

Chapter 4: Economic growth, human development and welfare

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Summary

Economic growth is often much lauded, but it also has its critics. (1.1) It may be viewed as a double-edged sword. On the one hand, it may be viewed as a narrative of liberation, lifting people out of poverty. On the other, it may be viewed as one of alienation, increasing inequality and associated with environmental degradation.

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Although GDP is used dominantly as a measure of economic growth, there are many competing definitions of the more general concept of economic development and also competing indicators proposed as alternatives to GDP in measuring economic growth. (1.2) There are many linkages between economic growth, sustainable development and social welfare (1.5). The industrial revolution, which was a milestone in economic growth, led to increasing per-capita incomes, but also fundamental transitions in the way societies are organized, including changed fertility patterns, increasing investment in education and rapid urbanization. (1.3) Determinants of economic growth and stagnation include population and demography (2.1), education and human capital (2.2), technological change (2.3), resource endowments, geography and environment (2.5) and various actors, institutions and politics (2.6).

Welfare/well-being⁵ is an overarching goal for policymakers. It is multi-dimensional in the sense that it includes poverty, inequality, the environment and other public goods such as health and education. It is normative in the sense that there are multiple perspectives on what matters to society (happiness, capabilities to function, etc.). Economic growth is important in that it positively impacts welfare along some dimensions and negatively along others. Growth in income per capita in itself is viewed onto to matter in that it contributes to other goods, such as preference satisfaction (3.1.1), happiness (3.1.2), capabilities to function (3.1.3) and the meaning of life (3.1.4).

There is a debate as to whether economic growth should be judged in terms of its contribution to maximizing happiness or preference satisfaction (3.2.1), ensuring equal

⁵ Welfare or well-being in this chapter may be defined as the level of prosperity or standard of living of individuals or groups of people. Welfare is more often used when referring to groups of people, implying that individual well-being has to be added up in some way.

amounts of utility (3.2.2), raising people above a certain threshold (3.2.3), or giving priority to the least advantaged (3.2.4), each of which has arguments pro and against.

Economic growth has been correlated with fundamental transitions in the way societies are organized, changed fertility patterns, an increase in manufacturing and service sectors as well as energy and material consumption, increasing investment in education and rapid urbanization. (4.1)

It has been shown to be associated with a widening gap in the control of global income/wealth, suggesting that the gains of economic growth have not been evenly distributed. Economic growth in recent decades has decreased inequality at the level of the world citizens, but has led to increasing inequality within countries.

Economic growth has also been correlated with environmental damage, such as climate change (4.2.3), water scarcity and pollution (4.2.5) and species extinction (4.2.7). Climate change and other environmental damages impact the poor disproportionately, and may also increase inequality within and between countries. Economic growth has also been linked to air pollution (4.2.4) and harmful impacts to nature and animals, which are argued to have an intrinsic value in themselves (3.1.6)

Welfare is a broader concept than income per capita of the status of the economy, and is measured by multidimensional indicators including health, education, political voice, environment, etc. (4.3.2) Several improved welfare measures have been developed over the last decades, classified into monetary and non-monetary measures. Indicators may be measured in a disaggregated way (i.e. a dashboard) or via a single indicator (4.3.2).

Economic growth has been shown to have adverse effects on the global commons, which need to be protected to ensure that any use is sustainable over time (5.1,5.2,5.3). Governing the global commons requires institutions that enable and facilitate collective action at international, national and sub-national levels.

The challenge for policymakers is to mitigate the negative effects of economic growth while preserving the positive effects. An integrated perspective on growth and capitalism allows for an evaluation of its costs and benefits, but also provides pathways for the transformation of contemporary capitalism, maintaining its driving forces, but addressing inequalities and protecting natural resources. Well-designed and implemented regulation of environmental and other externalities⁶ leads to increasing welfare, without necessarily impeding economic growth. Environmental regulation creates assets for society.

Key Recommendations

1. Public policy needs to be formulated for the purpose of achieving social objectives. These social objectives involve intra- and inter- generational synergies and trade-offs.
2. Economic growth is not a social objective in itself, but it can promote social objectives and help to overcome trade-offs. It can also exacerbate conflicts among social objectives.
3. Economic growth has led to increasing welfare. However, the quality of growth matters.
4. To achieve the desired social objectives, appropriate policy instruments are needed.

1. Introduction

The purpose of this chapter is to evaluate the compatibility of human development and planetary welfare with economic growth. It does so by reviewing the theoretical and empirical literature on the two-way interface between economic growth on the one hand, and human development and planetary welfare on the other.

⁶ An externality is a positive or negative impact on an unrelated third party that results from the production or consumption of a given good.

The Chapter begins by introducing different narratives of economic growth (Section 1), discussing different definitions and determinants of economic growth and providing historical context (Section 2). Section 3 then examines the various normative criteria that can be used to evaluate economic growth, showing that growth matters in that it contributes to other goods. Section 4 examines the effects of economic growth in the framework of social and natural wealth. The Chapter concludes by discussing how the global commons may be governed in order to prevent the adverse effects economic growth has had in the past. (Section 5)

1.1 Narratives

Economic growth can be understood in multidimensional terms, though is defined here as “the process by which the amount or quality of goods and services one can earn with the same amount of work increases over time.” (See Section 1.2)

There are two major narratives about economic growth: the first emphasizes the benefits such as material prosperity and poverty eradication. The second is concerned with the detrimental effects: unfair distribution and environmental destruction. Both narratives have influenced current theories and debates on economic growth. This section provides an overview of these two narratives and then discusses the synthesis - or “third way”- proposals, which attempt to find pathways to move ahead, bringing together the positives of both narratives. This framing is applied throughout the chapter to explain the compatibility of human development and planetary welfare with economic growth.

Capitalism, which has been credited with unprecedented economic growth, is an economic system based on three institutions: private property rights, markets and firms. These institutions are developed to different degrees in different countries, which leads to a wide variety of capitalist systems. Capitalism can create externalities on the environment and on

society. The balance of power between the government, markets, firms and civil society determines the degree to which these externalities are accounted.

The two major narratives about capitalism and growth are as follows (Randazzo and Haidt 2015): In the first narrative, economic growth is viewed as a process of liberation. It provided an abundance of material goods after centuries of life at the subsistence level for almost the entire population. It brought along dramatic improvements in life expectancy, health care, education and cultural development.

In the second narrative, economic growth is viewed as a process of alienation or exploitation. Capitalism's success in efficiently providing goods and services for individual consumption created a mindset that tends to underestimate resulting environmental problems, biasing distribution of gains towards owners and managers of resources and against workers, and causing uncompensated harm to nature while at the same time neglecting long term sustainability concerns. When left unregulated, capitalism can create exploitation and large inequalities and threaten human existence by putting adequate environmental conditions at risk. .

The popularity of the narratives of capitalism as “liberation” and “exploitation” with different segments of society raised a concern about finding a more integrated perspective in order to forge a welfare enhancing and socially progressive pathway for economic growth.⁷ In recognition of this, third way approaches emerged to highlight the potential of capitalism (and its limitations) in order to move the discussion forward. Such a broad theoretical framework allows for an evaluation of the costs and benefits of capitalism but also provides pathways for the transformation of contemporary capitalism: making growth more equitable and sustainable. The common idea is to maintain the driving forces of capitalism for innovation,

⁷ Mattauch (2015) argues that neoclassical growth theory is dominated by the narrative that capitalism is liberation, and proposes building a public economic theory that unifies both narratives.

diversity and democratic institutions and to address inherent problems such as inequality and environmental degradation by suitable policies.

1.1.1 Economic Growth as a Process of Liberation

In the 18th century Thomas Malthus described economic growth as an endless cycle of small technological improvements and ensuing small increases in population (Malthus, 1798). Towards the turn of the 19th century, however, the previous pattern of stagnation changed into a quite stable process of exponential economic growth that still continues today. This was driven mainly by technological change (Solow, 1956; Swan, 1956), which shifted the trend of having a large number of children to educating children. This allowed the escape from the Malthusian “trap” (Galor and Weil, 1999 and 2000, Hansen and Prescott, 2002).

Exponential growth could take off once inventors were rewarded adequately by receiving a share of the benefits that accrued from their invention. This link between the effort and the reward was established with the first modern patent system in England in the 16th century (MacLeod, 1988).

The patent system demonstrates the pattern that good institutions foster economic growth. Institutions here are understood as the social and legal norms and rules that underlie economic activity (Rutherford 2001). Acemoglu et al. (2005) use the Korean peninsula as an example. When the Korean peninsula gained independence after World War II it was extremely homogeneous. The political division into a northern and a southern part, however, installed very different types of institutions. The democratic South Korea embarked on a process of rapid growth while the repressive North Korea stagnated. Hall and Jones (1999) confirm this with a sophisticated econometric analysis: differences in productivity can be explained by differences in institutional quality.

What is it about institutions that make them so powerful in generating economic growth? Easterly (2013) argues that the decisive element is that they grant individual rights. Individuals with rights can essentially solve their own problems, in particular that of poverty. Rights, enforced by functional institutions, help individuals to claim the benefits of their work. Ultimately, they provide incentives to innovate and develop technology. These incentives create a positive externality that allows the economy as a whole to grow.

The remarkable stability and persistence of economic growth was famously observed by Kaldor (1961). While capital per worker had increased, the real interest rate and the ratio of capital to output were stable in the long run. Most remarkably, however, labor productivity grew at a sustained rate, implying that inventions and productive new ideas had not run out. Jones and Romer (2010) confirm the stability and persistence of economic growth. They show that institutions have an undisputed central role for economic growth.

The recognition that freedom generates wealth fueled a process of liberalizing international trade (Williamson, 1993). Over time it was realized that globalization requires careful regulation (Rodrick, 1997; Stiglitz, 2002, Cetorelli and Goldberg, 2012), but there is a lot of empirical evidence on positive effects of international trade (Wacziarg, 2001; Winters, 2004). Even concerns about higher unemployment and brain drain turned out to be unfounded (Felbermayr et al., 2011; Docquier and Rapoport, 2012). Once countries open to trade, they converge towards the most developed economies (Sachs and Warner 1995; Ben-David, 1996).

1.1.2 Capitalism as Alienation or Exploitation

Capitalism also has had several adverse effects, which threaten to destroy some of its greatest achievements. There are four major inherent problems of growth-focused capitalism:

(1) increased wealth inequality; (2) overuse of natural capital; (3) unrestricted corporate power; and (4) too narrow a focus on material consumption.

Recently, wealth inequality increased strongly in several industrialized countries: the gap between the top 1% and the rest of the population has increased significantly over the course of the last three decades (Piketty, 2014; Piketty and Zucman, 2014). This development also results in an increasing wealth/income ratio during the same period (Piketty and Zucman, 2014).⁸

The increase in wealth inequality can be attributed to different drivers. Stiglitz (2015) and Stancheva et al. (2012) see political changes that facilitate the appropriation of economic rents⁹ by wealthy economic agents among the main drivers of wealth inequality. This includes monopoly rents (which can result from excess market power) and political rents (which occur when economic agents also have political influence). Several types of exploitation rents occur in the financial sector, for instance through predatory lending practices and market manipulation (Stiglitz, 2015).

Technological change is the main driver behind economic growth. However, it can have adverse distributional effects since it is biased towards high-skill workers (Autor, 2015; Brynjolfsson and McAfee, 2014). Autor (2015) argues that technological change is a two-edged sword: there is both a substitution effect between machines and human labor and a complementary effect between the two. The substitution effect has outweighed the complementary effect in the last decades to some extent, but this will not prevail in the longer term. Journalists and even expert commentators are argued to overstate the substitution effect.

⁸ A large part of this increase, however, can be attributed to a change in land prices (Homburg, 2015).

⁹ An economic rent is the share of income received by a factor owner that exceeds the cost of providing the factor in production (Wessel, 1967; Segal, 2011).

Piketty (2014) identifies reduced growth of economic output and population as a further driver of inequality: Slower growth means that less wealth is newly created. The wealth created in the past, however, is more concentrated than newly generated wealth due to inheritance. While the individual's right to retain created wealth provided the basis for growth, it also causes increasing inequality in a situation of slow growth.

For a long time, growth-focused policy makers ignored that, if natural capital stocks are left unregulated, they tend to be overexploited. Apart from climate change, other forms of environmental degradation have occurred over the years, affecting the sustainability of economic growth and welfare of regions and sub-populations within countries. (see Section 4.2) The historical use of fossil fuels demonstrates this point. Fossil energy is an important economic input - its deployment, however, releases greenhouse gases into the atmosphere, which cause climate change (Stocker et al., 2013). An individual's use of fossil energy enhances total output, but has an impact on the economic activity of others. It hence creates an externality that cannot be addressed if the market is left to its own devices.

The strong correlation between economic growth, greenhouse gas emissions (Edenhofer et al., 2014a) and natural capital depletion in general has led some authors to the conclusion that economic growth causes more harm than good. Schneider et al. (2010), Jackson (2009) and Kallis (2011) argue that economic growth is so strongly associated to the destruction of natural capital that de-growth, the deliberate halt or reversal of economic growth, is the only feasible approach to maintain the natural capital. This line of reasoning has been questioned mostly for the premise that the depletion of natural capital and economic growth are inseparable (Jakob and Edenhofer, 2014), but has gained significant popular support. This is reinforced by concepts such as the circular economy, which aims at reducing waste and pollution by recycling industrial and biological waste in production (EMAF, 2016).

A major concern behind a more globalized economy is the enormous market power and political influence of large (multi-national) corporations, which often exceeds the protective power of nation states. These corporations exercise their power through lobbyism, trade regulations and liberal financial markets (Stiglitz, 2006). Large corporations can move abroad to avoid strict local regulations such as environmental policies and labor rights (Stiglitz, 2006). They can even erode beneficial health, environmental and labor regulations by suing governments in front of international courts (see e.g. Sud et al., 2015). An increase in corporate power is also linked to a decrease in collective bargaining. According to Mishel et al. (2015), between one-fourth to one-third of the growth in wage inequality between 1973 and 2007 in the U.S. can be attributed to the erosion of collective bargaining (“de-unionization”). Furthermore, some multi-national corporations have been accused of complicity in cases of violations against human rights, for example through collaborations with repressive regimes (Ramasastry, 2002).

The drive for private profit, which is at the heart of capitalism, has also been identified as a threat to economic growth itself. Tollison (1982) identifies two forms of rent-seeking: rent-seeking for natural rents, which is a productive search for profitable activities, and rent-seeking for artificial rents, which is the unproductive competition for existing rents. The second type of rent-seeking has been identified as harmful for economic growth by Murphy et al. (1993) and Mohtadi and Roe (2003) since it consumes resources, but does not create additional value for the society.

A final criticism of current growth patterns concerns the usefulness of growth in consumption for increased well-being. Hirsch (1977), for instance, points out that there may be “social limits to growth” if people use their income predominantly to pursue status seeking behavior. Further, Frederick and Loewenstein (1999) and Layard (2011) show that consumers overestimate the pleasure they will derive from new purchases, misjudging the rapid

psychological adaptation to new goods. This effect is often reinforced through advertising (Layard, 2011). Both effects explain a rather weak positive effect of personal income on subjective well-being (Kahneman and Deaton 2010).

1.1.3 The “Third Way” Alternatives

Economic policies that allow for a “third way” (preserving the benefits of capitalism while addressing its inherent problems) are organized around making growth more equitable and environmentally sustainable. There are four essential elements to such a model: (i) increased public investment, (ii) environmental policy, (iii) international cooperation, (iv) redistribution without harming growth.

First, public capital, in a broad sense that includes energy, transport, health and education infrastructure, is crucial for both economic growth and equity, but tends to be underfinanced in most developed economies (Bom and Ligthart, 2014; Estache and Fay, 2007; Romp and Haan, 2007). Increasing public investment has the potential to address several of capitalism’s inherent problems: First, an increase in education investment can supply workers with the skills necessary to flourish in a labor market that increasingly focuses on skills which are complementary to machines (Autor, 2015). This increased public investment should be financed preferably through non-distortionary taxes on externalities and less distortionary taxes on rents or bequests to reduce adverse growth effects. Second, depending on the financing mechanism, public investment has the potential to decrease inequality (Chatterjee and Turnovsky, 2012; Klenert et al. 2016).

Second, the destruction of natural capital can be countered, conceptually, by investing in natural capital. This can be achieved in a straightforward manner by obliging individuals to pay the social cost for natural capital. The alignment between individual and social costs can

be achieved by Pigouvian taxation. By increasing Pigouvian taxes to very high or prohibitive levels even concepts of strong sustainability can be realized (Edenhofer et al. 2014b). Problems such as biodiversity loss can also be addressed in this way, for example through prohibitive taxes on deforestation. Additionally, complementary measures such as subsidies for renewable technologies (Acemoglu et al., 2012, Mattauch et al., 2015), public investment into sustainable infrastructure (Guivarch and Hallegatte, 2011) and direct restoration of natural capital (through the removal of pollutants for example) are needed for transition towards an environmentally sustainable economy.

Third, the problems generated by abusive corporate power can be addressed by global cooperation (Finkelstein, 1995). The tendency for pollution intensive firms to produce in countries with the weakest regulation can be addressed through international environmental agreements like the 2015 Paris Agreement (UNFCCC, 2015). Similarly, the race to the bottom in social protection and labor standards can be addressed through the International Labour Organization (ILO). Strengthening international cooperation between governments can generally reduce the risk of corporations playing countries off against each other. To address the ability of corporations to start well-funded legal attacks, Stiglitz (2006) suggests that "advanced industrial countries finance strong legal assistance for the developing countries."

Fourth, there is an important distinction to be made between inequality in returns to efforts, (which has a generally positive effect on growth) and inequality in factors that go beyond the personal responsibility ("inequality of opportunity"), which can have detrimental growth effects (Marrero and Rodriguez, 2013; Roemer, 1993). We propose three pathways towards reducing inequality of opportunity: (1) inheritance taxation (Piketty and Saez, 2013), (2) public investment, as proposed in point one and (3), policy changes to reduce rent income. Other ways of reducing inequality such as the taxation of aggregate wealth might have

adverse growth effects and are hence less desirable (Judd, 1985; Chamley, 1986). Finally, alternative forms of industrial organization such as labor-managed firms have been proposed to enhance workplace democracy and to reduce inequality (Meade, 1972).

1.2 Concepts and measurements of growth

Economic development today is understood in multidimensional terms. Income continues to be an important component, though there are several other dimensions to defining an acceptable notion of development in an economy such as health, education, people empowerment, gender equality etc.

Nowadays, economic growth covers a very precise and narrow notion, which comes from growth theory (a branch of macroeconomics):

Definition: Economic growth is the process by which the amount or quality of goods and services one can earn with the same amount of work increases over time.

Example: Almost everything people buy today requires fewer days of work than it did in the past. A classic example is provided by Nordhaus (1996, Table 1.6) in his history of lighting. According to him, 10 minutes of work today buys 3h of reading light each night of the year, while it only bought ten minutes of light per year two centuries ago.

The most widespread empirical measure of economic growth is GDP per capita. It should be noted, however, that historically GDP was not developed with the primary aim of measuring long-term economic growth, but that this use of GDP numbers became a practice over time (Coyle, 2014). As GDP is the sum of all primary incomes distributed by resident production units, GDP per capita is a broad measure of income per person in an economy. Economic growth generally implies that income per person rises over time, unless hours of work fall steadily.

The above definition has the merit of stressing that economic growth is rooted into productivity improvements. Rising GDP per capita is just one possible manifestation of these improvements. The productivity based view is consistent with most of the theories of growth developed so far. Later in this chapter, we consider the multidimensional measures of human development and discuss the relationship to economic growth (both positive and negative aspects).

The above definition stresses also that economic growth is not necessarily quantitative (like buying more goods with one hour of work), but can be qualitative (buying higher quality goods with one hour of work).

The definition, relevance and measurement of economic growth has been challenged from many sides. Since GDP is an indicator of economic activities which lead to monetary transactions it cannot act as an accurate measure of welfare (Fleurbaey, 2009; Stiglitz et al., 2009).¹⁰ The reasons for this can be structured into three groups (Afsa et al., 2008; Fleurbaey, 2009): First, being an aggregate monetary measure, GDP neglects distributional issues as well as determinants of well-being which have no direct or indirect market value such as health, longevity, social relations and personal safety. (Different conceptions of well-being relevant for assessing the social impact of economic growth are discussed in Section 3). Second, it is a measure of productive flows and hence by design does not account for the impact of economic activities on stocks, in particular on stocks of natural capital. Third, it does not include household production of services. In some cases, events generally considered detrimental to well-being can lead to an increase in GDP. For instance, an increase in traffic jams may lead to higher gasoline consumption which increases GDP, but reduces well-being and has adverse effects on the environment (Stiglitz et al., 2009).

¹⁰ Even though some say that it actually can be used as a proxy for welfare (see e.g. Jorgenson et al., 2006).

Several improved welfare measures have been developed over the last decades, which can be classified as monetary and non-monetary measures. The monetary measures can be seen as a generalization of GDP, which take national income as a starting point and then correct it for factors such as non-market aspects of well-being and sustainability. Non-monetary approaches aim at including more subjective factors such as happiness (see Section 4.3.1 for a definition of some determining factors of non-monetary measures). Non-monetary measures may capture determinants of well-being which are difficult to conceive with a monetary approach. For instance, the Social Progress Index does not incorporate GDP directly, it rather combines different indicators for three dimensions of well-being: basic human needs, foundations of well-being and opportunity (Stern et al., 2016). However, one of the major shortcomings of non-monetary measures is the arbitrary weighting of different determinants of well-being. Due to this subjectivity they are not able to provide a comprehensive measure of well-being, but they can be valuable components of synthetic indicators. In the following we thus focus on monetary measures.

There are several measures of national productivity that are closely related to GDP. Gross national product (GNP) counts production by all citizens of a country, at home and abroad, while GDP counts all production occurring within a country. Gross domestic income (GDI) is basically GDP measured by the income method. GNI is GDI plus income received from outside the country, minus income payments leaving the country. Fourth, the previous measures are all gross indicators, which means that they do not account for depreciation. Both, the net domestic product (NDP), and the national income (NI) factor in depreciation. The NI metric additionally subtracts indirect taxes such as sales taxes. Finally, some authors argue that gross output (GO), i.e. the sum of all sales both final and intermediate, is a “natural measure for the production sector” that is complementary to GDP (Jorgenson et al., 2006).

The accepted view on the relationship between economic growth and other aspects of development has appreciably widened over the years. It now accounts for the multiple factors that impact growth, from the role of natural, social, political and institutional capital, to the challenges of sustaining economic growth in terms of distributional concerns across people, societies and time.

Several alternate measures have been proposed in place of the GDP-type definitions to account for the environment, such as the Measure of Economic Welfare (MEW) (Nordhaus and Tobin, 1972) and the Index of Sustainable Economic Welfare (ISEW) (Daly and Cobb, 1989). In addition, the quest for better capturing human progress have led to the emergence of a number of viewpoints in which the dimensions of human development are intricately linked with economic growth. There are many illustrations of these such as the propagation of the capabilities approach, and the multidimensional poverty index for policy planning purposes in developing countries.

The following sections elaborate on the evolution of definitions and narratives on economic growth. Specific measurements of sustainability are discussed in Section 1.4, and aggregate indicators that integrate aspects of social and natural wealth appear in Section 4.3.

1.3 The great acceleration/transition from stagnation to growth

Measuring economic growth is difficult, especially for periods for which little information is available. Harmonized National Accounts were set up in most countries after World War II. They provide different ways to measure aggregate production, either through summing the added values of all resident production sectors, or through summing all the incomes distributed by those sectors. Making data comparable across countries requires correcting for differences in price levels to obtain estimates that capture the real purchasing

power of income. The most comprehensive database so far is the Penn World Tables version 8.0 (Feenstra et al. 2013) which provides information on relative levels of income, output, inputs and productivity, covering 167 countries between 1950 and 2011. Based on a broad set of historical studies, Maddison (2003) reconstructed income per capita data over the past two centuries, and added some point estimates for earlier periods (in 1 Common Era (CE), 1000 CE, 1500 CE, 1600 CE and 1700 CE). Such estimates very often require educated guesses on unobservable trends - nonetheless, they show the best information given what is known at one point in time. Very recently, Bolt and van Zanden, (2013) have revised and complemented Maddison's work (the "Maddison project"). Figure 4.1 presents the latest estimates for GDP per capita for selected countries.

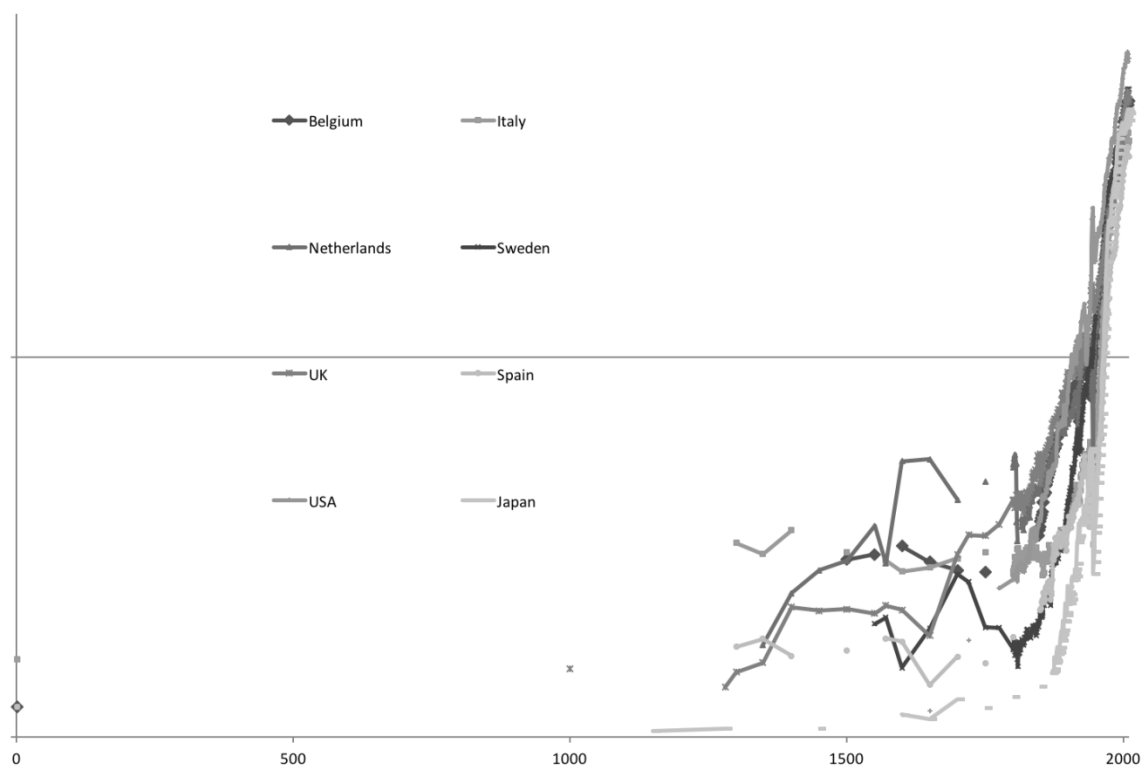


Figure 4.1: GDP per capita in selected countries, 1-2010CE. Logarithmic scale. Horizontal line = 5,000 dollars (1990 GK\$). Source: Bolt and van Zanden, 2013.

Over the past millennium, income per capita in the selected countries has increased 32-fold, from \$717 per person per year around the year 1000 to \$23,086 in 2010. This contrasts sharply with the previous millennia, when there was almost no advance in income per capita. The figure shows that it started rising and accelerating around the year 1820 and it has sustained a steady rate of increase over the last two centuries. One of the main challenges for growth theory is to understand this transition from stagnation to growth and in particular to identify the main factor(s) that triggered the take-off.

Is the finding that there was stagnation in the standard of living until 1820 truly robust? This claim is particularly striking given that mankind experienced significant technological improvements that would have been expected to increase productivity and income per person, from the Neolithic revolution to the invention of the printing press. Three facts corroborate the idea that there was indeed stagnation over the most part of human history: first, estimates of life expectancy computed on specific groups across time and space do not display any trend before 1700 CE (de la Croix and Licandro 2015). Second, body height computed from skeletal remains does not display any trend either, while height is known to depend very much on nutrition when young (Koepke and Baten, 2005). This indicates that there was no systematic improvement in nutrition over time. Third, real wages computed from historical sources did not tend to rise in any sustained way before the Industrial Revolution (Allen, 2001).

The industrial revolution led not only to increasing per-capita incomes, but fundamental transitions in the way societies are organized, including changed fertility patterns, increasing investment in education, and rapid urbanization (Galor 2005) (see Section 4.1.3). Industrialization also implies structural change in economic activity with increased specialization and division of labor. As a consequence, the emergence of new constituencies

and interest groups also results in fundamental changes in the political system, such as an expansion of the franchise (Acemoglu and Robinson 2000) (see Section 4.1.4).

This increase in economic activity in one part of the world has led to what has been described as “the Great Divergence” (Pomeranz 2000). Countries that successfully embarked on a course of industrialization, i.e. Europe and its offshoots (the US, Canada, Australia, and New Zealand) dominated the global economy, giving them geo-political weight to shape global institutions to their advantage. After the Second World War, Japan was the first Asian country to industrialize. Only recently, coinciding with the acceleration of the ‘second wave of globalization’ (Baldwin and Martin 1999), industrialization has become more widespread in poor countries.

Economic integration into global market by means of trade and investment across national borders gives poor countries the opportunity to specialize in activities for which they enjoy a comparative advantage (e.g. labor-intensive activities, such as textiles and assembly of electronic products.). Hence, trade openness has often been a central feature of newly industrializing countries’ development strategies (Rodrik 2005). China’s spectacular growth performance is a salient case in point for such ‘export-led growth’ (Rodrik 2006). Yet, these countries did not simply liberalize trade and foreign direct investment, but also employed an array of specifically tailored industrial policies to overcome market failures, such as financial frictions and coordination failures (Rodrik 2005).

Whereas successful growth take-offs have occurred predominantly in Asia (Hausmann, Pritchett, and Rodrik 2005), it has been argued that about one billion people are still mired in extreme poverty, especially in Sub-Saharan Africa. It seems rather unlikely that this ‘bottom billion’ living in resource rich, land-locked, badly governed and conflict-ridden countries will achieve decent living standards in the near future (Collier 2008).

1.4 Sustainable Development

The idea of sustainable development encompasses various aspects – from that of sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987), to preserving ecosystem services, and co-evolution of the three pillars of economic, social and environmental objectives. (Fleurbaey, et al 2014; WG III, ch 4)

The Millenium Development Goals (MDGs) became widely associated as sustainability indicators (UN 2006 and UN 2012). Several other indicators have also emerged, ranging from measures of green GDP (See section 4.3.1 for discussion on green accounting) to measuring footprints such as those of carbon or water. Other developments include the Measure of Economic Welfare (MEW) (see Section 1.2; Nordhaus and Tobin 1972), the extension of the system of national accounts (SNA) to incorporate the use, augmentation and depletion of natural resources through building satellite accounts (SEEA), and the extension of the concept of capital to include natural capital. More recently, the Sustainable Development Goals (SDGs) relate to the availability and management of water and sanitation, access to affordable and modern energy for all, ensuring a quality education, achieving gender equality, and ending poverty and hunger, while achieving food security and improved nutrition. (UN, 2016)

In order to find an improved measure of sustainability, several investment measures have been proposed which separate consumption from net investment and which correct prices whenever necessary and feasible. In these frameworks different methods are used to impute prices on non-marketed goods and services. Genuine savings (GS) is among the most common such measures and its development goes back to Hamilton (1994) and Pearce et al. (1996). Hamilton and Clemens (1999) demonstrate that GS are negative in many developing

countries, in particular in sub-Saharan Africa, while they tend to be positive in high-income industrial countries.

GS as a measure of sustainability has been extended as well as criticized on several aspects: Considering extensions, Arrow et al. (2003) analyze the role of varying population in measuring genuine savings and find that including population as a type of capital is the only consistent approach. Pillarisetti (2005) argues that GS is flawed as a measure of sustainability and can lead to erroneous policy implications for several reasons: (1) GS is GDP-based and industrialized countries appear to have positive GS, even though they have a substantial ecological footprint¹¹, (2) many externalities manifest themselves on a global scale and national indicators are hence futile, (3) it is empirically redundant since education expenses have a strong influence on the numerical value of GS, (4) it is based on the concept of weak sustainability, which assumes a perfect substitutability between different types of capital such as health, physical and natural capital.

The right way to measure sustainable development continues to invoke much debate. While a framing in terms of threshold levels of attainment is endorsed by countries (as in the case of the SDGs to eliminate poverty) it fails to address the issue of sustainability in a holistic manner (for instance, questions of adequacy in terms of intergenerational equality as discussed in Section 3.2.2).

¹¹ The ecological footprint measures how much land is required for the generation of consumption within a country. This includes land needed for waste disposal and land-based climate change mitigation options (CO₂ sequestration). The world economy is considered unsustainable if the ecological footprint of all countries exceeds the amount of available land. One major problem with this measure is how to aggregate over different types of land uses (Smulders, 2008).

Critics of sustainable development argue that economic growth cannot be green¹². (Alier 2015) The concern of whether growth is radically incompatible with sustainability depends to a large extent on the definition of growth and the extent to which its distributional aspects matter to society (See Sections 3.1, 3.2). The decoupling of material resource consumption and economic growth is considered to be one way of bringing compatibility between economic growth and sustainable development, with particular emphasis being laid on the decoupling of fossil fuel energy use with growth in GDP. However, the evidence on this is not clear, since in most countries the growth in per capita consumption clearly overrides any gains from the lowered intensity of resource use in production (see for instance the discussion in Fleurbaey, et al 2014). Amartya Sen proposes a more complex and multidimensional perspective (see Section 3.1.3) (Sen 2000). An integrative approach calls for more complexity in operationalization of the concept of sustainable development, which recognizes the multiple linkages between growth, development and social welfare as emphasized through the different sections of this chapter. The idea of sustainability thus is inherently problematic to operationalize and its articulation in a functional way as “sustainable development” does not provide an unequivocal answer as to its implications for economic growth, or vice versa.

1.5 Global commons

The United Nations Environmental Programme defines “global commons” in jurisdictional terms to be “resource domains or areas that lie outside of the political reach of

¹²According to The Organization for Economic Co-operation and Development (OECD), *green growth* seeks to promote growth and economic development while ensuring that natural assets continue to provide the resources, and the environmental services on which our welfare depends. This as a development approach that seeks to achieve long-term Sustainable Development Goals from concrete axes of action.

any one nation State.” (UNEP, 2016, p.1). Classical global commons from this perspective include the High Seas (including the sea bed, Antarctica, the atmosphere and outer space (Buck 1998). The lack of authority to comprehensively regulate the global commons creates great challenges for their governance, which we will turn to in Section 5. Historically, some global commons have been regulated “guided by the principle of the coming heritage of humankind” (UNEP, 2017). Frequent overuse and the importance of global commons for wellbeing and economic growth require that principles of justice for their governance are established.

Economic growth has a relationship with the “global commons” in at least two ways. First, economic growth can have adverse effects on the global commons. For example, economic growth has historically involved high emissions of greenhouse gases and thereby brought about the prospect of dangerous anthropogenic climate change (UNFCCC Article 2, See also Section 4.2.3). In addition, economic growth can lead to high emissions of CFCs which damage the ozone layer, and thus increase the prospects of skin cancer and eye cataracts. Other impacts of economic growth include pollution of the high seas and the depletion of resources. (See Sections 4.2.4 and 4.2.1) All of these effects may be deemed to increase threats to health, food or water – thereby viewed as ‘bads’, which should, other things being equal, be minimized and distributed equitably.

A second interrelation is the source of resources and environmental services that global commons provide, which in themselves can facilitate or enable economic growth. For example, the sea beds are rich with resources such as cobalt, copper, manganese and iron (Buck 1998, p.90 and, more generally, pp.88-91). In addition, Antarctica contains mineral resources (such as copper, gold, iron, silver, and petroleum) (Franck 1995, pp.401-405).

There is a need for principles of justice to protect the global commons and ensure that any use is sustainable over time. There is also a need to regulate access to the natural

resources and environmental services contained with the “global commons” (Caney 2012). In particular, since the atmosphere, Antarctica, the high seas and space exist beyond the confines of states there is a need for principles of global justice. Furthermore, since current economic behavior affects the standard of living of future generations there is a need for principles of intergenerational justice to regulate the global commons.

This raises a methodological question of how to treat the global commons within a theory of justice. Some propose principles designed to treat the global commons on their own (Risse 2012, Part II), whereas others argue that the issues surrounding the global commons (like the use of the atmosphere) should be treated in light of people’s overall rights (such as their rights to develop and promote a reasonable standard of living) (Caney 2012).

2. Determinants of economic growth and stagnation

Determinants of economic growth include changes in demographics (2.1), accumulation of human capital (2.2), endogenous technological innovation (2.3), resource endowments, geography and the environment (2.4) the existence of institutions (2.5) and cultural, social movements and social capital (2.6).

2.1 Population and Demography

The growth take-off was systematically accompanied by a demographic transition. (See Figure 4.2, demonstrating this transition as took place in Sweden)¹³. Birth and death rates

¹³ Sweden is the only country with more than 250 years of population censuses.

were systematically high before the takeoff, then mortality went down, while fertility stayed high for some time. During this period, population size increased fast. Then fertility dropped quickly and population growth decelerated. Once economic growth had taken-off, both birth rate and death rate were low, and population growth became negligible (or even negative in some cases). The demographic transition took two centuries in England and other European countries. In East Asia, it was much faster, of the order of half a century. Causality between the two transitions goes both ways: the demographic transition was triggered by the income take-off, at least as far as the drop in mortality is concerned. At the same time, the economic take-off was made possible by the demographic transition, because investment in the education and health of a smaller number of children was made possible.

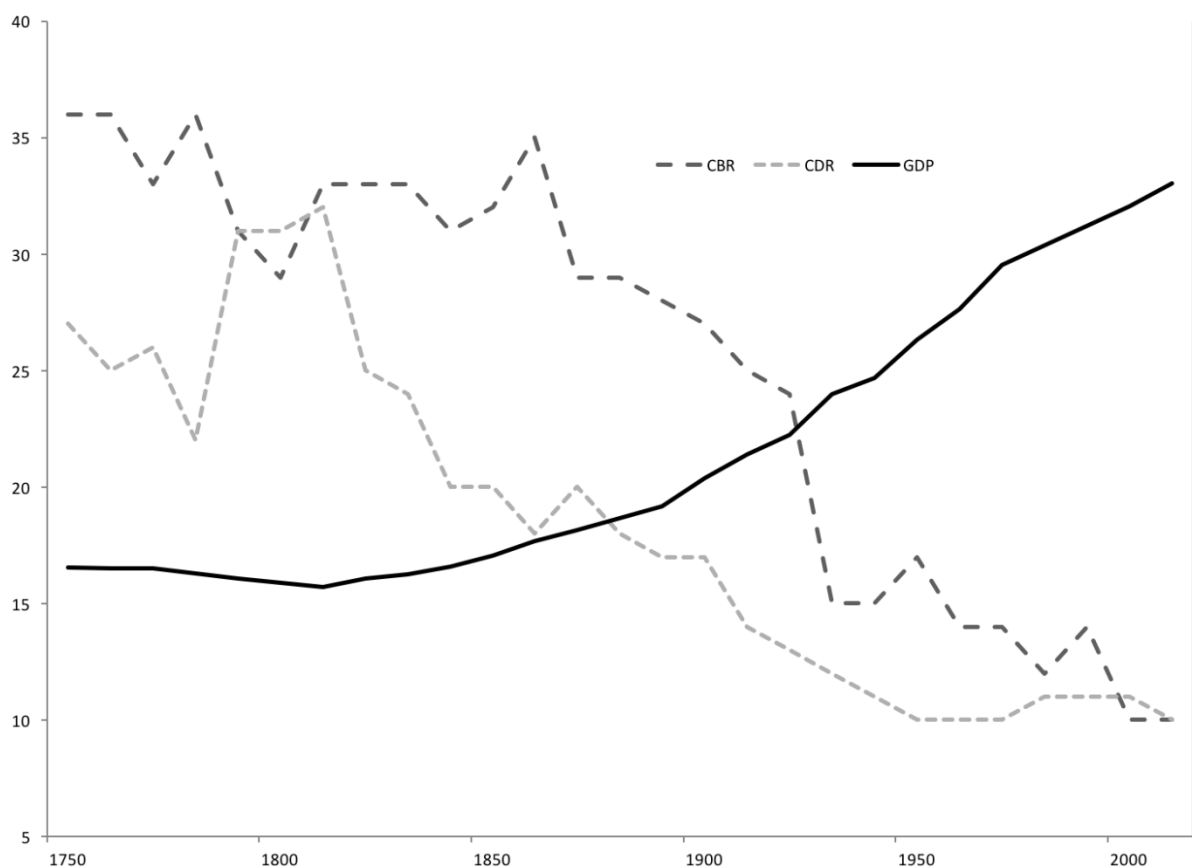


Figure 4.2. Correlation of economic growth and demographics in Sweden. Left axis: crude birth rate (CBR) (dark gray dashes) and crude death rate (CDR) (light gray dots) in Sweden in per 1,000. Right axis: GDP per capita. Logarithmic scale (1990 GK\$).

The link between the demographic transition and the take-off of economic growth is a process of “quality-quantity trade-off”. (Galor, 2011, Cervellati and Sunde, 2005) This originates in a simple budget constraint, which holds both at the individual level and at the country level:

$$\text{Total spending on children} = \text{number of children} \times \text{spending per child}$$

Keeping the total spending constant, enhancing the “quality” of children by spending more on each child requires reducing their number. Consequently, the drop in fertility observed during the demographic transition allows for an increase in spending on education and health, thereby making the accumulation of human capital from one generation to the next easier. For the case of Sweden, Figure 4.3 shows that the drop in fertility comes with a sharp increase in formal education, with a rise in adult longevity, and with a rise in people’s height, which signals better nutrition and a lower exposition to disease when young (see de la Croix and Licandro 2015).

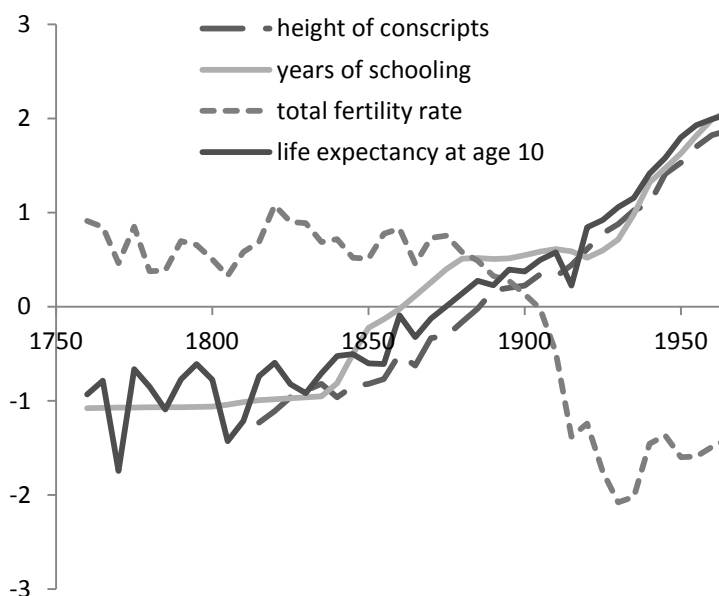


Figure 4.3. The quantity-quality trade-off for 1760-1965 birth cohorts in Sweden. Three measures of quality (body height, years of schooling, life expectancy at age 10), vs. total fertility rate. All data normalized.

In a neo-classical growth model, the quantity of capital (“machines”) per worker is key to determine income per worker. Keeping this capital-labor ratio high is more difficult when population grows rapidly, because every new investment is “diluted” in a fast rising number of workers. This establishes a negative link between grows of population and income per person.

Demographics also matter for growth by means of the “demographic dividend” (see Lee and Mason, 2006). According to this view, countries face a window of opportunity to grow just after fertility has gone down. At that moment, the population is mostly composed of working age persons, and the burden of dependent (both young and old) is small. This view is confirmed by the empirical literature, which finds that the correlation between the age-composition of the population and economic growth is stronger than between a global measure of population growth and economic growth (see e.g. Kelley and Schmidt, 1995). The composition of the population, as well as age-specific variables, is relevant to growth. A decrease in the death rate of workers in particular does not have the same effect as a decrease in the death rate of dependents, young or old (Lindh and Malmberg 2007). From these studies, it is also clear that the impact of population growth has changed over time and varies with the level of development.

2.2 Education and human capital

The accumulation of human capital (the combination of education, experience and health) is one way to sustain economic growth. Even if a country cannot increase its supply of labor indefinitely, it can enhance the quality of labor. Human capital can be accumulated in two ways: 1) by education during the early stage of life; and 2) by accumulating experience (learning-by-doing) during the working life or on-the-job training. Investment in formal

education has increased substantially all over the world. In England for example, the number of years spent at school went from two on average in 1820 to more than fourteen in 2000. (Maddison, 2007). In developing countries, school enrolment grew rapidly between 1960 and 2000.

Several explanations for the take-off towards modern growth rely on incentives to accumulate human capital. If, for some reason, it becomes profitable for households to invest in education, growth can be sustained thanks to the human capital externalities stressed in the endogenous growth model literature. Two types of shocks are considered here. The first is based on Ben-Porath's (1967) idea that the return on investment in education depends on the length of time during which education will be productive, implying that a longer active life makes the initial investment in human capital more profitable. Provided that human capital is an engine of growth, an initial increase in longevity (for exogenous biological/climatic/medical reasons) may in turn sustain the permanent accumulation of human capital and income growth (see e.g. Cervellati and Sunde 2005). The second type of shock triggering education can be institutional. For example, Engerman and Sokoloff (2002) identify conditions under which a country will introduce public education early, favoring a skilled workforce and a rapid industrial revolution. One key condition is to have a relatively equal distribution of land among the population (such as nineteenth century Canada and USA), avoiding the case where a land rich elite would oppose education reform, fearing more skilled workers and more taxes (such as in Latin America).

Human capital accumulation may run into the problem of diminishing returns. Even without diminishing returns, its accumulation may be limited by the finite lifetime available for learning and the fact that, though institutions and social conditions may affect the productivity of learning, each generation has to accumulate its human capital anew. Recent literature stresses that the quality of education matters more than its quantity (OECD 2010).

It is however fair to recognize that many poor countries experienced an educational boom without an accompanying take-off in economic growth. Empirical studies stress the lack of correlation between educational attainment and growth. As Maloney and Valencia (2016) explain, “Empirically, documenting the impact of even very basic measures of human capital on growth or relative incomes has proved surprisingly complex”. The accumulation of human capital is a necessary condition for growth, but it does not seem to be a sufficient condition.

2.3 Technological and Structural Change

In economics, technology is generally understood as “the utilization of natural phenomena and regularities for human purposes” (Mokyr, 2008). In a more abstract sense, it also includes the utilization of social phenomena, e.g. through the design of organizations or the creation of brand value. In economic theory, technology is often assumed to be simply the functional relation between inputs and output. Technological change can in this sense be understood as the process by which people are looking for ways to produce more or better output from inputs. Its meaning is thus closely related to that of innovation. When empirically assessing innovation, the distinction between technological innovation (based mainly on research and development) and non-technological innovation (based on organization, design, training etc.) is often made, which refers to a narrower definition of technology, restrained to the realms of natural sciences and engineering. In sociology, technology is also understood to embrace “all forms of productive techniques” (Penguin Dictionary, p.425). The fields of analysis related to technology, however, differ from those of economics, focusing i.a. on the social processes underlying technical change, on the influence of technology on work situation, work morale and alienation and on the role it plays in conflicts between employees

and management (Lawson, 2012). Technological change in this chapter is discussed primarily from the point of view of economic research.

Technological change as the invention of new production methods is in a trivial sense the central engine of growth in the long term. If there are limits to producing more output using given methods, the only way to sustain growth over a long period is to invent better methods. Over shorter periods, given methods can be exploited in more productive ways by more investment, better education, greater availability of land, improvement in institutions and many other factors. But ultimately these increases in productivity hit limits (economists speak of “diminishing returns”) and higher productivity is possible only with new or better methods to produce goods and services.

Technological progress has always been present in human history, but it led to sequence of waves of innovation and a sustained increase in standard of living only during the last few centuries. Mokyr’s explanation of the take-off of modern economic growth with the industrial revolution sees the main driving force in a new culture of knowledge developing with the enlightenment (Mokyr, 2005)

Five features are central for understanding the way in which technological change increases economic growth: 1) non-rivalry of technology; 2) partial tacitness and 3) partial excludability of knowledge related to technology; 4) the existence of large R&D organizations; and 5) the process of creative destruction.

1) Non-rivalry means that technological (as well as other) knowledge can be used by many agents simultaneously without anyone’s individual use of it being diminished. One far-reaching prediction implied by the non-rivalry of knowledge is that a larger population generating new ideas based on existing ideas will lead to faster technological progress and faster growth in income per capita. This prediction is, however, hard to test because the international diffusion of knowledge makes it difficult to define the set of knowledge

generated and used by a particular population (Jones, 2005). Externalities (spill-overs) play a central role here and they are related to the non-rivalry of knowledge. If, when a firm or an individual invests, this investment has positive spill-overs on other firms or individuals, the private return of the investment (to the firm or the individual) is smaller than the social return (to all firms or individuals together). Free availability of knowledge for further knowledge creation is one kind of externality associated with technological change. Another externality occurs in learning-by-doing, when better production methods are developed as part of the practical use of technology. Non-rivalry does not imply that technological ideas can diffuse across individuals, firms, regions and countries without cost.

2) The development and use of technology involves not only codified but also to a large extent tacit knowledge, which “has not been stated or measured in explicit form” (Freeman and Soete, 1997). Skills acquired through learning on the job often represent tacit knowledge. In many cases, tacit knowledge is necessary to make productive use of codified knowledge. The importance of tacit knowledge, but also local infrastructure, demand patterns institutions and culture are factors that make transfer of technologies across firms, industries and countries costly and in some cases impossible despite the non-rivalry of knowledge.

3) Partial economic excludability means that it is possible to exclude others from some of the economic benefits of knowledge (e.g. via a patent), but not from all benefits, since knowledge that has been made available at some point can always serve as a basis for creating new, useful knowledge. This applies in particular to codified knowledge, which can be written down using language or other symbols.

4) While part of technological knowledge emerges as by-product of practical experience with available technologies, much of technological change in advanced economies is the result of purposeful research and innovation activities. Modern R&D has been increasingly moved to large organizations. As Freeman and Soete (1997) point out: “During

the twentieth century the main locus of inventive activity shifted away from the individual inventor to the professional research and development (R&D) laboratory, whether in industry, government and academia” (p.197). This implies that the assessment of risks and benefits of R&D activities have to be advantageous with regard to the objectives of the specific organization for technological change to take place.

5) Technological change is not a smooth, continuous process but has since the work of Kondratieff and Stolper (1935) and Schumpeter (1942) been recognized to occur in waves of “creative destruction”, which make old products and processes obsolete. Each wave is associated with a particular “general purpose technology” (Bresnahan and Trajtenberg, 1995), a technology that differs in a fundamental way from previous technologies. General purpose technologies diffuse in many industries and offer much scope for internal improvement and secondary innovation. The diffusion also operates through firm entry and exit. While the exact delineation of general purpose technologies and of the associated long waves of variations in rates of economic growth are subject to debate, frequently listed candidates of GPTs are the steam engine, electricity, the internal combustion engine, mass production, computer technology, the Internet.

Technological change at the macroeconomic level has always been intertwined with structural change. Structural change refers to the reallocation of production activity and employment across the broad economic sectors agriculture, manufacturing and services. In many advanced countries (including the EU-15 countries, the US and Japan), employment in agriculture fell with rising GDP from more than three quarters in the 19th century to below 10% at the end of the twentieth century. The share in manufacturing peaked between 30-45% in most countries and has been declining. The share in services exceeds 60% today. In developing countries, a similar relation between GDP and sectoral employment shares is observed (Herrendorf et al., 2014).

Economic theory distinguishes two main drivers of structural change. One is associated with uneven technological change across sectors. When technological change is higher than average in one sector, less labor is needed to produce a given level of output and falling relative prices increase the demand for this sector's output. The second is associated with the dependence of consumer preferences on income. At a low income, demand is relatively high for agricultural goods and other goods are often home-produced or not consumed at all. With rising income, nutritional needs are largely satisfied and the demand for manufactured goods such as household appliances, automobiles and entertainment devices rises. Once consumption of manufactured goods approaches satiation, it increasingly moves towards personal services, such as health services, education, entertainment services, coaching and counseling or financial services. Overall these two driving forces have led in advanced countries to a declining share of employment and value added in agriculture and to an evolution of the shares of manufacturing following an inverted U-shape (Herrendorf et al., 2014).

The forces of creative destruction and structural change have on average hugely increased GDP per capita in many countries. Phases of downturn in particular regions or industries where processes and skills became obsolete have, however, had temporary or permanent negative consequences for some groups. Technological and structural change have moreover radically transformed the boundaries between private and professional life and different roles played by men and women in their economic lives. Before the industrial revolution, most men and women worked on the family farm or in small, family-owned business. A gendered division of work tasks existed, but it did in many cases not lead to women and men working in different economic sectors. With industrialization, many men moved to factory work, whereas married women increasingly stayed at home. Home production was still an extremely time-consuming activity, involving e.g. the carrying of

water, the baking of bread and the making of clothes. With the spread of running water, indoor plumbing and electricity and with the diffusion of household appliances such as refrigerators and dishwashers the time needed for household work has been greatly reduced (a further important innovation was contraception). This offered the possibility for women to increasingly enter the labor market without men being obliged to share a large amount of household work (Gordon, 2016). On the other hand, the sphere of R&D organizations has developed in many parts as a male-dominated world, where women are underrepresented compared to their overall presence on the labor market.

The move of economic activity to the service sector has meant that an increasing share of economic output and investment has become intangible and knowledge-based. Knowledge-based services as an input into production, such as software or R&D, have continued to fuel productivity growth in conventional goods production, e.g. in the production of automobiles. As a final good, e.g. as movies, counselling services, medical services or legal services to final consumers, their productivity growth is in many cases more qualitative than quantitative. In some areas, the quantitative progress in terms of longevity or survival rates for severe diseases has been impressive (Gordon, 2016).

Processes of structural change and industrialization continue to be important for economic growth in developing countries. The fact that many technologies have already been invented in advanced countries offers much scope for technology diffusion and catching up. In the recent past, Asian countries have largely built their fast economic growth on increasing shares of their manufacturing sectors. In other regions, such Latin America and Sub-Saharan African countries, a premature deindustrialization is feared to limit future growth opportunities (Rodrik 2016). While economists worry about the future of the pace of technological change in advanced countries (see Section 2.8), a lack of technological opportunities is not the most pressing concern when it comes to poor countries, where factors

discussed in the other sections of this chapter (such as education, institutions, geography) represent larger obstacles to productivity growth and to taking advantage of better technologies. Foreign direct investment (FDI; see Section 2.4) and higher education gained abroad are important channels for transfer of technological knowledge to developing countries and for building up intangible capital.

2.4 Globalization, trade and international capital flows

Economic theory emphasizes that welfare gains can be achieved if countries specialize in the production of goods and services for which they enjoy a ‘comparative advantage’. Sources of such comparative advantage can be due to technological advantages (Ricardo 1817) or a relative abundance of production factors, e.g. labor or natural resources (Heckscher and Ohlin 1991). Hence, a country can export products that it can produce relatively cheaply and import those from the world market which would be more costly to produce domestically. In addition, recent theories show that countries may also trade in quite similar, but differentiated products (such as cars or computers of different brands; see Krugman 1979; Melitz 2003).

Empirical evidence demonstrates that trade-openness, defined as the sum of imports and exports divided by GDP, is positively related to economic growth (Wacziarg 2001). In a similar vein, trade liberalization has been found to increase plant productivity, arguably by increasing market size as well as competitive pressures to innovate (Bustos 2011; Lileeva and Trefler 2010). However, even though more profound integration into the global economy can be beneficial at a certain stage of economic development, trade liberalization is not a silver bullet to spur economic growth, but needs to be employed selectively (Rodríguez and Rodrik 2000). That is, trade openness has often been a central feature of newly industrializing

countries' development strategies (Rodrik 2005). Yet, these countries did not simply liberalize trade and foreign direct investment, but also employed an array of specifically tailored industrial policies to overcome market failures, such as financial frictions and coordination failures (Rodrik 2005).

Even though trade results in overall economic gains, the associated benefits and losses are not evenly distributed (Stolper and Samuelson 1941). In particular, trade openness is likely to increase inequality in earnings and may result in higher unemployment (Helpman, Itskhoki, and Redding 2010), which may explain the recent backlash against already existing as well as planned free-trade agreements.

Similar to trade in goods and services, the literature on FDI suggests positive effects on firms in recipient countries by means of so-called 'technology spill-overs' (Blalock and Gertler 2008). Yet, whether these benefits materialize depends on numerous factors, including host country conditions and the type of FDI inflows (Javorcik 2008; Crespo and Fontoura 2007). Finally, financial globalization also takes place in the form of equity flows, as investors in one country acquire, say, company stocks or government bonds from another country. Even though theoretical considerations suggest that easier access to finance should be expected to spur investment and economic growth in countries that receive financial inflows, empirical evidence suggests that relatively rich countries have benefited, whereas poorer ones often did not have the absorptive capacities to employ those inflows effectively (Prasad, Rajan, and Subramanian 2007). Moreover, the link between openness to financial flows and the onset of financial crises, in which currency and banking crises mutually reinforce each other, is well documented in the literature (Reinhart and Kaminsky 1999).

2.5 Resource endowments, the resource curse, geography and environment

A growing body of literature that relies on cross-country comparisons is increasingly pointing to the critical importance of resource endowments, geography, and the environment (Rodrik, 2002). Several competing theories attempt to explain the channels through which resource endowments affect economic growth and its distribution. Easterly et al. (2003) emphasize that resource endowments affect the policies and institutions that emerge in different countries. It has also been argued that in resource rich countries colonization has resulted in extractive institutions, which, in turn, have hampered economic development in recent times (Acemoglu et al. 2002). Kim (1999) argues that factor endowments determine the geographical distribution of manufacturing over time, potentially facilitating the exploitation agglomeration benefits. Auty (1997, 2001) documents an empirical link between resource endowments, landholding systems, the type of political state, the choice of development strategy, and the overall economic performance of a country.

2.5.1 The resource curse

Empirical evidence has established a so-called curse from natural resources. (Sachs and Warner, 2001; Frankel, 2010). The ‘curse’ refers to an observation that countries endowed with richer natural resources systematically grow slower than resource-poor countries. Frankel (2010) speculates about possible links that lead to the curse, and examined the effects of resource endowments on long-term trends in world commodity prices, volatility, crowding out of manufacturing, civil war, poor institutions, and the Dutch disease. Isham et al. (2005) provide empirical evidence that many oil, mineral, and plantation crop-based economies experienced a substantial deceleration in growth following the boom and bust of the 1970s and 1980s. Isham (2005) further attributes the curse to the fact that in resource rich countries economic activity is developed along a narrow geographic and economic base, and

is predisposed to social divisions and weak institutions. As a consequence, these countries don't have the ability to respond to shocks. Bilion (2001) examined theories of relationships between resources and armed conflicts, and puts forwards a clear argument where, in the presence of rich natural resource endowments, capital is misallocated towards the production of criminal-style activities.

Ploegh (2011) argues that volatile resource revenues are a major factor for political instability and hence bad economic performance. He also points out that 'resources are not destiny' and that some countries, such as Norway and Botswana, have successfully used their resource endowments to promote economic development. According to Mehlum et al. (2006), sound institutions have been a key element behind this outcome.

The literature identifies a variety of institutional settings appropriate to counter the resource curse. Enhancing transparency (e.g. via the Extractive Industries Transparency Initiative) can help to keep corruption in check and contribute to sound spending policies. In addition, sovereign wealth funds can smooth volatile revenues and provide a buffer to maintain public spending in times of low commodity prices (Sala-i-Martin and Subramanian 2003).

2.5.2 Geography and the environment

Geography impacts on economic development either directly (e.g. by factors related to climate and the disease environment,) as well as indirectly (e.g. by its effect on trade via transportation costs (Gallup et al. 1999)).

Some authors (Easterly et al. 2003) note that by shaping diseases, geographical endowments can constitute a limit to growth. Gallup et al (1999) demonstrate the effects that location and climate have on income levels and income growth, attributing these to channels

such as transportation costs, disease burdens, and agricultural productivity. Geography appears to limit growth in tropical regions, since these bear a heavy burden of disease. These geographical barriers to growth are likely to become increasingly problematic, since most of the expected population growth will occur in these disadvantaged regions (Sachs and Warner, 1997), and can further be exacerbated by climate change (IPCC, AR2).

Some geographic areas have been conducive to agglomeration of population and the development of cities and ideas that lead to increased growth through learning and agglomeration. Geography can limit growth in regions located far from coasts or navigable rivers, where transportation costs are high and, as a consequence, possibilities for trade are limited. Redding and Venables (2004) provide convincing evidence that access to markets and sources of supply explain cross-country variation in per capita income.

2.6 Actors and institutions

Institutions can be defined as “commonly known rules used to structure recurrent interaction situations that are endowed with a sanctioning mechanism.” (Voigt, 2009, p.8). They are often blamed or praised for their role in promoting growth with the argument “that it is the way that humans themselves decide to organize their societies that determines whether or not they prosper” (Acemoglu, 2005, p.397). Key institutions for economic growth are property rights, markets (including labor and capital markets) and rules of government revenue collection and spending.

Democratic political institutions also offer a large potential for growth because they foster equal opportunity and collective decisions over the resources of the state. But there are examples of strong economic growth without democracy (China).

In assessing their potential effect on economic growth, it is important to verify whether the sanctions prescribed by an institutionalized rule are actually enforced (Voigt, 2009). It is difficult to detect a robust additional effect of short-run policies (e.g. in the area of trade or monetary policy) on economic growth when controlling for institutions that often change only slowly. (Easterly, 2005) One reason might be that poor policies often reflect poor institutions.

Emphasizing the persistent influence of institutions over a long period, Acemoglu et al. (2002) argue that relatively rich countries colonized by European powers in the 1500s are now relatively poor and vice versa. They explain this ‘reversal of fortune’ by the types of institutions imposed by European settlers. ‘Extractive’ institutions were introduced in the relatively rich countries. They were characterized by an absence of protection of property rights and rule of law for the local population and focused on appropriation of the countries’ natural wealth by the settlers. In the relatively poor areas, there were fewer incentives to plunder, and so to prevent the development of investment-friendly institutions. As a result, the decline or rise of those countries is rooted in a major – exogenous – institutional change linked to colonization.

A number of authors have also linked the poor performance of many developing countries with governance issues: corruption, ethnic fragmentation, civil wars etc. (Bloom et al., Collier and Hoeffler, 2000, Easterly and Levine, 1997, Mauro, 1995). Mere political pluralism is often associated with more internal conflicts and political disorder. It appears that the implementation of institutions protecting private property and contracts as well as the rule of law and increasing the quality of bureaucracies does not only have a direct effect on economic activity but also helps attenuating ethnic conflicts. Still it is not obvious how to foster these developments (Fosu, 2017).

Institutions supporting innovation are of particular importance for growth. Interactions of many actors at the micro level, which are governed by markets as well as non-market institutions, result in innovation at the aggregate level (Soete et al., 2010). Actors crucial for innovation include the following: “(1) governments and related agencies supporting innovation through regulation, standard setting, public private partnerships, and funding of basic research, (2) sectors and industries comprised of firms which generate commercial innovations through experimentation, R&D, and product improvement, (3) universities which conduct basic research and train a technical and scientific workforce, and (4) other public and private organizations that engage in education oriented activities” (Watkins et al., 2015).

In addition to national actors and international non-profit organizations, multinational corporations are actors that play an important and sometimes ambiguous role in fostering innovation and growth in developing countries (Watkins et al., 2015).

2.7 Culture, social movements and social capital

Social movements are multidimensional and are mediated by cultural values (sets of identities and practices) – they have been led by workers, peasants, indigenous groups, women, and others. They may take place through their forms of expression in social media, educational processes to promote critical thinking, strengthen the democratic system and exert socio-political pressure.

Such movements have played a fundamental role in economic growth because they have manifested dissatisfaction and demanded improvements in different dimensions of human development. For example, social movements have covered quality of education, comprehensive health systems, wage improvements, and other dimensions that seek to raise social welfare through equity and social justice. In the second half of the twentieth century,

the degradation of natural resources caused in part by economic growth has led to the emergence of environmentalist social movements (Leff 1986).

2.8 On the possibility of slowed future growth

Is it possible to imagine a situation where technical progress would come to a rest, or would only pertain to marginal and useless aspects of technology? For example, if the state of the art turns so complex that it becomes beyond human capacities to push further the frontier of knowledge. Or it could be that the required technologies to achieve the needed ecological and energy transitions remain without reach. Such a pessimistic view is defended by Gordon (2016) who, after a careful analysis of productivity measures, claims that the enormous productivity-enhancing innovations of the last century and a half cannot be equaled.

Such a halt to progress seems unlikely, in particular given mankind history of permanent improvements since the Neolithic revolution (see Mokyr et al. 2015 for a brief history of the idea of progress and some arguments against technophobia). Hence the primary engine of growth is likely to stay on for the next centuries. It is not the case however of the secondary engines. In the developed world, years of schooling and longevity are bounded above by limits to the length of human life. Even if one can break some biological limits, the gains in terms of growth of further improvements along this dimension will remain low. About education, there might remain some reserves for improvement on the side of quality. Still in developed countries, the urbanization process, which was so key for generating the take-off to modern growth of the nineteenth century, is now completed. The same remark applies to the fertility transition: demographic dividends are over for developed countries (and for most of the developing world too).

This extinction of the secondary engines of growth does not apply to developing countries, which still have several decades of bonuses to obtain from them, in particular in Africa which has just started its demographic transition.

Slowed future growth seems thus a true possibility for the rich countries. The implications of such a situation are still very poorly understood. Certainly, it would put the social protection systems of rich countries under stress. It will make any redistribution policy more difficult to implement within the existing institutions, and the whole policy debate more tense. The usual trade-off between equality and efficiency will be tougher. Indeed, relying exclusively on productivity gains to generate income growth requires the economy to work as efficiently as possible, which, in some cases, may restrict the scope for redistribution policies. It is the case for example of capital taxation policies, including bequest taxations. Higher capital taxes are needed to help redistribution resources and contain the rise in wealth inequality (Piketty, 2013), but the cost of such policies in terms of loss of efficiency is likely to be more severe in a slowly growing economy.

Beyond the debate on the advent of slower growth, some authors have argued in favor of halting growth on purpose. Jackson (2011), for example, argues that “for the advanced economies of the Western world, prosperity without growth is no longer a utopian dream. It is a financial and ecological necessity.” Jackson’s approach is based on a formal model of Keynesian inspiration – hence designed to tackle short-run issues – where growth is driven by demand (consumption, investment). This approach contrasts strongly with the classical approach relating growth to technical progress. For Jackson, stopping growth amounts to fighting consumerism, probably not to fighting progress.

3. Evaluation of growth, welfare and human development

As discussed in Section 1.1, economic growth is often much lauded, but it has its critics too. Such positive and critical evaluations rest on both empirical and normative commitments. In this section we consider various normative criteria that can be used to evaluate growth. These normative criteria have been introduced in Chapter Two.

Here we focus on the normative standards *specifically as they apply to economic growth*. The section is divided into two halves. First, Section 3.1 identifies different accounts of what should be deemed to be a benefit and what a burden. Its focus is on ‘what matters’ – happiness, preference satisfaction or something else. There is widespread recognition that analyses of economic growth that assess it simply by appealing to Gross Domestic Product (GDP) are unsatisfactory since GDP does not *in itself* matter. It matters because, and to the extent that, it contributes to other goods (Stiglitz, Sen, Fitoussi 2010). Section 3.1 considers some accounts of what they might be. Once we have an account of what matters, the next question is what is the right rule concerning those benefits. Should economic growth be judged in terms of its contribution to maximizing the good, or ensuring equal amounts of it, or raising people above a threshold, or some other criterion? These issues are explored in Section 3.2. Not all of the goods to be discussed in Section 3.1 (such as political stability) are easily treated as goods to which distributive principles can be applied. Some (such as benefits like happiness, preference satisfaction or capabilities), however, are, and thus a discussion of what rule should govern the distribution of those goods is required.

3.1 What matters

3.1.1 Preference satisfaction

Some hold that what matters is that people's preferences are satisfied. To evaluate economic growth or the lack of it one must, on this view, determine what impacts it has for the satisfaction of people's preferences as a measure of their well-being.

Is it valid to appeal to preference satisfaction to evaluate economic growth? One challenge is posed by Amartya Sen, who argues that preferences formed in unjust social circumstances might reflect this (Sen 1987, p.11). The appeal of the preference satisfaction approach is lost if the account simply reflects unjust circumstances set up by the powerful in ways that advantage them.

A second concern arises from the phenomenon that J. K. Galbraith referred to as the "dependence effect" in his classic *The Affluent Society* (1958, chapter 11). His claim was that if people had exogenously given preferences then the fact that an economic system satisfied them would count in its favor, but since economic systems create preferences they deserve little credit for satisfying people's preferences.

Advocates of a 'preference satisfaction' view can respond to some of these objections. For example, in response to Sen's critique they might stipulate that a person's good is what he or she would desire in a situation in which – as well as having full information and being fully rational – they have genuine choice and are not subject to the manipulation of others (Brandt 1979). This might also help respond to Galbraith's challenge for the emphasis would then be *not* on satisfying preferences produced and created by the existing economic system, but rather preferences that a well-informed non-manipulated rational agent would choose. This takes us far from actual desires to desires formed in rather idealized circumstances (Griffin 1986, chapter 1 especially pp.10-15).

3.1.2 Happiness

A second criterion that might be used to evaluate economic growth equates individual well-being with happiness, where happiness is defined in terms of pleasant mental states. Some argue convincingly that economic growth does not promote happiness (e.g. Easterlin, 2010, pp.13-45: originally published in 1974). (See Chapter 8 for a full discussion of the Easterlin paradox.)

Should we then judge economic growth in terms of its impact on happiness? Several objections have been pressed against this criterion. For example, Robert Nozick argues that it would not be desirable to be plugged into an ‘experience machine’ that provides wonderful pleasant mental states for life, indicating that there is more to life than pleasant mental states (Nozick 1974, pp.42-45). A second objection argues that happiness is not a reliable criterion as to what matters. Dan Moller, for example, reasons that other goods matter and that economic growth has value to the extent that it furthers these goods (Moller 2011, pp.186-189).

3.1.3 Capabilities to function

A third concept of well-being by which one might judge economic growth is the “capabilities” approach pioneered by Amartya Sen (1987; 1999; 2009, Part III) and Martha Nussbaum (2006, pp.69-81), which is discussed in depth in Chapter 2. Unlike the preference satisfaction and happiness theories, it takes a more objective approach. It identifies human functionings and evaluates social, economic and political institutions (and so economic growth) in terms of their effects on people’s capability to enjoy these functionings.

One might assess economic growth (or its absence) in terms of its impacts on capabilities. For example, economic development that lifts people out of poverty will, of course, promote several key capabilities (Alkire 2002, Sen 1999). At the same time, growth

can also result in harms to other capabilities. In particular, environmental externalities (such as climate change and biodiversity loss) will have adverse effects on some capabilities, most notably the capability for good health as well as control over one's environment.

This approach is, however, not without critics (Fleurbaey and Banchet 2013, p.225ff). One question concerns the issue of how one identifies 'capabilities' – is one list of capabilities more plausible than another? These concerns notwithstanding, the capabilities approach provides a useful and intuitive framework for evaluating growth.

3.1.4 Meaning of Life

Some might argue that the previous three criteria do not constitute an exhaustive basis on which to judge economic growth. They might, thus, appeal to the idea of a “meaningful” life to evaluate economic growth. Human beings do not exclusively strive for happiness, but a sense of meaning also matters for the conception of individual targets in life. Some correlates of happiness and meaning, such as religion, friends, and family overlap. Others, however, point in opposite directions. For instance, one recent cross-country study (Oishi and Diener 2014) found that people in poor countries on average enjoy a greater sense of meaning in life than people in rich countries. Likewise, one recent study in the US (Baumeister et al. 2013) points out that “concerns with personal identity and expressing the self contribute[s] to meaning but not happiness”, concluding that one can lead an unhappy, but nevertheless a meaningful life.

Living a good life can mean living in accordance with one's values, i.e. that one's identity is constituted by adhering to these values. This perspective is closely related to the ancient concept of virtue ethics, which states that leading a good life means striving for fundamental virtues, such as wisdom or justice.

3.1.5 Status consumption

People assess their economic well-being not only in absolute terms, but also relative to others (“keeping up with the Joneses”, Gali 1994). This phenomenon of ‘status consumption’ can be defined as:

“the motivational process by which individuals strive to improve their social standing through the conspicuous consumption of consumer products that confer and symbolize status both for the individual and surrounding significant others” (Eastman, Goldsmith and Flynn 1999, p.42; Eastman and Eastman 2011, p.10).

The importance of status consumption increases with income, as people use higher shares of their income to acquire scarce goods (such as houses or works of art) that convey social status. (Hirsch, 1977)

Does it matter that economic growth promotes status consumption, and, if so, in what ways? For a preference satisfaction theory, it matters whether status consumption aids in satisfying people’s desires. If it does not, or if it just generates further insatiable desires then status consumption does not advance someone’s good. Similarly, for a happiness-based theory status consumption has value because, and to the extent that, it results in happiness; but if acquiring the goods turns out not to result in the pleasant mental states then it will not count as advancing people’s good.

A capability approach will take a different tack. For example, status consumption could matter only insofar as it contributes to an “affiliation” capability (forming associations with others and being treated with equal respect) (Nussbaum 2006, p.77).

Whilst it might be rational for an individual to seek status consumption to keep up with others, society as a whole may benefit little from economic growth if increasing incomes

turn into a zero-sum game in which one individual's gain is the other's loss (Frank 2005). In this case, every member of society could be made better off by collectively agreeing on restricting consumption and benefit from the reduced effort (in terms of labor, natural resources, etc.) needed to produce this consumption in the first place (Howarth 2006, Frank 2008).

3.1.6 Non-anthropocentric values, intrinsic value of nature and animal welfare

The focus so far in Section 3.1 has been on ways in which economic growth impacts human beings, though economic growth may also impact the environment or non-human animals in adverse ways.

Does the impact on the environment and non-human animals matter, if it does not also have an impact on human beings? Anthropocentric concerns have been the primary values that traditional western philosophers have recognized, though in the latter half of the twentieth century, environmental ethics emerged as a separate philosophical discipline. (See Chapter 2, Section 3.7 for a full discussion of the intrinsic value of nature debate.) One of the thorniest ethical issues that remain is how to balance human and non-human welfare (Regan, 1983; Singer, 1975; Taylor, 1986). Whatever the ultimate theoretical account of human-non-human balancing, in many cases human-and-non-human goods are aligned. Of course, some situations embody genuine conflict between human survival and biotic or abiotic welfare. Yet because both humans and nonhumans rely on the same biotic and abiotic systems for survival and well-being, many cases of human-environment conflict are avoidable. As Thomas Pogge suggests, many such conflicts have arisen from colonialism, greed, imperialism, and the desperation and human inequality that they cause. (Blackstone, 1974; Shrader-Frechette, 2007; Singer and Mason, 2006; Pogge, 2002; Bob and Bronkhorst, 2010)

3.1.7 Political stability and legitimacy

A further criterion for the evaluation of economic growth concerns its impact on political stability and legitimacy. Some authors have explored whether economic growth furthers political stability (Paldam 1998), and there is an established literature on how economic growth – and the rate of change of growth – impacts both political stability and political legitimacy (Hirschman 1973; Huntington 1968; Przeworski, Alvarez, Cheibub & Limongi 2000). There is, in addition to this, a literature on whether political stability promotes economic growth (Alesina, Özler, Roubini & Swagel 1996).

Political instability should not be confused with mere “political change” (Przeworski, Alvarez, Cheibub & Limongi 2000, p.188), and so political stability should not be understood as a lack of political change. Political stability can instead be understood as an absence of major “political upheavals” (Przeworski, Alvarez, Cheibub & Limongi 2000, p.189ff). Political stability can also be defined as “the state in which a political object exists when it possesses the capacity to prevent contingencies from forcing its non-survival” (Dowding and Kimber 1983, pp.238-239).

Political legitimacy can be distinguished into ‘normative’ notions of political legitimacy (which claim that a political institution has legitimacy if it meets some moral standards) and ‘descriptive’ notions of political legitimacy (which claim that a political institution has legitimacy if those subject to it recognize it as being entitled to govern) (Peters 2010).

The value of political order and political legitimacy is, to some extent, a derivative value. That is, they have value, in part, because, and to the extent that, the social and political institutions that are in place are valuable ones that should be stabilized and legitimized. So

before knowing whether stabilizing and legitimizing a regime is valuable it is necessary to know whether it is worth preserving, or whether there is a more just and less oppressive alternative available.

Bernard Williams has argued that the question of how to secure order and political stability is the “first political question”, meaning that “the securing of order” is necessary to pursue other ideals (like social justice) (Williams 2005, p.3). However, this is consistent with thinking that its value derives from the realization of these other goals. An evaluation of the effect of economic growth on stability and legitimacy must therefore be conducted together with its effects on justice and the standard of living.

3.2 How is it distributed?

The previous section considered some of the metrics that might be used to evaluate economic growth, and specified various benefits (happiness, preference satisfaction, capabilities, meaning of life, etc) and various burdens (pollution) that need to be borne in mind. There is a further question concerning how the goods in question (whether happiness or capabilities or some other good) should be distributed. This section turns to those questions.

3.2.1 Maximizing the good

One familiar view of distributive criteria is that the good should be maximized. The best-known version of this is utilitarianism, which takes utility (understood either as happiness or as preference satisfaction) as its good and then calls for its maximization (Sidgwick 1981 [1907]). See Chapter 2, Section 4.3.5 for a full discussion of utilitarianism’s distributive implications.

Since our focus is on economic growth and thus the standard of living of people in the future, it is worth noting that an additional set of questions arise when we apply a maximizing approach to future generations. Derek Parfit has argued that if the aim is to maximize total utility then this might lead to what he calls “the repugnant conclusion” – a world with very many people all of whom have a low (but positive) standard of living (Parfit 1984, chapter 17). Others object that applying a maximizing approach might impose very demanding obligations on current generations who are required to sacrifice their consumption in order to create greater benefits for future generations. This has led some to embrace ‘discounted utilitarianism’ (which applies a positive pure time discount rate), and for others to abandon maximizing views (Parfit 1984, pp.484-485; Rawls 1999 p.262).

3.2.2 Equality

An alternative distributive principle by which to evaluate economic growth would be to assess it in terms of its impact on the realization of equality. (See Chapter 2 for a discussion of different kinds of egalitarianism.)

One question that is very relevant when evaluating economic growth is whether the focus should be just on inequality within a country or whether it should concern global inequalities. The issue at stake is that of the scope of egalitarian justice. Given that economic growth often has implications beyond the borders of any given state, it is important to consider whether egalitarian principles apply globally or not (for a discussion see Chapter 2).

On one view, inequality matters only within a state. This view holds that there is something special about the state that entails that egalitarian principles apply there but not elsewhere. This might be because the state exercises coercion over its citizens (Blake 2013) or because the state is a scheme of cooperation (Sangiovanni 2007). A contrasting, cosmopolitan, view maintains that it is arbitrary to apply equality within one country. Luck

egalitarians, for example, will hold that egalitarian principles should apply at the global level, and thus criticize global inequalities as unjust (Caney 2011).

A second question concerns the application of this principle over time. Given the effects of economic growth on future generations it is necessary to enquire whether egalitarian principles – or some other principles – should be applied over time. One concern about maintaining that equality should apply across time is that it would seem to prohibit one generation from making future generations better off. As such it seems vulnerable to a particularly acute version of the ‘leveling down’ objection (Parfit 1997, pp.210-211). It would seem implausible to limit growth if and because it would result in an intertemporal inequality.

In light of this, one might consider an alternative view, voiced by Brian Barry, who argued that “those alive at any time are custodians rather than owners of the planet, and ought to pass it on in at least no worse shape than they found it in” (Barry 1991, p.258: emphasis added). On this view, one generation may not leave future ones worse off but may leave them better off.

Related approaches claim that members of each generation have a right to an equal standard of living on the grounds that it is objectionable for some to have less or more purely because of when they are alive. However, they argue, each generation has a right to leave future generations better off, and in line with this preference governments should maximize the standard of living of current generations subject to leaving future generations better off (thereby honouring what they term “growth sustainability” (2015, pp.4 & 34)). For this argument see Llavador, Roemer and Silvestre (2015, pp.1-5 & 34-38; also Roemer 2011, 2013).

3.2.3 Sufficiency & meeting core needs

As noted above, one rationale for reducing inequalities is that it is necessary for reducing human misery and suffering. This argument is not deeply committed to equality (Scanlon 1997, p.2). It implies that inequality is acceptable so long as people's standard of living is above some designated level. This takes us to sufficientarianism, "the doctrine that what is morally important with regard to money is that everyone should have enough" (Frankfurt 2015, p.7). Sufficientarianism insists that there is a threshold standard of living, below which no one should fall. This could be quite a minimal standard, calling for meeting everyone's basic needs. Or it could be something more demanding, requiring a higher standard of living.

At the global level, many endorse a sufficientarian threshold. One version of this, for example, is couched in terms of rights and it holds that all persons throughout the world have rights to have their basic needs met (Shue, 1996). This approach contrasts with purely aggregative approaches which seek to promote the good of the whole, and it emphasizes the rights of everyone not to fall beneath a minimum standard.

Such a sufficientarian approach can also inform intergenerational justice and thus be employed to judge the value of economic growth over time. On one widely held view, current generations have a duty not to act in ways that result in future generations being unable to enjoy a basic standard of living.

One difficult issue surrounding sufficientarianism is the question of how to define the sufficiency threshold and where to draw the line (Casal, 2007). It is also unclear why differences just below any designated threshold have immense moral significance but benefits above it lack any. It would be implausible to insist on a policy that improves the standard of living of someone below the threshold at the cost of imposing considerable losses on everyone else leaving them just above the threshold (Casal, 2007). As she notes, a

sufficientarian approach to evaluating economic growth – whilst important – cannot be the full story: it needs to be supplemented with additional principles, such as equality or prioritizing the least advantaged (Casal, 2007).

3.2.4 Priority for the least advantaged

This takes us to a fourth distributive principle that might be applied when evaluating economic growth – the principle of prioritizing the least advantaged. Parfit, defines “the Priority View” as follows: “Benefiting people matters more the worse off these people are” (Parfit 1997, p.213). This is importantly distinct from egalitarian views for whereas egalitarian views are concerned with how people fare relative to others, prioritarian views, by contrast, are concerned only with people’s absolute level, and not with how well one person does in comparison to another.

Some apply prioritarianism to the global level, and thus would evaluate global economic growth in light of Parfit’s Priority View. The reasons given in defense of the Priority View, if sound, would seem to apply with equal force at the global level as well as within the state (Caney 2005, chapter 4). Similarly, to the extent that it is a valid principle at all there is no reason to think that it should apply solely within one generation. An intertemporal priority view would thus evaluate economic growth in terms of its effects on current and future generations, giving more weight to persons the worse off they are, though it would have to address the complicated issues raised by population ethics (Holtug 2010, chapter 9).

The Priority View is not without critics, however. Some have argued that whatever appeal it has, it has none when all are above a high sufficiency threshold. In a society where some have very high levels of wealth but others have even more, there seems, they argue,

little reason to attribute greater weight to the interests of the first group (Crisp 2006, p.157). Rather, it gets its force from cases where people are severely disadvantaged.

3.2.5 Environmental justice

The previous sections have discussed the general principles of distributive justice normally applied to the economy as a whole. In this section, a specific focus is given to environmental justice, or injustice, which occurs whenever a vulnerable group of people faces disproportionate environmental risks, has less-than-equal access to environmental goods, or has less opportunity to participate in environmental decision-making.

Children represent a minority victimized by environmental injustice because they are more sensitive to the same doses of virtually all forms of environmental pollution. Studies consistently show that socioeconomically deprived groups are more likely to be subject to environmental injustice, as are people in developing nations – these people tend to be less able to prevent and to remedy such inequities. Members of communities facing such threats typically are too poor to "vote with their feet" and move elsewhere (e.g., Boer, Kastor and Sadd, 1997; Ringquist, 1997; Maher, 1998; and NAACP, 2016).

Critics of environmental justice typically claim that, on balance, victims of alleged environmental insults may benefit from living near noxious facilities because of factors such as cheaper housing costs. (Starkey, 1994; Baker, 1993; Hayward, 2013) Such claims ignore the fact that those living amid environmental injustice likely have not consented to it, but instead can afford nothing better. This supposed consent is not genuine consent if people have no other options. Environmental injustice need not be deliberate, albeit a serious concern for many members of society.

4. Social and natural wealth

The previous section has shown that economic growth matters in that it contributes to other goods, though there is debate as to how economic growth should be judged in terms of different distributive principles. This section examines the effects of economic growth in the framework of social and natural wealth, and clarifies the positive and negative impacts it has had historically, which contribute to the two overarching narratives introduced in Section 1.1: liberation and exploitation.

4.1 Social wealth

In the framework of social wealth, this section discusses the relationship of economic growth with health and poverty (Section 4.1.1), inequality (Section 4.1.2), urbanization (4.1.3), political change and democracy (4.1.4) and consumption patterns more generally (4.1.5). Social wealth can be understood as the set of established social practices (including practices in private production, governmental institutions, and people's daily lives) that affect the potential for generating human well-being in a society. Much of the section provides support for the first narrative of economic growth – liberation.

4.1.1 Health and poverty reduction

Historical changes (see Chapter 18, Section 2 on the rise in longevity) show that improvements in average health and reduction in its variability have been made possible by economic growth. Many scientific discoveries, medical advances, and public health initiatives that have produced enormous health gains in the most advanced countries would not have occurred outside the context of industrialization and growth (Weil, 2014).

The impact of economic growth on poverty reduction is not straightforward. Dollar et al. (2016) argue that overall, “growth is good for the poor”. That is, even though the relationship between countries’ growth performance and poverty reduction shows quite some variance, on average every percentage point of economic growth increases the income of the two poorest quintiles by about one percent. The finding that economic growth seems to ‘lift all the boats’ is confirmed by more recent developments. Absolute poverty, defined as the number of people with daily income below US\$ 1.90 (measured in year 2011 US\$ at purchasing power parity)¹⁴, has dropped from about 2 billion in 1990 to less than 800 million in 2013. Most of this decline can be attributed to East Asia and the Pacific, i.e. the region that displayed the highest rate of economic growth during the respective period (See Figure 4.4). However, even though poverty rates have fallen considerably in all regions of the developing world (from 40% in 1990 to 11.5% in 2013), the progress when measured by the number of people in absolute poverty is less impressive. For example, the number of people in poverty has increased in Sub-Saharan Africa (SSA), and now stands at about almost 400 million, even though the poverty rate has fallen slightly from 54% in 1990 to 41% in 2013 (WDI, 2016).

The responsiveness of poverty to economic growth differs substantially across regions, with a lower level of initial inequality associated with a higher rate of transformation (Fosu, 2010). In particular, SSA has generally exhibited less impressive progress on poverty, compared to the rest of the developing world, even during the more recent period of substantial growth resurgence. This is not only due to relatively high levels of inequality, but also to the low levels of income, which tend to reduce the rate at which growth is translated into poverty reduction relative to the rest of the world (Fosu, 2009). Nevertheless, on average,

¹⁴ Such low thresholds have frequently been criticized as constituting a mere subsistence level (Pritchett 2006), suggesting that poverty itself may go much beyond this measure.

economic growth has been the main force behind the recent progress on poverty in SSA (Fosu, 2015).

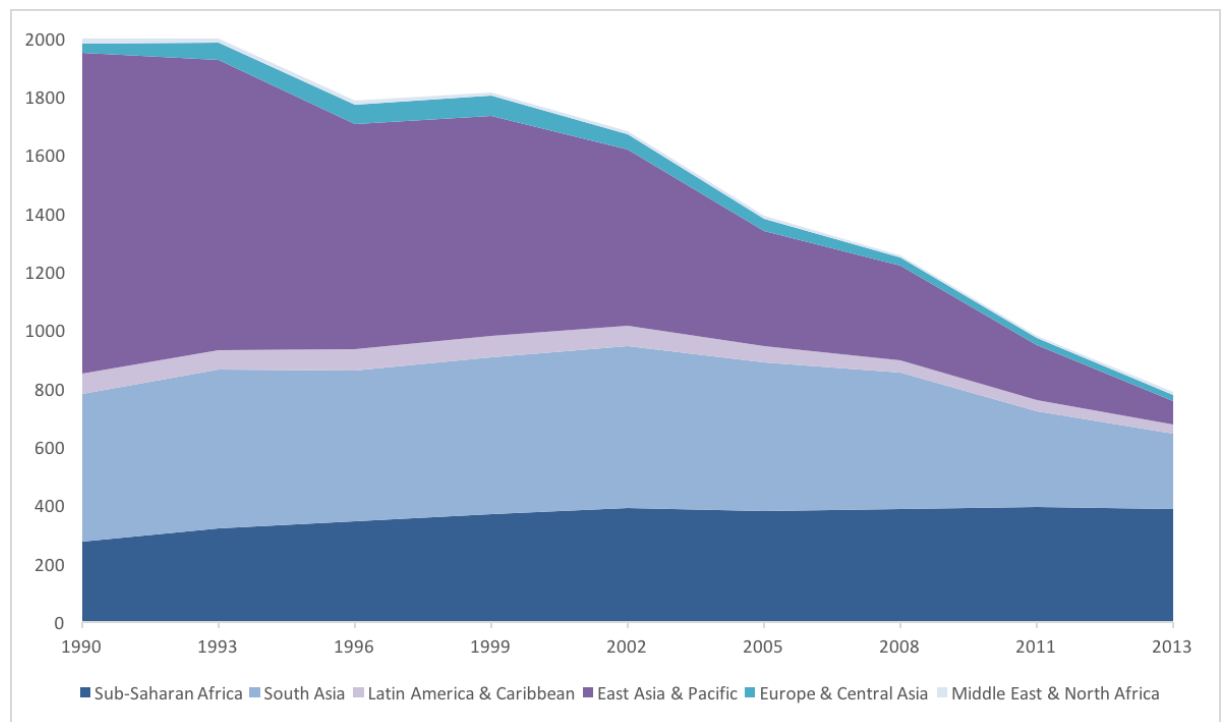


Figure 4.4: Development of absolute poverty (defined as disposable income below 1.90 US\$ per day) over the period 1990-2013. Source: WDI (2016) [Vertical Axis in Millions]

Growth therefore doesn't automatically reduce poverty. The disconnect is due to weak institutions, policy-making, research capacity and to insufficient public investment.

Another major reason, in particular in SSA, is slow agricultural growth and rural development (Diao et al 2012). Most of the poor are to some degree dependent on farming and so fostering agricultural growth is often seen as a strategy to support pro-poor development (Thriddle, Lin, and Peisse 2003). Agricultural growth rates in many African countries are less than a third of the nonagricultural sector's growth rates, and per capita agricultural income increased at less than 1% per year from 2000 to 2015 (World Bank 2016). Consequently, the rural-urban divide in Africa continues to widen. Diao et al (2012) found that improving agricultural productivity in most African countries is essential to achieving inclusive, pro-poor growth. Staple-food crop and livestock production must be expanded

because they have the scale and linkages to poor households needed to reduce national poverty within a reasonable period of time.

Poverty alleviation is not exclusively a matter of disposable income, but a matter of development possibilities in a broader sense. This includes access to physical and social infrastructures necessary to satisfy basic human needs. Examples include health, education, and social security, as well as expansion of physical infrastructure (Alkire 2002a). This view is further buttressed by the recent finding that poverty is persistent, in that the level of poverty prevailing in an earlier period tends to promote further poverty in the future (Ravallion, 2012).

Economic growth can therefore support poverty alleviation and provide the means to physical foundation for human well-being, such as basic infrastructure. Yet, there is no automatic link between economic growth and access to development opportunities. In order to ensure that growth is indeed good for the poor, accompanying policies can support societal transformations during the process of industrialization (Drèze and Sen 2013). Vice versa, even with low rates of economic growth, governments can take measures to address poverty by strengthening social inclusion. For instance, the Indian state of Kerala is often cited as a good example of how good development outcomes can be achieved even with comparatively low per-capita incomes (Kannan 1995).

4.1.2 Inequality

The ‘Kuznets curve’ suggests that inequality first increases and then decreases in the course of the growth process. (See Figure 4.5) The rising part of the curve is true mechanically, as growth proceeds a gap tends to emerge between leaders and laggards, but the decreasing part is dubious in light of the rise in inequality observed in both the more advanced

countries as well as the emerging economies in the last 30 years. A detailed analysis of within-country inequality trends is provided in Chapter 3.

Among-nation or international inequality may have begun because of variations – in climate, environment, and geography, including different amounts of natural resources and available farmland – that contributed to western European agricultural, technological, and immunological advantages (Diamond, 1997). As a result of these disparities in natural advantages, international gaps in economic development increased. These gaps, in turn, made possible colonialism, slavery, and imperialism, which includes the murder or socioeconomic, political, or military subjugation of millions of people (Bartolome de las Casas, 1992, Cooper, 2005, Hobsbawm, 2008, Howe, 2002).

As a result, the income of the average Angolan or Ethiopian is only 2% of that of the average American. An American with the average income of the bottom 10 percent in the country is nevertheless better off than two-thirds of the world's population. Hence within-nation inequality is dwarfed by among-nation inequality (World Bank, 2005, Branko Milanovik, 2002, Frieden, 2001).

Among-region inequality increased partly because of colonialism, as Western Europe has been mainly a colonizer and not its victim, whereas Latin America and Africa have been predominantly victims and not perpetrators of colonialism. Some regimes likewise tend to have victimized regions rich in natural resources and hence created and exacerbated regional inequalities.



Figure 4.5 Long run inequality trends: income Gini coefficients (Source Roine, J., Waldenström, D. 2015).

Beyond the causal effect of growth on inequality, we can also wonder whether income inequality is good or bad for growth? Most of the existing literature on inequality and growth concentrates on the accumulation of physical capital. In countries with large numbers of poor, there is a high demand for redistribution policies, which in turn lead to tax distortions that slow growth. Inequality can also influence growth because of its effects on the accumulation of human capital, in particular if the poor are subject to credit constraints, preventing them from investing enough in human development (e.g. education, health and skill formation).

Demographic variables must be taken into account in order to assess the effects that economic growth may have on income distribution (differential fertility and mortality). When inequality is high, fertility of the poor is very high as compared to that of the rich, making it more difficult to accumulate human capital in the economy (de la Croix and Doepke, 2003).

4.1.3 Social transitions

Urbanization is the increase in the proportion of households living in cities. High urbanization levels always accompany high income per person. Urbanization is necessary for growth, but is not sufficient to spur growth in itself. Advanced societies without a large proportion of their members living in cities are not observed. But poor or stagnant societies with high urbanization rates (from the Roman Empire to some developing countries today) do exist. Gollin, Jedwab and Vollrath (2015) develop the idea of premature urbanization, which arises in particular in resource-exporting countries, with “consumption cities” having a larger fraction of workers in non-tradable services, high poverty rates, and extensive slums.

Urbanization directly contributes to growth by moving people from low efficiency sectors to more productive ones (McMillan and Rodrik, 2011). Part of the growth observed in developed countries today came from this reallocation. Now that this movement is coming to an end, one of the "engine" of growth is no longer operating.

Beyond its direct effect on productivity, urbanization is also very much related to the increase in human capital. Indeed, cities are the place where people acquired secondary and tertiary education, and where upper tail human capital was developed, through institutions tightly linked to cities, such as academies, museums, universities, libraries, etc... More generally, cities generate agglomeration externalities, by allowing private resources to generate social benefits (Fujita and Thisse, 2002).

Urbanization is also an inevitable component of "modernization", and is related to many other features of development, such as democratization, secularization, individualization, rising standard of living and the emancipation of women (See Chapter 17).

4.1.4 Political change and democracy

Income per person is strongly correlated with social institutions that are usually considered positive for welfare, such as democracy and gender equality. Most countries were not democracies before the modern growth process took off at the beginning of the nineteenth century. Democratization came gradually together with income growth. However, there is no one-directional causality between institutions and economic development. Economic and political change can therefore probably best be understood as a process of co-evolution, in which economic changes affect political power structures, which in turn can promote or delay economic change. This view can be traced back to Marx (1867), who predicted the demise of capitalism, which, as a consequence of its internal contradictions, will be overthrown by the exploited working class and replaced by socialism. A similar perspective is also exposed by Schumpeter (1942), who expected capital accumulation to result in huge bureaucratic structures, which will increase demand for more democratic control and result in a socialist regime.

Sen (2013) discusses three channels through which economic growth interacts with political factors. These include, first, provision of public goods by the government, second, credible commitment to potential and current investors that it will not expropriate their profits, and, third, overcoming coordination failures. He also emphasizes that these political factors may be of different importance in the stage of transitioning from a phase of economic stagnation to growth acceleration and the stage of maintaining stable long-term growth, respectively.

Recent literature has frequently emphasized the importance of robust institutions, such as secure property rights, free media, accountable government and democracy as an important foundation for economic development (Rodrik, Subramanian, and Trebbi 2004). However, it

has also been argued that in numerous cases improvements in democracy have only occurred after a phase of building up industrial production structures, as in the case of state-led industrialization in numerous Asian countries (Chang 2007).

Regarding the role of the state, Hall and Soskice (2001) identify major differences between liberal market economies, such as the UK and the US, on the one hand and controlled market economies, such as France, Germany and Scandinavia, on the other. Whereas for the former, the market is employed as the main device to guide economic decisions, the latter adopt a more corporatist model, in which business associations and labor unions play more important roles in political decision making. In a similar vein, even though industrial policy has frequently been criticized due to the impossibility of ‘picking winners’ (Pack and Saggi 2006), some authors argue that it might have an important role in facilitating coordination between different sectors, in particular in economies and facing a large array of political and institutional constraints (Hausmann and Rodrik 2003). Hence, in such cases, industrial policy does not amount to actively picking winners, but rather removing barriers to create conditions that allow for ‘self-discovery’. In such a setting, the state would aim at simultaneously addressing multiple market failures facing an uncertain and politically constrained second-best setting, not unlike the process of robust policy-making outlined in Section 5.4.

4.1.5 Consumption patterns

The effect of economic growth on changes in consumption patterns is closely related to the process of structural change discussed in Section 2.3. Gordon (2016) described the evolution of consumption patterns in the USA since the onset of the industrial revolution in a way that is exemplary for advanced countries, but that also reflects patterns witnessed in

emerging and developing countries. Between 1870 and 1970, American's consumption drastically changed in many respects: Homes became more comfortable in terms of size, lighting and protection from extreme temperatures, humidity and insects. The quality and variety of the diet increased – decreasing in terms of consumption of meat (but becoming more varied) and corn, and increasing in terms of consumption of fruits, milk products, eggs, fats and oils and sugar. The share of processed food and fabricated clothing increased relative to home-made products. Household appliances increased the productivity of home production. The innovations eased the work burden on wives and daughters whose task in the household had been to carry water, to bake bread and to make clothes. Access to many networks became available such as electricity, running water, trains, paved roads and automobiles to drive on them, daily mail delivery extending to rural areas, telegraphs and telephones, radio and television. After 1970, the Internet was the most important new network. Raising incomes allowed people to consume more and new goods and services beyond the basic needs of food and shelter. The share of consumption on perishable goods declined from 52% in 1869 to 9% in 2013. The share of semi-durable goods remained stable at around 15% but changed its compositions to new goods motor vehicle fuels and pharmaceuticals. The same applied to the share of durables of around 10%, where new goods such as telephones and motor vehicles became available. The share of consumption of services rose from 24% to 66%. This evolution, especially also the diffusion of network access, has been widespread throughout the population and not concentrated to rich classes.

4.2 Natural wealth

In the framework of natural wealth, this section discusses the relationship of economic growth with the depletion of exhaustible resources (Section 4.2.1), planetary boundaries (Section 4.2.2), climate change (4.2.3), air and water (4.2.4 and 4.2.5), food security (4.2.5),

biodiversity (4.2.6) and socio-economic metabolism (4.2.7). Much of the section provides support for the second narrative of economic growth – alienation.

4.2.1 Depletion of exhaustible resources

Historically, the economists' view was that there is a finite stock of resources available to humans (Hotelling, 1931). This model predicts that resource use declines over time and resource prices increase exponentially. Empirical tests of the Hotelling model, however, fail without exception, due to the geology of resources (Halvorsen and Smith, 1991; Lin and Wagner, 2007; Hart and Spiro, 2011; Atewamba and Nkuiya, 2017).

While the exact figure varies between resources, current consumption of exhaustible resources can be maintained for centuries with the resources available in the Earth's crust (Nordhaus, 1974; Krautkraemer, 1998). As the most accessible deposits get exhausted, further deposits become increasingly difficult to reach. At the same time, technology advances and keeps pace with the difficulty of reaching the deposits (Managi et al. 2004; Hart, 2016; Stürmer and Schwerhoff, 2016), thus allowing increasing resource consumption.

Exhaustible resources do indeed produce rents, but these rents are rents from market power, not scarcity (Ellis and Halvorson, 2002; Hansen and Lindholt, 2008; Huppmann and Holz, 2012; Nakov and Nuno, 2013).

The abundance of exhaustible resources is no reason to be unconcerned, however. The carbon emissions embodied in fossil fuel reserves is at least ten times higher than the remaining disposal space in the atmosphere (Jakob and Hilaire, 2015). If dangerous climate change is to be avoided the majority of fossil fuels must remain unburned. In addition, mining of all kinds of resources causes significant local pollution. As a consequence, sustainability is not threatened by the sheer availability of resources, but rather by the side-effects of

producing and using them, in other words by the planetary boundaries (Section 4.2.2) and climate change (Section 4.2.3).

4.2.2 Planetary Boundaries

The Industrial Revolution stimulated unprecedented economic growth. (See Section 1.3) Since that time, human activities have become the main driver for earth system changes, pushing the system beyond a stable natural state and introducing substantial environmental problems such as air and water pollution (Section 4.2.4 and 4.2.5), climate change (Section 4.2.3), soil pollution by heavy metals, a hole in the ozone layer, wetland retreat, and loss of biodiversity (Section 4.2.7) (Crutzen, 2002; Steffen et al., 2007; Hudson, 1992 and Rockström, 2009a).

The damage to environment and resources threaten both current and future generations. Therefore, there is an inevitable conflict between short-term and long-term development as well as local development and global development.

Rockström et al. (2009a, b) proposed a framework to quantify the planetary boundary within which we can safely operate. This framework identifies nine biogeochemical classes: climate change (Section 4.2.3), ocean acidification, stratospheric ozone depletion, nitrogen (N) cycle, phosphorus (P) cycle, global freshwater use (Section 4.2.5), land system change, biodiversity loss (Section 4.2.7), atmospheric aerosol loading and chemical pollution. The baseline of all the calculations is the beginning of Industrial Revolution. Three of these classes have transgressed their limit: climate change, nitrogen cycle and biodiversity loss. Global P and N cycles, atmospheric aerosol loading, freshwater use and land use change are close to their limits. It is worthwhile to note that if one boundary is transgressed, other boundaries are under serious risk. For example, land use in the Amazon could change water

resources on the Tibetan Plateau (Cynder et al., 2004). Change of the nitrogen-phosphorus boundary can influence ecosystems, absorption of CO₂ and therefore impact the climate boundary (Rockström 2009). Climate change will influence the local monsoon climatic system, subsequently altering local energy and precipitation patterns, and eventually freshwater accessibility and ecosystems services.

This framework of planetary boundary – even if subject to further research and future insights – provides a blueprint of where human beings' position is in different dimensions of natural boundaries. This can also guide us to take measurements to maintain and support sustainable development. Within these nine planetary boundaries, humanity can continue to develop and thrive for generations to come – while crossing them could generate abrupt or irreversible environmental changes.

4.2.3 Climate change

About half of cumulative anthropogenic CO₂ emissions between 1750 and 2010 have occurred in the last 40 years – this increase has been driven by growth in economic activity. Climate change also poses risks to economic growth as it is likely to have far-reaching consequences across sectors, impacting human well-being in multiple ways.

The currently observed impacts of climate change, the projected risks for the future, and the challenges and opportunities for adaptation and mitigation under alternative scenarios have been documented in the recently published IPCC reports (IPCC 2014: Summary for Policy Makers WG II and WG III, Synthesis Report). Impacts occur across components of natural wealth including biodiversity, water, and land, with adverse consequences for ecosystem services, whether regulatory, provisioning or cultural. Social and economic

consequences arise for food security, human conflict, and loss of economic assets (MEA 2003, MEA 2005, Atkinson et al 2012)

Climate change impacts health in direct and indirect ways: direct impacts on morbidity and mortality include the impacts from floods, droughts, extreme heat, and cyclones while indirect impacts can occur from disruptions and changes in ecological processes impacting spread of disease vectors, food production and under nutrition, and displacement of populations, disruptions in provisioning of health care services and damages to health infrastructure among others. (See Table 4.1) Human health is impacted adversely by climate related occurrences, and many of these impacts are seen to be distributed unequally, often disproportionately affecting the poorest and those facing current deficits in water, sanitation and basic health care services (Watts N, et.al 2015, Dasgupta 2016, Smit et al. 2014).

For resource constrained, low and middle income economies, where multiple co-stressors such as poverty, malnutrition, lack of basic amenities and health care services exist, accounting for climate change implies new demands on resources and prioritization within a development agenda, to ensure that the gains from sustainable development are not eroded in the near or longer term due to climate change impacts.

Conventional ways of understanding the relationship between economic systems and ecosystems are no longer adequate and create challenges for the long-run sustainability of the process of economic growth. It reinforces the idea that economic systems and ecosystems are both complex adaptive systems, and the need for economic policy interventions that can lead to increased resilience and robustness (Arrow et al. 2014, Chopra and Dasgupta 2016). Expert judgments are required about the elasticity of substitution between natural wealth and other modes of wealth for long-run sustainability and innovative methods for economic valuation of

the ecosystem assets and services that would get adversely impacted due to climate change (Atkinson et al 2012).

Table 4.1 Economic analysis of health impacts of climate change in Europe. Source: Hutton and Menne 2014.

DISEASES	COVERAGE	YEAR	ECONOMI C MODEL	ANNUAL COST OR SAVINGS	REFERENCE
Health impact cost studies (attributed to climate change)					
Cardio-respiratory	EU	2050	CGE	€38 billion savings	Bosello et al.
	FSU			€4 billion savings	
Heat related, Salmonellosis, Flooding	EU	2080	Bottom-up	€46–147 billion cost	Kovats et al.
Heat-related	EU	2080	Bottom-up	€50–118 billion cost	Watkiss et al.
Salmonellosis		2011–40		€70–140 million cost	
Heat-related	Skopje, FYRM	2005–10	Bottom-up	€1 million cost	WHO Regional Office for Europe
Heat-related	Rome, Italy	2020	Bottom-up	€281 million cost	Alberini et al.
Heat-related	Germany	2071– 2100	Bottom-up	€300–€700 million (hospital admissions) cost	Hübler et al.

				€2.5–€10.3 billion (productivity) cost	
Cardio-respiratory	EU	2050	Bottom-up	€125 billion cost	Holland et al.
Pollution	OECD Europe, Eastern Europe	2100	CGE	0.02% of GDP cost	Nordhaus and Boyer
Adaptation cost studies (attributed to climate change)					
All health-related adaptations	Europe and Central Asia	2010– 2050	Bottom-up	€1.18 (CSIRO) – €4.32 billion (NCAR) cost	World Bank
Diarrheal cases	WHO European Region	2030	Bottom-up	€148 million cost	Ebi
Disease treatment	Western Europe	2060	Bottom-up	€0.68 billion savings	Agrawala et al.
	Eastern Europe			€0.06 billion savings	

4.2.4 Air pollution

Air pollution is a problem for much of the globe, especially particulate matter. PM sources include electric-power plants, industrial facilities, automobiles, trucks, trains, ships, biomass burning, and fossil fuels used for heating (Rohde and Muller, 2015).

The impact of air pollution on economic growth is dominated by health effects like higher mortality, higher health expenditures, and lower production. Air pollution is estimated to cause between 3 and 7 million of the 9 million annual preventable deaths. Other economic losses may arise from crop losses attributable to air pollution, acidification, eutrophication, and the discouragement of tourism (IEA, 2016).

Pollution control has been shown to drive growth, and also to save more in benefits than is required for regulation. (US EPA, 2011)

4.2.5 Water

Population growth, urbanization, rapid economic growth and climate change have put increasing stress on our planet's water resources. Both water scarcity and declining water quality are global concerns. Water shortage is connected to food security, poverty, public health, conflict, energy production and ecosystem management (WWAP, 2015). A lack of sanitation is linked to malnutrition, poverty and disease – roughly 2.4 billion people worldwide do not have access to safe, affordable sanitation. An estimated 645,000 children younger than 5 years of age perish every year from diarrhea – a preventable, sanitation-related disease (WHO, 2016). To complicate the issue, global water demand is expected to increase by 55% by 2050. Though agriculture is anticipated to remain the largest user of water

(currently around 70%), water demand for manufacturing is expected to increase by 400%, for electricity by 140% and for domestic use by 130% (OECD, 2012; UN-Water, 2015).

Water quality has been impacted by human activities, which impact Biochemical Oxygen Demand (BOD), as well as Nitrogen (N) and Phosphorus (P) levels. Globally, 1 in 8 people are at high risk of water pollution from organic compounds, affecting BOD; 1 in 6 people are at high risk of N pollution and 1 in 4 people are at high risk of P pollution. Most of these people live in developing countries in Asia (Veolia and IFPRI, 2014).

The frequency and intensity of local water crises have been increasing, which have had severe impacts on food security, economic development and environmental sustainability. Solutions to these potential crises are available, including enhancing the resilience of the water system for irrigation, domestic, and industrial purposes through highly selective and efficient investments in infrastructure and in water governance. Even more important are water conservation and water use efficiency improvements in existing irrigation and water supply systems through water management reform, policy changes, and investment in advanced technology. The investments, policy reforms, and the water institutions must be tailored to local conditions, both ecologically and socio-economically (Rosegrant, Cai and Cline, 2005). There is enough water available to meet the world's growing needs, but not without dramatically changing the way water is used, managed and shared. The global water crisis is one of governance, much more than of resource availability. To allow water resources to enable rather than limit economic growth and sustainable development, this is where the bulk of the action is required (WWAP, 2015).

4.2.6 Food security

Food security has been theorized, analyzed and measured in different ways. It is a contested, evolving and multidimensional construct (Foran et al, 2014). Its early conceptualization relates to the “right to food”. Within the context of the Green Revolution, the idea evolved to “food self-sufficiency” (Chaifetz and Jagger, 2014), meaning the improvement of infrastructure, innovation and institutional governance. The imbalance between population growth and food availability was considered the main threat. Consequently, since the 1970s focus has been paid to agricultural productivity: the priority has been to meet demand.

A much broader understanding of food security was adopted by the World Food Summit in Rome in 1996, which included in addition to availability, access to affordability and utilization of food. The “stability” dimension was later added to the definition, given the recognition of resource scarcity (such as for phosphorus; Cordell and Neset, 2014) and the exacerbation of the environmental and climate change crises. The implications of which include crop productivity reduction, food safety, incidence and prevalence of foodborne diseases, rising food costs, and the potential unrest for land and resources (Ericksen, Ingram and Liverman, 2009; Tirado et al, 2010; Lobell and Burke, 2010; Rockström et al, 2011; Lin, 2001; Allouche, 2011; Brooks and Loevinsohn, 2011; McCann, 2011; Smith et al, 2014).

Globally, the percentage of undernourished has gone from 18.6% in 1990-92 to 10.9% in 2014-16 – equivalent to an absolute decline of about 216 million during a time when the population increased by 1.9 billion (FAO, IFAD and WFP, 2015). Currently, up to a third of total calories in developed countries are of animal origin (Kastner et al, 2012). Growing demand for meat and dairy products, particularly in emerging economies, is expected to be between two to three times its current levels, which means greater pressure on productivity and land demand (Ibid.).

Food insecurity under existing socioeconomic and environmental conditions could be reduced through a portfolio of policies and interventions, from improving transport, storage and communications infrastructure, to market incentives, trade regulation, social protection programs, resource efficiency, resilience increasing and coping strategies strengthening. Urban and peri-urban agriculture may be an additional strategy for food security and climate change mitigation, particularly in low-income countries (Barthel and Isendahl, 2013; Magnusson and Bergman, 2014; Poulsen et al, 2015). More profound transformations would need to review issues of land property and use; seed ownership and sharing; preservation of crops biodiversity and its associated knowledge; a reconsideration of the most convenient types of food production systems in socioecological and productive terms (including modern agroecology versus genetically modified organisms) while avoiding food waste (about 1.3 billion tons of wasted food are generated annually) and attaining aspects of reducing food demand by promoting diet changes.

4.2.7 Biodiversity

Biodiversity conservation, in the traditional sense, refers to the preservation of wild living species in protected areas and remnant wild lands, and the economic value of biodiversity is frequently conflated with the economic value of wildlife tourism. But biodiversity covers much more than endangered wild species, and biodiversity change covers much more than traditional conservation efforts. Biodiversity has changed as a result of people's decisions about which species to promote, and which to control, which gene stocks to build, and which to run down. The value of biodiversity to people lies in its role in the production of foods, fuels, and fibers, on the moderation of environmental threats, on disease and disease control, on the recreational, aesthetic, scientific, and educational benefits it offers,

and on many other things. All ‘ecosystem services’ depend either positively or negatively on the composition of species. In some cases, more biodiversity is better for people. Erosion control on hill slopes, for example, tends to be increasing in the number of grass species. On the other hand, the health of people living in the humid tropics tends to be decreasing in the number of disease vectors, parasites, and pathogens. Similarly, the production of foods, fuels, and fibers depends on reducing the number of crop competitors (weeds), crop predators (pests), and crop diseases (pathogens).

The impact of biodiversity on economic growth is mixed. In countries that are home to charismatic megafauna or flora (African savannas, pacific coral reefs, tropical rainforests) biodiversity is the basis for ecotourism—the most rapidly growing sector worldwide. In 2015, travel and tourism contributed US\$7.2 trillion or 9.8% of global GDP. In countries subject to climatic or geophysical extreme events (sub-tropical coastal areas in particular), the species richness of coastal and inland forests reduces the damage done by storms, floods, and tsunamis. We do not have estimates of the impact on Global GDP, but we do have estimates of the impact of individual events. The Indian Ocean Tsunami of 2004, for example, is thought to have caused damage of \$15 billion, mostly in areas without coastal protection. The production of foods, fuels, and fibers in agriculture, aquaculture, forestry and fisheries all depend on the conversion of habitat and the reduction of biodiversity. These industries together currently account for around 10% of global GDP. As with tourism, the importance of these industries varies widely.

4.2.8 Socio-economic metabolism

Modern economic growth has led to entirely new and intense forms of consumption, which include the rising use of fossil fuels, the emergence of novel technologies, the

expansion of infrastructures, and industrialization. Other changes include standardization process, mass production, just-in-time production and more recently the outsourcing of production within a context of a globalized market, the expansion of urban infrastructure, transportation and logistics, and of technologies such as the automobile, air transportation, petrochemicals, electronic communications, among others.

The amount, variety and intensity of goods and services consumption has changed drastically in the course of economic development. Analyses of historical consumption patterns of energy and materials show an increasing use of resources over time. The “metabolic profile”, or the energy and material average consumption patterns in biophysical terms, for hunter-gatherers has been estimated in about 10-20 GJ/cap/yr of energy and 0.5-1 ton/cap/yr of materials; for agrarian societies within 40-70 GJ/cap/yr and 3-6 ton/cap/yr; and for the industrial society between 150 to 400 GJ/cap/yr and 15 to 25 ton/cap/yr (Haberl et al, 2009).

The metabolic intensity of industrial societies, mainly, since the second half of the 20th century, or what has been called the Great Acceleration (Steffen et al, 2011), has resulted in a growing transgression of planetary boundaries, taking us further apart from the Holocene-like conditions which support human life, as well as other forms of life (Steffen et al, 2015). Data show that during that period, material and energy use increased 5.6 times faster than population (Schaffartzik et al, 2014). Yet, per capita consumption patterns were asymmetrical as they are associated to purchasing power and therefore to income levels. Hence, by the year 2000, 10% of world population consumed about 40% of energy and 27% of materials (Steinberg, Krausmann and Eisenmenger, 2010).

Energy and material consumption patterns, which reached a total consumption of 70.1 billion tons in 2010, or 10.1 tons per capita (UNEP, 2016), have been coupled with economic growth during the last century (Csereklyei and Stern, 2015); while the human population

increased fourfold and the economy grew about twenty times, material and energy use increased an average of tenfold: biomass consumption increased 3.5 times, energy consumption 12 times, ores and industrial minerals 19 times and construction minerals up to 34 times (case of cement) (Krausman et al, 2009; UNEP, 2011a). From 2000 to 2010 all material consumption, except for biomass, increased further: fossil fuels by 2.9%, metal ores by 3.5% and non-metallic minerals by 5.3% on average (UNEP, 2016) (See Figure 4.6).

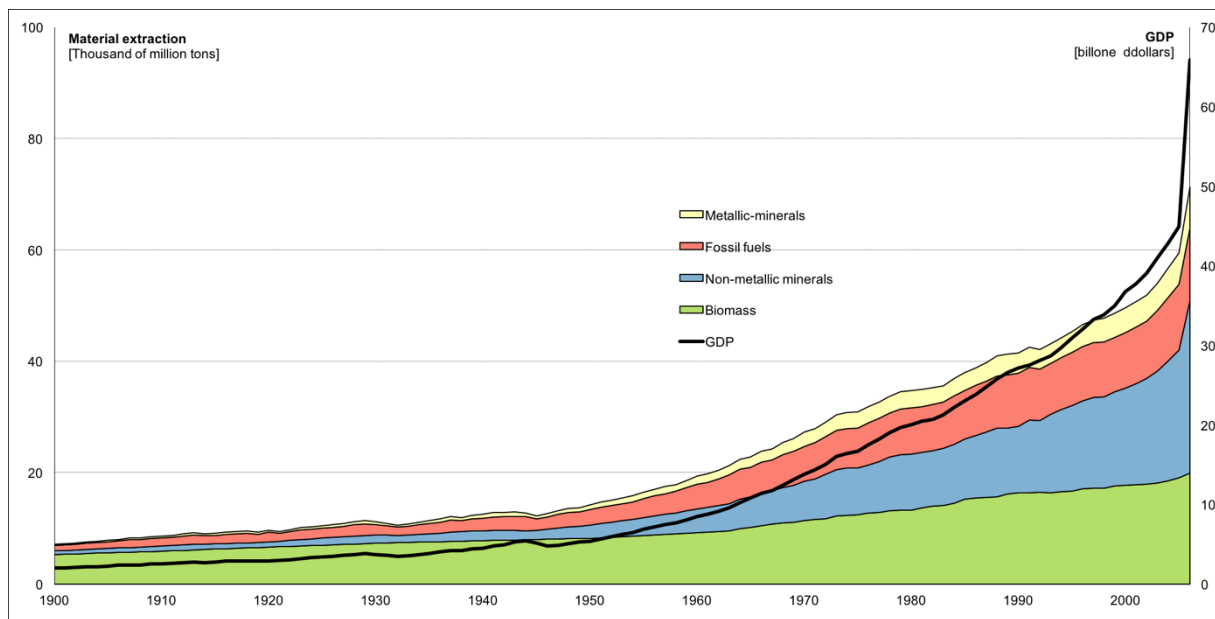


Figure 4.6: Material extraction and GDP, 1900 – 2010 (based on Krausmann et al, 2009; The World Bank data (<http://data.worldbank.org/indicator/NY.GDP.MKTP.CD>); and UNEP data (<http://environmentlive.unep.org/>)

A business as usual scenario may lead to an extraction of about 150 billion tons of resources annually by 2050 or almost three times the amount of the year 2000 (UNEP, 2011a); other estimations even consider a scenario of up to 180 billion tons (Schandl et al, 2016). Material stock, mainly urban infrastructure, utilities and vehicle fleet, will be of particular relevance as they increased 23-fold from 1900 to 2010, reaching 792 billion tons of which two-thirds were added since 1980 (Krausmann et al, 2017). Since 82% of all in-use material stock is 30 years or younger, pathways to reuse and recycling materials will be

central; only by 2030 about 35%, or 274 billion tons of materials, of the stock in-use in 2010 will be discarded (Ibid).

Opportunities for decoupling material consumption and stock formation from economic growth are already being explored through, for example, more efficient production technologies and practices, renewable energies, urban sustainable planning and development, behavioral and consumption adjustments, material substitutions and light weighting, extension of service lifetimes, or the reuse and recycling of materials (two key actions to additionally confront material supply risk and reserves depletion). For policy orientation, a sustainability corridor of material consumption patterns has been suggested at “10-2-5 target” of abiotic, biotic and used biotic and abiotic materials (UNEP, 2016).

4.3 Measuring sustainability: social and natural wealth

This section gives an overview of different methods for measuring wealth. Building on the introduction of GDP and GDP-based indicators in Section 1.2, Section 4.3.1 begins with a discussion of measurements of welfare that include non-marketed assets into the calculation of a GDP-like indicator, such as the net national product and genuine savings. The advantages of a whole dashboard of indicators for well-being are discussed in Section 4.3.2. Section 4.3.3 shows how public policy decisions can be drawn from such a dashboard of economic and well-being indicators by using the welfare diagnostics approach.

4.3.1 Aggregate indicators

As discussed in Section 1.2, GDP is only one aggregate measure of national productivity. In spite of its wide acceptance, measuring economic activity through GDP has

several drawbacks. A number of alternative measurements of income and sustainability were presented in Section 1.2 and 1.4 respectively. This section is focused on indicators that incorporate a number of social and natural wealth measures, reflecting those discussed in Sections 4.1 and 4.2 respectively.

Green accounting is a form of accounting that extends national income measures to include different concepts of sustainability, with a focus on the environment (Smulders, 2008). It develops a broader welfare base and allows welfare to depend on factors such as health, pollution levels or environmental quality. Altruistic preferences that account for inter- (and to a lesser extent intra-) generational inequality are also allowed. Several monetary measures for green accounting have been developed such as the (green) net national product (NNP), genuine savings (GS) and the index of sustainable economic welfare (ISEW).

The NNP takes the intertemporal component into account and factors in depreciation of physical capital and depletion of natural capital stocks (Weitzman, 1976). Non-marketed goods such as health and the environment are assigned values by using their shadow prices. These shadow prices can be interpreted as the opportunity cost in foregone consumption of investing in a non-marketed good.

The theoretical result that, if there are no externalities, or if all externalities are internalized by appropriate policy instruments, NNP is proportional to social welfare is sometimes called the Weitzman principle (Weitzman 1976, 2003).¹⁵ Some sustainability concepts are related to this principle, such as the Hartwick (1977) rule that states that investing all profits and rents from exhaustible resource extraction into physical capital allows a society to maintain a constant level of utility. This is equivalent to green net investment being zero (Smulders, 2008). In reality, however, several externalities are likely not to be

¹⁵ Asheim and Weitzman (2001) evaluate under which conditions the Weitzman principle holds when NNP is measured in monetary rather than utility terms.

internalized and factors such as exogenous technological change and changing global prices invalidate the finding that zero green net investment implies sustainability (Asheim et al., 2007).

NNP is theoretically neat and has inspired some practical approaches to define wealth in a broader way, see Section 3.1. However, NNP has several shortcomings and two major lines of criticism have emerged: The first is the difficulty of implementing it in practice. The second is that it suffers from some of the same conceptual shortcomings as GDP like ignoring the unequal distribution of wealth in society and not considering the possibility of changing preferences.

Putting NNP into practice requires determining the value of variables other than consumption. In simple cases the value of capital stocks other than private capital is given by the marginal rate of substitution between consumption and the other variable. How many units of consumption would society be willing to sacrifice for one unit of improvement in the state of nature for example? The marginal rate of substitution is difficult to measure with precision.

Fleurbaey and Blanchet (2013, Section 3.5) identify two additional difficulties in measuring the prices required for the calculation of NNP. The first is that many individuals cannot freely choose the exact consumption bundles they would prefer, in particular concerning exactly how many hours they would like to work. In this case market prices (like wages) do not reflect the true appreciation for goods (like leisure). The second is that individuals appreciate goods like leisure differently so that there is no unique market price for these goods. In order to replace market prices, which do not reflect the value of a good in society when markets work imperfectly, Fleurbaey and Blanchet (2013) propose the use of the willingness-to-pay, which reflects the true appreciation of individuals for a good.

NNP thereby offers an improvement over GDP in two important ways. It identifies variables other than consumption that contribute to the wealth of society and it gives a guideline on their importance relative to GDP. Like GDP, however, it does not address inequality. NNP is concerned only with aggregate values and is blind to the distribution of wealth in society. Monetary aggregates often implicitly assume that the measured aggregate quantities are distributed equally. If this condition is not met, welfare can be improved by improving the allocation without changing the aggregate quantities. Refinements to monetary aggregates such as presented in Jorgenson (1990) can take inequality into account, but even those lead to problematic results when personal abilities and needs are unequal (Fleurbaey, 2009, Section 2.4).

4.3.2 A disaggregated dashboard of welfare indicators

In 2008, a commission was created to assess how to improve the statistical information about the status of the economy and society - the “Commission on the Measurement of Economic Performance and Social Progress” (CMEPSP). The commission’s report comes to several important conclusions, which can be summarized as follows (Stiglitz et al. 2009): First, the perspective should shift from production-based indicators to indicators of well-being. Second, well-being is multidimensional (and in large parts subjective), it includes material living standards, health, education, personal activities including work, political voice and governance, social aspects, environment (present and future conditions) and insecurity (economic and physical). Third, measuring sustainability involves the future and hence always requires taking normative assumptions. Sustainability should be examined separately from well-being, since a high current level of well-being can be achieved at the cost of low sustainability, while increased sustainability today may imply lower levels of

current well-being. In order to measure sustainability several indicators are needed that measure changes in the quality and quantity of stocks that matter for future well-being such as natural, human and physical capital.

Regarding the third point, the measurement of sustainability, Stiglitz et al. (2009) discuss the advantages and the shortcomings of using a set of indicators, instead of aggregating the indicators into one number. Both, monetary and non-monetary measures would be necessary for deriving sound policy advice from such a dashboard of indicators. Such a set of indicators can be interpreted as analogous to a car's dashboard: If all the indicators in the dashboard of a car such as gasoline level, speed and revolutions per minute would be aggregated into one single indicator, this indicator would not be very helpful.

The CMEPSP made great progress in providing tools for the measurement of social progress, it did not, however, develop recommendations on how to draw public policy decisions from such a set of indicators.

4.3.3 Welfare diagnostics

As discussed above, there is a broad spectrum of possible perspectives on how one can define well-being (see Section 3). For this reason, a flexible approach that encompasses the concept of social welfare from the perspective of multiple policy objectives is required as a basis for policy-making.

Even though public policy cannot optimize social welfare, it can nevertheless aim at removing the most serious obstacles to human well-being (Jakob and Edenhofer, 2014). This so-called 'welfare diagnostics' aims to identify factors that are essential for human well-being—i.e. basic needs—and correcting deficiencies. Welfare diagnostics can be understood as a process that includes the following three steps:

1. Identify the relevant dimensions of welfare (e.g. consumption possibilities and their distribution, or capabilities) as well as the trade-offs between them. Define minimum thresholds for environmental quality and human development.

2. Establish limits regarding the use of natural resources in line with the feasibility set from step 1 by means of fiscal policies, such as Pigouvian taxes, tradable permit schemes, or resource rent taxes. Appropriate the associated rents to the public budget.

3. Use the revenues from step 2 to invest in infrastructure required to meet the minimal thresholds for human development defined in step 1. That is, revenues from e.g. carbon pricing could be used to finance water or electricity access.

As public deliberation is crucially important to determine which factors matter for social welfare, how basic needs are to be defined, how trade-offs between them should be assessed, and how individual indicators of well-being are added up to a social indicator (see also Chapter 3), welfare diagnostics is also closely related to the capabilities approach discussed in Section 3.1.3.

Welfare diagnostics identifies determinants of well-being that are considered essential (basic goods such as access to clean water and hygiene) (Jakob and Edenhofer, 2014). It then aims at increasing the supply of these basic goods. Large groups of individuals with potentially different views about social welfare could agree to such policies. Not all factors of well-being have to be at their optimal levels to enhance social welfare (Hausman et al., 2005). Therefore, a more pragmatic approach that aims at correcting major deficiencies already leads to large increases in social welfare.

Minimum thresholds (so-called ‘guardrails’) can be established for capital stocks essential to welfare. Welfare diagnostics can provide some guidance on how to simultaneously address over-use of natural resources and under-provision of access to infrastructure services (such as water, sanitation, electricity, health, education...) that are

fundamental for human development. The central task for public policy is then to ensure the attainment of these minimum thresholds for sustainable development.

In order to successfully carry out welfare diagnostics, policy-makers need accurate scientific information on environmental limits as well as the economic, technological and institutional requirements to remain within these boundaries. For instance, for the case of climate change, the benefits of slowing down global warming would need to be compared with mitigation costs and potential risks of key technologies to reduce emissions, such as use of bio-energy, carbon capture and sequestration, or nuclear power (Jakob and Steckel 2016).

However, defining thresholds and deciding what constitutes a socially acceptable risk is an inherently normative question that cannot be answered by scientists but requires public deliberation (Edenhofer and Kowarsch 2015). For this reason, participative democracy is a fundamental cornerstone to express social preferences and guide policy decisions aiming to find the right balance between short term exigencies of human development and long-term considerations to safeguard environmental quality.

Measures such as those proposed above may have important distributional impacts across time and income groups. For instance, infrastructure access will likely be obtained only after a certain time period needed for construction, but higher energy prices are experienced immediately. For this reason, well-designed policy packages that prevent adverse distributional impacts and compensate political losers need to be devised (IMF 2013).

5. Governing the commons – overcoming the under-provision of social commons and avoiding the exploitation of natural commons

Economic activity often involves the utilization of natural resources such as oceans, forests and the atmosphere. Governance is needed to keep the exploitation of these natural

commons in check (1.1.2), and is a key ingredient of the “third way” of creating economic growth without environmental degradation (1.1.3). At the global level, the overuse of natural commons is particularly severe because international treaties have proven a poor and difficult substitute for the absent global authority (5.1). Learning from successes in managing local common-pool resources (5.2) could be the foundation of a polycentric governance of global commons (5.3).

5.1 The problem of Collective Action

5.1.1 Tragedy of the commons

The definition of global commons and their influences by and on economic growth were discussed in Section 1.5. Commons problems usually relate to common-pool resources (CPRs), or underprovided and impure public goods.

Garrett Hardin’s (1968) influential analysis of the “tragedy of the commons” had established the perception that common pool resources (CPRs) are prone to overuse and collapse unless either private property or central state solutions are implemented. However, subsequent research particularly by Elinor Ostrom (1990) clarified that Hardin’s analysis more specifically addressed a “tragedy of open-access”. Ostrom finds empirically that humans routinely devise complex governance arrangements to transform open-access situations into regulated commons regimes. Strategies for ensuring the sustainable use of CPR systems often focus on strengthening the degree of excludability, i.e. assigning property rights to ensure enclosure of the resource system or parts of its output. Successful commons governance in these cases works through establishing a private good or club good, often including decisions on distribution or exclusion. Commons management also often involves the provision of

public goods, such as technologies that reduce the costs of protecting the commons (for example, low-carbon energy technologies in the case of protecting the atmospheric commons). It is important to clarify that there is no single “right” governance or property regime for goods or resource systems with CPR or public good characteristics. An unregulated forest has the characteristics of a CPR, but its sustainable use can be organized via privatization, state property or any other form of mixed property rights assignment including common ownership. The choice of governance often has severe implications regarding the distribution of wealth, and should be guided by principles of justice.

Governance of commons is not about a blunt call for implementing common property regimes wherever possible, but a specification of complex rules and property rights. In the context of commons governance property rights refer to a bundle of rights including the authority to undertake particular actions, including rights of access, withdrawal, management, alienation (i.e. sale), appropriation of value, or exclusion from a resource (Ostrom 2000, Barnes 2006). The private owner of a forest, for example, may choose to delegate access or harvesting rights to other individuals or group agents. Addressing questions of commons governance often includes addressing highly controversial questions of inclusion and exclusion, of initial entitlement and legitimate ownership.

A key challenge of global commons governance is that they are either situated outside national jurisdiction or their conservation and sustainable use conflicts with national sovereignty and regulation. Their use may affect different levels of governance in distinct ways, often requiring global cooperation. Yet, policies to govern the global commons will often conflict significantly with existing patterns of resource use, sovereignty rights and other related well-established interests. Additionally, most global commons interact with other global resource systems, i.e. management of one common will most likely also impact the use of others.

5.1.2 Global perspective without world government

The management of global commons, however, cannot be delegated to a central authority but involves negotiation and agreement by up to 200 sovereign states and other stakeholders such as industry and civil society groups. Managing global commons thus becomes a collective action challenge: while it is in everybody's interest that some management scheme is implemented, there are strong free riding incentives for the individual state (or actor) not to comply (cf. Sandler 2004, Barrett 2007).

Thus a key approach to manage global commons has been establishing multilateral institutions through international agreements (Barrett 2007), and to make participation as broad and as ambitious as possible. However, achieving this turns out to be difficult. For the case of environmental commons, Barrett (2003) reviews more than 300 treaties but observes that most of the treaties do not succeed in making a difference. The academic game theory literature that investigates the underlying causes for this cooperation failure (Heal 1992, Carraro and Siniscalco 1993, Barrett 1994), pinned down strong free riding incentives as the culprit for low cooperation and/or little ambition of international environmental agreements. An extensive body of literature explored designs of environmental treaties to overcome the cooperation failure, which included minimum participation clauses (Carraro et al, 2009), sanctions (Nordhaus, 2015) and rewards or transfer payments (Lessmann et al., 2015). These studies were summarized in Benckekroun and Van Long (2012) and Carraro (2014).

5.2 Successful management of the commons

5.2.1 Taxes, property right and regulation

The neoclassical economic tradition has long since come up with solutions for a strong central state to prevent an overuse of natural commons. Overuse of commons is driven by the social costs of utilizing a commons exceeding the individual costs. Taxing the individual for accessing the commons at the marginal social costs, as suggested by Arthur C. Pigou, will therefore align individual and social interests. The so-called Pigouvian tax will thus trigger the socially optimal utilization of the commons (Pigou 1920).

The same can, however, be achieved with (arguably) less intervention by the state: If the state merely establishes property rights, i.e. access rights to the commons, and if these permits can be traded at no cost, then bargaining among private agents for these permits will achieve the same socially optimal utilization (Coase 1960).

Although theoretically equivalent in the outcome, the Coasean perspective has emphasized the benefits of a smaller role of the state and the informational problems for the state to know the socially optimal utilization. By contrast, the Pigouvian perspective has pointed out that trading permits is hardly without costs, and thus Coasean bargaining is therefore likely inefficient in situations with large numbers of agents (Hovenkamp 2009).

Beyond arguments of political economy and transactions costs, the equivalence of price and quantity instruments (here: Pigouvian tax vs. Coasean bargaining) frequently breaks down when the restrictive idealized assumptions are relaxed. Weitzman (1974) showed that under uncertainty, the ratio of marginal costs and marginal benefits of accessing the commons is distinctive for the superiority of one instrument over the other, sparking a branch of literature on “prices vs. quantities” (cf. Hepburn 2006 for a survey). For the specific case of the uncertainties associated with climate change, for example, a price instrument has been shown to be superior (Newell and Pizer 2003).

Contrary to the intuition that additional instruments improve welfare, the efficiency of Pigouvian taxes is undermined if private actors additionally engage (uncoordinated) in Coasean bargaining (Buchanan and Stumblebine 1962, Turvey 1963). But again, this result is turned on its head if (ex ante) transaction costs of bargaining are high (MacKenzie and Ohndorf 2016). Lehmann (2012) identifies a range of situation where a mix of multiple instruments improves over the outcome with a single pricing instrument.

Applied to global commons, the choice between price or quantity instruments translates to choosing between a global tax on the utilization (e.g. harvesting or polluting) or a global trading scheme for rights to utilize or pollute (Stavins 2010). According to Stavins, in the final analysis only few differences between a tax and a permit trading scheme remain, and even among environmental economists preference for one instrument over the other is unsettled (Goulder and Schein 2013). There is, however, overwhelming consent that it is essential to (a) establish a price for accessing commons, and (b) in doing so, rely on one of the market based instruments, i.e. a tax or a permit trade system.

One asymmetry between tax and trading identified in recent research with particular relevance in the context of polycentric global commons management concerns their different properties in enabling heterogeneous actors to express diverging preferences for the commons (Goulder and Stavins 2011; Williams 2012; IPCC 2015, Chapter 15). For example, in the context of a greenhouse gas (GHG) cap-and-trade system unilateral efforts to enhance mitigation efforts by states or other actors, e.g. via additional policies such as renewable feed-in tariffs, have been shown to have no impact on carbon emissions. Still, additional policies can be merited to address other externalities, such as those related to learning-by-doing in new technologies. By contrast, with a price instrument (e.g. a GHG tax or minimum price in an

ETS 16) unilaterally-enhanced abatement can increase the overall amount of emission reductions, if the price signal for other covered emission sources remains unchanged.

5.2.2 Political economy and rent-seeking

Even if an ideal policy to manage externalities exists, implementing it successfully requires overcoming political hurdles. Environmental policies to manage a common are bound to generate winners (e.g. occupants of vulnerable sites and future generations) and losers (e.g. businesses and sometimes consumers). In addition to the political-economy problem of garnering sufficient support from the population, policy changes are subject to rent-seeking, whereby political actors aim to steer policy for their private benefit. The problem is even more pronounced when several tiers of government interact (national, state and maybe even municipal). These challenges can be illustrated using the example of carbon pricing, as outlined in Section 5.2.1.

Carbon pricing affects the entirety of the population, who sees e.g. the price of gasoline and electricity rise as a result. In some low- and middle-income countries, this may actually be progressive, meaning that the poor suffer disproportionately less (Brenner et al, 2007; Datta, 2010; Nurdianto and Resosudarmo, 2016). This is but a mild consolation, considering that this progressivity occurs, in particular, where the income distribution is so unequal that the poorest are unable to afford energy-intensive goods. By contrast, high-income countries tend to experience regressive distributional impacts (Stern, 2012; Flues and Thomas, 2015). Significant carbon pricing (and ambitious climate policy more generally) also distributes costs and benefits unevenly across groups with asymmetric political influence.

¹⁶ Minimum prices in cap-and-trade systems have e.g. been implemented in California, Quebec, the Northeastern US RGGI trading system, and some Chinese provincial ETS (ICAP 2016).

While costs are concentrated on the present and particularly affect well-organized interest groups such as the fossil resource industry, the benefits of climate change mitigation (reduced climate change impacts) accrue to future generations and the dispersed global population, which is hardly politically organized at all (Victor 2007). These concerns help explain why, when priced, carbon is priced far below most estimates of the 'social cost of carbon' (World Bank and Ecofys, 2016), which is the price that would yield an optimal reduction in GHG emissions.

Even if set below the social cost of carbon, a carbon price (tax or permit auctions) could generate sizeable government revenues. Should the political-economy challenges to raise revenues from climate policy be overcome, a government faces another set of challenges in how funds should be allocated. Both sets of challenges cannot be completely disentangled because public support for carbon pricing depends on revenue usage. More support is given to revenue recycling that is geared towards environmental projects or returned to the population in a revenue neutral way than when usage is unspecified or destined to national debt reduction (Kallbekken et al, 2011; Amdur et al, 2014). Support could also be garnered by lowering taxes for those who would be more adversely affected by the climate policy – or who would oppose it the most – in a sort of ‘double dividend’ fashion, but with an emphasis on redistribution (Klenert et al., 2017; see also Dissou and Siddiqui, 2014). Alternatively, revenues maybe be earmarked for financing specific projects, e.g. building social commons such as public infrastructure. Earmarking, however, is controversial. As there is no relation between the amount of revenue generated by climate policy and the revenue that should be spent on any given project, it is not clear how much should be allocated to each project (Parry, 2016). Hence, infrastructure funding is best done nationally rather than through earmarks that target specific infrastructures separately (Marron and Morris, 2016). Moreover, the funds available for such projects will have to be what remains after transfers and programs

benefitting the political losers—transfers for the general population, especially the poor, and re-training programs for the displaced workforce—are made.

5.2.3 Social norms, informal institutions and social movements

Prospects of commons management via self-organization of local communities may be more promising (Ostrom 1990; Ostrom 2009). Successful local CPR management via different forms of cooperative management regimes is possible, though success depends on a number of design principles (Ostrom 2000). Humans do self-organize and succeed in problem-solving even in situations with weak individual incentives for cooperation – but not always. Facilitative formal and informal institutions enable people to carry out their management roles (Ostrom 2010b), including mechanisms such as effective monitoring, conflict-resolution or sanctioning for non-compliance, and devising rights to organize and to participate in rule-setting (Dietz et al. 2003).

Findings in experimental (behavioral) economics in recent decades have provided the empirical and theoretical underpinnings for this understanding of human capacities for successful cooperation despite pervasive incentives for free-riding by self-interested agents (Ostrom and Walker 2002; Carlsson and Johansson 2012; Fehr and Fehr 2016). It can be shown that humans are conditional cooperators, especially in reciprocal settings. Many humans are not purely self-interested but have other-regarding preferences. Face-to-face communication and trust are particularly conducive to such behavior. As the perception of fairness matters for the agents' willingness to cooperate, burden-sharing and transfer mechanisms among asymmetric players can further facilitate cooperation. This is in stark contrast to the neoclassical perspective on the homo economicus and explains the divergence of neoclassic pessimism and the optimistic message from Ostrom's research.

5.3 Up-scaling to the global level: polycentric governance of global commons?

Sustainable governance of global commons is increasingly important to maintain global prosperity and human well-being in the 21st century, e.g. related to problems of climate change (see Section 4.2.3), biodiversity loss (see Section 4.2.7) or access to and conservation of other ecosystem services. Compared to local commons, global commons problems face a set of additional difficulties, especially due to challenges of scale, diversity, and complexity (Ostrom 1999, Stern 2011, Ostrom 2014). Research following Ostrom can offer at least two useful directions to mitigate and partly overcome global collective-action challenges: applying lessons to international negotiations (Section 5.3.2) and taking a polycentric perspective for global problems (Section 5.3.3).

5.3.1 Upscaling local lessons to the international level

Lessons may be taken from successful local commons management to enhance cooperation among states on the international level. Some have argued that the community of international negotiators may exhibit dynamics similar to CPR settings with low number of participants (“small-N”), and applying lessons from smaller scale CPR and experimental research may be applicable in this context (Messner et al. 2013; LeVeck et al. 2014). For example, research has shown that repeated communication affects trust levels, which themselves substantially determine levels of cooperation (Cole 2015). Positive experience of cooperation can further enhance mutual reputation and trust, potentially resulting in even higher cooperation levels. Graduated sanctions and rewards through transfers, and monitoring and compliance mechanisms can also catalyze trust-building and help deter free-riding. It

remains an open question if lessons from small-N settings can indeed be applied to the international level where negotiators are embedded in principal-agent relationships with their governments and population (Putnam 1988) that are critical for structuring their behavior.

5.3.2 A polycentric approach

Local lessons may also be applied where the harsh dichotomy between top-down and bottom-up approaches to global commons governance is transcended in efforts that include the broad array of sub-international actors (Ostrom 2010a; Ostrom 2010c). Many problems with global commons properties need some kind of international action to be properly addressed – they all are also dependent on implementation, compliance, or even structural changes on several subsidiary policy levels. As there is no first-best monocentric governance architecture for global commons problems, polycentric theory stresses the benefits and needs of an adaptive and decentralized system of multiple self-governing and interacting units of different scale across policy levels (Dorsch and Flachsland 2017). Recognizing site-specific conditions, i.e. heterogeneous preferences as well as heterogeneous competencies and constraints of different actors, enables policy design to realize site-specific co-benefits and to mitigate costs (Dalmazzone 2006). Participation in smaller units can foster self-organization and trust-building, while the interaction between units can foster mutual learning and diffusion of norms (Shobe and Burtraw 2012; Hoffmann 2011; Hulme 2009). Externalities between subsidiary groups can be addressed in larger organizational settings, i.e. to avoid conflicting policies.

The prevalent task for real-world multi-level governance arrangements is then to mobilize collective action at several scales by organizing this interplay of interests, capabilities and externalities productively. Also, transfer schemes among different groups

with asymmetric preferences can be used to enable higher levels of ambition by providing compensation for increased policy ambition on behalf of those particularly able and willing to provide such compensation.

5.3.3 Polycentric climate governance architecture

Empirically, most global commons problems like climate change mitigation are to a large extent already addressed via polycentric policy approaches, encompassing international agreements as well as a multitude of subsidiary policies, institutions and civil engagement on the local, national and regional level all over the globe (Jordan et al. 2015; Paavola 2011). These arrangements include traditional state-led and market instruments as well as other forms of climate action by different state and non-state actors.

Still, national governments remain key actors not only for international multilateralism. Many nation states adopt a growing number of unilateral climate policies and strategies (Dubash et al. 2013, Nachmany et al. 2015), coordinate and mutually foster their climate policies in bi- and minilateral agreements (like US-CHN, G7/G20, EU; see Falkner 2015), but also provide various support functions for non-state initiatives (Hickmann 2016; Hale and Roger 2014).

In many cases, regardless of the specific interests of their national governments, sub-national entities such as states and cities can also be policy drivers (e.g. for California, Rabe 2010 and Urpelainen 2009, for cities, Hakelberg 2014). In transnational networks such as the C40 Cities Climate Leadership Group, the ICLEI Local Governments for Sustainability network or the World Mayors Council, sub-national governments as well as non-state actors self-organize to commit to specific climate and energy targets, introduce review schemes and foster policy transfer through information sharing or capacity building (Hoffman 2011,

Bulkeley et al. 2014). Additionally, a broad range of climate action by non-state actors is evident – from business self-regulation, civil society groups, universities, foundations or individuals (e.g. UNEP 2015, Partzsch and Ziegler 2011). Given the encyclical intervention *Laudato Si* by Pope Francis, even religious groups contribute to the eclectic but increasingly meaningful emerging global climate governance landscape (Edenhofer et al. 2016).

Efforts at achieving such international agreements remain necessary to address international free-riding incentives, but they are already characterized and complemented by polycentric governance structures aiming not only at ensuring implementation but also at harnessing decentralized potentials for mitigation.

5.4 Robust and context specific policies

Strategies for governing the commons should prove robust, able to meet multiple near- and longer-term goals even in the face of deep uncertainty regarding the efficacy of specific actions and how the future might evolve. In some cases, identifying a robust strategy can prove simple. But as systems come under increasing stress, identifying and implementing robust strategies can prove more difficult, in particular considering the ethical implications of many management choices. In recent years, the processes and tools for providing quantitative, evidence-based, multi-objective, multi-scenario decision support have grown sufficiently mature to help identify robust strategies for addressing complex challenges of managing the commons.

In laying the context for such processes and tools it proves useful to frame two broad approaches to social choice in polycentric governance systems, described by Sen (2009) as transcendental and relational reasoning. The former seeks to first envision a common vision of a perfectly just world, which can then be used to inform our near-term choices. (Rawls,

1971) This approach infuses much climate policy and its supporting quantitative analysis. Among its virtues, transcendental reasoning provides a clarity of purpose that may add in communication and coordinating diverse action across a polycentric society.

Relational reasoning posits that two fundamental attributes of our world include irreducible uncertainty about the consequences of our actions and a diversity of priorities, goals, and values. With such attributes, no transcendental vision of the type envisioned by Rawls would be possible because the level of agreement it presupposes does not (and ideally should not) exist in a diverse society. Neither would any common transcendental vision prove sufficient to inform near-term choices, because the uncertainties are too deep to chart an unambiguous path to the ideal. Relational reasoning thus envisions an iterative process of deliberative social choice that seeks to distinguish more just choices from less just choices in the face of imperfect knowledge and conflicting goals. A variety of literatures also embrace this view as both an apt description of reality as well as a normative ideal, including concepts of risk governance (Renn 2008), democratic experimentalism (Ansell 2011), and the broadly inclusive socio-technical experiments (Stilgoe 2015) envisioned in the science policy literature. Policy frameworks such as the Paris Agreement include both transcendental and relational elements, the former in its temperature targets and the latter in its iterative pledge and review process of national pledges.

A key challenge for relational reasoning is assuring that an iterated set of choices converges to acceptable near and longer-term outcomes. To prove successful, such processes should result in policy choices that prove robust and adaptive, that is, meet multiple objectives over a wide range of plausible scenarios (Lempert et al. 2001, Lempert et al. 2003, Walker et al. 2010). This can prove particularly challenging in contexts of polycentric governance that involve complex systems with path dependence and threshold behaviors.

As one means to address this challenge, quantitative tools for multi-objective robust optimization (Kasprzyk et al. 2013), scenario discovery (Lempert 2013), and exploratory modeling (Bankes 1993) have increasingly been combined to support iterative, participatory decision processes similar to the “pragmatic-enlightened model” (PEM) approach (Edenhofer et al. 2015) described in Section 4.3.3. The most advanced examples involve adapting to the impacts of climate change. For instance, four neighboring cities in North Carolina, USA – Raleigh, Durham, Chapel Hill, and Cary – have linked their previously independent water supply systems to improve risk management in the face of increased climate variability, in particular an increased prevalence of drought (Zeff et al. 2014, Zeff et al. 2016). Examples of such multi-jurisdictional robust strategies for reducing greenhouse gas emissions are harder to find. Some jurisdictions have begun to link carbon price regimes, which should increase efficiency, but without any guarantees that multi-decadal reduction goals will be met in the face of many uncertainties. Some analyses have examined how emission reduction goals depend on alternative definitions of social welfare (Drouet et al. 2015, Adler et al. 2016, Garner et al. 2016) or the long-term policy persistence (Patashnik, 2014) of alternative carbon pricing compensation schemes (Isley et al. 2015). But such analyses have not yet been incorporated into polycentric decision processes that seek robust near-term actions in the face of deep uncertainty about the consequences of human choices regarding greenhouse gas emissions and a diversity of views on how to value those consequences.

6. Conclusions & Action Toolbox

Economic activity clearly is not a complete measure of social welfare. For this reason, economic growth cannot be characterized as ‘only good’ or ‘only bad’, as the two polar narratives in the introduction suggest. Rather, social welfare includes a number of social and

environmental dimensions in addition to material consumption. Similarly, the wealth of a given society cannot exclusively be measured in terms of physical capital, but also includes social and environmental capital as reflected in Section 4. Protecting and growing social and environmental capital requires a much better management of the global commons as described in Section 5.

So how can this fundamental insight be translated to policy action? Section 3 gives a wealth of ideas on how welfare can be measured in better ways than in gross domestic product (GDP). These can be used as a starting point for three blocks of action (summarized in Table 4.2):

First, governments would have to define a set of welfare indicators that can be used to assess how far implemented or proposed policies either have contributed or are expected to contribute towards social objectives. While scientist can generate knowledge and communicate policy options it is the responsibility of politicians to make value judgements. A welfare indicator is a way of making these value judgements transparent and justify policy choices. International organizations could perform important tasks in collecting the information necessary to establish welfare indicators (for example by measuring social and environmental capital), help to transfer knowledge across jurisdictions and make different indicators comparable. By elicitation of social preferences, civil society and citizens could contribute to the choice of which welfare dimensions should be included in the respective indicators. NGOs may also have an important role to ensure that the reporting is conducted in a transparent and objective manner.

Second, the welfare indicators can then be used to identify bottlenecks. Bottlenecks in this context are those policy changes or government actions that would achieve the greatest improvements in social welfare. For instance, in countries with high levels of poverty, the bottleneck might be a reform policy to increase economic performance, measured in an

increase in GDP, whereas in a country where pollution threatens human health, environmental regulation might be the most important bottleneck. NGOs and citizens could create demand for reforms of public policies by identifying bottlenecks and communicating them to the public sector. Governments would need to design roadmaps to guide bold long-term reforms that can address the most important bottlenecks. International organizations could provide technical expertise to link the identification of a bottleneck to the design of responding policy.

Third, governments would need to seek to actively learn how to implement robust and effective policy instruments and overcome political resistance, e.g. by means of appropriate compensation schemes. This requires policy makers to engage in an ongoing process of innovating, evaluating, comparing and refining policies. The basis of evaluation would be the welfare indicator selected in the first step. International organizations could support the process by gathering data on best practices and by offering technical expertise in the design of policies for given objectives defined by the government. NGOs and citizens would need to provide feedback on the experiences with implemented policy and to draw attention to dysfunctional aspects and adverse side-effects of adopted policies.

Table 4.2: Overview of how policy-makers, international organizations and civil society can participate in the definition of welfare indicators, identification of bottlenecks and implementation of policies.

Action	Policy-makers	International Organizations	NGOs and individual citizens
Definition of welfare indicators	Monitoring and reporting of indicators.	Data collection; harmonization and comparison of indicators.	Elicitation of social preferences; holding governments accountable for reporting.
Identification of	Design roadmaps to	Link the identification	Identify bottlenecks and

bottlenecks	guide reforms.	of a bottleneck to policy design.	communicate them to the public sector.
Implementation of Policies	Implement policy instruments; overcome political resistance	Gather data on best practices.	Provide feedback on the experiences with policy; draw attention to problems and adverse side-effects.

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