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Poverty, Inequality, the Environment and Social Issues

Introduction

One of the most hotly debated issues is the actual path of world poverty and inequality and its relation to openness. The analysis of public goods of Chapter 5 of Volume I is extended in a specific section to regional, international and global public goods GPG.

An individual section considers the economics of analysis of the environment and its relation to openness. Climate change is allegedly the largest market failure in history, generating a debate on the types of required economic policies. There are major research efforts to uncover empirically the relationship between political regime, mostly democracy, and openness.

Global poverty and inequality

There is no conclusive evidence on the relationship of globalization to poverty and inequality among and within countries. There is no evidence that openness causes an increase in poverty. Theory suggests that economic growth diminishes poverty. Openness is one of various forms to increase economic growth. There are many factors operating on growth at the same time, preventing isolation of the effects of openness. The literature is vast and conflicting. In addition, various arguments are based on value judgments. The differences in judgments prevent comparisons. On a narrow definition of a poverty line, poverty has decreased. There is controversy on the definition of poverty that limits the research design and conclusions. A significant portion of the poor of the world concentrates in China and India because of the large population of these countries. The increase in the rate of growth of these two countries, especially in China, accounts for a major part of the reduction of world poverty. The issue of inequality is more complex. There appears to be a strong case for the argument that economic growth is the only way for the poor to escape poverty.

In their comprehensive and deep survey of the literature on trade liberalization and poverty, Winters *et al.* (2004, 72) claim that the accepted view by most economists is that open economies have better performance than closed

economies and that policies of open exchange make significant contributions to economic development. They are aware of the concern of many analysts that the poor may suffer from liberalizing policies and that even in the long term some people remain in poverty. Distributional effects are likely to occur in shocks of openness. An important research issue is the nature and extent of these effects. If there were cases in which liberalization is the only shock, it would be possible to isolate effects of openness on distribution and poverty. As in all economics, many shocks occur simultaneously. Winters *et al.* (2004) propose the decomposition of the effects into multiple steps to analyze them individually.

A key result from systematic analysis of the empirical literature is that it is not possible to obtain a general conclusion on the relationship between trade liberalization and poverty (Winters *et al.* 2004, 106). According to theory, trade liberalization will alleviate poverty on average and in the long term, with broad supporting empirical evidence. There is no empirical support for the proposition that trade liberalization worsens poverty. However, the evidence does not indicate that trade liberalization is one of the key factors of reduction of poverty or that the static gains from trade always benefit the poor. The essence of the explanation is the familiar displacement of some people and firms in the short term, which may include some of the poor.

The empirical evidence surveyed by Winters *et al.* (2004) strongly supports the view that trade liberalization has significant positive effects on productivity. There is no strong empirical support for the view that liberalization has general adverse effects on employment or wages of the poor. However, there is insufficient evidence on transitions of employment and the transfer of price effects resulting from trade liberalization.

A distinguishing characteristic of the nineteenth century was innovation, consisting of the application of science to developing new goods and improving production (Becker 1994). This effort began in Great Britain during the industrial revolution and then spread to Europe (Cameron 1961). Becker (1994) calls the twentieth century the “age of human capital” because the success in improving a country’s living conditions depends on its success in developing and using “the skills, knowledge, health and habits of the population.” Human capital consists of education, on-the-job training, other training and health; it consists of about 80 percent of the capital or wealth of the United States and other developed countries. Becker (1994) argues that the countries in East Asia, such as Japan, Taiwan, Hong Kong and South Korea, compensated with human capital their lack of natural resources and the discrimination against their products in the West. Policies of improving human capital cut across cultural barriers, producing success stories in Latin America and Africa. Machines are important in this view but they require human capital to operate them and manage the firms.

It is difficult to separate in empirical research the effects of higher economic integration on poverty and inequality from other effects (Ravallion 2004, 3). There are diverse types of outcome of the impact of integration policies depending on the structure of countries. Generalizations are difficult for samples of many countries but disagreement may be less sharp when focusing on an individual country.

In addition, the various sides of the debate have different values on what should be a fair distribution of the gains from economic integration. There are different value judgments in how the gains should be measured. However, the differing ethical judgments are not necessarily discussed in the debate in explicit form.

There are three discrepancies on the methods of measuring poverty and inequality that, according to Ravallion (2004), depend on value judgments. The first discrepancy is in whether countries are weighted or not by population in measuring the change in poverty that could result from increasing economic integration. If countries are weighted by population, there has been significant decline in the inequality among nations in the past 50 years. This is the method advocated by the proponents of the benefits of globalization. However, if countries are not weighted by population, there has been a marked increase in inequality. This is the method used by those opposed to globalization. Ravallion (2004) argues that the significant decline in inequality in China and the large size of its population together with rapid growth and large population in India determine most of the outcome of the analysis based on weighting by population. If China and India are excluded, the decline in inequality disappears. Thus, most of the decline in inequality has occurred in China and India. There are arguments supporting both sides. It would appear that if the intention is to measure the behavior of inequality for the world as a whole, weighting by population provides a better measurement.

The world population could experience a decline in inequality but it would not be reflected in the method of not weighting by population (Ravallion 2004). If the intention is to merely consider the difference in inequality among countries, then giving all countries the same weight may be appropriate. The combination of both measurements leads to the conclusion that world inequality has declined but that differences among countries have increased. There is no convincing empirical result showing that these trends have anything to do with increasing integration in the world economy in the past quarter of a century. There is the additional issue of diversity of experience among nations with very different economic and social structures that have followed sharply different policies toward economic integration. In fact, the same policies have not been consistent for individual countries over long periods.

Economic integration, as all major policy changes, causes gains to some and losses to others. There is a revealing example of the concepts of vertical and horizontal inequality (Ravallion 2004, 20–1). China's accession to the WTO caused changes in prices of goods and factors. A GE model measures the impact on prices resulting from direct and indirect effects of initial tariff changes. The results show positive effects of WTO accession on mean household income. Inequality does not change and aggregate poverty increases moderately in the short term. This is the vertical result, showing little change in inequality. However, the variance of effects across households is significantly high, showing horizontal losses. The impact of the tariff reforms on regions is larger in some areas of China than in others and rural families lose while urban households tend to gain. The conventional measurements of welfare effects capture only the vertical effects but not the horizontal

ones. The proponents of globalization focus on the vertical effects while the critics alert to the horizontal ones.

A final choice of measures on the basis of individual values is between relative and absolute measures of income inequality (Ravallion 2004, 23–7). The typical economic research uses measures of inequality relative to the mean. These measures do not show any relation between growth and inequality. Thus, to the extent that economic integration causes growth it does not increase inequality. Absolute inequality tries to capture the absolute differences in income. Consider the illustration by Ravallion (2004, 23–4) of an economy with two households, one earning \$1000 per year and the other \$10,000 per year. If growth results in doubling of income for both households, one would earn \$2000 and the other \$20,000, experiencing the same gain from growth. The mean is \$5500 before growth, with the first household having a ratio of 0.182 relative to the mean ($\$1000/\5500) and the second household a ratio of 1.818 relative to the mean ($\$10,000/\5500). The mean jumps to \$11,000, with the ratio of the first household being unchanged at 0.182 and the ratio of the second household also unchanged at 1.818. In terms of welfare relative to the mean, there is no change for either household. However, in the initial situation, the absolute difference in income was \$9000 that jumps to \$18,000 after the reform. The absolute difference of \$18,000 instead of \$9000 is interpreted as a doubling of deterioration in absolute welfare levels. The relative and absolute measurements are simply two ways of making calculations. The choice of one over the other is a value judgment.

Ravallion (2004, 27) concludes that his “paper has demonstrated that the factual claims one hears about what is happening to inequality in the world depend critically on value judgments embedded in standard measurement practices.” Normative judgments are difficult to defend on the basis of not weighting countries by population. Those measurements would prevent the evaluation of well-being of large segments of the world population. Ignoring horizontal changes may not be a sound foundation for policy because of the high costs of displaced labor and firms. Absolute inequality is what everybody experiences in real life. It may be too much to ask for a policy that can erase in the short term historically accumulated absolute differences in income levels.

There is an unusually acute poverty problem in India. Bhagwati (1998b) argues that early literature unjustly claimed that pro-growth policies ignored poverty and inequality. Income redistribution was unfeasible in a country with many poor and hardly any wealthy from whom to redistribute. The growth of population in a stagnant economy would have almost immediately eliminated any gains from redistribution. Economic growth was the instrument to effectively draw the unemployed and underemployed into the productive sectors of the economy. The initial Indian approach of import substitution industrialization (ISI) in activities that were capital intensive did not contribute to employment generation. The reduction of poverty accelerated when the growth rate of the economy rose from 3–3.5 percent per year to 5 percent per year in the 1980s.

Increasing integration into the world economy by means of freer trade and FDI flows can also assist in eradication of poverty (Bhagwati 1998b, 35). External

integration can also work with programs of privatization to further promote growth of the economy. The government requires tax revenue, increasing together with economic growth, to finance schools, infrastructure and health.

There are two static arguments in favor of the proposition that trade contributes to reducing poverty in developing countries (Bhagwati and Srinivasan 2002, 180). These countries specialize in labor-intensive economic activities. Thus, in accordance with the Stolper and Samuelson (1941) argument, the remuneration of labor would increase. Evidence from multiple countries confirms that trade benefits employment and wages in developing countries (Krueger 1983). The second argument is that trade promotion requires a stable domestic environment. Inflation hurts the poor in developing countries. The more careful attitude toward inflation resulting from external integration contributes to reducing poverty.

The dynamic argument is that trade promotes growth, which reduces poverty (Bhagwati and Srinivasan 2002, 180). The more general form of the argument is that trade has links with two fundamental causes of growth, accumulation of factors and innovation that discovers new and more productive use of resources. The increase and variety of imported inputs surmounts the limitations imposed by protection. There are opportunities in larger scale available under trade relative to the more limited scale under protection. External integration opens a much larger world market than under protection, increasing the marginal efficiency of capital. If there is plentiful supply of labor for the growing sectors of the economy, trade and growth will reduce poverty. There are extreme cases in which trade and growth may not affect the remote tribal areas that cannot supply labor to the new activities. Technological change may increase the output of larger farms, reducing prices that have adverse effects on poorer farmers working in small plots.

The best way to evaluate the impact of growth on poverty is by analysis of China and India where most of the world poor live (Bhagwati and Srinivasan 2002, 182). WB data show that China grew at the average yearly rate of 10 percent in 1980–2000 and India at 6 percent per year. China had the largest growth rate in the world and less than ten countries grew more rapidly than India. Bhagwati and Srinivasan (2002, 182) refer to data from the Asian Development Bank (ADB) and the government of India showing that the incidence of poverty declined in China from 28 percent in 1978 to 9 percent in 1998 and in India from 51 percent in 1977–8 to 27 percent in 1999–2000. In those 20 years, India and China increased their external integration. Poverty in India oscillated around 55 percent in 1950–80 when there was extreme intervention by the government in the economy.

Cross-country studies of the relation of growth and inequality encounter data and institutional hurdles (Wei and Wu 2004, 1–2). There are significant differences in the comparability of data on income inequality across countries. These data are also adjusted by purchasing power parity (PPP), which requires the construction of a basket of representative consumption. There are numerous differences in cultures, legal systems and other institutions that are difficult to quantify and control in cross-country regressions. Bhagwati and Srinivasan (2001) propose that country studies may be more revealing. Wei and Wu (2004, 2) argue that country

studies may complement the other cross-country research. In a short time period it may be possible to control culture, legal systems and other institutions. Data comparability problems may not be as critical as in cross-country research.

The choice of China is important beyond the size of the country (Wei and Wu (2004, 3–4)):

- *Trade openness.* The ratio of trade to GDP of China increased from 8.5 percent in 1977 to 36.5 percent in 1999. Large fluctuations permit better measurement of effects.
- *Regional variation.* The effective increase in openness varies across regions in China because some regions are too remote to actively participate in trade. It is possible to analyze the impact of openness on inequality, controlling numerous factors.
- *Large sample.* The large number of regions in China provides a large sample.
- *Limited migration.* Migration was discouraged during the sample period, making China more like a collection of countries for sample purposes.
- *Geography.* The geography of China prevents some regions from effectively participating in trade, allowing for the use of access to major seaports as an important instrumental variable.

There is presumption in the Heckscher (1919), Ohlin (1933) and Samuelson (1948, 1949, 1951, 1953) model that openness will lower inequality in China (Wei and Wu 2004, 4). The opening to trade would increase the remuneration to the factor of production that is abundant at home. China is evidently abundant in labor. Because labor has low remuneration before openness, external opening should reduce inequality. However, there is ambiguity in the theory as pointed out by Rodriguez and Rodrik (2001) and Baghwatic and Srinivasan (2001). This ambiguity dictates an appeal to data.

There are three major conclusions of the econometric research of Wei and Wu (2004). The rural–urban inequality of China declines as a result of trade openness. This is an important result because the largest inequality in China is between rural and urban areas. The inequality within the urban sector is modestly associated with increasing openness. The inequality within the rural sector is reduced by trade openness. The three results taken together are used by Wei and Wu (2004) to show a combined effect of trade openness in reducing inequality in a labor-abundant country.

Because of conflicting reports on the evolution over time of poverty data, Chen and Ravallion (2004) recalculated the numbers using consistent data and methods. The data originate in nationally representative surveys whenever possible. They use the conventional poverty line of \$1 per day. There were 200 million fewer people in the world in poverty in 1998 compared with 1980, creating the controversy. Their new calculation shows that there were 1.1 billion poor people in 2001, close to 400 million less than in 1981. Chen and Ravallion (2004) show that the poor in China declined by 400 million. Most of the decline in the poor in China occurred in the early 1980s. The number of poor outside China increased slightly.

They project that the number of poor on \$1 per day will be reduced by one-half by 2015. However, the reduction will be concentrated in East and Southeast Asia.

There are limitations in these studies of poverty reduction, acknowledged by Chen and Ravallion (2004, 4). There is concern about the welfare measures used in the surveys, their accuracy and comparability and various aspects of the data, such as the PPP exchange rates. An important problem with earlier studies was the choice of 1987 as starting point for the series because it coincided with much lower growth in China and India, countries with significant weight in population. Chen and Ravallion (2004, 4) use 454 surveys of 97 countries that account for 93 percent of the population of all low and middle income countries of the world. The surveys were conducted by government statistics offices. The measures of poverty are calculated from the primary survey data.

There is strong criticism of the measurement of the poverty line by Chen and Ravallion (2004, 8–10) in the work by Reddy and Pogge (2005, 4–9). The argument of Reddy and Pogge (2005, 5) is that the poverty line should provide a measurement of the resources required to satisfy basic human needs. They argue that the WB uses an international poverty line (IPL) that does not have relation to such resource needs. The WB IPL is defined in abstract monetary units and in domestic currency equivalents. The IPL was constructed in 1990 based on information for 33 countries for the 1980s. The domestic consumer price index (CPI) was used to calculate the IPL for 1985 converted into common units of real purchasing power equivalents using the 1985 PPP conversion factors. The chosen IPL was \$31 per month and rounded to \$1 per day. The IPL was converted into national currency units using the Penn World Tables (PWT) and inflated by the local CPI data obtained from the International Monetary Fund's (IMF) International Financial Statistics.

The IPL used by Chen and Ravallion (2004, 9) is \$32.47 per month, equivalent to \$1.08 per day. Reddy and Pogge (2005, 7) argue that the WB uses the United States as base country. The US CPI increased by 34.3 percent in 1985–93 while the increase in the IPL was from \$30.42 in 1985 to \$32.74 in 1993, implying CPI change of 8 percent. Reddy and Pogge (2005, 7) argue that this caused a lowering of US national poverty lines by 20 percent. They argue that examples of the resulting poverty lines show lowering by 30 percent for Nigeria and increase by 157 percent for Mauritania. Because of these and other methodological objections, Reddy and Pogge (2005, 9) contend that the IPL would have to be significantly higher to provide resources required for the nourishment of a human being. They also argue that the PPP concept is not well defined or appropriate for measuring poverty. A final criticism is that the WB extrapolates from limited data that suggest likely large errors that cannot be precisely estimated.

The transition of Russia and China during the 1990s was very dissimilar in terms of rates of economic growth. As Table 2.1 shows Russia experienced negative rates of growth during most of the 1990s for cumulative decline of 32.7 percent. Meanwhile, China had close to double digit growth rates through the decade with cumulative growth of 161.6 percent. Russia made the transition

Table 2.1 GDP growth in Russia and China
1991–2000 in %

	Russia	China
1991	–5.0	9.2
1992	–14.5	14.2
1993	–8.7	13.4
1994	–12.7	12.7
1995	–4.1	10.5
1996	–3.6	9.6
1997	1.4	8.8
1998	–5.3	7.8
1999	6.4	7.1
2000	10.0	7.9
Total Δ%	–32.7	161.6

Sources: China, National Bureau of Statistics of China, Russia, International Monetary Fund, World Economic Outlook Database, September 2006.

with a parliamentary regime and freer press. China merely made some economic reforms and maintained a centralized, closed and oppressive regime.

Surprisingly, Galbraith *et al.* (2004) find unusual similarities in income inequality in the same period for both countries. There was significant increase in inequality in both countries in the turmoil of 1991–8 and in China during the growth collapse of 1993–4. The rise in inequality was sharper at the regional than at the sector levels. The increase in relative income was sharper in the financial and political urban centers, Moscow, Beijing and Shanghai. The regions generating exports in hard currency, West Siberia and Guangdong, also experienced significant rise in relative income. Galbraith *et al.* (2004) suggest that rents in sectors with monopoly power in activities for the domestic sector, such as transportation and public utilities, were obtained from the liberalization process. Financial capitalism in both countries was able to obtain significant gains. The transition to market allocation was accompanied by decline in the relative income of the agricultural sectors. Education sectors made more gains in relative income than other sectors in China but experienced major losses in Russia.

It is difficult to measure inequality of household income and the data originate in unofficial surveys (Galbraith 2002, 15–16). There are accurate measurements of level of pay for many countries. The UN provides an industrial accounting framework that permits cross-country comparisons. Galbraith (2002, 16) argues that level of pay is only part of income but calculations are more accurate than for household income inequality. The UN provides data on the year 2000 on 3200 country/year observation in 1963–98. Galbraith (2002) calculates the Theil index of inequality. Conceição and Ferreira (2000) provide an intuitive description of the Theil index, explaining its superiority over the conventional measure of inequality, the Gini coefficient. For the purposes here, inequality is measured as the dispersion of the distribution of income among individuals.

The findings of Galbraith (2002) show lowest inequality of manufacturing pay in 1963–98 in the social democracies of Scandinavia and Australia and in the communist regimes in Eastern Europe, China and Cuba. This measure of inequality was also low in a second group of countries in Southern Europe and North America. Some of the wealthier countries in Latin America and Iran constitute a middle group. The highest inequality occurred in a broad group around the equator, including Peru, Brazil, central Africa and southern Asia. Manufacturing and production of capital goods was weakest in the highest inequality group. Galbraith (2002) argues that there is inverse association between inequality and the level of development of a country. He postulates that inequality declines with greater industrialization and the increase in income.

The findings of Galbraith (2002) indicate that inequality increased in the two decades 1980–2000. He considers the important events of that period to be the rise of neoliberalism and the end of Keynesian policies. The hypothesis preferred by Galbraith (2002) is that there is a global element in the world economy influencing the inequality of manufacturing pay. In this view, trade and the transfer of technology are not the major factors and the term globalization does not explain the rise in inequality. Galbraith (2002) claims that the process of integration on the basis of unsustainable finance caused the inequality. This process of indebtedness transferred wealth from poor to rich countries and to the richest class in the rich countries. The system divided the world into an advanced center composed of wealthy countries and a periphery of countries without the means to develop. The advanced countries did not assume any responsibility for the poor. There is no process for reversing the fate of the poorer countries and evident apathy to their fate. Galbraith (2002, 25) characterizes the process as similar to a “perfect crime.”

In 1980–2000, the rate of growth of trade was twice that of world income (Dollar and Kraay 2001). The focus of research by Dollar and Kraay (2001) is the impact on growth and inequality in a group of 24 countries that experienced significant openness in 1980–2000. The ratio of trade to GDP doubled to 33 percent for this group of countries. Over one-half of the population of developing countries is in this group because it includes China and India. Dollar and Kraay (2001) reach four conclusions from the experience of this group of countries:

1. *Increasing growth rates.* The rate of growth of per capita income increased from 1.4 percent in the 1960s and 2.9 percent in the 1970s to 3.5 percent in the 1980s and 5.0 percent in the 1990s. There was strong growth performance in 18 of the 24 countries and the results are independent of the inclusion of China and India in the sample. The countries that did not globalize experienced lower rate of growth of per capita GDP from the peak of 3.3 percent in the 1970s to 1.4 percent in the 1990s.
2. *Sharing in the gains.* There is no evidence that inequality increases with growing trade.

3. *Declining poverty.* Growth with stable inequality contributed to lowering poverty incidence.
4. *Narrowing poor/rich gap.* The poorer countries in the sample lowered their gap relative to rich countries because of comparatively higher growth rates.

Criticizing the results of Dollar and Kraay (2002), Watkins (2002) claims that advanced countries with 14 percent of the world population held almost three-quarters of the income of the world at the beginning and end of the 1990s. Watkins (2002) claims that international trade reinforces income inequality among nations. The shares in world trade are reflected in the pattern of world income distribution. Exports have a strong influence on world income because of the faster rate of growth of exports than world GDP. Watkins (2002) argues that \$0.75 of every \$1 of exports is received by advanced countries. Poorer countries receive about \$0.03. The gap between poor and rich countries can only close if the poorer countries can obtain a higher share of world exports. Watkins (2002) argues that globalization is increasing inequality in various ways with limited access of the poor to markets, productive assets and education. The rights of workers have eroded with various types of exploitation, in particular, gender deprivation. The policy according to Watkins (2002) should be the complete elimination of tariffs and restrictions of exports of developing countries. The benefits of the WTO on international property rights (IPR) only accrue to MNCs in advanced countries. The trade agenda does not include issues of true interest to developing countries.

In reply, Dollar and Kraay (2002) argue that openness by itself will not be sufficient to reduce poverty. Their only claim is that a more liberal trade regime is one of various instruments in a strategy to promote growth and reduce poverty. They dispute the claim of Watkins (2002) that globalization increased inequality. Dollar and Kraay (2002) argue that the only possible statement is that inequality stabilized after the 1980s and that the number of people living on less than \$1 a day has declined. The high rate of growth of the countries in the sample contributed to narrowing the gap in living standards with the advanced countries.

Globalization may affect inequality within countries, which is a typical type of research. Another approach is to analyze inequality among individuals in the world as a whole, which is the objective of Milanovic (2002). The data consist of 216 country surveys, averaging 10.8 data points in 1988 and 11.4 data points in 1993. The data points are weighted by the population in which they originate. The quality of the surveys and the definition of income and expenditures vary from country to country. It is possible to standardize the definitions of income and expenditure. The sample covers about 84 percent of the world's population and about 93 percent of world GDP in 1988 and 1993. Milanovic (2002) uses this sample to estimate the world income and expenditure with household surveys.

The conclusion of Milanovic (2002) is that world income inequality is quite high. The Gini coefficient is 66 using income adjusted for purchasing power of countries and about 80 using current dollar incomes. He estimates that the Gini coefficient increased from 62.8 in 1988 to 66.0 in 1993. The most important factor of world inequality is the difference in mean income of countries, explaining

75–88 percent of overall inequality. The main reason for increase in the Gini coefficient was the growth of rural per capita income in China, India and Bangladesh in comparison with income growth of various countries of the Organization for Economic Co-operation and Development (OECD). The faster growth of urban China versus rural China and rural India was also an important determinant. World inequality is dependent on the relative position of China and India relative to the United States, Japan, France, Germany and the United Kingdom. Milanovic (2002, 88) argues that the richest 1 percent of the world receive the same as the 57 percent poorest. The total income of the 25 million richest Americans is equivalent to the income of about 2 billion poor people.

There is an estimate of the world distribution of wealth prepared with household data by Davies *et al.* (2006). Their data show significantly higher concentration in world wealth than income. Common shares of the top 10 percent in a country's wealth are about 50 percent. The share of the top 10 in world wealth in 2000 is 85 percent.

There is significant difficulty in defining poverty. It is a concept with multiple dimensions beyond income (Sala-i-Martin 2004). The adjustment for PPP is the subject of considerable debate. The welfare implications may vary with the measurement of either income or consumption poverty. Even if it were possible to solve the methodological discrepancies and obtain a monetary measurement, Sala-i-Martin (2004) argues that the drawing of the line of definition of poverty may be quite difficult. The existing lines are the extreme poverty line of \$1 per day and the poverty line of \$2 per day. They are as arbitrary as any other lines.

The research of Sala-i-Martin (2004) shows that in 1970–98 the rates of poverty declined: from 40 percent to 18 percent for the \$2 per day line and from 17 percent to 6 percent for the \$1 per day line. He also finds decline in the number of people in poverty in 1976–98: from 600 million to 350 million for the \$1 per day line and from 1.4 billion to 1 billion for the \$2 per day line. Moreover, Sala-i-Martin (2004) shows that poverty declined in 1970–98 for every conceivable poverty line. The debates on the choice of poverty line are fruitless. Any poverty line chosen will show a decline in poverty.

Another aspect of the debate is the argument that when China and India are excluded poverty increases. Sala-i-Martin (2004) provides calculations showing that poverty declined in China, in the rest of Asia and in Latin America. Poverty increased in Africa. There could still be an argument that globalization was stronger in East Asia, South Asia and Latin America compared with Africa. Sala-i-Martin (2004) follows the approach of Dollar and Kraay (2001), dividing the world in two groups, according to globalization after 1980. The conclusion of Sala-i-Martin (2004) is that poverty counts decreased by 309 million for the globalizing countries using the \$1 per day line and increased by 79 million for the non-globalizing countries. The \$2 per day line shows decline in poverty counts of 478 million for the globalizing countries and increase by 80 million of the non-globalizing countries. Sala-i-Martin (2004) argues, with significant value, that there is no precise definition of globalization that could permit cross-country regressions of poverty rates with globalization as the explanatory variable.

Sala-i-Martin (2002) calculates that worldwide income inequality increased in the 1970s, declining in the following two decades. There are disputes about the validity of using PPP-adjusted income and GDP per capita to anchor the mean. There is an important result that the Gini coefficient does not decline uniformly. That is, there are reversals of the improvement in income distribution. Sala-i-Martin (2004) argues that there should be caution in using inequality data for very short time periods such as the comparison of 1988 and 1993 by Milanovic (2002). Sala-i-Martin (2004) shows that inequality behaves in similar fashion with the use of many other indexes: Theil index, Atkinson index with coefficients 0.5 and 1.0, the variance of log-income, the coefficient of variation, the ratio of the income of the top-20 percent to the bottom-20 percent of the population and the ratio of the income of the top-10 percent to the bottom-10 percent of the population. There is significant variety in the cross-country econometric results of the relation of openness to growth and inequality. Sala-i-Martin (2004) argues that there is no empirical evidence in this vast literature that openness is inversely associated with economic growth. The critics of globalization are concerned and skeptical about the arguments that openness promotes growth. Sala-i-Martin (2004) contends that these critics should be more concerned and skeptical about the claim that openness restricts economic growth, for which there is no evidence.

Regional, international and global public goods

The need for collective action at various levels originates in the existence of regional, international and GPGs. The market may not supply these goods. There are also threats to nations such as financial instability and wars that require collective action. The discussion below consists of an analysis of the reasons contributed by various economists for the provision of public goods at the international level and the classification of those goods. Stiglitz (2006) strongly argues the need of providing public goods and finds that the current governance of international financial institutions is not conducive to an adequate provision of public goods.

Health is one of the earliest and most important concerns and involvement of many countries in public goods. A well-known example is preventing the spread of contagious diseases, requiring cooperation by nations and international organizations, such as the World Health Organization (WHO). The classic properties of public goods constitute the departing criterion of a taxonomy for activities of transnational nature (Sandler and Arce M. 2002, 198). These characteristics are that the benefits of public goods are non-rival and non-payers cannot be excluded. In the case of many nations, the consumption of one good is non-rival if consumption by one country does not diminish the consuming opportunities of other nations for the same unit of the good. The property of not being excludable means that once the good is supplied, the benefits are enjoyed by payers and non-payers alike. Sandler and Arce M. (2002, 198–206) argue that global and transnational goods in preserving health can have these two properties in various forms.

There are five different types of public goods according to the two basic properties of non-rival and non-excludable (Sandler and Arce M. 2002, 198–206):

1. *Pure public goods.* The two properties of public goods apply to many nations. Consumption does not diminish the benefit to other nations and once provided other nations cannot be excluded.
2. *Impure public goods.* There is one property and/or both that is not met entirely. The consumption of the good by one nation may partially detract from the consumption of another, breaking the non-rivalry condition. A country may enjoy the benefits of the good but that may not be entirely the case of another nation.
3. *Club goods.* The benefits are not excludable but there is rivalry in consuming them. It is possible for the users to create a club to provide the good.
4. *Joint products.* An activity can create two or more outputs that differ in the characteristics as public goods.
5. *Private goods.* There is rivalry among nations in consuming the benefits of the goods and nations can be excluded from consuming them.

The second form of classifying public goods used by Sandler and Arce M. (2002, 206–14) is according to the technology of public supply aggregation, or aggregation technology. The global supply of the public good is determined by the effort of nations in providing it. Pure and impure goods and also joint products can be classified into subcategories. The need of international public policy depends on the type of aggregation. Sandler and Arce M. (2002, 206–14) identify six different aggregation technologies:

1. *Summation.* The summation of individual provisions equals the aggregate level of the public good that is available. The individual provisions are perfect substitutes and thus do not depend on the nation providing them. There is a tendency for free riding by individual nations. The richer nations are likely to engage in provision of the public good. Multilateral organizations could have a role in supporting provision to compensate for the less than optimal national contributions.
2. *Weighted sum.* Individual weights are assigned to obtain a weighted sum of provisions. The technology of an individual nation may be more advanced than those of others.
3. *Weakest link.* The overall success of providing the public good depends on the nation providing the smallest effort. Sandler and Arce M. (2002, 17) provide polio as an example where the efforts of many countries with vaccination programs did not eliminate the disease because some nations did not make efforts of eradication.
4. *Weaker link.* There are some smaller gains in providing more than the smallest effort (see analysis in Arce M. and Sandler (2001)).
5. *Best shot.* The minimum required effort of supplying the good determines its provision. Provisions below the minimum do not add to the global or transnational supply of the good.

6. *Better shot.* Provision below the maximum required may still contribute to the overall level of the public good. There are likely several suppliers compared with the best-shot public good.

The large diversity of public goods leads to the policy implication that institutions and policies must adapt to the specific characteristics of public goods (Sandler and Arce M. 2002).

Economic openness has been associated with cross-border flows of goods, services, capital and labor. There are other cross-border flows: pollutants, diseases, terrorism, knowledge, culture, financial crises, political turmoil, medical discoveries, innovations and computer viruses and worms (Sandler 2006). Globalization and technology drive these flows, suggesting that collective action, sometimes influenced by international organizations, may be required beyond the boundaries of nations in controlling transnational public goods (TPG). TPGs can benefit people in two or more countries. When the benefits or costs have global effects the goods are called GPGs. There are benefits and costs of goods that affect two or more countries in a specific location, being called regional public goods (RPG). The taxonomy and policy implications can proceed with the same characteristics of public goods – non-rival, non-excludable and aggregation technology (Sandler 2006).

There are three key types of RPGs (Sandler 2006). Peace and security is an important regional concern. Regional conflicts have negative externalities that can be reduced by RPGs. Regional wars have very adverse effects on economic growth. According to Sandler (2006), knowledge is the archetype of best-shot or better-shot public good. The best results are obtained by concentrating efforts in research centers of excellence. Provision of knowledge as a public good requires coordination. Thus, knowledge that is specific to a region would be best developed by a global or regional institution. Governments give patents to these goods, in an exchange of a short-term monopoly for larger numbers of discoveries. There are short-term losses from the monopoly power given to a producer that must be compared with the long-term benefits of more active innovation. The third important RPG underscored by Sandler (2006) relates to the effects of communicable diseases. A disease such as avian flu (SARS) requires worldwide epidemic controls in the form of providing a GPG. There are region-specific diseases that require collective action in the form of RPGs.

The environment

The conservation of the environment is the classic case for public intervention considered by neoclassical economists. The problem is the lack of a price for clean air. The most promising approach is applied welfare economics or cost/benefit analysis. Unfortunately, the economic arguments are quite appealing but have not convinced decision makers. Other criteria are used in environmental legislation, requiring the analysis of the political economy of decisions. Empirical research has not made great progress because of the lack of a theory of economic growth and the role of the environment in such theory. The issue becomes even

more intractable when trying to relate openness to the environment. Developing countries complain that the imposition of environmental standards in trade agreements prevents them from improving their living standards.

The basic regulation theory required for analysis of environmental policy is covered in Chapter 5 of Volume I in the section on the public interest view. A specific survey relating to environmental economics is provided by Cropper and Oates (1992). There is no observable price for clean air. Pollution causes an externality, such as in the classic example of the laundry soiled by the emissions of the factory. The market failure caused by the negative externality of pollution prevents the market from attaining a Pareto-optimal outcome. The marginal social cost of the output of the factory is higher than the marginal private cost. A tax in the sense of Pigou would attain the Pareto-optimum outcome. This is the case for regulation based on the public interest view.

Coase (1937, 1960) introduced transaction costs, arguing that they were not negligible. With negligible transaction costs, there could be an agreement between the company affected by the pollution and the polluting company. Cropper and Oates (1992, 680) make the important point that such an agreement would not occur in reality because of the large number of market players involved in environmental issues. The hurdle becomes one of finding the second-best outcome in the presence of major transaction costs. The case for government regulation is not as straightforward as in the theory before Coase (1960). The government also faces the same transaction costs as market players and regulation may cause government failure. An appeal to the methods of welfare economics, by calculating costs and benefits of regulation, was not incorporated in the early legislation on the environment (Cropper and Oates 1992, 675–6).

The criterion of Pareto efficiency is that an economic state is Pareto improving if at least one person is better off without anyone being worse off. There are few public policies that can meet this test (Stavins 2004, 1). The criterion of Hicks (1939) and Kaldor (1939) intends to identify simpler conditions. There is a Pareto improvement if the winners of a change could fully compensate the losers and at least one gainer would still be better off. This is the essence of applied welfare economics covered in Chapter 5 of Volume I.

The tools of applied welfare economics provide standard evaluation of environmental regulations in terms of the familiar net present value of net benefits (*PVNB*) as in (Stavins 2004, 2):

$$PVNB = \sum_{t=0}^T (Bt - Ct)/1 + r \quad (2.1)$$

Bt are benefits at time *t*, *Ct* are costs at time *t*, *r* is the discount rate and summation is from *t* = 0 to the terminal period at time *T*. If

$$PVNB = 0 \quad (2.2)$$

the project may yield a Pareto improvement, meeting the Hicks (1939) and Kaldor (1939) criterion. Equation 2.1 consists of a discounted sum, by an appropriate discount rate, of the net benefits in every period. The practical problem of the

criterion is to obtain good estimates of the benefits, costs and the discount rate. There are other more complex approaches to the economics of regulation. Stavins (2004, 13) concludes that “economic analysis has assumed a significant position in the regulatory state. At the same time, despite the arguments made for decades by economists, there is only limited political support for broader use of benefit-cost analysis to assess proposed or existing environmental regulations.”

The analysis of the gains from trade concludes that trade raises national income. An important issue in environmental analysis is the relation between the quality of the environment and higher income (Copeland and Taylor 2004, 10). An important early contribution is the inverse-U relation of inequality and economic growth discovered by Kuznets (1955). The economy is initially concentrated on agricultural activities with relatively low per capita income and not much inequality. The smaller industrial sector has relatively higher per capita income and possibly income inequality. Economic growth is driven by the industrial sector, increasing the inequality of incomes for the economy as a whole. Industrialization draws labor from agriculture and eventually overall income inequality diminishes. Barro (1999, 32) relates inequality and growth with a broad panel of countries, concluding that “The Kuznets curve – whereby inequality first increases and later decreases in the process of economic development – emerges as a clear empirical regularity. However, this relation does not explain the bulk of variations in inequality across countries or over time.”

A significant body of empirical literature surveyed by Copeland and Taylor (2004, 10) finds an inverted-U relation between growth and the environment. This research is called the environmental Kuznets curve (EKC) because of the work of Kuznets (1955) on economic growth and inequality. The EKC shows the environment deteriorating with economic growth in developing countries and improving for countries with high levels of income. There is little theoretical development behind the changes in the EKC such that the results are open to various explanations (Copeland and Taylor 2004, 10).

One explanation of the EKC is based on the sources of growth (Copeland and Taylor 2004, 16). The process of growth is initially driven by capital accumulation and in later stages by acquisition of human capital. Environmental quality would deteriorate during the first phase and then improve with the composition of growth factors changing toward human capital. A second explanation focuses on income effects: demand for environmental quality rises with income (Copeland and Taylor 2004, 17–8). The willingness to sacrifice income to clean the environment increases with economic growth. A third possibility is that the quality of the environment deteriorates in the early stages of growth but improves after reaching a threshold.

Research on the EKC makes important contributions (Copeland and Taylor 2004, 23). The common uninformed view that economic growth necessarily results in deterioration of the environment is not supported by evidence. It also suggests the likely policy action at higher levels of income. The next step of research requires analysis of the causes of the EKC. Further theoretical research is required to specify the relationships.

There are two hypotheses on which countries attract industries that deteriorate the environment after liberalizing trade (Copeland and Taylor 2004, 29–34). According to the pollution haven hypothesis, countries with careless policies on the environment will specialize in production of goods that deteriorate the environment. There are multiple types of this hypothesis that assume that low-income countries are those with weak environmental controls. The factor endowment hypothesis postulates that there is no relation between trade and environmental policy. Trade is determined by differences in factor endowment or technology.

The pollution haven effect postulates that the weakening of environmental policy determines exports of goods that adversely affect the environment and the location of plants in the country with such policies (Copeland and Taylor 2004, 34–5). According to the stronger version, the pollution haven hypothesis, activities that adversely affect the environment relocate from more advanced countries with stronger environmental policies to poorer countries without such policies. In this extreme version, the lack of environmental policy determines the location of pollution-creating industries. Thus, pollution increases in the developing countries and decreases in advanced countries. The alternative hypothesis is that conventional factor endowment and technology determine the pattern of trade.

Data limitations restrict research on trade and the environment. Data on pollution are quite difficult to obtain. The hypotheses also involve data requirements of poorer countries, which are also of lower quality and restricted availability (Copeland and Taylor 2004, 35). The literature also suffers from more precise theoretical development of the hypotheses. Copeland and Taylor (2004, 66–7) find three major conclusions from the empirical literature. There is evidence showing that increasing income positively influences the quality of the environment. An earlier professional view that environmental policy does not affect trade and investment flows is not warranted. There is some evidence of pollution haven effects but not confirmation of the pollution haven hypothesis.

A common argument against environmental policy is the possible adverse impact on jobs and the rate of economic growth. Openness gives a new dimension to the issue because companies can relocate production to other countries without environmental policy. The loss of firms and investment could have adverse effects on the domestic economy. Schofer and Granados (2006) analyze the impact of environmental policy during the period of globalization 1980–2000, using a sample for 100 countries. Their results indicate that countries with positive policies toward the environment experience better economic results on various measures than countries with lax environmental policies. There is no exodus of firms, investment and production as a result of environmental policy or an adverse impact of FDI inflow. There are some limitations of these results. There is not conclusive evidence that every conceivable type of environmentalism is conducive to higher growth or that the observed relation will continue in the future. Economic activity could be affected by extreme forms of environmentalism. International institutions and regulation could better coordinate economic outcomes.

Distinguished economists are voicing strong complaints against the environmental and labor restrictions in trade agreements, depriving poor countries of the

opportunity to develop. There is characterization of the green movement as ecological imperialism (Lal 2005b). The historical evolution would provide support for this view. Initially, the West depended on organic agriculture. The progress of the economies of the advanced countries was achieved by changing their production into the exploitation of minerals and energy. The supply of minerals and energy would be unlimited. The institutional transformation, according to Lal (2005b), was defended by Smith (1776). Productivity improved even in an organic economy. The physical transformation consisted of using the capital in energy derived from fossil fuels. The liberal world economy of the nineteenth century was partly dismantled by imperialism, which found a motivation in the “white man’s burden” (Lal 2005b). Western values were imposed on the colonies by the force of imperialism.

A similar phenomenon occurs presently under the new values of ethical trading and foreign policies. Lal (2005b) claims that these policies are imposed in trade and investment agreements, preventing the development of poorer countries such as China and India. He argues that there is neither ethics nor logic in these ethical arguments that threaten to undermine the liberal world order that can bring progress to poorer countries. According to Lal (2000, 21), the Greens are opposed to the key forms of capitalism that can transform poorer countries – free trade as promoted by Smith (1776) and the continuing burning of fossil fuels. The elimination of these alternatives for development would simply condemn poorer countries to permanent poverty. Lal (2000, 29) recommends that developing countries resist the international treaties motivated by the agenda of the Greens. He sees the Green movement as part of Western cultural imperialism, a descendant of the spirit of Christian missionaries.

Climate change

Global warming because of greenhouse gas (GHG) emissions allegedly is the largest market failure ever invoked. There is no private solution for the problem and it would require global collective action. There are two reviews of the problem by the United Kingdom and by the UN, discussed below. There is strong criticism by economists of the use of near zero discount rates in the UK report. The comparison of welfare among individuals and over generations is quite challenging. The near zero discount rate would concentrate all the effort of adjustment in the current generation. Conventional economic analysis has used what Nordhaus (2006) calls the “ramp” approach. The adjustment would occur as in the rising slope of a ramp, allowing for economic growth to make the costs of the adjustment more amenable.

The HM treasury review

The critical scientific finding of the Stern review on the economics of climate change (HM Treasury 2006, 3) is that CO₂ concentrations increased from 280 parts per million (ppm) around 1750 to 380 ppm in 2006. The ppm is “the ratio of the

number of GHG molecules to the total number of molecules of dry air. For example: 300 ppm means 300 molecules of a greenhouse gas per million molecules of dry air" (IPCC 2007Feb5, 2 note 3). The burning of fossil fuels, deforestation and other changes in the use of land are the main causes of these concentrations. There have been concentrations of other GHGs, such as methane and nitrous oxide. The greenhouse effect consists of the warming effect on the world's climate resulting from increasing GHGs that raise the infrared radiation, or heat energy, blocked by the atmosphere (HM Treasury 2006, 3). The radiation of the sun increases the warmth of the earth. However, a major part of infrared radiation moves back to outer space, cooling the earth. Part of the infrared radiation is blocked by GHGs, with resulting cooling of the earth. The net effect is a trend of warming of the earth. The warming caused by GHG emission of human activity is about 430 ppm of CO₂, growing at 2.3 ppm per year. The levels of GHGs surpass the highest in 650,000 years of history.

Scientists use the concept of global mean surface temperatures to measure climate change (HM Treasury 2006, 5). The warming of the earth since 1900, measured by global mean temperature, has amounted to 0.7 °C. The rate of warming has been about 0.2 °C per decade, on average, in the past 30 years. The warmest 10 years on record have been experienced since 1990. HM Treasury (2006, 6–7) claims that "the rising levels of greenhouse gases provide the only plausible explanation for the observed trend [of global warming] for at least the past 50 years." The climate models surveyed by HM Treasury (2006) suggest that the doubling of GHGs could lead to an increase in global mean temperatures of 2–5 °C, in 2030–60. There has not been similar experience in the world since the last ice age to the present. By 2100, there could be warming of the world by 3–10 °C. The stock of CO₂ would reach 850 ppm or four times higher than in preindustrial times (HM Treasury 2007a). Under the assumption of stabilization of annual emissions at the level of 2000 through the entire century, the concentrations of CO_{2e} would reach 650 ppm by 2100.

There would be significant effects of global warming (HM Treasury 2006, iv–viii). There would be winners and losers of an increase of temperature of 1–2 °C. There would be economic gains from longer growing seasons in northern latitudes, lower mortality from cold phenomena and new activities in energy and tourism. However, there would still be impact on indigenous communities in the Arctic Circle and the need for evacuation in tropical islands at low levels. Coral reefs are vulnerable to changes in temperature and the intensity of droughts could increase. HM Treasury (2006, iv) argues that the difference between the present and the last ice age is 5 °C. An extra 5 °C could have major impact on the physical and human geography of the world. The damages increase sharply in accordance with the rise in temperatures. There would be a stronger El Niño and Siberia or the Amazon could experience forest fires. The decline in monsoon rains could affect agricultural production in Asia, Australia or Latin America. Food output could be threatened and there could be migration, misery and social disruption in areas of the world with high density of population. The rise in global temperatures would make these catastrophes more likely.

The Stern review (HM Treasury 2006, i) claims that climate change “is the greatest and widest-ranging market failure ever seen.” The challenge of analyzing the economics of climate change is formidable. The analysis must encompass the entire world during very long periods. It requires elements of the economics of risk and uncertainty. There are likely non-marginal jumps in variables. The analysis must borrow from multiple areas of economics and even quite recent research. The framework of analysis is that climate change is caused by global actions and has global consequences. Thus, the approach is that the nature of the response and its dimensions require international collective action. Such response is the only type that could result in effects that are effective, efficient and equitable. It is difficult not to consider some of the similarities with the economics of mineral and fossil fuel analysis. In particular, the analysis of Adelman (2004) appears relevant. The long horizons of analysis of climate change probably require knowledge of the development of science in similarity to the analysis of oil reserves. If applicable, such analysis may be even more difficult than recognized in the economics of climate change that assumes that science is constant.

The Stern review (HM Treasury 2006, i) is careful in acknowledging that there is no certainty in the estimation of the consequences of climate change. However, it argues that the knowledge is sufficient to understand risks. Early mitigation of climate change can be viewed as an investment that could reduce the consequences of high risks in the future. Careful analysis of investment can limit costs, providing growth opportunities in the future. The objective of policy is to reveal market signals to conquer market failures. The core must consist of risk mitigation and equity.

The Stern review focuses on stabilizing GHG concentrations in a range of 450–550 ppm CO₂e (HM Treasury 2006, ix). In the upper range of 550 ppm CO₂e, global emissions would peak in 10–20 years and then fall at 1–3 percent per year, being below 25 percent of current levels by 2050. The world economy would be three to four times larger than currently. Thus, emissions per unit of GDP in 2050 would be 25 percent of current levels. Stabilizing the concentration at 450 ppm CO₂e by 2050 would require a peak in 10 years and then decline by over 5 percent per year. In 2050, emissions would be 70 percent lower than currently. The reduction of emissions would consist of combinations of reducing demand for goods and services that are emission intensive, increasing efficiency to save money and emissions, increasing non-energy emissions and using technologies for power, heat and transportation that are low in carbon use.

The estimate of resource costs by the Stern review is 1 percent of world GDP by 2050 to stabilize concentrations at 550 ppm of CO₂e (HM Treasury 2006, xiii). The range of forecasts is –1–3.5 percent of GDP. The review concedes that there are numerous difficulties in this estimation. The estimation requires the costs of various technologies in periods of half a century. It may be added that it could be impossible to foresee new technologies that are presently unknown. The estimates require trajectories of prices of fossil fuels over the long term when it is almost impossible to forecast them for short periods. Demand cannot be ignored because people will certainly have behavior responding to price changes that is difficult

to foresee. The proposal is based on a carbon-price signal of difficult estimation. There are multiple other policies requiring effective regulation.

The UN IPCC

The World Meteorological Organization (WMO) and the UN Environment Programme (UNEP) created in 1988 the Intergovernmental Panel on Climate Change (IPCC). Membership is open to all members of the UN and WMO. The objective of the IPCC is to evaluate all aspects of climate change induced by human activities. The IPCC does not engage in original research or in monitoring climate data. Peer review and the technical and scientific literature constitute the elements for evaluation by the IPCC.

The structure of the IPCC consists of three working groups and a task force on national GHG inventories. Working Group I (WGI) evaluates the scientific aspects of the climate system and change. The role of Working Group II (WGII) is to evaluate how climate change creates vulnerabilities for natural, social and economic systems; it also assesses negative and positive effects of climate change and available adaptation alternatives. The evaluation of options to limit GHG emissions and mitigating climate change is the objective of Working Group III (WGIII). The IPCC national GHG inventory is the responsibility of the Task Force on National Greenhouse Gas Inventories (TFIPCC).

There is a plenary meeting of the IPCC every year where reports and work plans of the working groups and the task force are accepted, approved or adopted. The panel elects the chair of the IPCC and the members of the bureau. There are two-three meetings per year of the bureau, which supports the chair in planning, coordinating and monitoring work progress. The Secretariat manages the IPCC at the WMO in Geneva, with support by the UNEP and the WMO. There are technical support units for the working groups and task force. These units receive support from the government of the country acting as co-chair of the working group or task force. A research institution in the co-chair countries hosts the technical support units. The key output of the IPCC is the series of assessment reports begun in 1990. These four reports provide an assessment of the state of knowledge on the issue of climate change.

The WGI adopted a summary for policymakers of the fourth assessment report (AR4) on February 2, 2007 (IPCC 2007Feb2). There were 600 authors of this summary, originating in 42 countries. In addition, there were 620 expert reviewers and many government reviewers. Representatives from 113 governments reviewed the details of the summary before its adoption.

The summary for policymakers of the WGI of AR4 provides an explanation of the human causes of climate change together with observations of actual change, the process and attribution of climate change and projections of future climate change (IPCC 2007Feb5). The foundation of the WGI of AR4 is the building on earlier assessments and the new findings of research in the 6 years after the Third Assessment Report (TAR). The WGI of AR4 claims that there has been significant scientific progress in the 6 years since TAR (IPCC 2007Feb5, 2).

There is anthropogenic influence (by human beings) of the environment that has accelerated since the middle of the eighteenth century following the industrial revolution (IPCC 2001). The composition of the atmosphere is especially influenced by the combustion of fossil fuels for industrial or home use and burning of biomass. These activities generate GHGs and aerosols. The GHG absorbs radiation generated by the surface of the earth and clouds. Then it emits infrared radiation at a level colder than the surface of the earth. As a result, it traps part of the energy, warming the surface of the earth. The ozone in the upper atmosphere filters damaging incoming ultra-violet radiation. The main GHGs in the atmosphere of the earth are water vapor (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and ozone (O₃). Most of the GHG emissions of the United States originate in energy use. CO₂ emissions from petroleum and natural gas account for about 80 percent of US anthropogenic GHG emissions (EIA 2003, EPA 2004, ES-6). The US Environmental Protection Agency (EPA) (2004, ES-6) estimates that fuel combustion accounted for 94 percent of US CO₂ emissions in 2004. This share of fuel combustion grew slowly from 77 to 80 percent in 1990–2004. In 2002, the United States accounted for about 23 percent of the emission of CO₂ in the atmosphere in 2002. Aerosol consists of a collection of airborne particles that has no relation to commercial aerosol sprays.

The stock of GHG content in the atmosphere was relatively constant in the thousand years preceding the industrial revolution but has increased since then by more than 30 percent. Infrared radiation absorption and emission is strengthened by increasing concentration of GHG. As a result, the emission of the earth's radiation is processed at higher altitudes where less energy is emitted because of lower temperatures, causing climate warming. The effects of aerosols are less known but they tend to offset the GHG effects. Numerical models of the climate system are used by scientists to quantify climate response because of the nonlinear behavior of variables. These models are based on principles of physics, chemistry and biology and are combined with empirical and statistical methods.

The most important anthropogenic GHG is CO₂. The concentration of CO₂ in the atmosphere was 280 ppm in the pre-industrial period. That is, there were 280 molecules of GHG per million molecules of dry air. In 2005, IPCC (2007Feb5, 2) estimates the CO₂ concentration in the atmosphere at 379 ppm. This concentration exceeds the range of 180–300 ppm in the past 650,000 years. The concentration is a stock. The addition to the stock is the rate of growth that was on average 1.9 ppm per year, much higher than the average of 1.4 ppm per year in 1960–2005. The growth of the stock of CO₂ in the atmosphere resulted mostly from use of fossils, with a smaller contribution by land use. The other sources of GHG also increased. The range of CH₄ concentration in the atmosphere was 320–790 parts per billion (ppb) compared with 1774 ppb in 2005, significantly higher than the pre-industrial value of about 715 ppb. The IPCC (2007Feb5, 3) considers very likely that anthropogenic activities in agriculture and fossil fuel use were important contributors to increasing CH₄ concentrations but other contributing factors are less certain. The pre-industrial value of the atmospheric concentration of N₂O was 270 ppb, rising to 319 ppb in 2005. The growth rate remained constant after

1980. Anthropogenic activities in agriculture contribute about two-thirds of all N₂O emissions.

The potential change in climate of a mechanism is measured by radiative forcing, which measures the effect in altering the balance of energy entering and leaving the earth's atmosphere (IPCC 2007Feb2). Negative forcing cools the earth while positive forcing warms it. The values of radiative forcing are expressed in watts per square meter ($W m^{-2}$). The conclusion of the WGI of AR4 is of high confidence that effects of human activities since 1750 contributed to warming the earth with a radiative forcing in the range of $+0.6$ to $+2.4 W m^{-2}$, with mean of $+1.6 W m^{-2}$. The combined radiative forcing caused by CO₂, CH₄ and N₂O is $+2.30 W m^{-2}$. The radiative forcing of CO₂ jumped by 20 percent in 1995–2005, the largest in any decade in the past 200 years.

The conclusion of the WGI of AR4 is that “warming of the climate system is unequivocal” (IPCC 2007Feb5, 5). There are multiple reasons for this conclusion, in the form of increases in global average air and ocean temperatures, snow and ice melting and an increase in the global average sea level. Temperatures increased by $0.76^{\circ}C$ from 1850–99 to 2001–5. The linear trend of warming per decade in the past 50 years of $0.13^{\circ}C$ is almost twice that of the last 100 years. The 100-year linear trend of temperature increase in 1906–2005 is $0.74^{\circ}C$. The IPCC (2007Feb 5, 10) concludes that anthropogenic GHG concentrations are very likely the cause of the increases in globally averaged temperatures and other aspects of climate change such as ocean warming, temperature extremes and wind patterns.

The IPCC (2007Feb5, 12) projects warming of global average temperatures by $0.2^{\circ}C$ per decade; these projections are based on six scenarios and additional observations. The change in 2090–9 compared with 1980–99 is $1.8^{\circ}C$ in the best estimate for the lowest scenario with range of 1.1 – $2.9^{\circ}C$ and $4.0^{\circ}C$ in the best estimate for the worst scenario with range 2.4 – $6.4^{\circ}C$. The sea level rise in the same period is in the range 0.18 – 0.38 meters in the lowest scenario and 0.26 – 0.59 in the worst scenario. The more confident projections on warming, wind patterns, precipitation and aspects of extremes and ice are not favorable. Stabilizing GHG concentrations would not prevent anthropogenic warming and rise of the sea level.

The report of the WGII of AR4 considers the effects of climate change on natural, managed and human systems as well as the adaptation and vulnerabilities of these systems (IPCC 2007Apr6). Temperature increases have been affecting natural systems. Some examples are the larger numbers and enlargement of glacial lakes, rock avalanches, ground instability and changes in Arctic and Antarctic ecosystems. Water quality and thermal structure have been affected by the warming of lakes and rivers. Rivers fed by glaciers and snow have experienced increasing runoff and peak discharge occurring earlier in the spring. Spring is coming earlier for leaf-unfolding, bird migration and egg-laying. There are changes in ranges in plant and animal species. Warming has increased in growing seasons with earlier greening of vegetation in the spring. Increasing water temperatures have affected marine and freshwater biological systems. The IPCC (2007Apr6, 3–4) concludes with “high confidence” that anthropogenic warming in the past three decades influenced many physical and biological systems.

There are disturbing projections by the IPCC (2007Apr6, 7–10) of various systems and sectors:

- *Fresh water.* The availability of water will increase by 2050 by 10–40 percent at high latitudes and wet tropics, decreasing by 10–30 percent in dry regions and mild latitudes and dry tropics. Droughts and heavy precipitations will increase while water from glaciers and snow will decrease.
- *Ecosystems.* The combination of climate change and associated disturbances will challenge the resilience of ecosystems.
- *Food, fiber and forests.* Changes in weather will affect crops and forest products in diverse forms.
- *Coastal and low-lying areas.* There are multiple vulnerabilities to areas around the coast and in low-lying locations resulting from changes in sea-level rise and similar disturbances.
- *Industry, settlement and society.* There will be significant changes varying by location, scale and the actual climate change.
- *Health.* Climate change will have strong adverse effects on health.

The WGIII of AR4 finds significant dynamism in 1970–2004 in the drivers of increasing energy-related CO₂ emissions: population growth was 69 percent and global income growth was 77 percent (IPCC 2007May4, 3). The increase of GHG global emissions weighted by their global warming potential was 70 percent. CO₂ emissions grew by 80 percent, representing 77 percent of total anthropogenic GHG emissions in 2004. The GHG emissions of the energy supply sector increased by 145 percent in 1970–2004. The growth of emissions for other sectors was slower: 120 percent for transport, 65 percent for industry and land use and 40 percent for land use change and forestry. A group of countries with 20 percent of world population and 57 percent of world GDP was responsible for 46 percent of GHG emissions.

Mitigation potential measures the reduction of GHG emissions by a given carbon price relative to emission baselines (IPCC 2007May4, 9). The market mitigation potential is measured using private costs and private discount rates. It takes into account current policy measures. The economic mitigation potential is measured using social costs and benefits and social discount rates (SDRT). It assumes improvements in market efficiency by policies and measures. The bottom-up studies evaluate mitigation options using specific technologies and regulations. The top-down studies measure the effects of mitigation options for an entire economy. The WGIII of AR4 argues that available bottom-up and top-down studies suggest that there is significant economic mitigation potential to reduce global GHG emissions relative to the projections without further policies. The estimated costs of stabilizing emissions in the range 445–710 ppm by 2030 are between a reduction of global GDP by 3 percent and a small increase of 0.2 percent, relative to the baseline. There are significant differences in the pattern of regional costs relative to the average (IPCC 2007May4, 15). The costs by 2050 of stabilizing GHG

emissions in the range of 445–710 ppm are in the range of a 1 percent gain and a 5.5 percent loss of global GDP (IPCC 2007May4, 26).

The economics of climate change

There is disagreement by economists on the cost and benefit analysis of climate change, as analyzed by Wolf (2007Feb6). An important criticism of the Stern review is that it exaggerates the economic consequences of climate change. The worst outcome would be that income per capita increases in the future nine times instead of 13 times. The consensus of economists is that climate change would not be an economic catastrophe. There is also the argument about action and science: future generations will adapt much better than what the review could model. There is a counterargument that environmental losses have value to people, are difficult to predict and become irreversible.

Another difference of opinion among economists found by Wolf (2007Feb6) is that there is high uncertainty in the costs of mitigation. The Stern review uses risk and uncertainty, two words that evoke the suspicion of imprecision and error among economists, especially those engaged in financial transactions. The Stern review has a wide range of a gain of 1 percent of world GDP by 2050 to a heavy loss of 3.5 percent of world GDP by 2050. The only way to find out is by allowing climate change to occur. However, Wolf (2007Feb6) argues that there would be gains of new technology on using fossil fuel energy more efficiently. The argument centers on the costs and benefits of that technology.

The critical issue of disagreement among economists is the calculation of net present value (Wolf 2007Feb6). The net present value is the estimation of the upfront cost of making the adjustments, requiring inputs of benefits, costs and the most controversial, the appropriate value of the discount rate.

An immediate critical reaction to the Stern review was on the assumption of the discount rate. Wilkinson (2006) interprets the assumption of a discount rate of close to zero as resulting in high present value of the damages of climate change: “a new economic framework based on a vision of Armageddon could turn out to be a big waste of money.”

Two of the academic authorities on the economics of the environment have expressed sharp disagreement with the Stern review. There are specific ethical values in the Stern review that cast the results in doubt, according to Dasgupta (2006, 3–4). The first value judgment is on the tradeoffs of welfare between future generations and the current one. The second value judgment is on the tradeoff of welfare among people no matter on what generation they appear on earth. The Stern review assumes that there should be high expenditures today for the well-being of future generations even if after adjusting for risk they were to be better off than the current generation. Dasgupta (2006, 7) illustrates the consequences of these ethical judgments in an economy with no population growth, no technological change and social rate of return of 4 percent per year. Under those assumptions, the current generation would have to save 97.5 percent of its output to pay for the future. In the United Kingdom, where Dasgupta resides, the savings rate is 15 percent. The tradeoff is that the current generation would have to starve in

order to save to pay for the future generation. The model assumes that “starvation isn’t all that painful!” (Dasgupta 2006, 7).

The problem with the economics of climate change is the rate of discount, *r*, used for the calculation of PVNB in equation 2.2. The rate of discount, as Nordhaus (2006, 7) emphasizes, is not the rate used in capital budgeting and cash flow discounting. The abridged term is the SDRT, measuring the welfare of future generations relative to the current generation. The key difference relative to the discount rate in other applications is that the SDRT discounts future welfare not future goods or dollars (Nordhaus 2006, 6). The Stern review uses a discount rate of 0.1 percent, which is about equal to zero. This assumption equalizes the welfare of future generations with the present generation. In the case of a positive SDRT, the welfare of future generations is discounted to the present generation by the SDRT.

Table 2.2 helps to illustrate the use of a zero or near zero discount rate. This table is similar to the discount tables used in financial calculations before the advent of the computer. The first column shows the discount factor assuming the rate of the Stern review of 0.1 percent. If the calculation were in finance, \$1 in 50 years from now would be worth \$0.99 today \$1 times the discount factor of 0.99. The comment by Nordhaus (2006, 6) is appropriate: it does not matter to use 0.1 or 0 as the discount rate. There is no discounting: all future net benefits of a policy of environmental cleaning would be simply added at face value. The discount to present value of \$1 received 200 years from now is \$0.82. At a very low rate of discount of 1 percent per year, the present value of \$1 received 200 years from now is only \$0.14. The effect of the zero discount rate is to significantly inflate the cost of cleaning the environment to the present generation.

The dynamic integrated model of climate and the economy (DICE) is used by Nordhaus (2006) to illustrate the differences between the Stern review and a more conventional economic measurement. Table 2.3 shows the results of simulations by Nordhaus (2006, 147) using DICE. The carbon price of the Stern review is \$311 per ton. The price of carbon per ton of the standard run of DICE is \$17.2 rising to

Table 2.2 Discount factors of future values

	Percent discount rates					
	0.1	1.0	2.0	3.0	4.0	10.0
1 year	0.99	0.99	0.98	0.97	0.96	0.91
2 years	0.99	0.98	0.96	0.94	0.92	0.83
10 years	0.99	0.90	0.82	0.74	0.67	0.38
50 years	0.99	0.61	0.37	0.23	0.14	0.01
100 years	0.90	0.37	0.14	0.05	0.02	0.00
150 years	0.86	0.22	0.05	0.01	0.002	0.00
200 years	0.82	0.14	0.02	0.002	0.000	0.000

Note: The discount factors are equal to the inverse of 1 plus (discount rate/100) to the power of the number of years.

Table 2.3 DICE model simulations by Nordhaus (2006)

	Run 1	Run 2	Run 3
Carbon price \$/ton			
2005	17.12	159	19.95
2050	84.00		
2100	270.00		
Optimal emission rate %			
2005	6		
2050	14		
2100	25		
Temperature increase 2000–100	1.8°C		

Note: Run 2 uses the same assumptions as run 1 with SDRT of 0.1 percent per year. Run 3 maintains the 0.1 percent per year SDRT but calibrates the curvature of the utility function or elasticity of the marginal utility of consumption.

Source: Nordhaus (2006, 14–7).

\$270 in 2100. Run 2 uses the same assumptions as run 1 but uses the 0.1 percent SDRT of the Stern review, which raises the price of carbon to \$159 per ton.

The literature on the economics of climate change finds that efficient economic policies of slowing climate change consist of lower rates of reduction of emissions in the short term followed by faster reductions in the medium and long terms. Nordhaus (2006) labels this policy as the climate-policy ramp. The policies become tighter as if climbing a positively sloped ramp over time. This model has survived intense scrutiny of assumptions and measurements. Nordhaus (2006) persuasively explains its rationality. The highest returns in investments are in physical capital, technology and human capital. R&D in the reduction of GHG emissions is one such investment. When economies prosper, becoming richer, it is rational to devote higher investments to reduction of GHG emissions. The decision on how to mix and time the reduction of emissions is determined by specific knowledge of costs, damages and the irreversibility of climate change and damages. The assumption of a zero SDRT simply flattens the policy ramp, concentrating all the costs of adjustment in the current generation. Nordhaus (2006) argues that the Stern review does not provide new analytical innovations with the exception of the zero SDRT.

There are three important requirements of an effective climate policy according to McKibbin and Wilcoxon (2006, 2–3). The policy must be widely adopted. In addition, it must be implemented indefinitely. The critical third condition is that there must be undisputed incentives in the policy for individuals and firms to commit investment resources that reduce emissions. McKibbin and Wilcoxon (2006) argue persuasively that individual countries can control policies within their borders only if they have the support of their citizens. Laws can be repealed or they can be imperfectly enforced until they become ineffective. The reduction of emissions requires major investment in capital and R&D. A carbon tax would be

economically efficient but eventually will organize lobbying efforts for its repeal or for exemptions. A credible, long-term policy must have the incentives that are required for major investments by the private sector in reducing emissions. This alternative is more likely to be successful than creating another large international institution while control of emissions is mostly within national boundaries. Policies at the local level must focus on the incentives to the solution of the problem without political challenges.

The concern on global warming is not enough, according to Bhagwati (2006a). There have to be effective policies to solve the problem. The Kyoto Protocol (KP) has been ratified by 160 countries, except the United States. Bhagwati (2006a) argues that “the Kyoto Protocol is dead in the water: you cannot stage Hamlet without the Prince.” The key hurdle in passing the KP is the exemption for two major polluters, China and India. In fact, China is closing in GHG emission to the United States. There was no support for these exemptions in the US Senate.

An important issue is that CO₂ is a stock instead of a threshold pollutant (McKibbin and Wilcoxon 2006, 5–6). There are problems with threshold pollutants only after emissions reach a threshold but not when they are relatively low. The key target of policy is to keep emissions below the threshold. In the case of CO₂, emissions remain in the atmosphere for decades. McKibbin and Wilcoxon (2006, 5) claim that “current annual emissions are equal to only about 1 percent of the total anthropogenic carbon dioxide in the atmosphere.” The accumulated stocks of CO₂ and GHG emissions create the risks of climate change. An additional ton of emissions raises the risk only slightly and there is no risk threshold for emissions. Every ton of new emissions, like cigarettes in causing cancer, causes the same damage as any other ton.

Although there are significant current emissions by China and India, the largest part of the accumulated stock that causes the risk occurred because of earlier emissions by advanced countries. Bhagwati (2006a) claims that “the accumulated damage attributable to India and China fossil fuel CO₂ for 1850–2004 shows as less than 10 percent while the European Union, Russia and the United States jointly account for nearly 70 percent.” The argument used by China and India in seeking no limits on their GHG emissions is that because they did not create the stock they should not be penalized for the flow.

The solution proposed by Bhagwati (2006a) is the spirit of the US Comprehensive Environmental Response, Compensation and Liability Act of 1980, typically called the Superfund. This act imposed a tax on the chemical and petroleum industries. In what Bhagwati (2006a) calls the “American fascination with torts actions” it provided for liability of people for “the release of hazardous waste at closed and abandoned hazardous waste sites.” The Superfund is a trust that would receive payment for past damage and would correct the damage of actions that could not be attributed to a known party.

The Bhagwati (2006a) proposal is to apply the Superfund concept at an international level. The advanced countries that created the stock of CO₂ in the atmosphere would collect damages into the global warming superfund. The damages would be assessed for a past period of at least 25 years by the estimated

opportunity cost of cleaning the atmosphere in the next 25 years. However, cleaning the atmosphere is not feasible in the case of global warming. The collections at the global superfund would be used to develop technologies that save CO₂ emissions and to subsidize the use of technologies by developing countries, including China and India, which are friendly to the environment. Bhagwati (2006a) expects that the advanced countries would accept the principle that they have already used and that business would also support it. The proposal would also include taxes on the flows under the principle of preventing significant deterioration. The market principle involved in the proposal is for every nation to pay for its share in total pollution. The tax would be a form of creating a missing market for clean air.

The FT (2007Feb) considers the forecast of the rise of global average temperatures of the IPCC to 3 °C by 2100. The difference is close to the change in temperature between the last ice age and today. Mitigation should aim to maintain the stock below 550 ppm, which would still be higher than the pre-industrial levels. The FT (2007Feb) finds comfort in the cost estimate of the Stern review of 1 percent of GDP but warns that the required mitigating investments have very long gestation. Thus, investment should be made immediately. Negotiations by 2010 should replace the KP that expires in 2012. Important discussions will take place between the advanced countries and several key developing countries – Brazil, China, India, Mexico and South Africa. The FT (2007Feb) argues that an agreement without the United States would not mean much. All that would be required from the United States is the implementation of an effective program for control of emissions that is linked to a global one. The developing countries would only join the discussion if the United States shows the will of action. However, developing countries are seeking lower emission controls than those that would be implemented by advanced countries.

The FT (2007Feb) proposes compensation to developing countries for the costs that would promote using the most efficient energy technologies. Another suggestion is for advanced countries to acquire emission rights issued by developing countries. A third proposal would be a common tax framework with cross-border transfers. The FT (2007Feb) argues that there must be a clear and predictable price for carbon. The lack of this price is the critical issue in traditional welfare economics à la Pigou (1932). A second important issue is investment in R&D of renewable sources of energy, nuclear power and methods of capturing and storing carbon. There would be a third requirement of disseminating the best technology around the globe. These three elements are all within the public interest view: incorporating the price of pollution in decisions, public policy of encouraging alternative technology and making that technology a GPG.

Political regime

Research on the relationship of liberalization, democracy and political regime has accelerated in the past few years. The major obstacle is the lack of precise theories. Research attempts to solve the issues by an appeal to data. Many contributions use

the instrumental variables (IV) method. Unfortunately, economics is abundant in endogenous variables and scarce in IVs. There is a group of contributions discussed below by Rigobon and Rodrik (2004), Yu (2005) and Li and Reuveny (2003) that find an inverse relation between democracy and openness, using different methods. A second group of contributions subsequently discussed is more optimistic about the relationship of democracy and openness. Several authors have used long historical series of data to explore the relationships. Interesting work by Giavazzi and Tabellini (2005) tries to unveil the ideal sequencing of democracy and openness.

There are critical issues in the social sciences that have not been adequately explored, according to Rigobon and Rodrik (2004, 1). These issues are the relationship of income and quality of institutions, the role if any of democracy in development, the types of effects of openness on development, the quality of institutions and democracy and the role played by geography. The quantitative measurement of economic variables such as income is available but finding measurements of the quality of institutions, democracy and geography is challenging.

Proxies can be found for some of the variables. However, Rigobon and Rodrik (2004, 1–3) argue that the most difficult hurdle is the inference of causality of the variables in the right-hand side of the equation on the dependent variable on the left-hand side. Research using cross-national samples has tried to solve the problems with IVs. There are three properties of an adequate IV: it is exogenous, correlated with the endogenous variable and does not have any other influence on the endogenous variables. In practice, it becomes extremely difficult to find a suitable IV.

The problem of inference of the influence of institutional quality on income is explained by Rigobon and Rodrik (2004, 3) by means of the following two equations

$$Y = \alpha I + \varepsilon \quad (2.3)$$

$$I = \beta Y + \nu \quad (2.4)$$

Y is income, I institutional quality, α and β parameters and ε and ν random disturbances. This is the typical problem of identification. The system requires estimation of four unknowns – the two structural parameters and the variances of the disturbances – but the data only provide three moments – the variances of income and institutional quality and their covariance. The IV approach consists of finding a variable that enters into the equation of institutional quality but not in the first income equation.

The intuitive explanation of the method of Rigobon and Rodrik (2004, 3) consists of dividing the sample into two subsamples, A and B , in such a way that the variance of the disturbance in the equation of institutions, $Var(\nu)$, is larger in A than in B . Thus, the distribution of points of Y and I in subsample A is closer to the first equation than in subsample B . It would then be possible to solve the problem of identification.

There are two splits of the data into subsamples by Rigobon and Rodrik (2004). The objective is to obtain differences in structural shocks without altering the values of the parameters. The data are split according to colonization or not and geographical location and used to jointly estimate four endogenous variables: income measured as GDP per capita, economic institutions as rule of law, political institutions as democracy and economic integration as trade. Rigobon and Rodrik (2004) find a positive association between income growth and democracy and the rule of law, with the latter having a stronger effect. The impact of openness, measured as trade relative to GDP, has an inverse effect on income levels, controlling for geography and institutions. There is weak impact of income on the quality of institutions. There is mutual positive influence of rule of law and democracy but the effects are not very strong. Opening to trade positively influences the rule of law but adversely affects democracy. There is a significant negative effect of trade openness on democracy. Trade has significant positive effects on the quality of institutions in one specification but non-significant in another. There is a positive but weak effect of income on openness and negligible effects of democracy and rule of law on openness. Geographic variables explain 50 percent of the variance in openness. The sample contains 43 countries in each subsample.

There are arguments on both sides of whether trade liberalization promotes democracy, according to Yu (2005, 3–5). Theory is not conclusive on the effects of openness on democracy. Increasing democracy in labor-intensive countries may motivate politicians to relax trade barriers to increase labor rewards and thus obtain political power. The flows of trade, capital and ideas may disseminate democratic principles, creating more competitive domestic political systems. Yu (2005, 4) argues that in less democratic regimes the rulers may liberalize trade but maintain repressive conditions on labor. Growing GDP could become a means to strengthen political power by the rulers. Thus, Yu (2005, 4) claims that the issue cannot be solved without empirical verification.

The sample used by Yu (2005, 11–12) uses panel data for 157 members of the IMF in 1962–98. He uses a two-step method. First, there is a benchmark analysis of how democracy affects trade. The gravity equation expresses volume of trade in terms of size of country and geography. Yu (2005) adds measures of democracy to a revised gravity equation that also has several control variables such as environmental quality, WTO membership, socio-economic variables and members in RTAs. The possibility of reverse causality is analyzed by a linear system of structural form estimation (Yu 2005, 9). Judicial independence is the key variable for democracy. The results suggest that trade liberalization can promote democracy. However, democracy does not have a significant effect on trade.

There are three types of arguments in vast literature, including the philosopher Immanuel Kant in the eighteenth century and Joseph Schumpeter in the twentieth century, analyzed by Li and Reuveny (2003, 35–8). Two of the arguments claim that globalization promotes or obstructs democracy; the third argument claims that globalization has no effects on democracy. Proponents of the promotion of democracy by globalization emphasize the positive effects of globalization on economic development and multiple other factors such as the diffusion of democratic

ideas. The argument that globalization prevents democratic progress claims that globalization results in public policies that benefit foreign investors instead of the population, creating more losers than winners in the short term. There are several additional arguments such as the unfavorable effects of financial crises and the increasing income inequality of countries allegedly resulting from globalization. The third group of arguments claims that the effects of globalization are vastly exaggerated and vary from one country to another.

The sample used by Li and Reuveny (2003, 39) consists of pooled time-series cross-sectional data for 127 countries in 1970–96. They find evidence that trade openness and portfolio investment have a negative effect on democracy. The trade effect remains constant over time but that of portfolio investment increases. There is a positive effect of FDI on democracy but it diminishes over time. The diffusion of ideas is persistent in positively influencing democracy over time. The results are similar for all countries and also for the group of developing countries. Li and Reuveny (2003, 53) conclude that “the economic aspects of integration into the world economy are beginning to cause a decline in national democratic governance.” The prospects of democracy, according to their results, are eroded by economic globalization. Continuing trade liberalization adversely affects progress in democracy. FDI and foreign financial flows threaten democracy.

An important characteristic of a democracy is that the chief executive requires approval of a majority in the legislature to implement trade policy (Mansfield *et al.* 2000). The legislative ratification of commercial policy is a feature of parliamentary and presidential systems. The candidate for prime minister in a parliamentary system must negotiate trade policy before taking office. The legislature enforces its preference for trade policy through confidence votes. The presidential system is characterized by ratification of trade policy by the legislature after the candidate takes office. The chief executive in an autocracy has more independent power than in democracy. The legislature does not exist or simply ratifies pro forma the preferences of the autocrat. The research objective of Mansfield *et al.* (2000) is to analyze theoretically and empirically trade policy among pairs of countries according to political regime. They argue that pairs of countries with democratic regimes tend to agree on lower trade barriers than mixed pairs of a democracy and an autocracy because of the institutional difference in the role of the legislature. The preferences of the chief executives determine if trade liberalization among pairs of autocracies is stronger relative to pairs of democracies or mixed pairs.

The hypothesis of Mansfield *et al.* (2000) is that there would be lower trade barriers between a pair of democratic countries than between an autocracy and a democracy. They use a sample of pairs of countries in the period 1960–90. Two chief executives in a democracy will opt for significant trade liberalization because trade wars between two protectionist legislatures are worse than a trade war with only one protectionist legislature. The empirical results show that there is stronger trade between pairs of democracies than within mixed pairs of an autocracy and a democracy. There is 15–20 percent less trade in mixed pairs of a democracy and an autocracy than in pairs of democracies. They also find evidence that the relation becomes stronger over time. In the 1990s, trade of mixed pairs was 40 percent

less than of pairs of democracies. Mansfield *et al.* (2000) do not find significant difference in trade within pairs of autocracies and within pairs of democracies, suggesting that preferences of politicians and officials making decisions determine the nature of trade policy.

Trade agreements have proliferated in such a way that the relationship of type of political regime to trade policy should be applied to trade agreements. Mansfield *et al.* (2005) argue that the type of political regime of a country, the number of veto players and the diversity of preferences among the veto players are critical in explaining the participation of a country in RTAs. They consider five different types of trade agreements among countries. The incentive to political leaders in engaging in RTAs is the potential gains. Democracies are less likely to enter into an RTA as the number of veto players increases. The type of trade agreement is dependent on the type of regime and the number of veto players. There are consequences in distribution of income and resources in full integration agreements. The increase in the number of veto players increases the possibility of development of a constituency against the RTA and the chances that it will be blocked. The depth of the type of integration raises the potential influence of veto players. Mansfield *et al.* (2005) use a sample of pairs of countries in 1950–2000 to conduct statistical tests. The conclusion supports the view that democracy and veto players have a major influence on the entering of states in RTAs and the types of agreement chosen.

There was significant change in trade policy of developing countries in 1970–99 documented by Milner and Kubota (2005, 161–3). Data for 85–90 countries shows tariff duties as percent of imports declining by 53 percent from 1973–99, reaching 10 percent of import value in 1997. The data of statutory tariffs also show decline to around 10 percent by the late 1990s. The decline in tariff rates was not offset by compensatory nontrade barriers. Trade as percent of GDP increased from 55 percent in 1970 to 85 percent in 1999. Milner and Kubota (2005, 162) conclude that there was significant reduction in trade barriers by many countries around the world.

The movement toward freer trade was accompanied by democracy. Milner and Kubota (2005, 158) find that the number of democratic countries in the world increased from about 30 in 1975 to 89 in 1992 and then 120 in 2002. They argue that democracy facilitated the movement toward freer trade. Many groups without representation in the period of ISI gained access to voting. These groups had more to gain from liberalizing trade than from continuing protectionism. Politicians experienced a reduction in their capacity to build political support with trade barriers. The relatively higher power of trade liberalization versus trade barriers in increasingly democratic countries became a new form of capturing political support.

The Heckscher, Ohlin and Samuelson theorem and the Stolper and Samuelson (1941) theorem provide an explanation of the distribution effects. Milner and Kubota (2005, 168–9) argue that the earlier regime of ISI benefited capital in the import-competing industries and the higher-paid unionized workers. This was the case in Brazil where the industrialists producing for the domestic market created

an alliance with the labor unions to maintain protectionism. The concentration of benefits in a few facilitated the maintenance of the trade regime. The losers in this process were agricultural workers and urban dwellers that did not work in ISI activities. After some point the model exhausted the limits of the domestic market, coinciding with the return to democracy. The groups that had been disenfranchised during the period of ISI were the ones that would gain from an outward-directed export policy. Trade liberalization in agribusiness and labor-intensive activities shifted the relative power of the members of society that had relatively less interest in trade protection and more in increasing foreign trade. Voters preferring lower levels of protectionism were enfranchised by means of voting. Democracy thus benefited trade openness as a policy.

The hypothesis of Milner and Kubota (2005, 169) is that democratic countries are more inclined to trade liberalization, which increases with the degree of democratization. These authors use a cross-section of time-series of 179 developing countries in 1970–99. They control for the competing hypotheses of influence on trade liberalization by financial crises, pressures from the advanced countries and international organizations and changes in ideas. The conclusion is that more democratic countries are more likely to open to the international economy, controlling for other factors.

The position of a party in the ideological spectrum from left to right is significantly important in determining its position on trade policy, according to Milner and Judkins (2004, 101). They analyze this hypothesis for 25 developed countries in 1945–98. The argument finds support in the Stolper and Samuelson (1941) theorem. Protectionism could support the rewards to the scarce factor, labor; and freer trade would tend to support the rewards of the abundant factor, capital. Parties position themselves in the ideological spectrum of left to right to attract voters that share similar preferences. Parties tend to maintain support from similar groups of citizens during long periods. Milner and Judkins (2004) argue that the distributional effects of trade based on factor endowments determine the partisan position on trade or protectionism. In advanced countries, left-wing parties tend to support more protectionist policies than right-wing parties. Globalization in the sense of increasing openness is also important. There is less protectionism by parties in countries that are more open to trade. The effects of partisanship are diminished by exposure to liberalizing trade. Differences among parties on the position on trade policy decline with globalization.

Increasing democracy is likely to promote liberalizing trade in countries where labor gains from freer trade and more protectionist regimes in countries where workers benefit from barriers to trade, according to the hypothesis of O'Rourke and Taylor (2005). The distributional effects of the Heckscher, Ohlin and Samuelson and the Stolper and Samuelson (1941) theorems suggest that democratization should promote trade liberalization in labor-abundant countries while causing protectionism in labor-scarce countries. The Heckscher and Ohlin model was intended to explain the late nineteenth century. That period is ideal for testing the implications of the model.

The data used by O'Rourke and Taylor (2005) consists of country-level panel data for 35 countries, developed and developing, in 1870–1914. The power of democracy to influence free trade depends on the political economy of trade policy that is not the same for every country. The Heckscher, Ohlin and Samuelson model is powerful in explaining trade and politics in the nineteenth century. The effects of democracy on tariff levels are different in Europe and the poor New World. Democracy did not significantly affect tariffs in land-scarce regions that were relatively poor and in land-abundant regions that were relatively rich. The conclusion of O'Rourke and Taylor (2005) is that the relation between democracy and trade openness is complex. The relation of democracy with more general economic liberalization could be even more complex. There is no assurance that democracy will guarantee the adoption of market-friendly policies. However, democracy does not prevent those policies. The preferences of voters significantly vary across countries and over time.

There is skepticism by López-Córdova and Meissner (2005) that the empirical literature on democracy and globalization has adequately solved the key problem of the endogenous nature of the variables. They are cautious in assessing if the results are definitive. There are likely missing variables in the analysis that affect the results of Rigobon and Rodrik (2004). The theoretical literature provides a role for income and asset distribution in determining democracy. Openness and income distribution are likely mutually affected. The method of identification through heteroskedasticity may be affected by the omission of variables. The heteroskedastic method leads to conclusions that openness adversely affects income levels but other studies using that method show the opposite effect. The method also assumes that the effects of openness on democracy are the same for all countries. There is evidence that the effects vary across countries and even time. There is not yet a definitive empirical solution to the relationship of openness and democracy.

The challenge of research is finding variables that influence the level of trade and are uncorrelated with the determinants of democracy, serving as IVs to capture the effect of trade liberalization on political outcomes. López-Córdova and Meissner (2005) follow an approach used by Frankel and Romer (1999) to analyze the impact of trade openness on output per capita. The method uses geographic variables, such as distance from other nations, land area and waterway access, to estimate the openness of a country by the gravity equation. The first equation consists of ordinary least squares (OLS) regression of the ratio of exports plus imports to GDP on the geographical variables. The prediction of openness of this equation is the IV for the actual openness. The second step consists of an IV regression of income per capita on openness as an endogenous regressor. López-Córdova and Meissner (2005) develop an instrument for trade openness with the gravity equation and additional variables than those used by Frankel and Romer (1999). In the second step, they run a regression of democracy on the predicted openness measure as IV. There is a challenge that other variables in addition to openness influence democracy. The estimation would not be biased if the omitted variables are uncorrelated with the geographic variables.

The general finding by López-Córdova and Meissner (2005) is strong association between openness and democracy in 1895–2000. The relationship is constant over time. The effects are of long-term nature and there can be variations by region. The data may not reflect all characteristics of democracy. Openness increases competition and participation in the choice of the executive and also checks and balances. The determinants of liberalizing trade influence the construction and strengthening of democracy.

There is an argument that globalization and democracy are related as analyzed by Eichengreen and Leblang (2006). If openness has benefits, citizens would demand elimination of restrictions to freer international transactions. Political competitiveness increases because openness not only increases competition in markets of goods and services but also disseminates ideas. The higher availability of diverse ideas promotes political competitiveness. Market stability in economies open to financial flows requires transparency by financial supervisors and regulators. Transparency is not possible in autocracies. Eichengreen and Leblang (2006, 1) argue that the number of democratic countries increased four-fold in 1975–2000 while the IMF measured that the number of countries open to international capital flows increased from 25 to 38 percent.

The diverse results in the literature suggest the possibility of bidirectional causality that Eichengreen and Leblang (2006) analyze for the period 1870–2000 using data on trade, capital controls, democracy and IVs. The evidence suggests that there is a two-way positive relationship between trade and democracy, with exceptions in specific times and geographic locations such as in labor-scarce countries.

An important issue is the nature of the relationship and the sequencing of economic and political liberalizations. Giavazzi and Tabellini (2005) use a sample of 140 advanced and developing countries in 1960–2000 to probe this issue. The analysis faces the problem of reverse causality. The econometric strategy is to consider a sample with as many countries as possible. Some of the countries experienced reform and are called “treated.” The countries that did not experience reform are called controls. In the case of economic liberalization, control countries were always liberalized so that they did not experience reform. Giavazzi and Tabellini (2005) then compare economic performance in the countries experiencing reform before and after the treatment in relation to the economic performance of the control group in the same period. They call the method “difference-in-difference” estimation. The method considers the variation within countries and also the comparison among countries. The concentration of economic and political liberalizations in the 1990s could confuse identification of effects in simple analysis of changes within countries alone. The high likelihood of omission of variables could confuse results in cross-sectional comparisons.

There are important conclusions on sequencing of reforms in the analysis by Giavazzi and Tabellini (2005). Growth and investment are positively affected by economic liberalization. Trade openness is only one of several other factors that must accompany economic liberalization. These factors include improvement of the budget surplus, diminishing corruption and enhanced protection of property

rights. Moving toward democracy improves the quality of institutions but deteriorates macroeconomic performance and has limited effects on economic growth. There are key feedbacks and interaction effects. The chain of causality, as shown by the timing of events, appears to run from political to economic liberalizations but there are feedback effects in both directions. There are less frequent observations of political liberalizations preceding economic liberalizations. The interaction effects are confirmed by the observation that countries that implement both economic and political liberalization show better economic performance than those that implement only one type of reform. There is better performance by countries that first liberalize the economy and then the political system than the converse. Russia liberalized politics and then tried to liberalize the economy with less favorable economic performance than China that first liberalized the economy and is yet to liberalize the political system.

There are some explanations for the economic impact of the sequencing of liberalizations, according to Giavazzi and Tabellini (2005). The volume of trade rises during an initial reform consisting of economic liberalization and then continues to increase after political reforms. The effects on trade are weaker for countries that first reform the political system and then proceed with economic liberalization. The pattern of economic liberalization is less effective in democracies than in dictatorships. Dictators are not likely to open economic regimes but if they take the decision of opening it is easier for them to suppress the opposing interest groups. A democracy that starts with a liberalized economy is likely to strengthen democratic rule. Liberalization accelerates growth and increases competitiveness. Growth following economic liberalization may permit redistribution required in democracy. In practice, political reforms may be imposed on politicians by the frustration of the people and could even originate in weak economic performance. Optimal sequencing may not be an option.

The United States should assume its role as the current empire, according to Lal (2004, 2005a). He argues that the world has been more prosperous and politically stable under empires. Lal (2004, 2005a) claims that the United States should assume the role of empire based on its asymmetric military and economic power. The British and Roman empires used combinations of direct and indirect administration of the territories under their influence.

The system of multiple states requires a dominant empire, according to Lal (2004, 2005a). He argues that globalization links areas of diverse resource endowment in a common geographic unit. The best hope for world progress is through globalization. In addition, the fall of empires can be followed by long periods of economic and political turmoil, as it was the case of the 500 years after the fall of the Roman Empire. Lal (2004, 2005a) argues that Britain maintained economic dominance in the world from 1820 until about 1870 when it lost it to the United States. Instead of assuming its role as an empire, the United States followed the model of Wilson of the League of Nations. According to Lal (2004, 2005a), the UN and the League of Nations have been unsuccessful in maintaining peace by means of sanctions. Peace requires dominance by an empire, such as the United States, that has asymmetric military and economic strength. The failure of the United

States in Iraq is attributed by Lal (2005a) to not assuming the administration of the country after the war. He believes that because the United States does not assume its role, China or India may become the next empire.

Summary

The evidence on the issues discussed in this chapter does not lead to very solid conclusions that are widely accepted. Empirical verification of causality in economics leaves much to be desired. There is a theoretical case for the provision of regional, international and GPGs. The management of market failures by the government finds the same lack of information on prices of missing markets and major cost/benefit calculations and hurdles.

It is not possible to clearly relate deterioration of the environment to trade openness. Climate change is an important issue but the economics appears to be more promising in the ramp approach of Nordhaus (2006).

The evidence at this time appears to favor the existence of some relation of democracy and trade openness. There appears to be a sequencing of democracy and openness but it is difficult to influence the process with actual policies because of respect of sovereignty.