1 | *The new world order*

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This book shows that the world economy is undergoing a massive transformation. The transformation is generating a new world order that is scarcely recognizable from the perspective of the twentieth century. According to the authoritative estimates of Angus Maddison, the United States was the world's largest economy throughout the century (Maddison 2001). In the twenty-first century the balance of the world economy has shifted from the industrialized economies, led by Europe, Japan, and the US, to the emerging economies of Asia, especially China and India.

Throughout the last century a fundamental transformation of the world economy seemed a remote and unlikely prospect. However, the World Bank's 2005 International Comparison Program (ICP2005) showed that China had overtaken Japan in terms of purchasing power more than a decade earlier (World Bank 2008). By 2012 India overtook Japan and has continued to grow much more rapidly. The obvious question posed by these findings is, will China surpass the US? The World Bank's 2011 International Comparison Program (ICP2011) has revealed that in 2014 China's output achieved parity with the US in terms of purchasing power (World Bank 2014).

We find that Germany will continue to lead Russia and Russia will lead Brazil, resulting in the new economic order: China, the US, India, Japan, Germany, Russia, and Brazil. Jim O'Neill, then a Goldman-Sachs economist, originated the terminology "BRIC economies" in 2001 and published a book documenting the progress of Brazil, Russia, India, and China in 2010 (O'Neill 2011). However, we find that Brazil and Russia, as well as Germany, Japan, and the US, will grow more slowly than the world economy.

Our second major finding is that world economic growth has accelerated during the twenty-first century and that rapid growth will continue. We answer the question, "Growth or Stagnation?" in favor of growth. While Chinese economic growth has already slowed, Indian

growth will increase. Both giant economies will continue to grow faster than the world economy. As China and India increase in relative importance during the twenty-first century, the accelerated growth of the world economy will be maintained.

At first impression the choice of growth over stagnation may seem implausible. Recovery of the industrialized economies from the Great Recession of 2007–2009 has been slow and fitful. The US has emerged with low unemployment but reduced prospects for growth.[1] Japan has continued to languish in the torpor of the Lost Decades, awaiting the implementation of a new growth strategy.[2] The fiscal and financial burden of public debt in Europe and the inability of international institutions to cope with a financial crisis like Greece pose potential threats to the restoration of growth.[3]

The most significant impact of the Great Recession on the emerging economies of Asia was the collapse of global trade in late 2008 and early 2009. This was quickly reversed and the leading Asian economies have continued to grow more rapidly than the world economy. The challenges facing these economies are different but equally daunting. Can China cope with inflationary pressures following the vast expansion of lending in response to the economic crisis?[4] Will India succeed in dealing with fiscal consolidation and a higher inflation rate?[5]

In this book we set aside short-term threats to the world economy to focus on the potential for long-term growth. We show that the fundamentals of the world economy remain strong. Trends established in the watershed reforms of China and India more than two decades ago have produced the dramatic changes of economic leadership in the twenty-first century. We can now recognize the emergence of Asia from the underdevelopment that persisted until the middle of the twentieth century as the great economic achievement of our time.

The third major finding of this book is that replication rather than innovation is the major source of growth of the world economy. *Replication* takes place by adding identical production units with no change in technology. Labor input grows through the addition of new members of the labor force with the same education and experience.

[1] For more detail, see Chapter 2 of this volume.
[2] For discussion of Japan's Lost Decades, see Chapter 3 of this volume.
[3] See Chapter 4 of this volume for more discussion.
[4] On China see Chapter 6 of this volume.
[5] On India see Chapter 7 of this volume.

Capital input expands by providing new production units with the same collection of plant and equipment. Output expands in proportion with no change in productivity. By contrast, successful *innovation* involves the creation of new products and new processes, so that productivity increases. Of course, replication and innovation are simply analytical categories for characterizing aspects of the complex processes that generate long-term growth and structural change.

The Asian model of economic growth relies on globalization and investment in human and non-human capital, rather than innovation. This new growth paradigm places a high premium on skillful management by public and private authorities. The performance of the leading economies in developing and implementing the new growth paradigm, first Japan, then the Asian Tigers – Hong Kong, Singapore, South Korea, and Taiwan – and now China and India, has changed the course of economic development in Asia and around the world.

The growing significance of the Asian model is overturning long-established theories of economic growth and accelerating overdue revisions of the official economic statistics. The ruling theories of growth of the twentieth century put enormous weight on innovation, which has played a relatively modest role. This view neglected investments in human and non-human capital, which are much more important for advanced economies as well as emerging economies. The new economic order will help to establish an empirically based view of the balance between replication and innovation.

In Section 1 of this chapter we analyze the recent performance of the world economy. We rely on gross domestic product (GDP) as a measure of output and define productivity as output per unit of both capital and labor inputs. We present output, inputs, and productivity for the world economy and major groups like the G7 and the G20. We also consider the individual economies of the G7 – Canada, France, Germany, Italy, Japan, the United Kingdom and the United States – and the major emerging economies – Brazil, China, India, Indonesia, Mexico, Russia, and South Korea. We refer to these emerging economies as the extended BRICs.

In analyzing the growth of the world economy we utilize the Total Economy Database (TED), originally developed by Maddison at the University of Groningen and maintained by the Conference Board. This was greatly enhanced by the Conference Board in collaboration

with Jorgenson and Khuong Vu.[6] The new database includes inputs and productivity as well as outputs. The Conference Board presents annual reports on the key findings. Jorgenson and Vu have published a series of international comparisons of outputs, inputs, and productivity (Jorgenson and Vu 2013).

The Conference Board's TED incorporates the advances in growth accounting summarized in Paul Schreyer's *OECD Productivity Manual* (2001) and his *OECD Capital Manual* (2009). International standards for measuring labor and capital inputs were established in Chapters 19 and 20 of the United Nations 2008 System of National Accounts (SNA), (United Nations 2009). This is the most recent revision of the United Nations' SNA, developed in collaboration with four other international organizations – the Organisation for Economic Cooperation and Development (OECD), the International Monetary Fund (IMF), the World Bank, and Eurostat.

Data on capital and labor inputs are essential in analyzing economic growth, preparing projections of future growth, and choosing among alternative economic policies. The framework for growth projections is provided by the neo-classical theory of growth (Jorgenson et al. 2008). Growth in labor inputs is based on demographic projections from the United Nations and by national statistical agencies like the US Bureau of the Census (US Census Bureau 2013). Productivity growth provides a link to innovation. Growth in capital inputs is determined endogenously by saving and investment behavior.

In Section 2 we present projections of economic growth for the major groupings of economies, including the G7, the G20, and the extended BRICs. We provide historical data for the period 1990–2012 and projections for 2012–2022. The future growth of the world economy will accelerate, relative to the historical period. The advanced economies of the G7, the OECD, and the European Union (EU) will grow more slowly, while the growth rate of the extended BRICs is almost the same. The acceleration in world economic growth is due to the rising importance of the more rapidly growing economies.

Jorgenson and Vu have adapted the methodology of Jorgenson, Ho, and Kevin Stiroh for projecting the growth of labor productivity and GDP (Jorgenson and Vu 2011). The driving forces in the future growth

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[6] See: Conference Board (2015). Sections 1 and 2 of this chapter incorporate the results of Jorgenson and Vu (forthcoming).

of the world economy are demography and technology. Projections of labor productivity incorporate projections of improvements in capital and labor composition and total factor productivity. For the advanced economies of the G7 we assume that output and capital input will grow at the same rate. The rate of economic growth is determined by the underlying growth in hours worked, improvements in capital and labor composition, and productivity.

The fourth major finding of this book is that the contributions of individual industries are essential for understanding the sources of economic growth. The modest rates of innovation needed to maintain long-run growth are usually concentrated in a relatively small number of sectors. For example, the production of information technology equipment and software has dominated recent innovation in the US. Data on the growth of outputs, inputs, and productivity at the industry level are required for identifying the sources of growth of the US economy.

The concentration of innovation in a narrow range of industries has important implications for changes in the structure of a growing economy. Surprisingly, many of the major emerging economies have discarded the traditional pattern of movement of resources out of agriculture into industry, followed by the growth of the service industries. International comparisons of differences in productivity levels based on purchasing power parities of outputs and inputs at the industry level provide a second focus for industry-level productivity research. These comparisons are essential in assessing changes in comparative advantage and formulating strategies for economic growth.

In Section 3 we present the framework for the measurement of growth of output and productivity at the industry level used in this book. A key feature is that capital input is measured by capital services rather than capital stocks. The prices of capital inputs used in aggregating different types of capital input are rental values rather than asset values. This approach to measuring capital was incorporated into official statistical systems in 2009 by the *OECD Capital Manual* and in Chapter 20 of the *2008 System of National Accounts*. The change from capital stocks to capital services has been critical in measuring the impact of the shift in the composition of capital input toward information technology equipment and software.

The measure of labor input in the TED includes investments in human capital in the form of education. This measure of labor

input incorporates differences in hours worked by workers with different levels of educational attainment. Labor quality is the ratio of labor input to hours worked, so that labor input is the product of hours worked and labor quality. Labor quality is essential for capturing the impact of investment in human capital on economic growth.

In Section 4 we outline the contents of this book. We draw on the results of the World KLEMS Initiative, a research consortium covering Europe, Latin America, and Asia, as well as major economies such as Australia, Canada, Russia, and the US. All of these countries have developed industry-level data on outputs and inputs of capital (K), labor (L), energy (E), materials (M), and services (S). Productivity is defined as output per unit of all inputs. The GDP is measured by aggregating over industries. Jorgenson and Schreyer (2013) have shown how to incorporate this industry-level productivity data into the United Nations' *2008 System of National Accounts*.

1.1 Growth of the world economy

To prepare for projections of world economic growth we analyze the sources of economic growth for the G7, the G20, and the world economy. We consider fourteen major economies – the G7 economies, including the US, and seven emerging economies of the G20, including India and China. We have sub-divided the period 1990–2012 in 1995, 2000, and 2005 in order to capture major changes in the growth rate of the world economy.

In Figure 1.1 we divide the contribution of capital services to world economic growth between information technology (IT) and non-information technology (non-IT). Figure 1.2 gives data on the world economy and seven major groups. We allocate the contribution of labor services between hours worked and labor quality, defined as labor input per hour worked. Finally, we present data on total factor productivity (TFP), defined as output per unit of both capital and labor inputs. The period 1995–2000 witnessed a major acceleration in world economic growth. The rate of world growth increased further during 2000–2005. The economic and financial crisis of 2007–2009 in the advanced economies dominated the world economy after 2005. Growth continued at a rapid pace but slowed relative to 2000–2005.
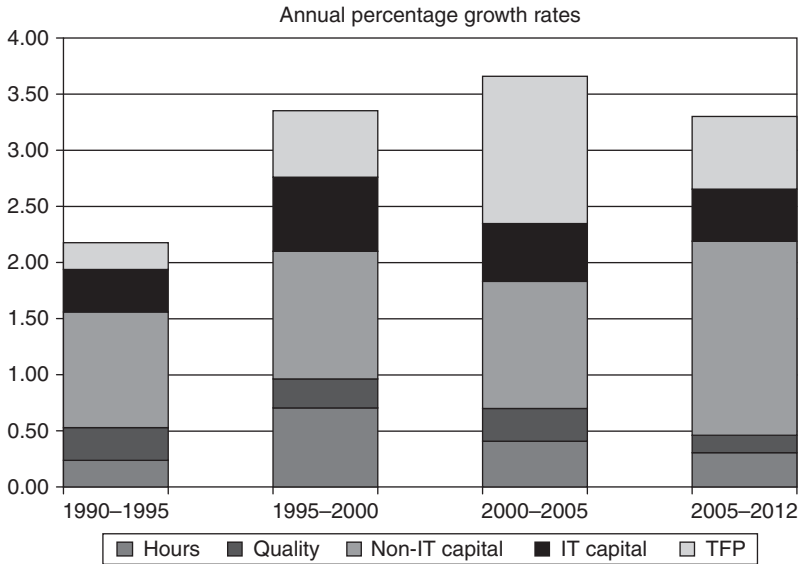
Annual percentage growth rates

Figure 1.1 Sources of world economic growth, 1995–2012

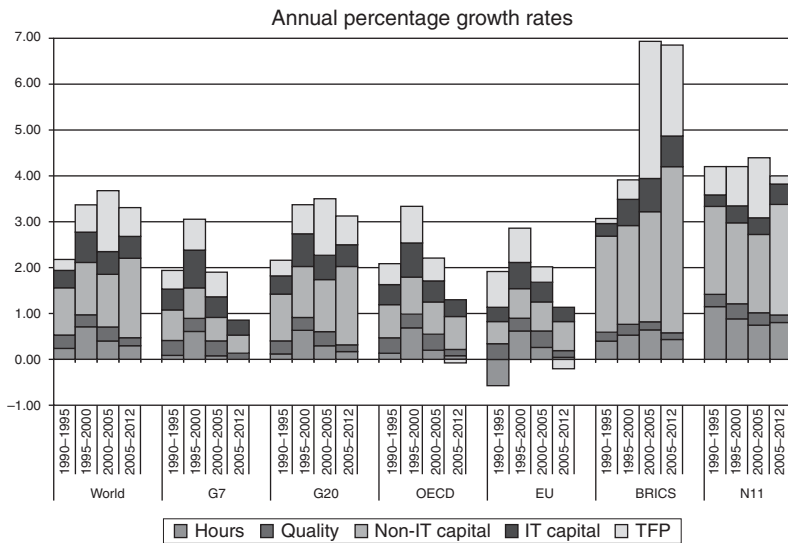Annual percentage growth rates

Figure 1.2 Sources of world economic growth

During 2005–2012 total factor productivity growth for the advanced economies of the G7 was negative for Canada, France, Italy, and the UK. This poses a paradox: how could innovation, reflecting changes in technology, be negative? The world-wide financial and economic crisis of 2007–2009 opened a wide gap between actual output and potential output for the G7 economies, determined by supplies of capital and labor inputs and productivity. Negative productivity growth is the difference between the positive effects of advances in technology and the negative effects of the widening output gap.

During the period 1990–2012 US economic growth has been strong, relative to growth of other advanced economies. This is due to capital deepening, increases in capital input per hour worked, especially during the information technology boom of 1995–2000. Growth in total factor productivity revived during the boom and continued at a brisk pace in the "jobless recovery" of 2000–2005. The growth of US GDP has been more rapid than that of any other economy in the G7 with Canada close behind. However, US economic growth collapsed during the period 2005–2012, largely due to the Great Recession.

The advanced economies of the G7 were strongly impacted by the Great Recession of 2007–2009. In Figure 1.3 we analyze the sources of
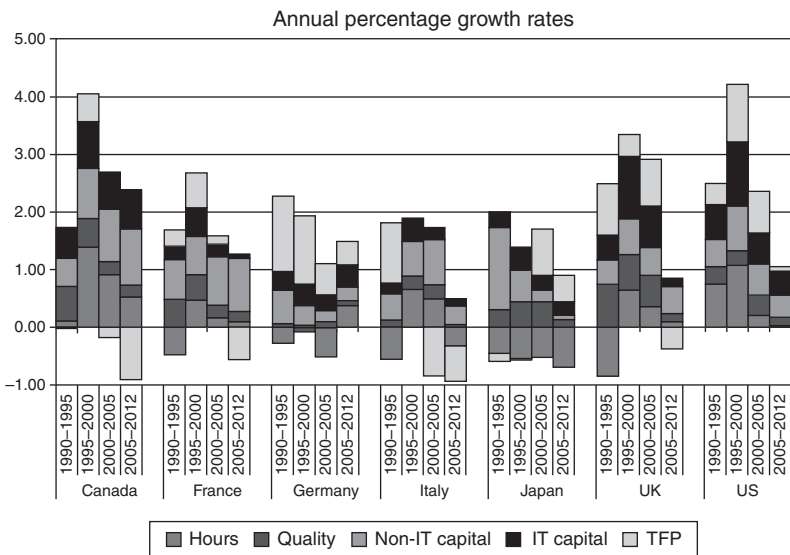

Figure 1.3 Sources of G7 economic growth

economic growth of the G7 during 1990–2012. Germany had the strongest economic performance with positive growth in total factor productivity and hours worked. Japan's productivity growth revived during the period 2000–2005 and this continued during 2005–2012. The revival of productivity growth was largely offset by a declining labor force throughout the period 1990–2012. Italy had the weakest performance during the Great Recession and was unable to maintain positive economic growth.

China sustained double-digit economic growth throughout the decade 2000–2012 with only slight deceleration during the Great Recession, as shown in Figure 1.4. India's growth rate rose steadily during the two decades 1990–2012. For both China and India capital input contributed more to economic growth than the rise in total factor productivity. Russia's economic growth was dominated by the collapse of the former Soviet Union and the gradual recovery of 1995–2005. The decline in growth of non-IT capital input from 1990 to 2005 is an unusual feature of Russian economic growth that was finally reversed after 2005.
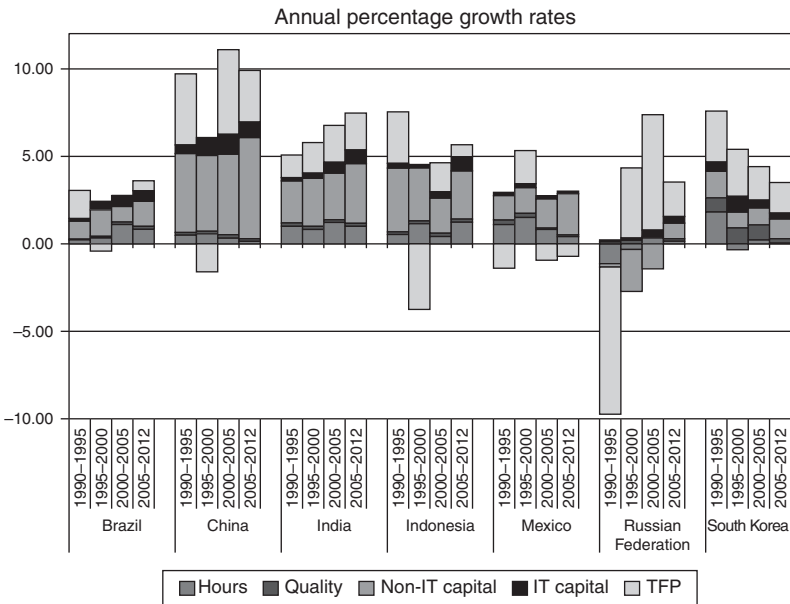

Figure 1.4 Sources of BRICs economic growth

1.2 Projecting the growth of the world economy

We consider three different scenarios for the growth of the world economy – Base Case, Pessimistic, and Optimistic. The contributions of hours worked and labor quality to potential economic growth over the next decade can be projected with little uncertainty, since most of the people entering the labor force are already in the population. Accordingly, we use the same projections in our alternative scenarios. Projections of technology are far more challenging. Our Base Case incorporates the average rate of total productivity growth for 1990–2012. Our Pessimistic Case is based on average productivity growth for the two worst sub-periods, while our Optimistic Case is based on an average for the two best sub-periods. For emerging economies like China and India we also extrapolate recent trends in the capital–output ratio.

We limit our projections to potential economic growth, leaving projections of actual growth to economic forecasters like the IMF (IMF 2015). We have incorporated differences in trends in demography and technology. For example, the growth of the Japanese population and labor force will continue to be negative and France, Germany, Italy, Russia, and South Korea will also experience negative labor force growth. The growth of the Chinese labor force will decline substantially and India's labor force will grow much more rapidly than China's.

We have represented the uncertainty in our projections of the world economy for 2012–2022 in Figures 1.5 and 1.6. The first bar in Figure 1.5 provides historical data. The average growth rate of labor productivity for 1990–2012 was 1.8 percent per year. The remaining bars give Pessimistic, Base Case, and Optimistic projections of labor productivity for the decade 2012–2022. More rapid productivity growth is associated with higher rates of growth of capital deepening, defined as the growth rate of capital per hour worked, as well as more rapid growth in total factor productivity.

Finally, we project the rate of GDP growth as the sum of the growth rate of hours worked from our demographic projections and the growth rate of labor productivity. The first bar in Figure 1.6 gives historical data for 1990–2012. The remaining three bars give Pessimistic, Base Case, and Optimistic projections.

Our Base Case projection of world economic growth for the period 2012–2022 is 3.4 percent per year. This corresponds to labor productivity growth of 2.2 percent per year and growth of hours worked of