropping in. Street intelligence is useful, but it requires manpower backed with a little software (e.g., for social-network analysis).

Lift and deployable C4ISR is also required,³⁴ especially for humanitarian assistance (e.g., forestalling genocide). Logistics is related to GDP, and manpower has a demographics base,³⁵ but both of these operations are truly lesser-included cases. It is the rare military that sizes itself to carry out such operations or grows in order to conduct

³³ David Ignatius, “Fighting Smarter in Iraq,” *Washington Post*, March 17, 2006, p. A19.

³⁴ See Micah Zenko, “Saving Lives with Speed: Using Rapidly Deployable forces for Genocide Prevention,” *Defense and Security Analysis*, Vol. 20, No. 1, March 2004, pp. 3–19.

³⁵ Countries whose noncombatant evacuation operations are limited to their own citizens would, everything else being equal, have fewer people to evacuate as their populations declined.

them more efficiently. Nevertheless, countries whose demographic and hence economic trends are unfavorable are likely to reduce their military and related contributions to the common global welfare accordingly, thereby forgoing the moral, influence, and diplomatic benefits of such actions.

Conclusion: *Manpower backed by enough money for logistics is essential.*

Implications

Everything else being equal, countries with more people have a greater capacity for warfare, be it regular or irregular warfare. Larger countries have more youths available for military service, proportionately higher GDPs, and a larger pool of educable individuals from which to draw their technical experts.

Of course, everything else is not equal. Those countries with the fastest-growing populations tend to be those least equipped, in general, to produce the kind of disposable income that permits them to arm themselves well. They also tend to lack the educational and institutional opportunities that permit them to cultivate and exploit technical experts. Conversely, rich countries are not known for high fertility rates. Indeed, with the current exceptions of the United States and (the far smaller) Israel, not one rich country is replacing one generation with another completely. Nor are many of the middle-income countries: Fertility rates in Eastern Europe and much of Southeast Asia are low.

Rich countries can resource some operations better; large poor countries, however, have their advantages for other operations. Controlling the commons and imposing a surveillance regime demand money and technical expertise. Conventional warfare demands both, with the advantage swinging toward money and software and away from manpower. Raids take quality manpower; defending against them takes manpower in quantity. Conversely, counterinsurgency and military operations other than war put a great emphasis on manpower. Nuclear power—or at least enough to enter into a confrontation—requires money, but if North Korea can build nuclear weapons, then

clearly great sums of money are unnecessary; determination may be more important.

From this one may infer that a military contest between a smaller rich country and a larger poor one will find each side trying to define the war in terms in which each can do well. What starts off as control over the local commons and the attempt by one to impose surveillance regimes on the other may descend into conventional combat and then further descend into an insurgency or low-intensity warfare—and perhaps back again. Asymmetric opponents produce asymmetric wars.

The likelihood that rich low-fertility-rate countries will, in time, be overwhelmed by the developing high-fertility-rate countries is remote, however. If nothing else, there are simply very few places where two such countries border each other (Israel vis-à-vis the Palestinian territories being a notable exception). However, in some cases middle-income countries with recently declining birthrates (e.g., Mexico, South Africa) abut low-income countries whose fertility levels are still high (e.g., Guatemala, Mozambique). The regions with high-fertility rates—sub-Saharan Africa, the Arab core, the broad Ganges valley—are remote from low-fertility-rate, high-income countries of Europe or East Asia, and there are generally other countries in between. Furthermore, high-fertility-rate countries tend not only to be poor, but, among the poor, they are also the least likely to be getting richer. They are more likely to implode (i.e., become failed states) than to explode (invade their neighbors). Many of the poorer countries that are moving up in the GDP per capita scale—China, Vietnam, Thailand, even southern India—first reduced their fertility rates. Thus, they do not need to invest so much in raising children and can divert more money into raising capital.

If one puts aside the possible long-mooted but oft-postponed struggle for mastery in Asia and quasi-apocalyptic exchanges of weapons of mass destruction/disruption, the potential trouble spots of interest to rich countries are likely to feature chaos and insurgency. These are wars in which the population is both battlefield and prize. In such cases, demographics make a great deal of difference. Intervening in failed states (or cleaning up after regime changes) is a manpower-intensive endeavor.

A full-fledged intervention by one state into another is ill-advised for countries that lack the requisite manpower.³⁶ As Jim Quinlivan noted in 1995, demographic changes in many developing countries—a combination of growing populations and rapid urbanization, especially in the national capital and chief port city—mean that forces required to establish effective policing are large and growing larger.³⁷ The U.S. military strained to maintain operations in South Vietnam against an insurgency fostered by North Vietnam (Vietnam’s combined population was 30 million at the time). The same war 40 years later would have put a larger—and likely unbearable—strain on the United States. Even though the U.S. population today is 50 percent larger (300 rather than 200 million), Vietnam now has 80 million instead of 30 million. U.S. manpower strained to pacify Iraq (population 30 million) even though Kurdistan and much of Iraq’s Shi’a half were quiet; it is having similar problems finding the forces to pacify Afghanistan (also with a population of 30 million), even though Afghanistan’s non-Pashtun half is fairly quiet. If any one of many large countries, such as Pakistan, Nigeria, and the Philippines, fails, there is little the United States can do, directly, to right things.

Such intervention is even more unthinkable for European countries, whose populations are not much higher than they were right after World War II. There is no one European country that can effectively intervene by itself in any but the smaller developing countries; by 2050, the ranks of such “smaller” countries will be thinner than today. The same is true for Russia: With its working-age population declining, its capacity to intervene in predominantly Islamic former Soviet states is rapidly waning,³⁸ even if its capacity to intervene in predominantly

³⁶ Robots can substitute for many aspects of counterinsurgency. Explosive ordnance disposal is one prominent example; they may also be useful as adjuncts for forcible entry or firefights. Nevertheless, it is hard to envision robots carrying out the manpower-intensive components of counterinsurgency, such as policing for suspicious activity or gaining the confidence of the local population.

³⁷ James T. Quinlivan, “Force Requirements in Stability Operations,” *Parameters*, Winter 1995, pp. 59–69.

³⁸ Russia’s capacity to suppress insurgencies even within its own Islamic-majority regions, such as Chechnya, is also waning.

Christian former Soviet states (with their similarly low fertility rates) remains unchanged.

Implications

Demographics are not destiny, but they are the next best thing. The accumulation of slow changes inexorably alters nations, especially vis-à-vis one another—and in ways that are not easy to reverse. Let us therefore review the key findings, draw some important implications for international security, and then examine the lessons that can be drawn for the USAF and, by extension, the U.S. military as a whole.

Findings

The world can be divided into the United States plus three broad demographic categories:

- The United States is unique by virtue of its size, affluence, high immigration levels, and a birthrate that can maintain its population indefinitely even without immigration.
- The slow-population growth countries can be characterized by low birthrates and thus aging populations. Most of them are rich, but this group also includes the countries of Eastern Europe, which are catching up to the West.
- Medium-growth regions and countries, whose birthrates have more recently declined and whose working-age cohorts are likely to drop or at least plateau in the 2020s, include Latin America,

North Africa, South Africa, Turkey, Iran, Central Asia, China, Southeast Asia, and the southwestern third of India.¹

- High-growth countries, most of whose birthrates may have dropped in recent decades but are well above ZPG, include sub-Saharan Africa, the core Arab world, and the swath from Bangladesh through the Ganges valley up to Pakistan and Afghanistan.

Although birthrates are subject to year-to-year change, large fluctuations in birthrates, though plausible, are unlikely. As a result, because roughly half of the world's working-age cohorts in 2050 have already been born, we know that the size of these populations is mostly predictable, even though nearly every country is progressing toward slower growth.

The effect of demographic changes on national GDP may be strong. Although year-to-year differences between the economic growth rates of various countries can be quite large, over the long run, most nations' underlying productivity (as measured by real GDP per capita in units of constant PPP) does not vary greatly within its respective band. Indeed, since 1980, among the 37 countries examined, only one (South Korea) made the transition between middle-income and upper-income status (as defined relative to U.S. GNP per capita), and only one (Thailand) reached middle-income status by leaving lower-income status. The more that growth rates in national GDP per capita resemble one another, the more that the growth in relative GDP is a function of relative demographic growth. As noted, demographic change accounted for 40 percent of international variation in GDP, while productivity (GDP per capita) accounted for the other 60 percent.

The aging of the rich countries—and some not-yet-rich countries, such as China—will absorb a growing fraction of their overall income and government budgets, possibly at the expense of spending on national defense. Yet, the relationship between aging and resourcing

¹ Jack Goldstone's article "The New Population Bomb: The Four Megatrends That Will Change the World," *Foreign Affairs*, January/February 2010, pp. 31–43, argues for having the West accommodate the demographic shift away from the West to the poorer countries but fails to recognize that birthrates in many parts of the poorer countries are also falling, notably in this medium-growth zone.

for defense is by no means fixed. Policy options to manage the fiscal impact of aging include such measures as postponing retirement or rationing health care, but such initiatives are often unpopular because individuals want the same benefits enjoyed by previous generations and in comparison countries. Not only are these policies often politically toxic, but the imbalances associated with demographic change also creep up slowly, and together these factors undercut the political will needed to respond responsibly to pressures that demographic changes place on the economy. Under such circumstances, it is not surprising that defense expenditures, empirically, show a stronger relationship with perceived security threats than with long-term demographic changes.

Demographics are not the only predictor of the resources a state can mobilize for military power: National income and its endowment of very talented people play strong roles as well. However, the mix between manpower, money, and technical expertise differs across military missions. For some missions (e.g., conventional land warfare), states can make different choices about how they want to mix the three, but the realities of combat often dictate their order of importance. As a general rule, such missions as surveillance and controlling the commons (the seas, the air, space, the RF spectrum, and cyberspace) are expertise-intensive, conventional conflict is money-intensive, and irregular conflict is manpower-heavy. If the latter is the predominant form of military expression, then rich but aging nations may find themselves uncompetitive if they get involved in fighting insurgencies and making long-term commitments to stabilizing youthful developing nations.

Major Themes

Caveats noted, our analysis of demographic and, to a lesser extent, economic trends (the relative stability of national rankings of GNP per capita) support the following major themes: (1) The United States is likely to remain the indispensable nation through at least 2050; (2) the world's zone of violence is increasingly limited to two and a half large areas (which may, themselves, be shrinking).

The Once and Future Indispensable Nation

The United States is likely to remain an indispensable nation for the protection of international stability and liberal (Western) norms through at least the middle of the century. Among the world's rich countries, no country (apart from tiny Israel) has a higher birthrate. The countries with higher immigration rates, such as Canada and Australia, have far lower birthrates than the United States. As noted in Chapter One, the U.S. working-age cohort is likely to constitute a growing percentage of the total manpower of the Atlantic alliance (essentially NATO) and the Pacific alliances (Australia, New Zealand, Japan, South Korea, and Taiwan).

This says two things. First, the United States will become an even more dominant partner in both alliances—although it is already very dominant today. Second, the incremental capability available from U.S. allies is likely to decline compared with what the United States can generate on its own. As it is, the United States can rarely count on the proportionate contribution of its allies. With rare exceptions (e.g., Greece and Turkey), they spend a smaller percentage of their GDP on defense, and they tend to spend it less efficiently (e.g., by maintaining garrisoned forces that cannot deploy easily). When it comes to supporting U.S. wars of choice, many tend to make their own choices and opt out. True, a great deal can change over 40 years. Our allies may invest more of their wealth in their militaries. Issues may arise in which they feel more solidarity with us. But the demographic trends are fairly well locked in, thus limiting the amount of manpower they can contribute to the commonweal, variations in spirit notwithstanding. The available manpower of U.S. allies has been in relative decline for several decades. In the global war on terrorism, when the United States needed troops on multiple fronts to suppress internal rebellions, the significance of shrinking allied troop levels was keenly felt.

Should the United States cast about for a new alliance structure with rising states (e.g., India)? If one assumes that the affluent countries that would support liberal Western norms in 2050 are the same countries that support it today, then the decline in their share of global population and hence in the global income represented by such countries should be cause for concern if these norms are to be sup-

ported by power. These new alliance structures need not be formalized in the same way that NATO was—a response to history, geography, and extant threats. NATO worked because the Soviet Union was next door. But when the interests of the United States and its major allies diverged—the Suez crisis (1956) being a good example—the United States had no problem squeezing its friends (Israel, France, and Great Britain) to get them to leave Egypt. Nevertheless, a growing recognition that the United States and many emerging countries share enough of the same values coupled with our willingness to share global leadership with them (as we now do with current allies) could be helpful. It may go a long way to recruiting more power to stand behind our goals of international stability and liberal norms.

U.S. power is almost certainly apt to grow vis-à-vis Russia, a country with low birthrates, little propensity to attract immigrants (or tolerate the immigrants it gets), and serious health problems. The health problems may abate.² But the demographic hole that Russia has fallen into over the last 20 years will be difficult to pull out of even if Russia's birthrates creep upward (as they seem to have been doing since 2006). As noted, within current borders, Russia could become one-third Muslim by 2050, which may well affect its self-definition, orientation, and cohesion.³ Since Russia has increasingly become a petro-state (more precisely a hydrocarbon state, given its vast natural gas reserves), its future prosperity is unlikely to be broadly based (compared to, say, Japan's). Although Russia's population decline contrasts with rising (albeit decelerating) populations in countries to its south, Russia's neighbors to its west and southwest share Russia's demographic trends. Thus, Russia's power vis-à-vis such countries (and correspondingly its ability to make mischief) is unlikely to fall, even if its numbers decline relative to U.S. numbers.

² Russia's health problems seem to arise from bad habits (e.g., vodka), a decrepit public health system, and environmental toxicity (including alarmingly high air, water, and radioactive pollution levels). Habits can change, recent trends notwithstanding. Money can help with health delivery. Toxicity, however, can be persistent.

³ This may or may not bring Russia's birthrate up, depending on whether birthrates in Muslim families regress to the national mean over the next few decades.

The trajectory of U.S. power vis-à-vis China is harder to predict. Today, the ratio of China's working-age cohort to its U.S. counterpart is 5 to 1; by 2050, as noted, the ratio would likely be closer to 3 to 1. For the last 30 years, however, China has experienced extraordinary rates of economic growth, and there is little sign that its momentum—essentially a doubling of per capita GDP (PPP basis) every ten years—will slow down any time soon. Beyond five to ten years, however, questions arise. Familiar concerns include China's aging population (whose feeding and maintenance will compete with investment for resources), its legal opacity (corruption, arbitrary decisionmaking), and environmental problems (air quality, toxic waste, falling water tables, and desertification). A great share of China's growth to date has come from rural-to-urban migration; until the 2008 recession hit, there were close to 120 million recent migrants in China's cities. At some point that reservoir will be drained, and so the "easy" gains from converting underproductive peasants to productive urban workers will have been exhausted. As of 2008, the U.S. GDP per capita is seven times China's; the U.S. growth rate is roughly 2 percent versus China's 7 percent. If these two rates are projected forward into the indefinite future, China's GDP per capita will overtake the U.S. GDP per capita before 2050. Since China's working-age population would be three times larger, its overall GDP would be three times larger as well. Thus, China, with three times the population and comparable per capita income, would have three times the resources for military power than the United States. But is simple extrapolation the best way to forecast GDP? Another way to project China's per capita GDP growth is by reference to its neighbors that have also experienced long periods of rapid growth. The Japanese GDP per capita rose rapidly relative to U.S. figures through the entire post-World War II era until the 1970s and reached a plateau of roughly 75 percent. But Japan started industrializing in the 19th century, a full century ahead of China. South Korea may be more relevant to China's case. Its GDP relative to the United States rose rapidly from the end of its war through the mid-1990s. It reached 20 percent in 1980 and an inflection point of 45 percent in the mid-1990s; it is currently at 55 percent. Let us assume that China replicates South Korea's track—and to do so, it would have to overcome

rising aged-dependency levels, adopt rule of law, and meet environmental challenges, none of which hampered South Korea's growth.⁴ By 2025, it would be where South Korea was in 1980, and by 2040, where South Korea was in 1995. Thus, under very favorable conditions, its total GDP in 2050 would be 120 to 150 percent of U.S. GDP—an economic peer, but not large enough to throw the United States into its dark shadow.

The Shrinking Zone of War

There is no iron law that says that low-birthrate countries are peaceful countries—one need only think back to the wars among the low-birthrate successor states of Yugoslavia in the 1990s. Yet, according to analysis by Population Action International, a decline in the birthrate of five per 1,000 people (in the late 1980s) corresponded to a decline of just over 5 percentage points in the risk of civil conflict (over the 1990s).⁵ At the other end of the demographic scale, the elderly tend to be preoccupied with matters other than national pride and fighting. Empirically, it is notable that the United States is fighting wars in two high-birthrate countries, Iraq and Afghanistan; that India's insurgencies are concentrated in its higher-birthrate northern two-thirds; and that the highest-birthrate country in East Asia, the Philippines, has faced several simultaneous insurgencies. High-birthrate Haiti suffers constant turmoil. Conversely, areas such as Southeast Asia, Latin America, northern Africa, Turkey, Iran, Central Asia, and southern Africa may enjoy greater stability in the decades ahead.

Countries whose birthrates are declining may be making a huge and irrevocable bet on their future. By lowering their birthrates, they are reducing their dependency ratios and raising the percentage of the population that is of working age (as well as liberating more working-age women to spend more years in the labor force) and who thus can

⁴ South Korea had the advantage that it was small and, even considered together with the other Tigers, could expand within particular export niches without distorting them. China is big and thus cannot grow by filling fast-track niches alone.

⁵ Richard Cincotta, Robert Engelman, and Daniele Anastasion, *The Security Demographic: Population and Civil Conflict After the Cold War*, Washington, D.C.: Population Action International, August 1, 2003.

take jobs and contribute to the economy (if such jobs exist). Low dependency ratios, in turn, free up investment dollars.⁶ The risk in this transition is that low dependency ratios are temporary. After two generations, dependency ratios rise because such a large percentage of the population is elderly—at which point there is no going back to low dependency ratios. Thus, such countries have a limited amount of time to accelerate their economic growth rates before their advantages disappear; this is the window in which they can grow rich before they grow old. It is unclear how many countries will succeed in this gamble. If they fall short, will they become seriously strained and thus a source of instability? Or, conversely, will they, in their elder state, be unwilling—and hence unlikely—to translate their disappointment into violence?

Declining birthrates also should be good for the environment, or at least those aspects of the environment that have the greatest potential for conflict: shortages of arable land, water, and firewood. As a general rule, man's impact on the global environment is proportional to global GDP,⁷ and demographic growth is just one component of GDP (especially if the demographic growth is concentrated in poor countries).

⁶ Elizabeth Leary, *The Shape of Things to Come: Why Age Structure Matters to a Safer, More Equitable World*, Washington, D.C.: Population Action International, 2007, p. 44, states, "As death rates and birthrates decline, every country experiences a decades-long 'demographic bonus' when working-age adults make up the largest share of its population, and there are relatively small groups of dependent children and older adults compared to previous generations. The lower dependency ratios during this period can lead to higher savings, greater per capita government spending on education and health, and increased wages. Such benefits of the demographic bonus contribute to boost countries' economies, as was the case of the 'Asian Tigers' in the 1970s and 1980s. The opportunity for countries to take advantage of this demographic window is relatively short, usually less than 40 years, until the median age of the population increases and the higher proportion of older adults begins raising dependency ratios. Countries in the later stages of a transitional age structure, such as Chile, will see their window of opportunity close by 2015." Bloom, Canning, and Sevilla, 2003, p. 34, argues that the demographic dividend accounted for as much as a third of East Asia's "economic miracle."

⁷ The relationship does apply to man's impact on the local environment. The transition from agriculture to industrialization, particularly rapid industrialization, is initially hard on the environment. But as countries grow richer, their citizens tend to "buy" more environmental protection, such as cleaner air and water and more parkland. Nevertheless, the total resource load required to support that affluence is slower to fall, and in many cases the environmental effects are not reduced so much as offloaded to others.

However, rich countries have yet to fight over environmental injury or resource scarcities; poor ones are more likely to do so. Thus, the number of low- and medium-income countries that are approaching ZPG means that officials have more time and can develop more ways to accommodate the rising stress on land, water, and wood, thereby reducing the odds that such issues will be a future *casus belli*. Yet, such stresses currently exist, and rising population levels will increase such stresses. The significance of declining birthrates is that it slows the rate at which such stresses build. Finally, public investment in resource conservation and environmental remediation may be squeezed to the extent that such spending competes with rising expenditures on the aged, particularly in the affluent West and East Asia.

Lessons for the Air Force

The effect of international demographics on what the Air Force does over the next four decades reflects potential differences in the components of national power from one country to another.⁸

The relative power of America's traditional allies is falling vis-à-vis both emerging economies and high-growth nations. True, the U.S. share of the world's power may not be shrinking as quickly, and so the independent capability of the USAF to carry out global surveillance and global strikes may remain. However, to the extent that the success of the USAF depends on its ability to work with others, notably other air forces, the shift in relative power should portend a shift in those with whom the USAF has to interoperate. It is one thing to accommodate the expansion of NATO in the sense of having new partners with whom to interoperate, but those new NATO countries have shrinking populations. The harder task for the Air Force is to learn how to interoperate with rising and still-growing countries that have different cultural contexts and value structures. Yet, if the United States and its

⁸ National demographics—i.e., the geographic, ethnic, and educational composition of the United States—were *not* examined in this monograph. Yet, they have profound implications for how the Air Force recruits.

allies are to retain the same share of global power, then they must reach out to new countries. Interoperability is likely to be a challenge, but, as with many such challenges, the earlier they are undertaken, the more time is available for working out the various issues. Here, the USAF needs to lean into the future.

The shrinking zone of instability worldwide, for its part, suggests that the current emphasis on counterinsurgency ought not to be confused with the Air Force's long-term future. The easy tendency to associate the Muslim world with rapid population growth is only partially correct. North Africa, Turkey, Iran, formerly Soviet Central Asia, Malaysia, Indonesia, and even Bangladesh have birthrates that are below or no more than 20 percent above ZPG levels (2.1 births per female). *Muslim* may not equate to *unstable*. If insurgencies are associated with demographics, as much as or more so than economic factors, then declining birthrates would, over decades, shrink the number of places heir to insurgencies, irrespective of the future of economic growth. By contrast, issues associated with protecting the commons or maintaining surveillance are far less dependent on demographic factors and are likely to maintain or even increase their relevance over the next few decades.

Delayed Maternity and Fertility Rates

Could what appears to be a decline in fertility rates be little more than a collective decision on the part of would-be mothers to have children later rather than earlier in their childbearing years? As Teitelbaum and Winter argued,¹

It is well established in demography that with constant lifetime or cohort fertility, period fertility measures will increase with change toward earlier timing of childrearing, and decrease with the opposite change of delays in childbearing. . . . While such effects are well understood by demographers, there is a danger that the levels and trends of period rates over a limited number of years will be misinterpreted by non-specialists as indicating comparable changes in average childbearing for actual cohorts of women.

And if women who previously postponed giving birth are now catching up, could the European birth dearth be a mirage? Indeed, as Martin Walker reported in 2009,

Britain's fertility rate has increased from 1.6 to 1.9 in just six years, with a striking contribution from women in their thirties

¹ Michael S. Teitelbaum and Jay M. Winter, "Demography and International Politics, 1870–1945," in Michael S. Teitelbaum and Jay M. Winter, *The Fear of Population Decline*, Orlando, Fla.: Academic Press, 1985, p. 142.

and early forties—just the kind of hard-to-predict behavior that drives demographers wild.²

The short answer to both questions is “probably not.” Although changes in birth timing can affect short-term birthrates, the effects are mild, and the result of delay can be permanent for the population as a whole even if not permanent for any one woman. The relationship between timing and fertility rates was modeled by positing a country in 2005 in which each year’s cohort has 50,000 women. Each woman gives birth to a boy and a girl. All women born in 1985 and earlier space the births of their children as births are spaced in developing countries (India was used as a template; see Table A.1). Women born in 1986 have children slightly later in life; those born in 1987 have them later yet. Those born in 1995 and thereafter space their births as in the United States (see Table A.1). In other words, in ten years, women entering their childbearing years underwent a major transition in child-spacing practices. Note that the main difference between India and the United States is that India’s women have more children in their early 20s; American women have more children in their early 30s and late 30s. As a gross comparison, roughly one birth in seven

Table A.1
Percentage of All Childbirths
to Women of Succeeding-Age
Cohorts

Cohort	India	United States
15 to 19	9	9
20 to 24	37	24
25 to 29	29	28
30 to 34	15	24
35 to 39	6	12
40 and up	4	3

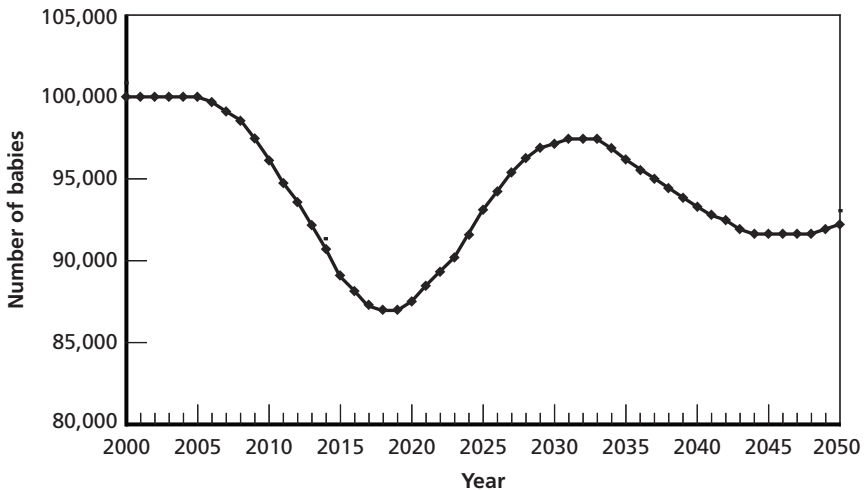
² Martin Walker, “The World’s New Numbers,” *Wilson Quarterly*, Spring 2009, p. 27.

takes place a dozen years later—socially significant but not necessarily a great statistical difference when totally averaged.

Thus, the results, shown in Figure A.1, are visible but hardly dramatic.

Births dip by 12 percent at their trough, recover when these later births come through, and, in the long term, run roughly 5 percent lower as a result of earlier decisions to postpone childbirths. As such, most, but admittedly not 100 percent, of what has occurred in Europe and East Asia can be ascribed to millions of decisions to have fewer babies rather than to have babies somewhat later in life.

Figure A.1
Long-Term Effects of a One-Time Decision by Women to Have Children Later in Life



Trade-Offs Between Fertility Rates and Migration Rates

The prospect of a nation losing power in the long run by failing to produce enough babies may press governments to find ways to raise population levels. In essence, there are three ways to do so: raise birth-rates, increase migration, or lower death rates. The last, lowering death rates, may be virtuous for its own sake, but with death rates among those under 60 as low as they are, there is not much, demographically, to be gained by improving them. This leaves a choice, essentially, between babies and newcomers.¹ To test the trade-off, we will start with German numbers as a test case. Germany now has a nearly 40-year history of below-replacement fertility rates and modest but positive immigration levels. The largest cohorts are in their early middle ages: For

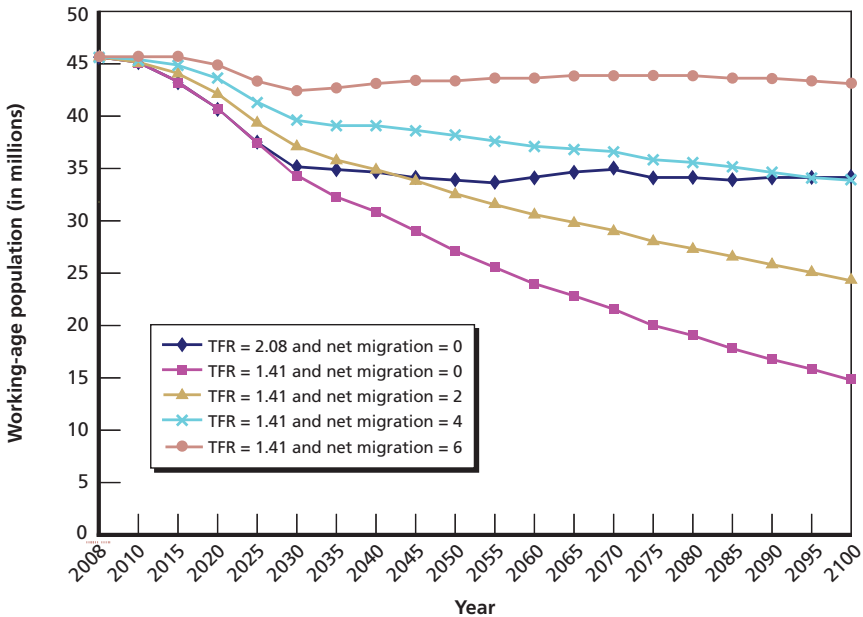
¹ Jonathan Grant, Stijn Hoorens, Suja Sivadasan, Mirjam van het Loo, Julie DaVanzo, Lauren Hale, Shawna Gibson, and William Butz, *Low Fertility and Population Ageing: Causes, Consequences, and Policy Options*, Santa Monica, Calif.: RAND Corporation, MG-206-EC, 2004, p. 24, notes:

The effectiveness of migration as a strategy towards preventing population ageing and a decrease in the size of the population depends on the ability of national governments to implement suitable migration policies. . . . The extent to which immigrants are ready and able to integrate into the receiving population appears to be a crucial factor for the success of immigration strategies [often discussed] . . . in terms of the 'quality' of the population, a term used in a similar context as social cohesion [and covering what] portion of immigrants [come] with low educational attainment. . . . In order to avoid such a development towards social exclusion, it has been argued that Western Europe would be better served by relatively small contingents of immigrants and a partial recovery of native fertility, than by continued extremely low native fertility that is offset by a very large immigration stream.

every two-year-old, there are two 42-year-olds. The total fertility rate is 1.41, which, if not supplemented by migration, ultimately implies a demographic half-life of just under two generations. Germany, however, has (or recently had) a net immigration rate of two per year per thousand—slightly less than half of U.S. levels.

Demographically, this country’s future is fairly grim. Figure B.1 shows the population of adults ages 20 through 60 (i.e., working age) over time, assuming a constant fertility rate and a net immigration rate. The current parameters result in a workforce that shrinks from 45 million in 2008 to 24 million in 2100. If immigration is stopped or dries up, the fall is greater—to 15 million. Comparing the two numbers suggests that by 2100, only 60 percent of the working-age population will be descendants of those who were residents in 2008. Note that

Figure B.1
Working-Age Population Projection of a Hypothetical Germany-Like Country with Alternative Birth and Migration Rates



SOURCE: Generated by a model based on data from United Nations Population Division, 2009.

RAND MG1091-B.1

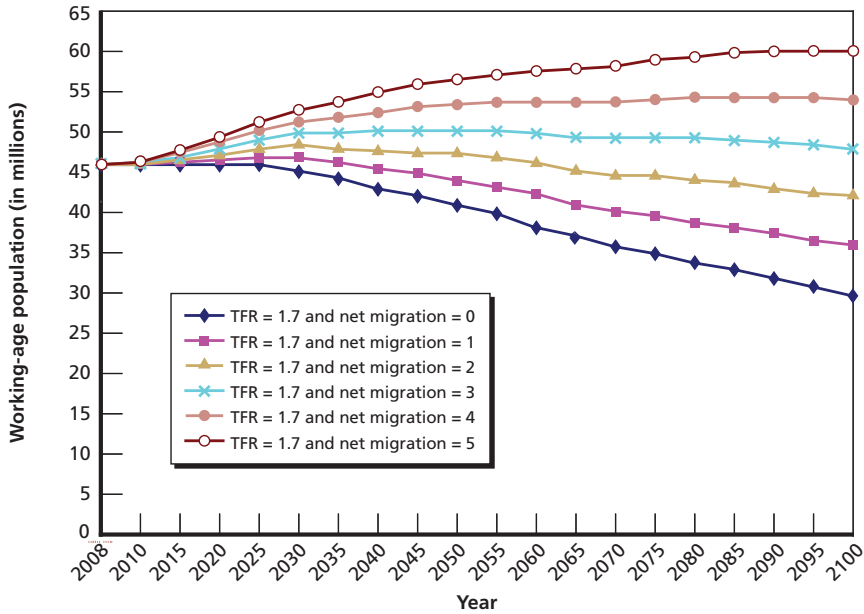
the underlying trends are only somewhat ameliorated if the fertility rate were to return to 2.08 (which generates ZPG in countries with low mortality rates). Absent migration, the working-age population drops to 34 million in 2035 before leveling (because babies not born earlier mean fewer childbearing women later).

Can migration make up the difference? Because the average age of migrants into affluent nations is in the low twenties, most immigrants add to the labor force on arrival; babies, not for 20 years or so. In Figure B.1, one gets to the same workforce by 2100 with the current (1.41) fertility rate and four immigrants per thousand as one does with a ZPG fertility rate. The demographic payoff from more rapid migration comes earlier, but after 2100 the higher fertility rate produces some higher numbers. Finally, if the migration rate hits six per thousand, the size of the workforce hardly declines over the following century. Admittedly, a migration rate of six per thousand is three times Germany's current rate, but it is only somewhat higher than the U.S. rate (five per thousand) and lower than Canada's (seven per thousand).

For comparison purposes, let us take another type of country, one which has had a ZPG fertility rate (2.08) for as far back as anyone can remember but which faces the immediate prospect that the fertility rate will fall to 1.7. What immigration rates should it seek if its goal is to preserve the size of the workforce? Figure B.2 illustrates some trade-offs.

The bottom line shows the base case: The workforce stays constant until the newborns enter the labor force and then starts to drop once more people leave than enter the workforce. By 2100, the workforce is down to 30 million and dropping. A migration rate of two to three per thousand can maintain the size of the workforce circa 2100, and in both cases the workforce rises somewhat in the first few decades, because migrants enter the workforce before newborns do. If the country wants to ensure that its workforce can achieve a steady state after 2100, it needs to attract (and retain) four migrants per year per thousand. Regardless of its migration rate, however, with a total fertility

Figure B.2
Working-Age Population Projection of a Hypothetical Country with ZPG Fertility Rates Under Alternative Future Fertility Rate and Migration Assumptions



SOURCE: Generated by a model based on data from United Nations Population Division, 2009.
 RAND MG1091-B.2

rate of 1.7, the size of the workforce that has descended from today’s workforce will decline to 30 million.²

So, if the policy goal is to maintain the size of the workforce, then migration can be a substitute for births, at least over a period as long as a century. North American–level immigration rates can compensate for Germany-level fertility rates (going back to the early 1970s). European-level immigration rates can compensate for a decline of fertility rates to slightly higher levels that characterize England or Scandi-

² Or less. The 30 million figure assumes that there is no emigration. If annual net immigration of, say, three per thousand is a combination of five immigrants per thousand and two emigrants per thousand, then the 30 million figure would be lower: 18 million (assuming that no immigrant was a descendent of a former emigrant).

navia. Left to be determined is the issue of how much leverage policies have in raising birthrates (some) and migration rates (a great deal, if the nation is fundamentally attractive to migrants).

This is hardly to say that babies and immigrants are perfect substitutes for one another. Additional babies are likely to earn incomes similar to others in the labor force when they mature. Immigrants, by contrast, tend to take lower-paying jobs and thus offer less income to be taxed (e.g., to support the elderly). Conversely, they do not have to be educated at public expense or brought up at private expense. Finally, high levels of immigration tend to shift the ethnic mix in the countries they come to, a matter that some countries may appreciate—but not necessarily all of them.

Bibliography

“The Accuracy of Past Projections,” in National Research Council, *Beyond Six Billion*, Washington, D.C.: National Academy Press, 2000, pp. 37–52.

Alemayehu, Berhanu, and Kenneth E. Warner, “The Lifetime Distribution of Health Care Costs,” *Health Services Research*, Vol. 39, No. 3, June 2004, pp. 627–642. As of May 24, 2010:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1361028/>

Berger, Marc L., James F. Murray, Judy Xu, and Mark Pauly, “Alternative Valuations of Work Loss and Productivity,” *Journal of Occupational and Environmental Medicine*, January 2001. As of March 28, 2011:
<http://www.aoem.org/Page3Column.aspx?PageID=7351&id=1340>

Biddle, Stephen, *Military Power: Explaining Victory and Defeat in Modern Battle*, Princeton, N.J.: Princeton University Press, 2004.

Billari, Francesco, Hans-Peter Kohler, and Mikko Myrskylä, “Advances in Development Reverse Fertility Decline,” *Nature*, August 6, 2009, pp. 741–743.

Binkin, Martin, *Military Technology and Defense Manpower*, Washington, D.C.: The Brookings Institution, 1986.

———, *Who Will Fight the Next War?* Washington, D.C.: The Brookings Institution, 1996.

Blondal, Sveinbjorn, and Stefano Scarpetta, “The Retirement Decision in OECD Countries,” OECD Economics Working Papers No. 202, 1999.

Bloom, David E., David Canning, and Günther Fink, “Population Aging and Economic Growth,” Cambridge, Mass.: Harvard Initiative for Global Health, Program on the Global Demography of Aging, Working Paper No. 31, April 2008.

Bloom, David E., David Canning, and Jaypee Sevilla, *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*, Santa Monica, Calif.: RAND Corporation, MR-1274-WFHF/DLPF/RF/UNPF, 2003. As of May 25, 2010:
http://www.rand.org/pubs/monograph_reports/MR1274.html

Bohn, Henning, “Will Social Security and Medicare Remain Viable as the U.S. Population Is Aging? An Update,” Munich: CESifo Group, CESifo Working Paper No. 1062, October 2003. As of May 24, 2010:

http://www.cesifo-group.de/portal/page/portal/ifoHome/b-publ/b3publwp/_wp_by_author?p_autor_id=55

Börsch-Supan, Axel, “Global Aging: Issues, Answers, More Questions,” University of Michigan Retirement Research Center Working Paper 2004-084, June 2004.

Bosworth, Barry P., Ralph C. Bryant, and Gary Burtless, *The Impact of Aging on Financial Markets and the Economy: A Survey*, Washington, D.C.: The Brookings Institution, 2004.

Bosworth, Barry P., and Gary Burtless, “Budget Crunch: Population Aging in Rich Countries,” Washington, D.C.: The Brookings Institution, Summer 1997. As of May 25, 2010:

http://www.brookings.edu/articles/1997/summer_saving_bosworth.aspx

Briscoe, John, *India’s Water Economy: Bracing for a Turbulent Future*, Washington, D.C.: World Bank, 2006.

Caldwell, Christopher, *Reflections on the Revolution in Europe: Immigration, Islam, and the West*, New York: Doubleday, 2009.

Cali, Massimiliano, “Urbanization, Inequality and Economic Growth: Evidence from Indian States,” World Bank, preliminary findings of a paper prepared for the World Development Report 2009, November 2007. As of May 24, 2010:

<http://siteresources.worldbank.org/INTWDR2009/Resources/4231006-1204741572978/Cali.pdf>

Canadian Foundation for the Americas (FOCAL), “FOCAL Summary of News Items Reported on Cuba, January–December 2004,” 2005. As of May 24, 2010: <http://www.cubasource.org/pdf/Security04.pdf>

Census of India, *Sample Registration System: Statistical Report*, 2005.

Cha, Ariana Eunjung, “In Aging China, a Change in Course: Looming Population Crisis Forces Officials to Rethink One-Child Policy but Couples Hesitate,” *Washington Post*, December 2, 2009, p. A8.

Chernichovsky, Dov, and Sara Markowitz, “Aging and Aggregate Costs of Medical Care: Conceptual and Policy Issues,” *Health Economics*, Vol. 13, No. 6, June 2004, pp. 543–562.

Cincotta, Richard, Robert Engelman, and Daniele Anastasion, *The Security Demographic: Population and Civil Conflict After the Cold War*, Washington, D.C.: Population Action International, August 1, 2003. As of May 24, 2010:

http://www.populationaction.org/Publications/Reports/The_Security_Demographic/Summary.shtml

Congressional Budget Office, *Projected Effects of Various Provisions on Social Security's Financial and Distributional Outcomes*, Washington, D.C., May 25, 2005.

———, *Technological Change and the Growth of Health Care Spending*, Washington, D.C., January 2008.

Connelly, Matthew, and Paul Kennedy, "Must It Be the Rest Against the West?" *The Atlantic Monthly*, December 1994. As of May 24, 2010: <http://www.theatlantic.com/past/politics/immigrat/kennf.htm>

Cordesman, Anthony H., and Abraham R. Wagner, *The Lessons of Modern War*, Boulder, Colo.: Westview Press, 1990.

DaVanzo, Julie, and Clifford Grammich, *Dire Demographics: Population Trends in the Russian Federation*, Santa Monica, Calif.: RAND Corporation, MR-1273-WFHF/DLPP/RF, 2001. As of May 25, 2010: http://www.rand.org/pubs/monograph_reports/MR1273.html

Dominguez, Jorge I., "Hello from Havana: Nuanced but Unmistakable Stirrings of Change in Cuba," *Harvard Magazine*, July–August 2009, pp. 24–27.

"Don't Go Yet: Why Early Retirement Must Get Later," *The Economist*, March 25, 2004.

Dougherty, Conor, and Miriam Jordan, "Recession Hits Immigrants Hard: Survey Shows First Decline in Foreign-Born U.S. Residents in Nearly 40 Years," *Wall Street Journal*, September 23, 2009. As of May 24, 2010: <http://online.wsj.com/article/SB125356996157829123.html>

Eberstadt, Nicholas, "What If It's a World Population Implosion? Speculations About Global De-Population," Cambridge, Mass.: Harvard Center for Population and Development Studies, Working Paper 98.04, March 1998.

———, "Growing Old the Hard Way: China, Russia, India," *Policy Review*, No. 136, April/May 2006.

Erlich, Paul, *The Population Bomb*, New York: Ballantine, 1971.

Exum, Andrew M., Nathaniel C. Fick, Ahmed A. Humayun, and David J. Kilcullen, *Triage: The Next Twelve Months in Afghanistan and Pakistan*, Washington, D.C.: Center for a New American Security, June 11, 2009.

Federal Old-Age and Survivors Insurance and Federal Disability Trust Funds, *The 2009 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Trust Funds*, Washington, D.C., May 12, 2009.

Felder, S., "Multiple Risks and the Demand for Insurance: The Case of Longevity and Long-Term Care Risks," *The Geneva Papers on Risk and Insurance, Issues and Practice*, 2000.

Ferguson, Niall, "The Way We Live Now: Eurabia?" *New York Times Sunday Magazine*, April 4, 2004.

Feshbach, Murray, *Russia's Demographic and Health Meltdown*, United States Congress, Joint Economic Committee, Russia's Uncertain Economic Future, 107th Congress, 1st Session, Washington, D.C.: Government Printing Office, December 2001.

Finkelstein, Eric A., Christopher J. Ruhm, and Katherine M. Kosa, "Economic Causes and Consequences of Obesity," *Annual Review of Public Health*, Vol. 26, 2005, pp. 239–257.

Fisher, Christopher, "The Illusion of Progress: CORDS and the Modernization in South Vietnam, 1965–1968," *Pacific Historical Review*, Vol. 75, No. 1, May 2006.

Fogel, Robert W., and Dora L. Costa, "A Theory of Technophysio Evolution, with Some Implications for Forecasting Population, Health Care Costs, and Pension Costs," *Demography*, Vol. 34, No. 1, February 1997, pp. 49–66.

Forelle, Charles, "Pension Glut Lies at Heart of Crisis Wracking Hungary," *The Wall Street Journal*, March 25, 2009.

Freedman, Lawrence, *The Transformation of Strategic Affairs*, London: International Institute for Strategic Studies, Adelphi Paper 379, 2006.

Gat, Azar, *War in Human Civilization*, Oxford: Oxford University Press, 2006.

"Getting Boots Off the Ground," *The Economist*, January 24, 2008. As of May 24, 2010:

http://www.economist.com/world/international/PrinterFriendly.cfm?story_id=10567033

Goldstone, Jack, "The New Population Bomb: The Four Megatrends That Will Change the World," *Foreign Affairs*, January/February 2010, pp. 31–43.

Gompert, David, John Gordon IV, Adam Grissom, David R. Frelinger, Seth G. Jones, Martin C. Libicki, Edward O'Connell, Brooke Stearns Lawson, and Robert E. Hunter, *War by Other Means: Building Complete and Balanced Capabilities for Counterinsurgency*, Santa Monica, Calif.: RAND Corporation, MG-595/2-OSD, 2008. As of May 25, 2010:

<http://www.rand.org/pubs/monographs/MG595z2.html>

Gonzales, Patrick, Trevor Williams, Leslie Jocelyn, Stephen Roey, David Kastberg, and Summer Brenwald, *Highlights From TIMSS 2007: Mathematics and Science Achievement of U.S. Fourth and Eighth-Grade Students in an International Context*, Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, NCES 2009-001 Revised, September 2009. As of March 28, 2011:

<http://nces.ed.gov/pubs2009/2009001.pdf>

Grant, Jonathan, and Stijn Hoorens, "The New Pronatalism?" *Public Policy Research*, March–May 2006.

- Grant, Jonathan, Stijn Hoorens, Suja Sivadasan, Mirjam van het Loo, Julie DaVanzo, Lauren Hale, Shawna Gibson, and William Butz, *Low Fertility and Population Ageing: Causes, Consequences, and Policy Options*, Santa Monica, Calif.: RAND Corporation, MG-206-EC, 2004. As of May 25, 2010: <http://www.rand.org/pubs/monographs/MG206.html>
- Gruber, Jonathan, and David A. Wise, "Social Security Programs and Retirement Around the World: Fiscal Implications; Introduction and Summary," Cambridge, Mass.: National Bureau of Economic Research, Working Paper 11290, April 2005.
- Haas, Mark L., "A Geriatric Peace?" *International Security*, Vol. 32, No. 1, Summer 2007, pp. 112–147.
- Headquarters, Department of the Army, *2006 Field Manual on Counterinsurgency* (FM 3-24), December 2006.
- Hinkle, James B., and Terry L. Glover, *Reduced Manning in DDG 51 Class Warships: Challenges, Opportunities and the Way Ahead for Reduced Manning on All United States Navy Ships*, conference paper, Arlington, Va.: Anteon Corporation, March 18, 2004. As of May 24, 2010: <http://www.stormingmedia.us/61/6112/A611224.html>
- Hofer, Michael, Nancy Rytina, and Christopher Campbell, *Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2006*, Washington, D.C.: United States Department of Homeland Security, Office of Immigration Statistics, Policy Directorate, Population Estimates, August 2007. As of May 24, 2010: http://www.dhs.gov/xlibrary/assets/statistics/publications/ill_pe_2006.pdf
- Homer-Dixon, Thomas, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International Security*, Vol. 16, No. 2, Fall 1991.
- , "Environmental Scarcities and Violent Conflict: Evidence from Cases," *International Security*, Vol. 19, No. 1, Summer 1994.
- Hosek, Susan D., "Leveraging Other Federal Health Systems," in Alice M. Rivlin and Joseph R. Antos, eds., *Restoring Fiscal Sanity 2007: The Health Spending Challenge*, Washington, D.C.: Brookings Institution Press, 2007.
- Hotez, Peter, "The Neglected Tropical Diseases and Their Devastating Health and Economic Impact on the Member Nations of the Organization of the Islamic Conference," *PLoS Neglected Tropical Diseases*, Vol. 3, No. 10, October 2009.
- Howe, Herbert, "Lessons of Liberia: ECOMOG and Regional Peacekeeping," *International Security*, Vol. 21, No. 3, Winter 1996/1997.
- Howe, Neil, and Richard Jackson, "Battle of the (Youth) Bulge," *The National Interest*, July/August 2008, pp. 33–40.

Hsu, Lucy L., Remington Nevin, Steven K. Tobler, and Mark V. Ruberton, "Trends in Overweight and Obesity Among 18-Year-Old Applicants to the United States Military, 1993–2006," *Journal of Adolescent Health*, Vol. 41, No. 6, pp. 610–612.

Hudson, Valerie, and Andrea Den Boer, "A Surplus of Men, a Deficit of Peace," *International Security*, Vol. 26, No. 4, Spring 2002.

Ignatius, David, "Fighting Smarter in Iraq," *Washington Post*, March 17, 2006, p. A19. As of May 24, 2010:
<http://www.washingtonpost.com/wp-dyn/content/article/2006/03/16/AR2006031601308.html>

International Monetary Fund, *International Financial Statistics*, Washington, D.C., undated.

Jackson, Richard, and Neil Howe, with Rebecca Strauss and Keisuke Nakashima, *The Graying of the Great Powers: Demography and Geopolitics in the 21st Century*, Washington, D.C.: Center for Strategic and International Studies, 2008.

Jackson, Richard, Keisuke Nakashima, and Neil Howe, with contributions by Jiangong Zhou, *China's Long March to Retirement Reform: The Graying of the Middle Kingdom Revisited*, Washington, D.C.: Center for Strategic and International Studies, 2009. As of May 24, 2010:
http://csis.org/files/media/isis/pubs/090422_gai_chinareport_en.pdf

Jansen, Don J., "Military Medical Care: Questions and Answers," Washington, D.C.: Congressional Research Service, CRS Report for Congress RL 33537, May 14, 2009.

Joint United Nations Programme on HIV/AIDS, "2009 AIDS Epidemic Update," accessed December 2007. As of May 24, 2010:
<http://www.unaids.org/en/KnowledgeCentre/HIVData/EpiUpdate/EpiUpdArchive/2009/default.asp>

Jones, Frank L., "Blowtorch: Robert Komer and the Making of Vietnam Pacification Policy," *Parameters*, Autumn 2005, pp. 103–118.

Jordan, Miriam, "Illegal Immigration from Mexico Hits Lowest Level in Decade," *Wall Street Journal*, July 23, 2009. As of May 24, 2010:
<http://online.wsj.com/article/SB124830603836573915.html>

Kasinof, Laura, "Water Crisis at Heart of Yemen's Conflicts," *Christian Science Monitor*, November 9, 2009.

Kopelman, Peter G., "Obesity as a Medical Problem," *Nature*, Vol. 404, April 6, 2000, pp. 635–643.

Kotlikoff, Laurence J., Kent Smetters, and Jan Walliser, "Finding a Way Out of America's Demographic Dilemma," Cambridge, Mass.: National Bureau of Economic Research, Working Paper No. 8258, April 2001.

Krebs, Ronald R., and Jack S. Levy, "Demographic Change and the Sources of International Conflict," in Myron Weiner and Sharon S. Russell, eds., *Demography and National Security*, New York: Berghahn Books, 2001.

Lange, Steve, "The Imperial Japanese Navy Air Force in the Pacific War," 1996. As of May 24, 2010:
<http://www.combinedfleet.com/ijnaf.htm>

Leary, Elizabeth, *The Shape of Things to Come: Why Age Structure Matters to a Safer, More Equitable World*, Washington, D.C.: Population Action International, 2007.

Libicki, Martin C., David C. Gompert, David R. Frelinger, and Raymond Smith, *Byting Back: Regaining Information Superiority Against 21st-Century Insurgents*, Santa Monica, Calif.: RAND Corporation, MG-595/1-OSD, 2007. As of May 25, 2010:
<http://www.rand.org/pubs/monographs/MG595z1.html>

"LTTE's Days Numbered—Karuna," *BBC News*, March 1, 2009. As of May 24, 2010:
http://www.bbc.co.uk/sinhala/news/story/2009/03/090301_karuna_ampara.shtml

Lu, Yang, and Dana Goldman, "The Effects of Relative Food Prices on Obesity—Evidence from China: 1991–2006," Cambridge, Mass.: National Bureau of Economic Research, Working Paper 15720, 2010.

Luttwak, Edward, "Post-Heroic Warfare," *Foreign Affairs*, Vol. 74, No. 3, May/June 1995, pp. 109–122.

Meadows, Donella H., Jorgen Randers, Dennis L. Meadows, and William W. Behrens, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, New York: Universe Books, 1973.

Millett, Allan R., and Williamson Murray, eds., *Military Effectiveness: Vol. 3, The Second World War*, New York: Cambridge University Press, 2010.

National Research Council, *Beyond Six Billion*, Washington, D.C.: National Academy Press, 2000.

Nichiporuk, Brian, *The Security Dynamics of Demographic Factors*, Santa Monica, Calif.: RAND Corporation, MR-1088-WFHF/RF/DLPF/A, 2000. As of May 25, 2010:
http://www.rand.org/pubs/monograph_reports/MR1088.html

NRC—see National Research Council.

OECD—see Organisation for Economic Co-Operation and Development.

Office of Management and Budget, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009*, Washington, D.C.: U.S. Government Printing Office, 2008.

———, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2010*, Washington, D.C.: U.S. Government Printing Office, 2009.

OMB—see Office of Management and Budget.

Organisation for Economic Co-Operation and Development (OECD), “Live Longer, Work Longer,” *DELSA Newsletter*, Issue 2, 2006, pp. 2–3. As of May 25, 2010:

<http://www.oecd.org/dataoecd/54/47/35961390.pdf>

Organski, A. F. K., and Jacek Kugler, *The War Ledger*, Chicago: University of Chicago Press, 1980.

O’Rourke, Ronald, *Navy CVNX Aircraft Carrier Program: Background and Issues for Congress*, Congressional Research Service, RS20643, updated February 19, 2002.

Papadimitriou, Dimitri B., “Economic Perspectives on Aging,” Annandale-on-Hudson, New York: The Levy Economics Institute of Bard College, Working Paper No. 500, May 2007.

Parker, John, “Burgeoning Bourgeoisie,” *The Economist*, February 12, 2009.

Pew Hispanic Center home page, 2011. As of April 5, 2011:

<http://pewhispanic.org>

Pincus, Walter, “From New DNI, Moderate View on North Korea and Warning About Iran’s Role in Afghanistan,” *Washington Post*, February 16, 2009, p. A13.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *2004 Revision*, New York, 2004. As of May 24, 2010: <http://www.un.org/esa/population/publications/WPP2004/2004EnglishES.pdf>

Population Reference Bureau, “2008 World Population Data Sheet,” Washington, D.C., 2008. As of May 24, 2010: http://www.prb.org/pdf08/08WPDS_Eng.pdf

Posen, Barry, “Command of the Commons: The Military Foundation of U.S. Hegemony,” *International Security*, Vol. 28, No. 1, Summer 2003, pp. 5–46. As of May 24, 2010:

http://belfercenter.ksg.harvard.edu/publication/271/command_of_the_commons.html

Preston, Julia, “Decline Seen in Numbers of People Here Illegally,” *New York Times*, July 31, 2009.

Quester, George H., “Demographic Trends and Military Recruitment: Surprising Possibilities,” *Parameters*, Vol. 35, No. 1, Spring 2005.

Quinlivan, James T., “Force Requirements in Stability Operations,” *Parameters*, Winter 1995, pp. 59–69.

Ratha, Dilip, "Workers' Remittances: An Important and Stable Source of External Development Finance," in *Global Development Finance: Striving for Stability in Development Finance*, Washington, D.C.: World Bank, 2003, pp. 157–175. As of March 28, 2011:

<http://siteresources.worldbank.org/INTRGDF/Resources/GDF2003-Chapter7.pdf>

Ratha, Dilip, and William Shaw, "South-South Migration and Remittances," Washington, D.C.: World Bank, January 19, 2007. As of March 28, 2011:

http://www.dilipratha.com/index_files/

South-SouthMigrationandRemittancesWP102.pdf

Razin, Assaf, Efraim Sadka, and Phillip Swagel, "The Aging Population and the Size of the Welfare State," *Journal of Political Economy*, Vol. 110, No. 4, 2002, pp. 900–918.

Ricks, Thomas, *Fiasco*, New York: Penguin Press, 2006.

Ruggeri, Joe, and Yang Zou, "The Fiscal Burden of Rising Dependency Ratios," *Population Research and Policy Review*, Vol. 26, 2007, pp. 185–201.

Seshamani, Meena, and Alastair M. Gray, "A Longitudinal Study of the Effects of Age and Time to Death on Hospital Costs," *Journal of Health Economics*, Vol. 23, No. 2, March 2004, pp. 217–235.

Singer, Peter, *Children at War*, Berkeley: University of California Press, 2006.

———, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, New York: Penguin, 2009.

SIPRI—see Stockholm International Peace Research Institute.

Spillman, Brenda C., "Changes in Elderly Disability Rates and the Implications for Health Care Utilization and Costs," *The Milbank Quarterly*, Vol. 82, No. 1, 2004, pp. 157–194.

Steinglass, Matt, "The Pitfalls of Pacification," *GlobalPost*, Boston, Mass., March 30, 2009. As of May 24, 2010:

<http://www.globalpost.com/dispatch/vietnam/090327/>

the-pitfalls-pacification?page=0,2,

Stockholm International Peace Research Institute (SIPRI), SIPRI Military Expenditure Database, undated. As of May 24, 2010:

<http://www.sipri.org/databases/milex>

Swanson, Eric, *World Development Indicators 2007*, Washington, D.C.: World Bank, April 1, 2004. As of May 24, 2010:

<http://econ.worldbank.org/external/default/>

main?pagePK=64165259&theSitePK=469372&piPK=

64165421&menuPK=64166093&entityID=000333037_20100421013221

Teitelbaum, Michael S., and Jay M. Winter, "Demography and International Politics, 1870–1945," in Michael S. Teitelbaum and Jay M. Winter, *The Fear of Population Decline*, Orlando, Fla.: Academic Press, 1985.

Tellis, Ashley J., Janice Bially, Christopher Layne, Melissa McPherson, and Jerry M. Sollinger, *Measuring National Power in the Postindustrial Age*, Santa Monica, Calif.: RAND Corporation, MR-1110-A, 2000. As of May 25, 2010: http://www.rand.org/pubs/monograph_reports/MR1110.html

Thompson, David, and Anne M. Wolf, "The Medical-Care Cost Burden of Obesity," *Obesity Reviews*, Vol. 2, 2001, pp. 189–197.

United Nations Population Division, *World Population Prospects: The 2008 Revision Population Database*, last updated March 11, 2009. As of May 24, 2010: <http://esa.un.org/unpp/index.asp?panel=2>

United States Bureau of Labor Statistics, Division of Foreign Labor Force Statistics, *International Comparisons of Annual Labor Force Statistics: 10 Countries, 1960–2007*, Washington, D.C., October 21, 2008.

U.S. Census Bureau, *International Data Base (IDB)*, as of September 30, 2009. As of May 24, 2010: <http://www.census.gov/ipc/www/idb/>

Vaupel, James W., James R. Carey, and Kaare Christensen, "Aging: It's Never Too Late," *Science*, Vol. 301, No. 5640, September 19, 2003, pp. 1679–1681.

Walker, Martin, "The World's New Numbers," *Wilson Quarterly*, Spring 2009.

Weil, David N., "Population Aging," Cambridge, Mass.: National Bureau of Economic Research, Working Paper 12147, March 2006.

West, Bing, *The Strongest Tribe: War, Politics, and the Endgame in Iraq*, New York: Random House, 2008.

Westoff, Charles F., and Tomas Frejka, "Religiousness and Fertility Among European Muslims," *Population and Development Review*, Vol. 33, No. 4, 2007, pp. 785–809.

World Databank, "World Development Indicators, 2007," accessed December 15, 2010. As of April 21, 2009: <http://databank.worldbank.org/ddp/home.do>

World Health Organization, "General Government Expenditure on Health as Percent of Total Government Expenditure 2006," in World Health Organization, *World Health Statistics 2009*, Part II, "Health Expenditure," Geneva, 2009, Table 7, pp. 107–117. As of May 24, 2010: <http://www.who.int/whosis/whostat/2009/en/index.html>

———, *World Health Statistics 2009*, Geneva, 2009. As of May 24, 2010: <http://www.who.int/whosis/whostat/2009/en/index.html>

- Xie, Jian, Andres Liebenthal, Jeremy J. Warford, John A. Dixon, Manchuan Wang, Shiji Gao, Shuilin Wang, Yong Jiang, and Zhong Ma, *Addressing China's Water Scarcity: Recommendations for Selected Water Resource Management Issues*, Washington, D.C.: World Bank, 2009. As of May 24, 2010:
http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/01/14/000333037_20090114011126/Rendered/PDF/471110PUB0CHA0101OFFICIAL0USE0ONLY1.pdf
- Zenko, Micah, "Saving Lives with Speed: Using Rapidly Deployable Forces for Genocide Prevention," *Defense and Security Analysis*, Vol. 20, No. 1, March 2004, pp. 3–19.
- Zweifel, Peter, Stefan Felder, and Markus Meiers, "Ageing of Population and Health Care Expenditure: A Red Herring?" *Health Economics*, Vol. 8, No. 6, September 1999, pp. 485–496.