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**Global Crises and Developing Countries:
Financial, Environmental, Resource and Food Perspectives**

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Global Crises and Developing Countries:
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Abstract

The global financial crisis has potentially many adverse effects on the developing world: falls in exports of goods and services to the OECD, dramatic falls in commodity prices and resource exports, and falls in remittances. Many of the poorer countries are heavily specialized and dependent on natural resources, often landlocked, ethnically polarized, and financially underdeveloped. They therefore suffer especially from the notorious volatility of natural resource prices. Volatile oil prices harm not only producers and consumers in the developing world, but also harm environmental quality if they hold back irreversible investments in costly energy-saving technology and hydrocarbon substitutes. In the aftermath of the crisis, political leaders should seek for a global deal whereby resource-rich developing countries are helped to cope with managing very volatile streams of resource revenues while cutting back pollution of the energy industries. The global crisis facing the world today is thus not only a financial crisis, but also a fuel and commodity crisis. In addition, the world also faces a food, water and climate change crisis, all of which undermine the ability to sustain prosperity and eradicate poverty in the developing world. Hence, the contours of a Global Green New Deal will be sketched.

Keywords: global crises, natural resources, environment, volatility, poverty

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1. Introduction

The most pressing crises and challenges facing our globe today are fivefold: firstly, the havoc created by the global financial crisis and the collapse of trust in the banking system; secondly, the damaging consequences of human actions on the climate, biodiversity and sustainability of our eco-systems; thirdly, the scramble for scarce natural resources rarely put to good use for development and future generations and often associated with corruption, conflict and wars; fourthly, the food crisis leading to famines and undernourishment in the poorest nations on earth; and finally, acute overpopulation and rapid projected population growth rates in many developing countries further exacerbating environmental degradation, the scarcity of natural resources and food shortages. A billion citizens in our world live below the poverty line and it is the poorest countries that suffer most from the warming of the earth, the wars about scarce natural resources, food shortages, water shortages and other environmental disasters while at the same time having fast population growth rates.²

Many developing countries have had the misfortune of experiencing a banking crisis in the past, but none on such a big scale and widespread as the current global financial crisis. They suffer from the global crisis, but the crisis originated in the developed world. The current financial crisis has its roots in the greed and excessive borrowing of many households and firms in the US and the UK, in a long period of extremely low interest rates following the dotcom bubble, and in a regime of unbridled financial deregulation. Until recently it seems that the economic growth in the emerging and developing economies would remain positive; according to the IMF 3.3% per annum.³ This appears a lot better than the forecasted decline of the developed economies by 2% per annum, but nowadays growth forecasts for the developing world and the BRIC countries are rapidly adjusted downwards. For example, Russia already showed early this year a shrinking economy by an astonishing 8%. The global financial crisis is eventually going to hit the developing world very hard indeed. And the negative shocks exacerbate the two ongoing crises for the poorest countries in the world: the climate crisis and the food crisis.

In section 2 we first briefly discuss the effects of the global financial crisis on developing countries. Section 3 is concerned with the massive environmental disasters that are creating havoc on our planet: the greenhouse effect, aridification and erosion of biodiversity. High population growth rates in the

² For an extensive discussion of poverty, natural resources, conflict and wars in especially Africa, see Collier (2007), and for an interesting and concerned discussion of the global environmental challenges and the consequences of an overpopulated planet for these challenges, see Sachs (2008).

³ IMF, April 2009, World Economic Outlook: Crisis and Recovery, Washington D.C.

poorest parts of the world amplify these environmental disasters. Section 4 discusses the curse of natural resources and shows that resource-rich countries, especially those with poorly developed financial systems, trade restrictions, no access to waterways, ethnic divisions and bad institutions, are most likely to suffer disastrous prospects for economic development. The struggle about natural resource is also the main reason why war is started and perpetuated in conflict zones. Section 5 discusses in more detail the food crisis and why shortages, high food prices, and food riots especially affect the poorest countries in the world, especially in Africa. Section 6 discusses what can be done to meet the challenges facing our planet. Various rescue plans for our overcrowded planet hit by environmental disaster, strife and poverty associated with the names of the economists Jeffrey Sachs and Paul Collier are discussed. We also offer some constructive critiques and warnings on these plans and sketch the contours of a Global New Green Deal. Section 7 concludes and offers some suggestions for further research.

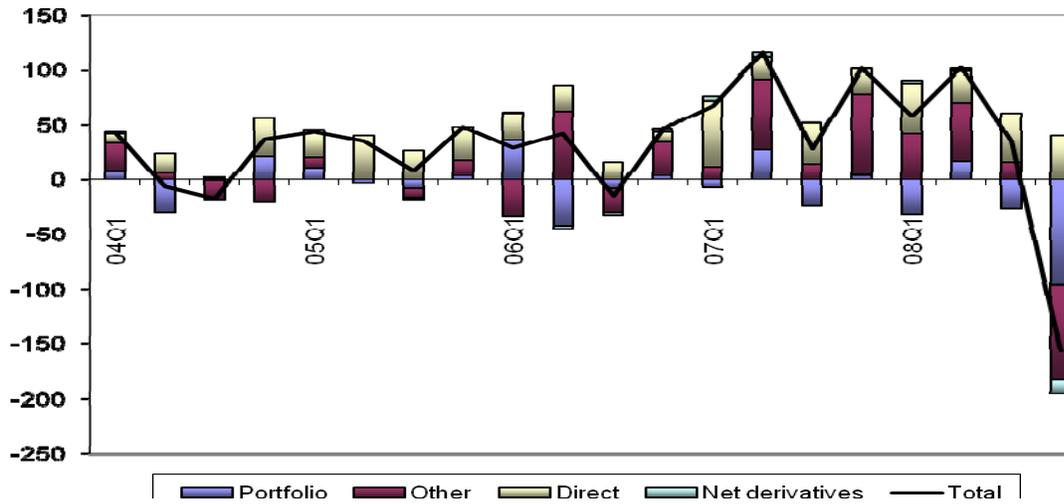
2. The Global Financial Crisis and its Impact on Developing Countries

The global financial crisis is spreading rapidly to the real economy. Its roots are in the developed economies. Despite that the low interest rates in the US and elsewhere were made possible to a large extent by investment resulting from enormous saving surpluses in developing countries such as China, those countries have little to do with decisions of banks, hedge funds and other investors to invest cheap capital in more and more risky projects. The direct consequences of the global crisis, collapsing banks, occur mostly in the Western world. However, the painful effects of the global crisis are beginning to hit the rest of the world as well.

Capital flows dry up as soon as investors in the West loose trust. In that case, capital flows to the developing world dry up as well. The *Global Association of Financial Institutions*, a global club of 375 banks and financial institutions, forecasts for 2009 that banks will repatriate more than US \$60 billion, whereas in 2007 they were still lending as much as US \$ 410 billion to developing countries.⁴ Figure 1 indicates that this turn-round is taking place for various types of investment in the emerging economies.

⁴ <http://www.iif.com>

Figure 1: Net Investments in Emerging Economies (flows, billion US \$, IMF, 2009)



This has severe consequences for countries with a relatively small internal financial market that depend rather a lot on finance from abroad as is the case for many countries in middle and Eastern Europe. The poorest countries depend for their income in large part on foreign aid. Unfortunately, donors in the developed world have to deal with budgets that are rapidly becoming out of control due to their domestic economies shrinking rapidly. This threatens foreign aid to receiving countries which often depends on GDP of donor countries; see Figure 2.

Figure 2: Foreign Aid as Percentage of GNP (1970-2007)

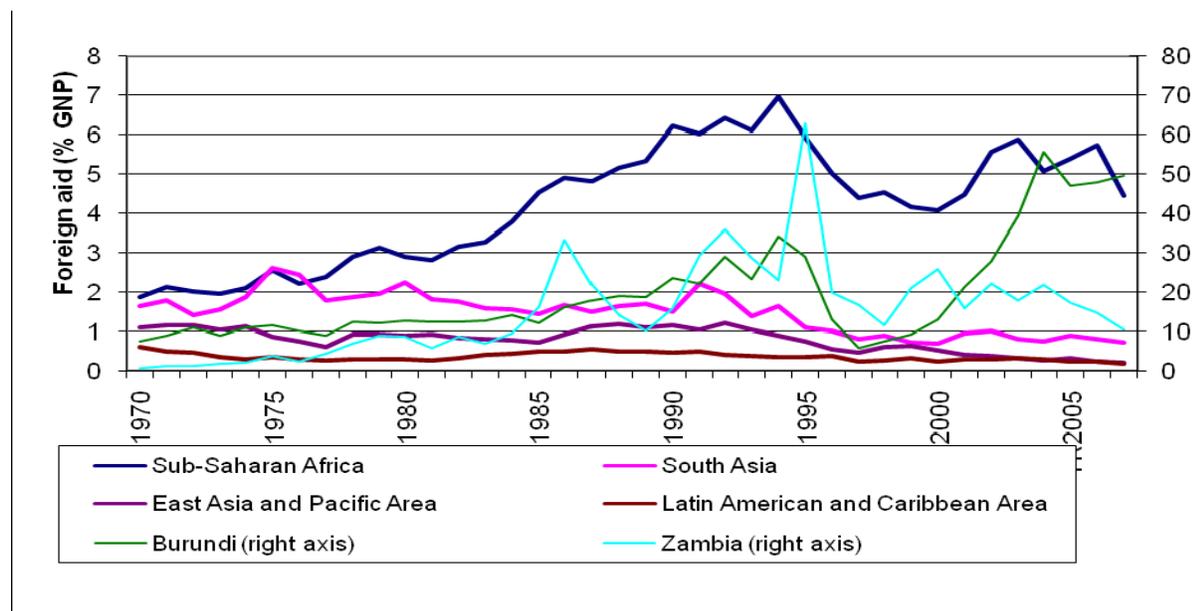
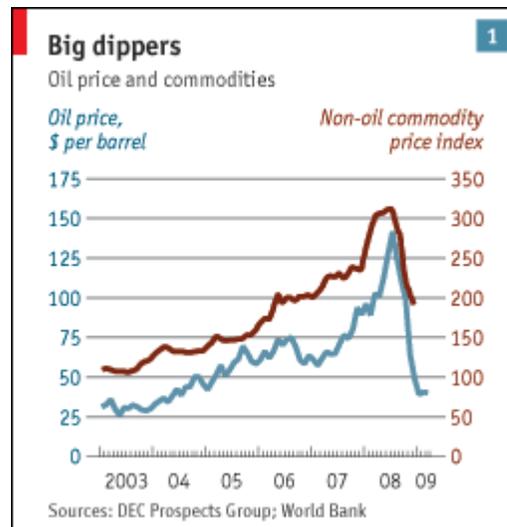


Figure 3 indicates that the stream of remittances from migrants of the developing world working in developed countries is getting smaller as the developed world suffers from recession and rapidly rising unemployment. In addition many developing countries depend for their income on the exports of natural resources. Figure 4 illustrates that prices of oil, gas, gold, diamonds, gold, metals and other primary commodities have collapsed now global demand for these commodities has shrunk. Since government budgets in many developing countries depend almost entirely on the sale of natural resources on the global market, government budgets are very sensitive to the notorious volatility of primary commodity prices. In particular, many resource-rich developing countries face huge budgetary problems due to collapsing commodity prices at a time when the global recession and poverty alleviation demand fiscal boosts to aggregate demand in their economies.

Figure 3: Sharp Falls in Remittances



Figure 4: Sharp Falls in Commodity Prices



Globalization has been a blessing for the Asian Tigers, but with falling global demand exporters in those countries are struggling.⁵ Many developing countries have very specialized economies, are not very diversified, and have a small domestic market. This makes those countries extremely vulnerable for external shocks.

Developing economies have much less opportunity to borrow funds to cope with the crisis. Fiscal boosts to aggregate demand are implemented on a large scale by the G20 countries including countries with

⁵ Exceptions are perhaps exports of goods with low value (e.g., clothing), because consumers in the developed world are switching to cheaper products in the recession. There is some evidence that this is occurring in Bangladesh; see Djurfeldt and Holmén (2005).

substantial national reserves such as China. Most developing countries, however, suffer from capital scarcity and have to pay a premium on government borrowing. Implementing precautionary buffers is therefore rarely feasible for many developing countries. For these reasons the budget of the IMF has been tripled at the recent G20 Summit and the possibility now exists to secure precautionary credits without the usual straightjacket of conditions for reform. Just to be sure, Mexico has already secured such a credit at a value of US \$40 billion.

The recent G20 Summit has unfortunately done nothing to reduce the fragility resulting from global imbalances. In contrast, the summit seems to have worsened imbalances. The US and UK have for decades lived above their means; to a large extent financed by China and Russia propping up the dollar in order to have a cheap-export policy and to avoid the adverse Dutch Disease effects arising from the sale of natural gas, respectively. But it is especially the US and UK who are most willing to boost their economies and fight the global recession by raising public spending according to Keynesian prescriptions. In contrast, surplus, more mercantilist countries such as China and Germany are very hesitant to boost demand and sacrifice their trade surpluses to get the world economy going again. Oil and gas exporters, such as Russia, keep on buying dollars to avoid appreciation of their real exchange rates and their non-oil/gas export sectors. The thrifty, but relatively poor Chinese are funding the spending bonanza and borrowing spree of the Americans and the British by continuing to purchase US and UK government bonds. However, these global imbalances are not sustainable and the dollar and pound will fall substantially unless the Americans and British become thriftier and start living according to their means. If this does not happen and the dollar and the pound collapse, this boils down to a huge default on their large-scale borrowing from countries such as China. Much of Chinese wealth that is invested in the US will become worth a lot less. Still, during the coming decades China and India will grow and become global power factors. There will be a scramble for natural resources to satisfy the growing demand for minerals, oil and gas from these countries. Many of these resources come from fragile states especially in Africa, and China has no moral qualms trading oil, gas and minerals from such states for infrastructure (roads, ports, airports, etc.) while many Western countries insist on good governance and do not engage in such activities. Given the growing scarcity of natural resources and the scramble that will result from it, this will put pressure on global international relations and may even threaten international security given that many resource-rich countries are plagued by war and conflict.

Long before the current global financial crisis started having its disastrous effects on developing countries, they were already suffering from two other crises, possibly with much longer adverse consequences: climate change and food shortages

3. Global Environmental Problems Hit Developing Countries Hardest

3. 1. Greenhouse Effect, Aridification, and Erosion of Biodiversity

The green and industrial revolutions have set in motion a spectacular growth in national income of many developing economies. This has led to an unprecedented growth in the population on our planet as well as a rapid growth in income per capita in many parts of the world. Since 1750 both the size of the world population and production per person has risen tenfold. Economic activity on our planet has thus since 1750 increased hundredfold. This has resulted in gigantic increases in the pressure on the natural environment. Demographers forecast that the global population will grow during the coming four decades from 6.6 billion to more than 9 billion people. All these new people on the planet earth will need to eat, to live somewhere, and to be transported. The pressure on the natural environment and on the living circumstances of other living creatures has never been so high. To make it worse, the environmental pressure will only increase even more during the coming decades. For example, the CO₂ concentration in the atmosphere shall double.

Climate change is, as the Nobel Laureate Paul Crutzen has pointed out, anthropogenic, that is caused by human beings. Half of CO₂ emissions can be ascribed to vehicles, industry, and especially energy companies that often rely on burning of coal. Roughly one fifth of CO₂ emissions are caused by deforestation. Methane, primarily a result of burping and flatulence of cattle, is another important contributor to greenhouse gases (and thus gives an important environmental reason to become a vegetarian).

The greenhouse effect is warming up the earth and the oceans. We will have to learn to live with a rising level of the oceans, more hurricanes, destruction of natural habitats of all kinds of animals and plants and whole ecosystems, acidification of the oceans and thus destruction of coral reefs and plankton populations, and a much more rapid and global spread of known and hitherto unknown diseases. The melting of mountain icecaps leads in the first instance to flooding of whole, often densely packed

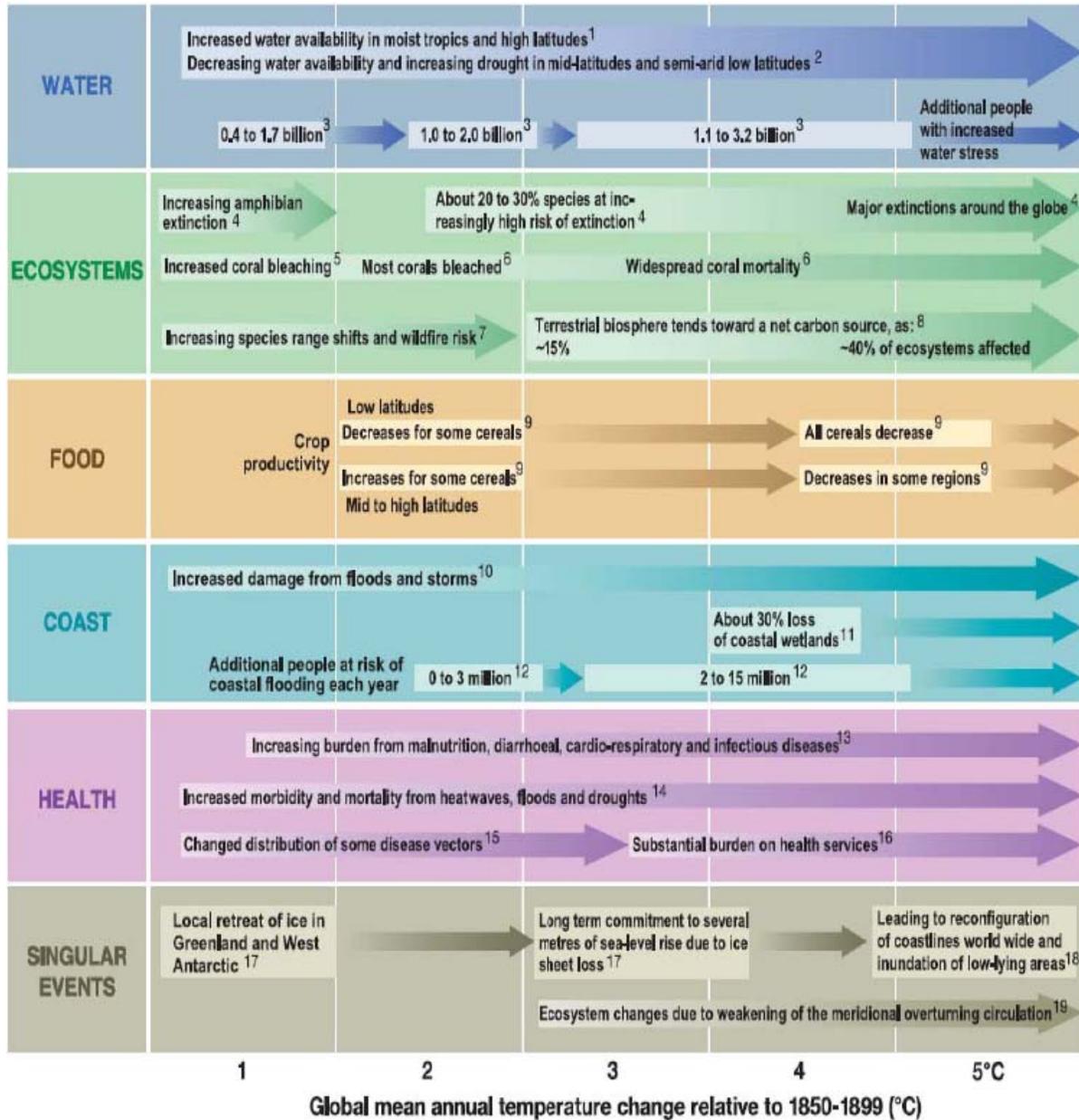
communities, but eventually it cuts off millions of people from their essential water supplies. The real problem is not that fossil fuels will be exhausted, because there is more than enough coal to supply us for the next 200 or 300 years. The challenge is to limit greenhouse warming due to burning of fossil fuels while the world economy will grow at least six fold during the next four decades. Putting a price on gas or oil will not help if we then switch to coal which is much dirtier from an environmental point of view.

Another mega environmental challenge is the ever-increasing shortages of water. Only 2.75% of water on earth is fresh water and three quarters of that is contained in ice caps, sea ice, Greenland and Antarctica. The remainder is mostly contained in fresh water lakes and a much smaller part in rivers, wetlands and the atmosphere. The ten least developed countries in the world are also the driest countries in the world. If it does not rain for a protracted period, people in those countries often end up fighting each other in order to get control of scarce water resources. Throughout the world many farmers drill for water and, due to undefined property rights and the dynamic common-pool dilemmas of interconnected water reservoirs under the ground that go with it, most underground lakes have now been depleted. Often the land on top of these empty underground lakes subsides and may even collapse, which occurs increasingly often in major cities such as Beijing. Another problem is that ground water is becoming increasingly salty. The biggest water users are agriculture and industry. Much damage has been caused by man-made dams which change the course of natural rivers. A big challenge is the huge inequity in the access to water resources both within and between countries. For example, Bangladesh is 91% dependent on water from India. And Israel has command over the water in the Gaza strip. There are indications that the dry-lands are becoming drier and the equatorial wetlands will become even wetter and suffer more from floods and other extreme events (Sachs, 2008, Chapter 5). For example, the Hadejia-Nguru wetlands on Lake Chad in Nigeria have been rapidly drying out which means that almost a million people suffer because of lack of fish and less flooding implies less fertile lands. Part of this may have been due to badly planned irrigation systems and dams. China's Yellow River dries up because of irrigation and urban use. The Aral Sea in Kazakhstan and Uzbekistan has been drained entirely for the huge water-guzzling water cotton producers in that region. `

The increasing environmental pressure including the rapid population growth rates is undermining biodiversity at a rapid rate. The so-called Living Planet Index has fallen by 40% between 1970 and 2000. Coral reefs are dying. The floors of the oceans are being swept clean of natural sea life by large trawlers, thus ruining complete ecosystems. The collapse of the Newfoundland cod fisheries is one of the most

disturbing and telling signs. The many species of toads and frogs is rapidly diminishing. The livelihood of human apes is threatened and the same is increasingly true for bees and other pollinating insects. Much land is turning into deserts, which destroys grass lands and the biodiversity that goes with it. The biggest worry of all is that most of the environmental damage that is inflicted by human activities is irreversible.

Figure 5: Environmental Hazards and Global Warming Necessitate Adaptation



Source: Edenhofer, presentation at Climate Summit, Munich, May 2009

Figure 5 summarizes what might happen to water, ecosystems, food, coasts, health, and the environment as the earth warms up 1-5 degrees relative to 1850-99. Since much of the projected warming is inevitable, much of global policies should be directed at coping with the changes in the environment resulting from global warming. Such adaptation measures are especially necessary for the developing countries. They get hardest hit by global warming (e.g., decrease in cereal production, loss of coastal wetlands, coastal flooding, malnutrition, infectious diseases, water stress, floods and droughts), but have the least funds to take adaptation measures. Furthermore, global warming is to a large extent caused by mankind in the rich countries.

3.2. The Green Paradox: Who Profits from Kyoto?

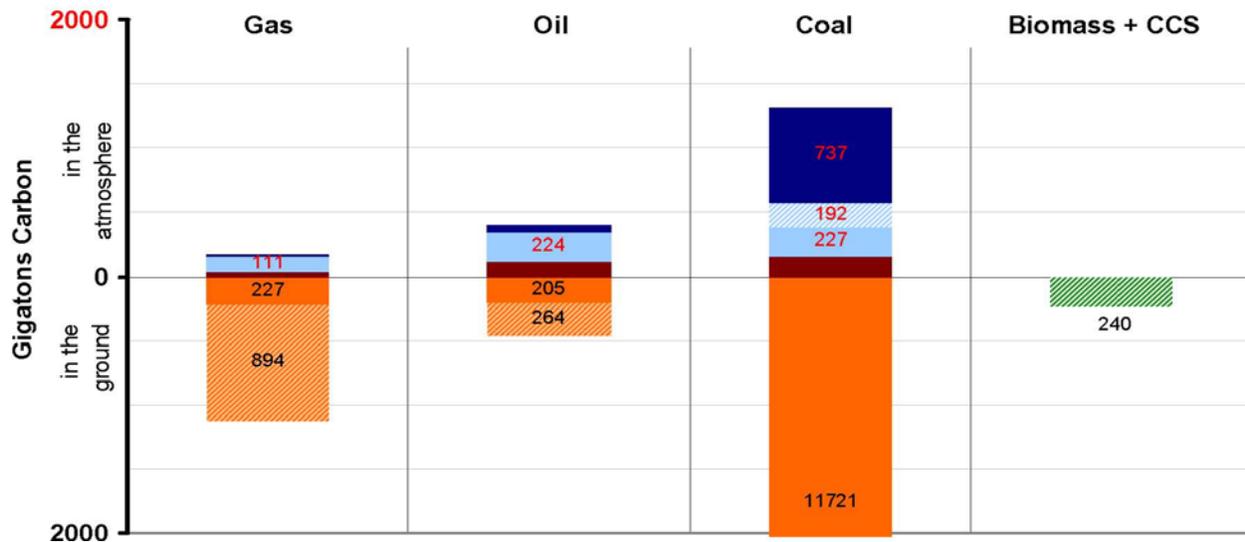
US greenhouse gas emissions are 15% of global emissions. They have fallen by about 3% during 2000-7 while during the same period they have risen 9.9% in India, 21.3% in Canada and a staggering 45.1% in China. The Obama administration wants to cut emissions to below 14% below 2005 level by 2020 and to below 83% 2005 level by 2050, which requires 1 to 6-7 Giga tons of CO₂ emissions. To get a reduction of one Giga ton, one could either build 320 'zero-emission' 500-MW fired power plants instead of coal-fired plants or build 130 new nuclear power plants of 1.0 GW to replace new coal-fired power plants without CO₂ capture and storage in size (Harbert, 2009). Alternatively, one could install 127,500 wind turbines of 2.0 MW each operating at 0.45 capacity factor, convert to biomass crop production a barren area of about 5.4 times the land area of Iowa, or convert to new forests a barren area 2.5 times the total land area of the State of Washington. The scale of the task ahead is thus momentous. Over 80% of the expected increase in greenhouse emissions between now and 2050 will come from developing countries, especially China, India and South-East Asia. It is thus absolutely crucial for the negotiations in Copenhagen in December 2009 that a climate deal is struck between the existing Kyoto countries, the US, India and China. Without China and India, otherwise mitigating climate change will simply not work.

Coal has very high carbon content and will be hit much harder than crude oil, gasoline or natural gas. A particular challenge is therefore coal, which is in much more plentiful supply than oil or gas. Coal supplies could last another 200 years while oil and gas may run out in a few decades.

Figure 6 shows that coal reserves in the ground hugely dominate gas and oil reserves, and that therefore future CO₂ emissions into the atmosphere coming from coal are much larger than that coming from gas

or oil. Seen from this perspective, CO₂ emissions are a coal problem. As the price of oil or gas increases to reflect their growing scarcity, producers will switch to coal especially in electricity generating industries which will lead to substantial increases in CO₂ emissions.

Figure 6: Coal Reserves dominate Gas and Oil Reserves



Key: The under-the-ground reserves are as follows. Probable and proven resources and reserves are for gas, respectively, 894 and 227 Giga ton, and for oil, respectively, 264 and 205 Giga ton of carbon. Reserves for coal are 11,721 Giga ton. For biomass plus carbon, capture and storage (CCS) there are reserves of 240 Giga ton of carbon, which is assumed to generate zero CO₂ emissions.

The CO₂ that has been emitted and will be emitted (under the scenario that CO₂-equivalent levels are stabilized at 400 parts per million compatible with the objective of limiting the increase in global temperature to a maximum of 2 degrees centigrade over pre-industrial levels) into the atmosphere is as follows. Estimated additional consumption is 737 Giga ton for coal, but almost none for gas and oil. Coal plus CCS has emitted much less, namely 192 Giga ton of carbon. The estimated consumption will lead to 227, 224 and 111 Giga tons of carbon for coal, oil and gas, respectively. The remaining bit immediately above the line is Giga tons of carbon emitted in the atmosphere due to cumulative historical consumption.

Source: Edenhofer and Kalkuhl (2009)

The so-called Green Paradox (Sinn, 2008, 2009) has generated much debate about the usefulness of trying to put a price on CO₂ emissions. This paradox may occur if the Kyoto countries use carbon taxes, emission permits or quota's to put a price on CO₂ emissions. Consumer prices in the Kyoto countries will increase by less than the price of the tax or permit as some of the cost of higher carbon taxes or emission permits is shifted to producers in terms of lower producer prices. This means that producer

prices of energy will also fall in the non-Kyoto countries. The non-Kyoto countries thus benefit from cheaper energy prices and thus demand more energy, thereby undoing some of the intended beneficial effects of the environmental policies of the Kyoto countries. The unintended gift from the Kyoto to the non-Kyoto countries in terms of lowering prices of fuel fuels is especially large if demand for fossil fuels is relatively elastic and supply of fuels relatively inelastic. In as far as governments announce more ambitious future environmental targets, owners of gas and oil reserves will anticipate some form of tax shifting and thus expect lower production prices in the future. Threatened by this future appropriation of their reserves, they expand gas and oil production today and thereby accelerate global warming. Rational owners of gas and oil with forward-looking expectations will therefore undo any attempt at mitigating global warming.

The Green Paradox thus relates to production expansion on the basis of forward-looking expectations and intertemporal speculation on the gas and oil markets (Sinn, 2008, 2009). The Green Paradox can, however, be criticized (e.g., Folmer, 2009). For example, the Green Paradox relies on the intertemporal arbitrage principle underlying the Hotelling rule of optimal oil extraction being valid, that is it presupposes that the expected return of oil under the ground (the expected capital gains) must be equal to the return on oil taken out the ground (the market rate of interest). But, in practice, oil prices do not increase at a rate equal to the market rate of interest. Oil prices are not on such an upward trend, because the growth in new oil reserves has been about 2-3% per year over the last few decades. This simple fact undermines to a large extent the Green Paradox.

However, even though one cast doubt on the intertemporal version of the Green Paradox, carbon leakage and environmental capital flight to countries with less ambitious environmental policies are problems that global policymakers have to face that do not rely on unrealistic intertemporal arbitrage arguments. Carbon leakage occurs if the emissions policies of one country raises local costs, because then other countries with less ambitious environmental policies have a trading advantage. If demand for these goods is unaffected, production will move offshore to countries with lower emissions standards and thus global emissions will not be curbed. Alternatively, if strict environmental policies in one country raise prices of fuels, the demand for fuels will fall and thus their price will fall. Countries that do not place a premium on fuels may then take up the demand and use the same supply, thus rendering the strict environmental policies unproductive from a global point of view. Carbon leakage may thus impede the Kyoto protocol. One of the problems is that the Kyoto control seems to ignore the

carbon footprint of imports. For example, almost a quarter of China's CO₂ emissions result from its exports to mainly the US and Europe. Hence, a focus on emission policies within national boundaries appears to be misguided.

The intertemporal rendition of the Green Paradox unrealistically supposes that the total amount of hydrocarbon reserves are fixed and that therefore the total amount of CO₂ emissions that will come from these reserves is fixed as well. However, the biggest problem with trying to mitigate global warming is substitution towards other sources of energy. Higher prices on CO₂ emissions encourage firms to substitute from gas and oil towards cheap coal. This will be especially so, if for all kinds of political economy reasons to do with ensuring cheap coal-generated electricity for the lower incomes, coal is (partially) exempted from CO₂ taxes. The result is that CO₂ emissions will increase tremendously. Just putting CO₂ taxes on gas and oil but not on coal (which would have to be very high indeed) means that consumer prices of gas and oil will not increase the whole way while coal prices will fall and thus coal demand will rise. CO₂ emissions thus rise as coal generates more CO₂ emissions per unit of energy than gas or oil, thereby rendering the piecemeal environmental policy not only ineffective but counterproductive.

A similar dilemma arises if the higher gas and oil prices make retrieving oil from the tar sands of Canada more attractive. This way of retrieving oil is in contrast to generating energy from coal much more expensive, but it is also very bad for CO₂ emissions. This is perhaps why Canada, in contrast to the US, has seen its CO₂ emissions rise by as much as 21.3% during 2000-7. Finally, if the higher prices on CO₂ emissions encourage substitution towards nuclear energy, CO₂ emissions will certainly decline but at an increased risk of fallout as long as safety of nuclear energy production and waste storage is still not effectively guaranteed. For the time being, government should stimulate research to safe nuclear power and safe disposal of nuclear waste.

Ultimately, there are only two options: keep the fossil fuels under the ground or put the CO₂ emissions back into the ground via sequestration (or use it in building materials or asphaltting roads). But this requires five times as much space as the original space occupied by anthracite coal or three times as much in case of crude oil, and depleted coal mines and oil and gas deposit offer room for only one tenth of recoverable carbon resources (e.g., Sinn, 2009). Sequestration will thus never be able to solve the problem of mitigating global warming. Another problem is public resistance due to leakage

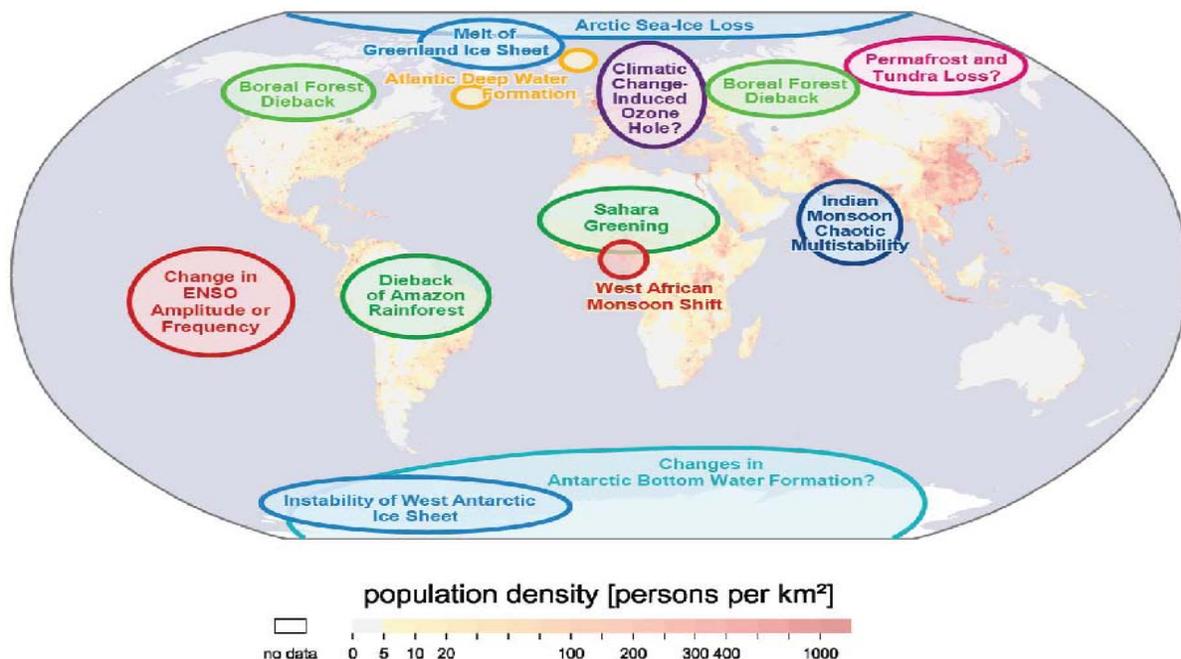
The world needs a global climate agreement which curbs demand for fossil fuels and for coal and encourages a technology breakthrough. Although Kyoto is flexible with joint implementation/clean development mechanisms allowing countries to meet their obligations via abatement in other countries and international emission trading, it is not legally binding. Furthermore, penalties for non-compliance are ineffective, clean development mechanism can be substituted for development aid, and for some countries the quota's are higher than their expected emissions. Also, in the EU only 40% of emitters are subject to trading. Grandfathering has led to an over-allocation of permits in the EU, so it is better to auction the permits. The challenge is to get agreement this December in Copenhagen on a global green deal. Only the 27 EU member states, Australia, Canada, Iceland, Japan, New Zealand, Norway, Russia and Ukraine have accepted a cap on CO₂ emissions, but the US, This raises the question in what respects Obama differs from Bush Latin America, Africa and Asia have not even though they are responsible for almost three quarters of global CO₂ emissions. This raises the question in what respect President Obama differs from President Bush.

The US House of Representative has on 26th June 2009 narrowly passed a bill to cut CO₂ emissions from 2005 levels by 17 percent by 2020 and by 83 percent by 2050. The US under President Obama will introduce its own emissions trading system from 2011 onwards, which may give the impetus for a new Global Green Deal. But for a new Global Green Deal to really come off the ground much more is needed than a US trading system alone: at the least, President Obama should be a full participant in the Copenhagen Protocol and take on the role of global leadership on fighting climate change. The recent G8 Summit has failed to get China and India to sign on onto the goal of cutting carbon emissions and other greenhouse gases in half by 2050. Although it may not matter much if Africa is excluded, mitigating global climate change will fail unless at the very least China and India participate. China emits already more CO₂ than the US and in the future this will only grow. It is thus important to find a deal whereby both the global imbalances resulting from excessive borrowing of the US and excessive saving of China and the growing contribution of China to global warming have to be tackled. This requires a large sustainable expansion of domestic demand in China and belt tightening in the US. The new Global Kyoto System would, of course, correspond to a partial expropriation of the owners of the gas and oil fields. The UN could function as a kind of global carbon central bank. The New Global Green Deal would only work if China, India, the European Union and the US take the lead and as many other countries like Brazil, Russia and Indonesia join in. Studies on all possible coalitions that would make a New Global Deal happens show that it is not strictly necessary that the African continent joins. (e.g., Bosetti, et al., 2009).

3.3. Tipping Points, Fat Tails, Precautionary Action and the Social Discount Rate

Deriving policy prescriptions to fight global warming are very much complicated by so-called tipping points such as dieback of the Boreal Forest or Amazon Rainforest, melting of the Greenland Ice Sheet, instability of West Antarctic Ice Sheet, climate-change induced ozone holes, greening of the Sahara, West African Monsoon shift, Permafrost and Tundra loss, or Indian Monsoon chaotic multi-stability.

Figure 7: Tipping Points in the Earth System



Source: Lenton and Schnellhuber (2007)

Figure 7 summarizes some of these potential tipping points. They correspond to nonlinear thresholds triggered by global warming, typically characterized by Knightian uncertainty (Knight, 1921) rather than just risk. Knightian uncertainty is a radically different notion than risk. Whereas risk is to some extent measurable (e.g., the aversion towards risky outcomes can be measured), Knightian uncertainty is fundamentally immeasurable as it is related not only to risky outcomes but to possible outcomes which we presently may not be able to envisage. Furthermore, climate change cannot really be discussed in the normal marginal analysis familiar from conventional cost-benefit analysis, that is one cannot equate the marginal benefit of reducing the adverse effects of climate change to the marginal costs of

mitigation and adaptation. The reason is that marginal analysis is, mathematically speaking, inherently a local rather than a global analysis, since the challenges posed by the many nonlinear thresholds and potential tipping points associated with climate change (see Figure 7) require a global and not a local analysis. Marginal analysis may miss that due to hitherto unforeseen events (Knightian uncertainty) the climate system may tip with unforeseen consequences. Much of climate change is further exacerbated by rapacious depletion of fossil fuels, often to do with lack of properly defined property rights (e.g., Sinn, 2008). This rapacious depletion of hydrocarbon resources occurs more voraciously in fragment and ethnically polarized societies (van der Ploeg, 2008, 2009). This further increases the risk of tipping points and nonlinear thresholds. Much of the conventional expected utility analysis of risk of global warming as discussed in the Stern Review and elsewhere is based on marginal analysis and is therefore not fully appropriate for discussing how to combat the adverse effects of climate change.

Two essential matters must be addressed. First, it is necessary to allow for aversion to extremely negative events occurring. This is easily done by having a framework of prudence. In fact, the principle of precautionary action ('better safe than sorry') was a key argument in the Stern Review to act now rather than to have a 'policy ramp' of gradually tightening environmental policies (Stern et al., 2007; Stern, 2009). Second, it is necessary to allow for 'fat tails' in the probability distribution of future global temperature, tipping points and Knightian uncertainty especially when considering extreme climatic events (Weitzman, 2009a). When discounting at an uncertain pure rate of time preference close to zero, the fat tails and temperature-sensitive disutilities can make expected present discounted damages of global warming very large indeed. Since CO₂ stays so long in the atmosphere and it takes so long to learn about irreversible climate changes and to then correct, a significant increase in expected welfare might result if climate change policy could be directed in such a way that the upper extremes of the tail of the statistical distribution of future climate damages could be truncated before reaching catastrophic temperatures (Gollier, 2008; Weitzman, 2009ab). To achieve this, one would have to engage in immediate drastic action to fight climate change rather than have a slow policy-ramp of gradually increasing carbon taxes. Addressing those matters takes one well beyond the normal practise of modelling climate change and deriving optimal mitigation policies based on marginal analysis and on expected utility analysis without paying due attention to the precautionary principle. The main point is that such fat tails of the statistical distribution of climate change damages warrant a smaller discount rate for evaluating future mitigation of climate damages and thus warrant a more vigorous climate

change policy, especially in economies with some persistence of shocks to the growth rate of the economy (Gollier, 2008; Weitzman, 2009b).

Still, for different reasons the Stern Review and Weitzman (2007, 2009a) emphasize the need for immediate action to mitigate climate change whereas Nordhaus (2007) and many of the Integrated Assessment Models make the more conventional case for a 'policy ramp' of gradually tightening mitigation policies over time as the globe warms up. Thinking a century ahead, global temperatures are predicted to rise by more than 3 degrees Celsius unless atmospheric greenhouse gases are stabilized at around 550 ppm CO₂e. In fact, within half a century we will reach this concentration of greenhouse gases at current emission rates.

To understand the key issues involved, it is instructive to recapitulate the drastically simplified arguments made by Weitzman (2007). The Keynes-Ramsey rule for dynamic efficiency states that the real interest rate r equals the pure rate of time preference δ plus the product of the coefficient of relative risk aversion η and the growth rate of consumption g , i.e., $r = \delta + \eta g$. Effectively, investors need a much higher rate of return than the rate of time preference if the growth rate of the economy is economy, especially if investors are risk averse.⁶ Weitzman (2007) believes the trio of twos, $\delta = g = 2\%$ and $\eta = 2$ is not an unreasonable assumption, which corresponds according to the Keynes-Ramsey rule to an annual interest rate of 6%. The Stern Review, however, judges a very low rate of time preference, $\delta \cong 0.1\%$ to be more defensible from the ethical consideration of intergenerational equity and also adopts a relatively low coefficient of relative risk aversion, $\eta = 1$, and a relatively low growth rate of consumption, $g = 1.3\%$. This corresponds to a much lower interest rate of $r = 1.4\%$. As a result, the discounted benefits from curbing global warming a century ahead are weighted 100 times as much by the Stern Review as with the more conventional estimates of the triple twos. Typical estimates of global climate damages as a fraction of global GDP a century away if nothing or little is done to arrest greenhouse emissions are in the range 0 to 3%, but the Stern Review again errs on the safe side as adopts a figure of 5%. The Stern Review further estimates the abatement costs corresponding to the

⁶ Given that in this framework the elasticity of intertemporal substitution corresponds exactly to the inverse of the coefficient of relative risk aversion, we can interpret the Keynes-Ramsey rule also as follows. Agents are happy to postpone consumption (corresponding to a higher growth rate of consumption g) if the market rate of return on their saving is greater than their rate of time preference, especially if it is easy to substitute future for present consumption (low value of η). One of the problems with this literature is that the a low elasticity of intertemporal substitution implies much too high risk aversion and that the link between the two should be severed to really get to grips with the intertemporal tradeoffs involved in the study of whether or not to combat climate change (e.g., Traeger, 2009).

target of 550 ppm CO₂e at 1% of GDP, while some put it more at double that figure. It is not surprising that with this repeated application of the precautionary principle the Stern Review ends up with a benefit-cost ratio of 4.5⁷ and thus makes a passionate plea for immediate action to fight global warming. The Stern Report not only loads the dice in favour of a high benefit-cost ratio and thus reinforcing the case for acting immediately to fight climate change by playing up the benefits and playing down the costs of fighting climate change, but also by using a low value for the growth rate g (1.3%), a low value for the coefficient of relative risk aversion η (equal to 1), and an extremely high weight to future generations implied by an extremely low value for the society's rate of discount δ . Instead, one could repeat the cost-benefit analysis to decide whether to act to combat climate change or not to act with the more realistic assumptions of the triple twos used by Weitzman (2007). In other words, one could a growth rate, a coefficient of relative risk aversion and a rate of discount of 2%. In that case, the interest rate implied by the Keynes-Ramsey rule would be 6% (i.e., $r = \delta + \eta g = 2\% + 2.2\% = 6\%$) and the benefit-cost ratio would be only 0.1. In that case, no case can be made for acting to combat climate change.

But Weitzman's (2007) fundamental critique of the Stern Review and its use of Integrated Assessment Models is directed at the lack of a proper treatment of uncertainty. For example, if there is a 50% chance of the correct discount factor being 1.4% of $\exp(-1.4)$ and a 50% chance of the discount factor being 6%, then the discount factor a century ahead is with 50% chance equal to 0.2466 (i.e., $\exp(-1.4)$) and with 50% chance equal to 0.0025 (i.e., $\exp(-6)$). This implies an expected discount factor of 0.12455, which corresponds to an effective discount rate of only 2% (not the arithmetic average of the two annual discount rates 1.4% and 6%, i.e., 3.7%). One should therefore use interest rates at the lower end of the spectrum of possible values. In this light, the very low discount rate used by Stern Review may not be that unreasonable after all. In fact, studies of climate change would benefit from capital asset pricing theory. At least one should distinguish between a risky economy-wide rate of return on investments that have payoffs that are correlated with the economy and a risk-free rate of return on investments whose returns are unrelated to the economy as a whole. If the growth rate of the economy in any year is normally distributed with a constant mean μ and a constant variance σ^2 , it can be shown that the risk-free rate of return is given by $r^f = \delta + \eta \mu - \frac{1}{2} \eta^2 \sigma^2$. In other words, the interest rate given by the non-

⁷ The discounted value of the rather high estimate of global climate damages 100 years ahead, using a growth-corrected real interest rate of $r-g = 1.4\% - 1.3\% = 0.1\%$, equals 4.5% of GDP (i.e., $\exp(-0.1)$ times 5% of GDP). Given that the abatement costs of acting today are estimated at 1% of GDP, we obtain a benefit-cost ratio of 4.5% of GDP.

stochastic version of the Keynes-Ramsey rule is biased downwards by the third term in the above expression for the risk-free rate of return. This downward bias is higher if the coefficient of relative risk aversion is high and the economy is very volatile (high η and high σ). A Lucas fruit-tree economy is characterized by identical agents that trade assets on spot markets that are claims to future dividend payments, by agents maximizing expected utility, and by agents having subjective beliefs that correctly reflect the objective probabilities of the stochastic process for dividend payments (Lucas, 1978). In such fruit-tree economy equity is thus viewed as a claim on consumption dividend produced by the economy itself. It can be shown that the equity risk premium of the return on equity r^E over the safe, non-risky rate of return r^F simply equals $r^E - r^F = \eta\sigma^2$ where $r^E \equiv \ln E[R^E]$ and R^E is the gross arithmetic annual return on equity. If one adopts Weitzman's quartet of twos (by setting the coefficient of relative risk aversion η equal to two, a rate of average annual growth in consumption μ of 2% and a discount rate δ of 2%) and also assumes a standard deviation of consumption growth on an annual basis σ of 2%, one finds that the risk-free rate of return r^F must equal 5.9% (i.e., $2 + 2 \times 2 - \frac{1}{2} \times 2^2 \times 0.02^2 = 5.92$) and the average return on equity r^E must equal 6% (i.e., $5.92 + 2 \times 0.04 = 6$). The resulting equity risk premium equals a mere 0.1%. This equity risk premium is much lower than the historically observed value of about 6% per year (until the crisis), since historically r^E and r^F are close to 1% and 7% per annum, respectively. This disconnect is known as Mehra-Prescott equity premium puzzle (Mehra and Prescott, 1985).

Whether one should use the risky or the risk-free rate of return depends on whether mitigating climate change investments are correlated with consumption growth in the future. In as far as curbing CO2 emissions by taking action now will lead to less global warming and thus more consumption growth in the future, the correlation coefficient between returns on combating climate change investments and returns to the economy as a whole (i.e., the climate investment beta β) will be positive. The relevant interest rate for discounting climate benefits hundred years from now is then $r = -\left[\ln\left(\beta \exp(-100r^E) + (1-\beta)\exp(-100r^F)\right) \right] / 100$. The implicit climate investment beta used in the Stern Review and Integrated Assessment Models is one, so the economy-wide interest rate $r = r^E$ ($\approx 6\%$) should have been used for discounting rather than the value of 1.4%, say. But this will undo the plea for immediate action of the Stern Review in favour of the more conventional climate policy ramp.

A key question, however, is whether climate mitigation investments are or are not correlated with the economy. In as far as climate change mostly affects coastal recreational areas, natural landscapes and

biodiversity and has much less of an impact on droughts, loss of agricultural production, diseases and the state of the economy, the investment climate beta being a measure of correlation between the return on climate mitigation investments and the future returns in the economy may not be very high. For example, using the historical annual returns on risk-free assets of 1% and on risky equity of 7%, if $\beta \cong 0$, then the appropriate rate to use for discounting climate benefits is $r = r^E = 1\%$. However, if climate mitigation policies are much more likely to prevent climate-induced economic disasters and, a much higher investment beta is warranted. For example, if β is close to 1, one should use a discount rate of $r = r^E = 7\%$. Interestingly, if $\beta = \frac{1}{2}$, the appropriate discount rate is not 4% but much less, namely 1.7% per annum. This is much closer to the discount rate used in the Stern Review. Since the climate investment beta is likely to be less than one, it is appropriate to use a much lower discount rate and thus the case for immediate action rather than a gradual climate policy ramp becomes stronger.

If it would indeed be the case that climate change affects returns on industry much less than it affects the livelihood of people living in many of the poorest countries on earth through droughts, floods and diseases much less than it would preserve natural habitats and so on, a small climate investment beta and a very low discount rate are called for and thus the case for climate mitigation investments becomes very strong indeed (even without appealing to the moral argument that these countries have mostly not been responsible for the recent global warming). However, if climate change is judged to adversely affect the likelihoods of poor people and economic development, a much higher climate beta is warranted and thus a much higher discount rate should be used. Alas, the case for strong and decisive climate change policies then falls apart. However, given that the global financial crisis has crushed the risk premium. The case for climate mitigation policies for when climate change adversely affects the economy may have become much stronger.

4. The Curse of Natural Resources

4.1. Some Stylized Facts

Figures 8-10 and Table 1 offer some stylized facts for the period 1970-2003 about why natural resources may stunt growth prospects of many resource-rich African economies:

- First, Figure 8 indicates that volatile countries with a high standard deviation of yearly growth in GDP per capita have on average lower growth in GDP per capita.
- Second, developing countries have more volatile output growth than developed countries. Whereas Western Europe and North America have a standard deviation of, respectively, 2.33 and 1.90 %-points of yearly growth in GDP per capita, the figures for Asia are 4.4 to 5 %-points and for Latin America & Caribbean 4.54%-points. Most striking is that Sub-Saharan Africa and the Middle East & North Africa have highest volatility. Their standard deviations of average growth in GDP per capita are, respectively, 6.52 and 8.12 %-points.
- Third, countries with poorly developed financial systems are more volatile. Countries in the bottom quartile of financial development have a standard deviation of annual growth in GDP per capita 2 %-points higher than those in the top quartile. North America and Western Europe have well developed financial systems while Eastern Europe & Central Asia and especially South Asia and Middle East & North Africa have poor functioning financial systems. Resource-rich and landlocked economies have less developed financial systems than resource-poor countries.
- Fourth, countries that depend a lot on natural resources are much more volatile. Countries with a share of natural resource exports in GDP greater than 19% (the top quartile) have a staggeringly high standard deviation of output growth of 7.37 %-points. For countries with a natural resource exports share of less than 5 per cent of GDP (the bottom quartile), the figure is only 2.83 %-points. Figure 9 also indicates that resource-rich countries have greater macroeconomic volatility. Figure 10 shows that world commodity prices are extremely volatile and are the main reason why natural resource export revenues are so volatile. Crude petroleum prices are more volatile than food prices and ores & metals prices. Volatility of agricultural raw material prices is less, but still substantial. Monthly price deviations of 10%-points from their base level (year 2000) are quite normal.
- Fifth, landlocked countries suffer much more from volatility. Indeed, countries that are less than 49 kilometers from the nearest waterway have a standard deviation of growth in GDP per capita that is 1.6 %-points lower than countries that are more than 359 kilometres from the nearest waterway. Empirical work also finds that landlocked are more likely to have undiversified exports and to experience greater volatility in output growth (Malik and Temple, 2006). Since Figure 8 indicates that the negative correlation between volatility and growth in income per capita is not

much different for landlocked countries, the disappointing growth performance of landlocked countries may be due to their higher volatility rather than being landlocked.

Figure 8: Volatility Correlated with Low Growth in GDP per Capita

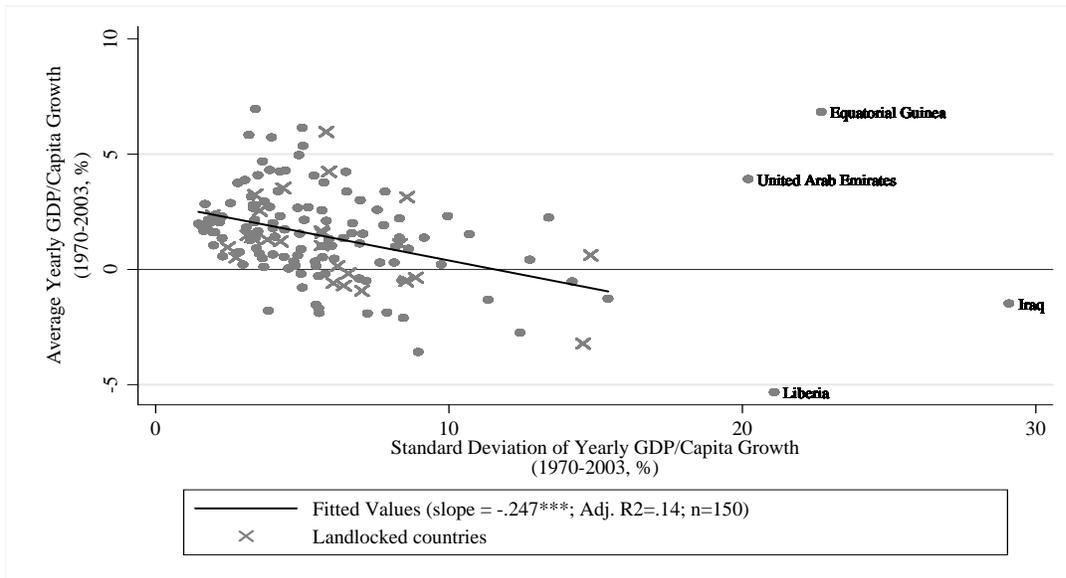
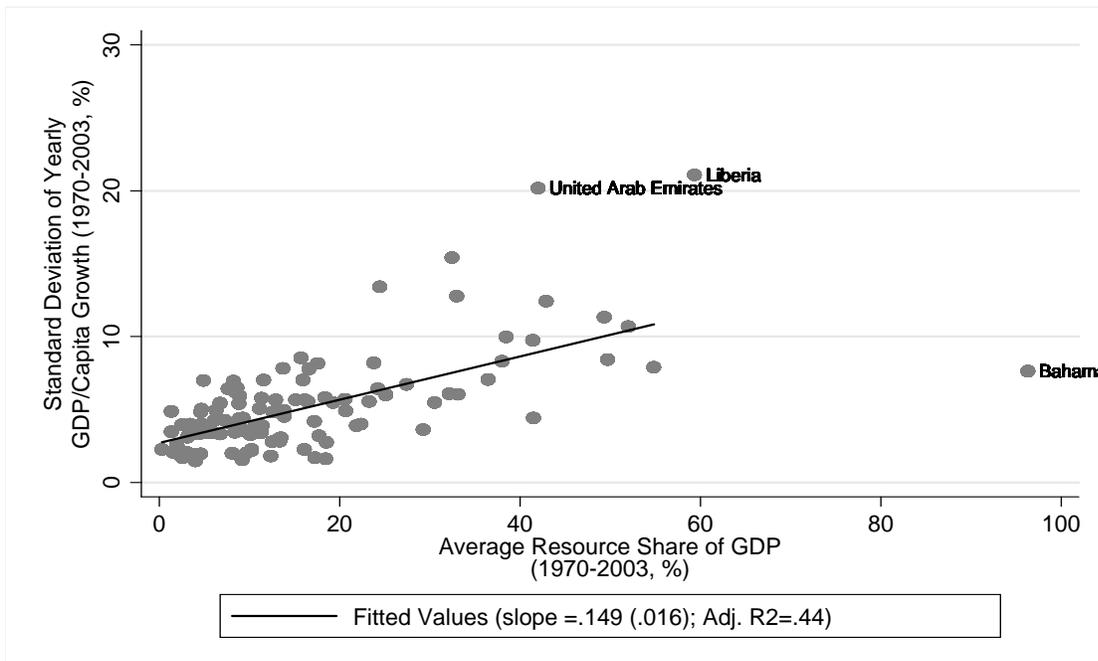


Figure 9: Resource-Rich Economies Are More Volatile



Note: Resource share measures the total of food, agricultural raw materials, mining and fuel export revenue, as a percentage of GDP, average over the period 1970-2003.

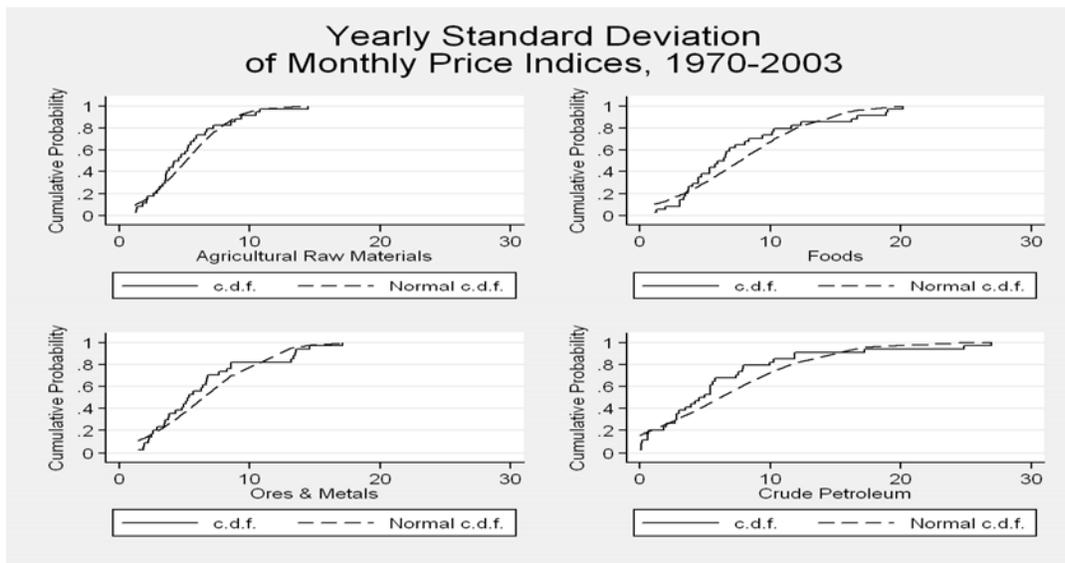
Table 1: Growth, Volatility, Financial Development and Resources in the World Economy

Regional Characteristics (% , 1970-2003, at least 10 observations per country)

Region	Yearly real GDP per capita growth rate		Export Value Share of GDP						Government Share	Financial Development
	mean	Sd	Fuels, Ores & Metals		Agricultural Raw Materials, Foods		All Resources		sd	mean
			mean	sd	mean	sd	mean	sd		
Middle East & North Africa (MENA)	1.18	8.12	22.24	9.30	2.51	1.52	24.75	9.07	5.82	41.41
Sub-Saharan Africa (SSA)	0.47	6.52	9.60	3.97	10.24	3.60	19.65	5.66	4.76	17.44
East Asia & Pacific (EAP)	2.47	5.00	6.81	3.45	10.04	3.11	16.71	5.49	2.72	51.77
Latin America & Caribbean (LAC)	1.47	4.54	4.99	2.64	9.66	3.70	14.59	5.34	3.98	34.87
South Asia (SA)	2.41	4.41	0.52	0.42	4.25	1.55	4.77	1.83	2.98	17.33
Eastern Europe & Central Asia (ECA)	2.56	4.34	2.07	0.66	3.50	1.03	5.57	1.54	2.52	22.70
Western Europe (WE)	2.35	2.33	2.71	1.00	5.20	0.95	7.86	1.60	1.53	76.08
North America (NA)	2.09	1.90	2.90	0.52	2.99	0.45	5.88	0.85	1.60	109.36
1 st q. Av. Fin. Development (<=16.2)	0.70	6.40	9.71	4.23	7.64	3.00	17.06	5.52	4.64	10.38
4 th q. Av. Fin. Development (>=52.9)	2.32	4.40	4.68	2.29	5.28	1.78	9.89	3.45	3.03	80.92
1 st q. Av. Resource Dep. (<=6.1)	2.73	2.83	1.17	0.48	2.23	0.64	3.41	0.93	2.38	64.96
4 th q. Av. Resource Dep. (>=19.3)	1.08	7.37	23.22	10.00	11.62	3.59	34.67	10.85	4.72	25.47
1 st q. Distance to waterway (<=49km)	1.76	8.12	6.72	3.41	8.22	2.65	24.75	9.07	5.82	41.41
4 th q. Distance to waterway (>=359km)	1.46	6.52	8.22	3.68	8.59	3.43	19.65	5.66	4.76	17.44

Note: *Means* are cross-country averages of country average growth rates or variable shares between 1970 and 2003. *Standard deviations (sd)* are the average cross-country standard deviations of country yearly growth rates or variable shares over the corresponding period.

Figure 10: Cumulative Density Function of Volatility of Commodity Prices



Note: The x-axis measures the yearly standard deviation of the monthly price index levels

4.2. Volatility is Quintessence of the Paradox of Plenty

Empirical evidence strongly indicates that volatility of resource-rich economies with underdeveloped financial systems harms growth prospects (e.g., van der Ploeg and Poelhekke, 2009a). Developed economies with advanced banking systems and a lot of oil or gas, like Norway and the Netherlands, seem better able to cope with liquidity shocks and volatility of oil and gas prices. However, many resource-rich developing economies have to make do with poorly developed financial systems and thus suffer more from the notorious volatility of oil and other commodity prices. This means that they are less able to hedge against the risks of commodity price fluctuations or to borrow for urgently needed innovation or infrastructure when commodity prices are low. Furthermore, when revenues from sale of commodities are volatile, there is less scope for investments in innovation and thus growth prospects are worse especially if financial markets are poorly developed. Uncertainty also implies that firms hold back investment in irreversible projects and make uncertainty-induced planning errors especially if it is costly to switch factors of production between sectors, so that growth is lower. Volatility may also harm growth due to excessive borrowing and induced boom-bust cycles in fiscal policy. However, there are also factors that suggest that volatility may be good for the economy. For example, investment projects with a volatile return command a higher return and thus boost growth more. Also, volatility induces

precautionary saving which gives more room for investment and may thus boost growth. Ultimately, the question of whether volatility harms or boosts growth performance cannot be settled theoretically. That is why it is important to know that empirical work strongly suggests a negative link between volatility and growth.

To establish what factors determine volatility and whether volatility increases or decreases growth performance, one can use a cross-country dataset to estimate simultaneously a regression equation explaining average annual growth in income per capita and another equation explaining the logarithm of the variance of unanticipated growth in income per capita (the variance of the average annual growth in income per capita that cannot be explained by the explanatory variables, i.e., the variance of the residual of the growth regression). Such estimates are presented and discussed in detail together with the definitions of the variables elsewhere (van der Ploeg and Poelhekke, 2009), but a summary of the results of the coefficients that are all significant at the 5% level are reported in the first column of Table 2. The estimates indicate that investment in physical capital and in human capital (as measured by the years of schooling) boost economic growth while population growth depresses growth in income per capita. There is also strong evidence for conditional convergence, which means that given all the other variables poor countries catching up. Also, the evidence strongly supports the hypothesis that countries with high population growth on average tend to grow much less. Hence, policies directed at reducing the population growth rate (e.g., birth control or education of young girls to delay the age of child bearing) are likely to boost growth. Interestingly, even controlling for these effects on average growth performance, there is a significant *positive* direct effect of the export revenue coming from point-source natural resources (e.g., oil, gas, gold or diamonds)⁸ on the average annual rate of growth in income per capita. There is evidence for a significant direct effect of financial development on economic growth, but it is negative. More important, volatility of unanticipated growth exerts a powerful and negative effect on growth in GDP per head (witness the coefficient -0.971). As expected, volatility itself increases with the GDP share of point-source resources but not significantly with the GDP share of diffuse resources. The underlying idea is that the volatility of commodity prices translates more strongly into macroeconomic volatility if countries are more dependent on natural resources, especially if these resources are point-based (cf., the coefficient of 1.621 versus that of 0.801). Consequently, more natural

⁸ Point-source natural resources are resources that are compact, have high value added, and are easy to loot. Diffuse resources (e.g., agricultural products) are less compact and have less value added.

resource dependence leads via higher volatility to lower growth. This indirect effect of natural resources on growth appears to be the quintessential feature of the natural resource curse. Not surprisingly, volatility decreases with the degree of financial development and openness of a country to international trade. Hence, countries that have better banking systems and are more open to international trade have less volatility and thus better growth performance.

Since the *direct* effect of natural resources on growth is positive (witness the coefficient of 0.05) and the *indirect* effect is negative, natural resource dependence is a curse for volatile countries and a boon for countries with relatively stable unanticipated output growth. In fact, if the standard deviation of unanticipated output growth exceeds 6.4%, resource dependence curbs growth and otherwise it boosts growth.⁹ More open and financially developed countries are expected to be more stable and grow faster even if they export many resources. We thus find that for the less volatile resource-rich OECD countries such as Canada, the Netherlands, Norway and the United Kingdom, resource dependence is a boon for growth, while for volatile landlocked Africa (especially Zambia) it is a curse. Indeed, the statistics given in Table 1 suggest that on average this is the case for all of sub-Saharan Africa and for the region of Middle East and North Africa.

Table 2 also compares resource-rich and landlocked Africa with the South-East Asian sample. Resource-rich countries are those in the global top 25 and natural resource exports valuing on average more than 17.31% of GDP during 1970-2003. Since the resource-rich countries of Africa were poorer in 1970 than the South-East Asian countries, they grow faster and catch up, everything else equal. We see from the top panel of Table 2 that this growth differential amounts to 0.87%-point per year (the difference in initial GDP per capita -0.619) times the coefficient on initial income per capita (i.e., -0.014). Allowing for the positive direct growth effects of higher natural resource dependence in Africa, we see that if resource-rich and landlocked Africa had the same point-source resource endowment as South-East Asia, it would have grown 0.44%-points less (i.e., $0.05 \times 8.80\% = 0.44\%$). Combining these two factors, we see that this part of Africa should have really grown 1.31%-point (i.e., $0.87+0.44\%$) faster than the South-East Asian countries.

⁹ This may be seen from the following calculation. The overall effect of point-source resources on growth consists of the direct effect, 0.05, minus the indirect effect, which follows from the chain rule $0.971 \times 1.621 \times \sigma_i/2$ where the term $\sigma_i/2$ comes in as the inverse of the derivative of the logarithm of the variance $\log(\sigma_i^2)$ with respect to the standard deviation σ_i . The overall effect of point-source resources on growth is thus negative if σ_i is greater than $0.05 \times 2/(0.971 \times 1.621) = 0.064$. Otherwise, the overall effect is positive.

Table 2: Counterfactual Exercise for Resource-Rich and Landlocked Africa

Resource-Rich Africa versus South-East Asian	sample mean	South-East Asia	Resource-rich Africa	Difference	on volatility	on yearly GDP/capita growth rate	
GDP per capita growth	1.49%	4.04%	0.25%	-3.79%			
Annual growth equation							
1st lag GDP per capita growth	0.221***	1.48%	4.00%	1.07%	-2.94%	0.65%	
Average investment share of GDP 1970-2003	0.045*	17.26%	24.45%	14.96%	-9.50%	0.43%	
Average population growth rate 1970-2003	-0.478***	1.72%	1.86%	2.75%	0.89%	0.43%	
Initial log per capita GDP 1970	-0.014***	8.362	7.747	7.129	-0.619	-0.87%	
Initial human capital 1970	0.002**	4.140	4.049	1.476	-2.574	0.46%	
Volatility (σ)	-0.971**	4.04%	3.43%	6.02%	2.59%	2.98%	
Initial point-source resources 1970	0.050*	4.35%	4.32%	13.13%	8.80%	-0.44%	
Initial financial development 1970	-0.018**	29.07%	26.89%	14.43%	-12.47%	-0.22%	
Log(variance unanticipated growth)							
Initial point-source resources 1970	1.621***	4.35%	4.32%	13.13%	8.80%	-0.41%	0.52%
Initial diffuse resources 1970	0.801	7.27%	11.08%	10.52%	-0.56%	0.01%	-0.02%
Initial financial development 1970	-1.290***	29.07%	26.89%	14.43%	-12.47%	-0.47%	0.58%
Sachs Warner updated openness dummy 70	-0.693***	0.374	0.746	0	-0.746	-1.37%	1.71%
Distance to nearest navigable river or coast	0.001***	277.763	90.902	552.571	461.669	-0.86%	1.07%
Estimated volatility		4.04%	3.43%	6.02%	2.59%		
Countries		62	4	6			

Note: Resource-rich African counties are Algeria, Congo, Rep. Ghana, Malawi, Togo, and Zambia. The South-East Asian countries in our sample are South Korea, Malaysia, Philippines and Thailand. The calculations are based on regression (6a). The effect of each variable on the growth rate (or on volatility) is measured as the effect of changing the respective variable to the sample mean level of the South-East Asian countries, while keeping all other variables constant. Standard errors of the estimated coefficients, goodness of fit tests, etc. are given in van der Ploeg and Poelhekke (2009). One, two and three asterisks indicate, respectively, significance at the 10%, 5% and 1% level.

However, other factors have dragged down the growth performance of resource-rich and landlocked Africa. First and second, if those African countries had invested as much in physical and human capital as

their South-East Asian counterparts, they would add a further 0.43% and 0.46%-points, respectively to their annual growth rate. Third, if resource-rich Africa's population growth rate were to be reduced in line with the South-East Asian sample, Africa would gain yet another 0.43%-point annual growth. These three factors combined yield an extra growth bonus of 1.32%-point.

Our key message is how much potential growth is lost due to the high volatility of unanticipated output growth in resource-rich Africa compared with their South-East Asian counterparts: 2.98%-point extra growth per annum! The main reasons for the high volatility of resource-rich Africa are their heavy dependence on resources (increasing volatility by 0.41%-points, translating into a 0.52%-points loss in growth¹⁰, lack of openness (increasing volatility by 1.37%-points and depressing average annual growth by 1.71%-point), under-developed financial markets (increasing volatility by 0.47%-points and depressing growth by 0.58%-points) and distance from waterways (increasing volatility by 0.86%-points and thus depressing growth by 1.07%-points).

We conclude that a big push to economic growth occurs if the volatility of unanticipated output growth in Africa is brought down to the level of the South-East Asian countries. The big contributing factors to Africa's volatility are its volatile stream of mainly point-source natural resource revenues, its lack of fully developed financial markets and openness to international trade, and its disadvantages of being relatively more landlocked.

The resource curse is foremost a problem of volatility. The high volatility of world prices of natural resources causes severe volatility of output per capita growth in countries that depend heavily on them. The resulting volatility of unanticipated output growth has a robust negative effect on average annual growth itself and is a curse. This is not limited to oil-exporters, but also applies to exporters of copper, coffee, foods, etc. which include many of the world's worst performing countries. Also, ethnic tensions, which are often fuelled by resource wealth, and current account restrictions increase volatility. This effect is especially strong in resource-rich countries. Government spending bonanzas after windfall resource revenues also increase volatility to the detriment of growth, because revenue drops inevitably follow.

¹⁰ This indirect effect of natural resources via higher volatility on growth is negative and should be contrasted with the direct effect of natural resources on growth (operating via the coefficient 0.05 in the growth equation).

Volatility can fortunately be reduced provided that countries have a sound financial system to cope with large and sudden fluctuations in resource income. Fewer capital account restrictions, openness and physical access to world trade also lower volatility. Countries can turn the curse even into a blessing, because we find evidence for a positive direct effect of natural resource dependence on growth after controlling for volatility. The key to a turn-around for many resource-rich countries is financial development, ensuring openness and mitigating the effect of being landlocked, because the indirect negative effect of resource dependence on growth, via volatility, is much larger than any direct positive effect. While it may be difficult to lower price volatility of resources themselves, it should be feasible to deal with volatility in a more efficient way. Large external shocks, volatile macroeconomic policies, microeconomic rigidities and weak institutions induce substantial income volatility in many developing countries, which imposes significant welfare losses for risk-averse individuals. The challenge is thus to how to cope with such volatility and manage the associated risks and find ways to overcome the political temptations of short-run resource wealth to create the financial and political institutions needed to reduce volatility, soften the impact of volatility on growth and prevent poverty.

4.3. Tough to Diversify and Boost Manufacturing Exports

Substantial oil, gas or other resource revenues can lead to appreciation of the real exchange rate and de-industrialization. The extra wealth generated by the sale of natural resources induces a demand for the local currency and thus an appreciation of the real exchange rate. The corresponding contraction of the traded sector and boom of the non-traded sector is known as the Dutch Disease. If African economies have substantial aid inflows as well as revenues from oil, gas and other commodity exports, the Dutch Disease effects will be amplified. In as far as the extra money is spent domestically; this pushes up the price of local goods and services. This sucks in labour, capital and other factors of production into non-traded goods and services, since it is more attractive to be employed in the non-traded than in the traded, non-resource sectors. Effectively, the extra spending power from natural resource revenues and foreign aid boosts spending on both locally produced and foreign produced goods and services. This is met by an expansion of the non-traded local economy and an expansion of imports.

Since the export structure of many African economies is not very diversified and relies extensively on commodity exports, there will not be much chance of achieving the goal of boosting labour-intensive manufacturing exports in countries flush with natural resource revenues. Many African countries suffer

from trade barriers and cannot hope to compete with upcoming giants like China and India. Unless they get preferential trade agreements for labour-intensive manufacturing products, they will be doomed to rely on commodity exports for decades to come.

Why should a natural resource bonanza be viewed as a problem? Is it not optimal for countries to specialize in whatever is their comparative advantage? The problem is that many African economies are very poorly diversified and specialize mostly in agriculture and other primary commodities and in non-traded goods and services. They are, typically, not very good in exporting manufactured goods and services to the developed world. In fact, China and India are beating much of Africa in the conquest of the markets of developed economies. This is a pity, since Africa has abundant and relatively cheap labour and should also try to develop a labour-intensive manufacturing base. This will make their economies less dependent on the whims of weather and global commodity markets and thus less volatile. Only manufacturing offers scope for learning by doing, ongoing technical progress and sustained growth in living standards. Clearly, the traded, non-resource production sectors (mainly labour-intensive manufacturing) benefit much more from learning by doing and other positive externalities than the non-traded sectors. In that case, the exploitation and generation of substantial natural resource revenues justifies government intervention.

Many resource-rich countries in Africa have a predatory state, little international trade, few incentives for the development of capital, weak linkages between the natural resource and other sectors of the economy, and lack of economic diversification into competitive manufacturing industries. It is therefore not surprising that such countries often follow a staple-trap path with growing income inequality and slow accumulation of social capital. The natural resource curse can be avoided with the right institutions and policies. Many African economies need a big demand push to generate enough demand complementarities to expand the size of their markets and recover the fixed costs of industrialisation, and thus to get much of the poorest African countries out of low-income traps. In that case, natural resources are productively used to make the transformation from an economy relying almost entirely on exports of primary commodities to economies with a substantial labour-intensive manufacturing base. A natural resource boom can under the right circumstances be an important catalyst of growth, development and the transition from cottage industry to factory production only provided that learning by doing and increasing returns to scale are stronger in non-traded than traded sectors. Unfortunately, in many African countries natural resource booms have done little to set in motion a dynamic growth process. A lot of that has to do with not implementing the right growth-promoting policies and, of

course, with the traded, non-resource sectors being if anything relatively capital intensive. This suggests that it is extra tough to make the big push towards diversification and developing manufacturing in the resource-rich parts of Africa.

4.4. Institutions, Corruption, and Conflict

There are many other reasons why natural resources may harm resource-rich developing economies. For example, the most talented young people are drawn into grabbing a share of the nation's natural resource rents rather than into productive entrepreneurship. By doing this, society does not only lose out due to lots of unproductive rent-grabbing activities (including conflict and war) but also loses out the most able people are rent seeking rather than working and contributing to the economy. Institutions and legal systems become corrupted. If property rights on natural resources are not properly defined, rapacious depletion of resources takes place with all the dangers that go with it. For example, millions of water holes have been bored by Indian farmers, each one of them ignoring the negative externalities this imposes via lower ground water levels on other farmers (e.g., Sachs, 2008). Other examples are the rapacious depletion of fish in the sea due to the impossibility of defining property rights in open seas. Many other natural resource reserves are interconnected with other reserves and thus suffer from the problem of seepage and to rapid depletion. Finally, there is ample evidence that natural resource fuel conflict and wars, especially in ethnically polarized societies. A much more detailed discussion of why natural resources have been so harmful for Africa and many other developing economies can be found elsewhere (van der Ploeg, 2007).

Table 3 summarizes some empirical evidence that natural resources such as oil and diamonds are associated with both a higher likelihood of the onset and the continuation of conflict and war (van der Ploeg and Rohner, 2009). A major problem with this literature, however, is that it does not tackle the problem of reverse causality, that extraction of natural resources itself may be hurt if there is fighting. Although fighting will be higher if natural resource rents are high and outside opportunities for fruitful labour (i.e., the wage) are low, investment in exploration will fall if there war. Fighting will also be more intense if more efficient foreign mining companies come in and raise the natural resource stake.

Table 3: Overview of Empirical evidence on Impact of Natural Resources on Civil Wars

	<i>Resource measure used</i>	<i>Main findings</i>	<i>Control extract. endog. to fight</i>
Onsets and Incidence			
De Soysa (2002), Fearon and Laitin (2003), Fearon (2005)	Oil exporter dummy, fuel exports / total exports	Both measures increase war onsets	No
Collier and Hoeffler (2004), Collier et al. (2009)	Primary exports / GDP	Increases war onsets (inverted U-shape)	No
Fearon (2005), Bulte and Brunnschweiler (2009)	Primary exports / GDP (with further robustness checks and instrumented)	The effect of primary exports on war onsets seems not very robust	No
Lujala et al. (2005), Lujala (2009)	Diamond deposit, diamond production, and oil production dummies	Secondary diamonds increase onset and incidence (ethnic) war, primary diamonds decrease incidence war, (onshore) oil increases onsets	No
Humphreys (2005)	Oil production, oil reserves, diamond production	Both oil production and diamond production increase war onsets	No
Ross (2006)	Fuel rents and diamond rents per capita	Fuel onshore and offshore and primary diamonds increase war onsets, secondary diamonds increase onsets separatist wars	No
Duration and fatalities			
Fearon (2004), Ross (2006)	Contraband (cocaine, gems, opium etc) dummy	Increases war duration	No
Collier et al. (2004)	Primary exports / GDP	Level not significant. Lower price of commodities exported shortens war	No
Lujala (2009)	Gemstones, oil reserves and production dummies	The presence of these measures in conflict zone increases duration war	No
Lujala (2009b)	Gem, drug and hydrocarbon production dummies	The presence of these measures in conflict zone increases combat deaths	No

4.5. Much of Resource-Rich Africa Fails to Reinvest its Natural Resource Wealth

Many economies endowed with abundant natural resources save less than the rents they get from extracting and selling natural resources. If they were to save more, they might grow at a faster rate. To gain a better understanding of sustainable development, consider the World Bank figures for *genuine*

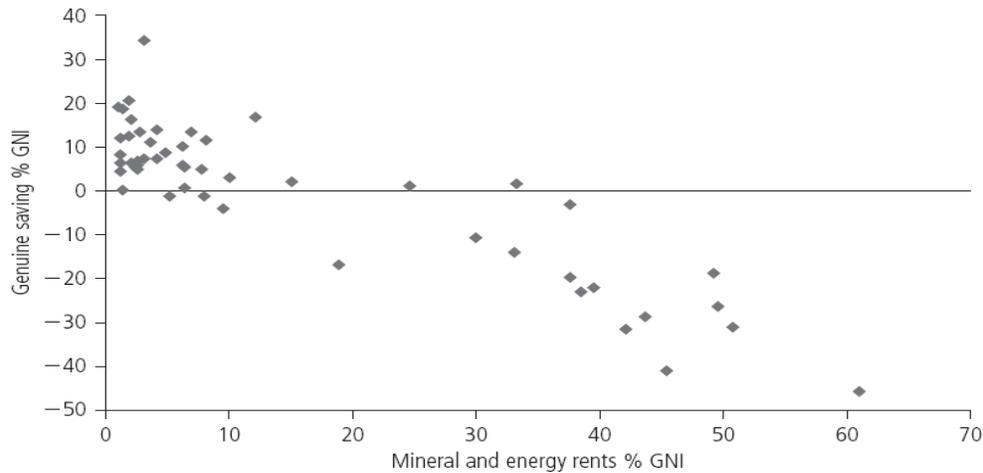
saving. Genuine saving is defined as public and private saving at home and abroad, net of depreciation, *plus* current spending of education to capture changes in intangible human capital *minus* depletion of natural exhaustible and renewable resources *minus* damage of stock pollutants (CO₂ and particulate matter). Genuine saving thus defined corresponds to the increase in the wealth of the nation. The Hartwick rule demands that any depletion of natural resources or damage done by stock pollutants must be compensated for by increases in non-human and/or human capital. This rule of zero genuine saving can be motivated by max-min egalitarianism. It requires that resource-rich countries adopt a strategy of transforming their natural resource wealth into other forms of productive capital.

Figure 11 paints, however, a gloomy picture. Countries with a large percentage of mineral and energy rents of GNI typically have *negative* genuine saving rates. This means that these countries squander their natural resources at the expense of future generations without investing in intangible or productive wealth. This may explain why Venezuela has negative economic growth rates while countries such as Botswana, Ghana and China with positive genuine saving rates enjoy substantial growth rates. Highly resource-dependent Nigeria and Angola have genuine saving rates of minus 30 percent, thereby impoverishing future generations on a massive scale. The World Bank suggests that resource-rich countries with negative genuine saving such as Nigeria or Venezuela would experience increases in productive capital by a factor of five or four if the Hartwick rule would have been followed. This is also true for oil- and gas-rich Trinidad and Tobago and copper-rich Zambia.

Why do so many resource-rich countries save so little? Even if there are no government and market failures, countries *should* save less than their rents on natural resources and postpone extraction if they expect the world price of natural resource prices to rise in the future (Vincent, Panayotou and Hartwick, 1997) or expect marginal costs of extraction to fall in the future (van der Ploeg, 2009). In anticipation of better times, countries with abundant natural resources thus run a current account deficit if the rents on natural resources fall short of the imputed interest on the value of natural resource reserves. This is more likely if the stock of reserves of natural resources is high. In practice, the adjustments to allow for future changes in resource prices are quite small if historical price trends are extrapolated (Hamilton and Bolt, 2004). Historical evidence on the US economy suggests that technical progress in extraction may be quite large if governments allow private property rights and collective learning takes place (David and Wright, 1997). There is no reason why forward-looking governments of today's resource-rich economies should not enjoy technical progress in exploration. It then makes sense not only to borrow

for necessary investments, but also to save less than the current Hotelling resource rents in anticipation of falling extraction costs.

Figure 11: Negative Genuine Saving in Resource-Rich Countries



Source: World Bank (2006, Figure 3.4)

However, in many African resource-rich countries political reasons may be more important in understanding why resource-rich countries save less than the Hotelling rents on natural resources (van der Ploeg, 2008). There is some weak evidence to suggest that fractionalized resource-rich countries are more likely to have negative genuine saving rates and not putting their natural resource wealth to good use (van der Ploeg, 2009). Squabbling and fighting rival groups trying to get their share of natural resource revenues at the expense of other groups induce a common-pool problem. The power struggle makes competing groups more impatient and thus the country depletes resources faster and natural resource prices rise faster than suggested by the Hotelling rule. As a result, the country experiences negative genuine saving rates which depress growth and harm social welfare (the so-called *voracity effect*). The Hartwick rule must also be modified for these political distortions. The only way to sustain a constant level of private consumption is to save more on the current account than the current natural resource rents accruing to households. Of course, this may be difficult to realize in societies with badly defined property rights and rapacious rent seeking. The political distortions in the Hotelling and Hartwick rules are bigger if the country is more fractionalized. The negative genuine saving rates of many African countries thus seem to be due to their natural resource abundance and poor legal systems. Furthermore, these political distortions are bigger in more fractionalized, less homogenous societies.

Natural resource discoveries can induce governments to engage in exuberant public spending based on the incorrect assumption that windfall natural resource revenues are permanent. This gives rise to unsustainable spending levels with painful adjustments when the resource revenues run out. Alternatively, a fraction of natural resource revenues may be siphoned off by the political elite and its cronies and cannot be used by the people for consumption. This also implies that less of current natural resource rents will be saved. One must understand how the optimal rates of resource depletion, government spending, saving and investment survives are affected when politicians seek office and try to grab resource rents for themselves or pay off political opponents and are able to get away with it due to poor institutions, bad legal systems and poor checks and balances in the political system. Rapacious rent seeking rather than anticipation of better times may unfortunately be a much more important reason why many fractionalized resource-rich economies squander their rents on exhaustible resources and suffer such disastrous economic and social outcomes.

On a more pragmatic note, the matter of observed *negative* genuine saving rates is worse for many African resource-rich countries with high population growth rates. Such countries need *positive* rather than *zero* genuine saving rates to maintain constant consumption per head. The standard neoclassical model of economic growth predicts that such countries have lower capital intensities and lower income per capita. Indeed the cross-country econometric evidence presented in Table 2 suggests that countries with high population growth have worse growth performance and end up with lower income per capita. In fact, in countries with high population growth rates, genuine saving may be positive while wealth per capita declines (World Bank 2006, Table 5.2). Such countries are on a treadmill and need to create new wealth to maintain existing levels of wealth per capita. They thus need to save more than their exhaustible resource rents, but rarely manage that. For example, sub-Saharan Africa has high population growth rates and shows substantial saving gaps of 10 to 50 percent of GNP. For Congo and Nigeria the saving gaps are as high as 110 percent and 71 percent, respectively.

5. Food Crisis Hits Africa Most¹¹

World prices for almost all agricultural commodities are at or above previous record levels. This may not last as many of the underlying determinants of the price hike are transitory as discussed in detail in

¹¹ This section is based very much on van der Ploeg and Poelhekke (2009b).

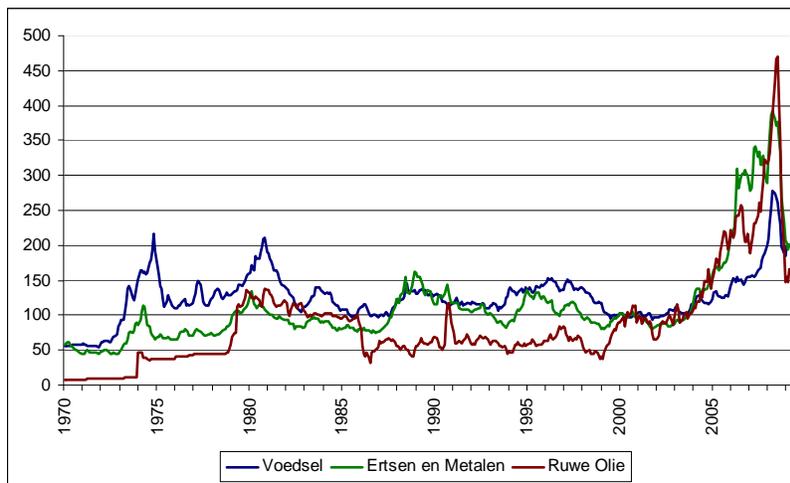
World Bank/FAO (2008). For example, adverse weather conditions in major grain-producing regions in the world, with spill-over effects on crops and livestock that compete for the same land, have contributed to the dramatic increase in food prices since 2005/6. Gradual productivity improvements in food prices boosting supply will lead to a gradual fall in food prices in the long run. Most of this results from continued yield growth for crops rather than new areas brought into cultivation. Also, slowly increasing dairy and livestock yields allow a gradual increase in milk and meat production. However, there are also permanent demand factors underpinning prices which have to do with the increased demand for food, feed and industrial demand for bio-fuel that will keep them both higher than in the past and will slow down the long-term decline in food prices. Changing diets, urbanization, economic growth and expanding populations drive demand for food in developing economies. Bio-fuel is now the largest source of new demand in the coming decades and thus really drives up food prices. World Bank/FAO (2008) thus indicates that, comparing the average for 2008-17 with that for 1998-2007, beef and pork prices may be some 20%, raw and white sugar around 30%, wheat, maize and skimmed-milk powder 40-60%, butter and oil seeds more than 60%, and vegetable oils over 80% higher. On top of that food prices will be more volatile as well as demand becomes less sensitive to food prices as people become wealthier, weather conditions and agricultural supply will become more volatile with climate change and speculation on agricultural futures markets will increase.

Appropriate policies, fully taking account of these transitory and permanent factors, must be taken to promote agricultural development to address the needs of the hungry and the poor in the developing world. Here we delve deeper into the sources of food shortages, especially in the developing world, and examine what can be done about them. This is crucial, since the coming decades both consumption and production of most agriculture except coarse grains, cheese and skimmed-milk powder will shift from the OECD towards developing economies (World Bank/FAO, 2008). Of course, high food prices are good for many commercial producers in both developed and developing countries but the poor especially in urban areas of net food-importing countries will suffer a lot. In many low-income countries food accounts for more than half the consumption basket and they will suffer most from sustained hikes in food prices. This indicates the importance of boosting the domestic supply capacity via infrastructure, better governance, GM technology based on of the least developed economies to make them less vulnerable to periods of high and volatile food prices. Most crucial of all the adverse effects of subsidized bio-fuel production for food production in those countries must be avoided.

5.1. Source of Food Shortages and Food Riots

In February 2008 food price rose above the historical record of 1973, but Figure 11 shows that food prices rose above the forty year average. The food crisis was thus a fact before all the problems associated with subprime mortgages hit the global economy.

Figure 11: Longer Perspective on Food Prices, Ores & Metals, and Crude Oil



Google Trends shows that around that time significantly more internet users looked up ‘food crisis’ with a peak in 2008.¹² The website also shows that most searches originated from Sri Lanka and other developing countries whereas only a fraction came from English speaking OECD countries, even though access to the internet and internet use is much higher in the latter group of countries. This illustrates that developing countries seem to be relatively more affected by high food prices. Of course, people in developing countries are poorer and spend a larger part of their budget on food and other basic needs, and therefore they are hurt relatively more by high food prices. Even now food prices are more than one and half times as high as on average. In contrast to what happens after failed harvests, the negative effects are felt worldwide. As a result, billions of people are eating less and become underfed, more vulnerable for disease and not sending their children to school. In various countries this has led to food riots.¹³ How come that food prices have risen to such high levels and why does this crisis hit developing countries so much more?

¹² <http://www.google.com/trends?q=food+crisis>

¹³ The New Face of Hunger, The Economist, April 17th, 2008.

5.2. Why is the Food Crisis Most Severe for Africa?

The most obvious answer is that food demand has risen very rapidly due to the high growth rates of China and India. Economic growth has given hundreds of million people the chance to raise their living standards and feed themselves more and better. Better food generally implies that for many people for the first time meat becomes an affordable part of their diet, but for the production of meat many more calories are needed than it finally delivers for human consumption. Consequently, the demand for agricultural products increases more than proportionally. The problem has become much more severe, since the world population has risen very fast in the last 250 years and demographers predict that the world population will increase during the next forty years from 6.6 to 9 billion people. These two factors – the switch away from vegetarian diet plus rapid population growth – combined push global demand for food up to unprecedented levels. Matters are worst on the African continent. Here the number of inhabitants will double to 2 billion while there is hardly sufficient agricultural land available to satisfy the needs of the rapidly growing number of African households.

The third factor contributing to food shortages are the increasing number of subsidies on so-called bio-fuels. These were introduced to improve the competitiveness of alternative fuels relative to that of the then cheap oil and gas. Subsidies like the American corn-ethanol policy contributed to the escalation of food prices and induced producers to switch from consumption crops to crops that can be used for the production of ethanol. The bottom billion – the poorest on our globe – can simply not offer as much as the rich developed world for the scarce agricultural land. This does not only harm global food production, but also destroys forests and therefore exacerbates the CO₂ problem. Supply cannot adjust fast enough to the increased demand, since it is difficult or impossible to just apply more capital-intensive methods of production to boost food output. But it is also possible to identify factors that can be changed by policy in order to alleviate the food crisis.

5.3. Green Revolution in African Agriculture

The Green Revolution in Asia of the 1970s prevented huge food shortages. Since the population of Asia has continued to explode, a second green revolution is badly needed. One needs to drastically increase

the level of agricultural investments, especially in Africa. That is easier said than done. The African continent has an extremely young population, which is ravished by extreme poverty, diseases, famine, conflict and war, does not benefit from growth in the world economy and struggles with corruption and dysfunctional institutions. Furthermore, only 4% of rural Africa has access to irrigation. Africa is too poor to save and thus too poor to invest in education, infrastructure, basic health amenities and agriculture.

According to Djurfeldt et al. (2005), government policy can be blamed that climate-adjusted species of seeds have not been introduced with the same level of enthusiasm as was the case in Asia. Give or take a few exceptions, governments saw the distribution of seeds and fertilizers more as a method to gain political influence than to boost food production. In Nigeria credits and subsidies did not reach farmers and in Ethiopia the road network is so patchy that food surpluses in one part of the country could not alleviate shortages in another part of the country during the draught of 2001.

5.4. Agriculture in Africa has No Access to Financial Markets and Suffers from Trade Restrictions

Other factors that might have contributed to the food crisis in developing countries are lack of knowledge, risk aversion leading to more predictable crops with a lower rate of return, and lack of credit for risky business ventures. Possibly, education is not specifically directed at the transfer of agricultural knowledge. The relative high price of oil has not helped either in alleviating the food crisis, since it has pushed up the prices of fertilizers and transport. Furthermore, despite high market prices for food, it can happen that the production of food is cutback even if on paper it is possible to make a profit. This can happen when fertilizers have to be bought now while the returns from sales occur in the future. Conning and Udry (2007) show that without bridging credits investments in food production (fertilizers, etc.) will not occur. The problem is that most poor farmers in the least developed countries in the world are very poor and do not have access to such credits. A complicating factor is that population growth has continuously reduced the average plot of land for small farmers, which makes it even more difficult to obtain the badly needed credit to invest. Normally, high food prices should lead automatically to more investments and increased supply but the reality in many developing countries is alas much gloomier. For example, Hossain et al. (2009) describe how the high price of diesel has driven up the cost of irrigation while this same cost hardly dropped after oil prices collapsed.

Another obstacle to alleviating the food crisis in many developing countries is the lack of stable and predictable food prices due to badly functioning international food markets. One part of this has the unintentional effect that price peaks and troughs in the price of foods are amplified. Some food-exporting countries implement export restrictions in response to escalating food prices with the idea of keeping prices at home low and citizens happy. The problem, however, is that food prices for importing countries continue to rise and that the incentive for farms in the poor food-exporting countries to invest in higher production are diminished. At the same time, by attempting to reduce domestic inequality and prevent social unrest, food-importing countries have gone so far that they allowed wages and food subsidies to rise rapidly.

Generally, complex systems of subsidies and import restrictions distort prices and incentives to invest in higher levels of food production. Strategic national interests therefore lead to distribution problems and high inflation. There may well be plenty of food, but demand and supply do not manage to reach each other. Such trade restrictions typically have as consequence that countries with the lowest income per capita suffer most. Within countries there is usually a varied menu of subsidies and price controls, which blunt crucial price signals and market incentives.¹⁴

Corporations and other businesses in Western countries normally find it relatively easy to borrow on the capital market to fund investments, to execute contracts on future markets to hedge against risks, to save for future generations, and to manage volatile price fluctuations and peaks in demand and supply. Financial instruments to cope with these tasks are very underdeveloped or unavailable in many developing countries, because domestic markets for basic financial services are typically very underdeveloped. Price fluctuations make it very difficult to make investment decisions. Price incentives change continually and are difficult to forecast, so that new initiatives are throttled before they even take off. These types of market failure suggest a task for governments to encourage and boost investments and credit, but alas corruption and weak institutions in many developing countries offer little hope of this happening.

¹⁴ Attempts to stabilize prices by storage schemes and financial instruments are discussed at length in Newbery and Stiglitz (1981).

6. How to Help Developing Countries?

6.1. Rescue Plan for an Overpopulated Planet

The economist Jeffrey Sachs presents in his book *Common Wealth: Economics for a Crowded Planet* a concrete rescue plan for our overpopulated planet: curb the population explosion in Africa and Asia by large-scale and widespread issue of free contraceptives, legalization of abortion and education programmes including sexual education. Educated girls want to use their education and obtain a return on it. They have a better bargaining position with their man and are thus much more likely to postpone having children and help to speed up the demographic transition of many developing countries. The disastrous cuts in birth control programmes for developing countries under the Bush administration (strongly influenced by the *moral majority* and the religious right) seem to be reversed by the Obama administration. It is crucial to reduce child mortality, because this reduces the need of poor people to have many children.

Sachs stresses again and again that the rich Western world has to pay up and invest in the development of the poorest countries on the globe. Governments, corporations, the ultra-wealthy and other citizens must get together and offer the poorest of Africa temporary support to help them get out of their poverty traps. What is needed are substantial and widespread investments in vaccination programmes, distribution of antibiotics and anti-malaria nets, clean drink water, education programmes including context-specific educational material, roads, rail, harbours, electricity networks and other essential public services. A Green Revolution for Africa requires subsidized fertilizers and will only boost the economy of many developing countries, but will also help to drastically curb the number of children delivered on earth by each woman. The Millennium Project is directed at villages and has some chance of success as it is not forced from above. As Sachs already did in 2005, he makes a passionate plea for a Marshall Plan for Africa, not just for the sake of disaster-stricken Africans but also for the people in the richest nations on earth.

The highest priority for Sachs is safe drink water and sanitation. He suggests a null tariff for the basic needs for water in the poorest countries and above that a market tariff for water use. Water reservoirs and the efficient collection of rainwater are needed to survive extreme draughts. Furthermore, investments are needed to improve water efficiency by drop-by-drop irrigation techniques, get the technology to plough less deep, and to develop seeds that can survive extreme draughts.

Like many others, Sachs demands a moratorium on deforestation of especially the tropical rain forests and also wants to forbid grazing ocean floors with trawlers. It is also urgent to realize protected habitats including protected fishery zones outside the territorial waters. Stimulating agricultural productivity implies that less agricultural soil is needed and thus helps to limit deforestation. Nitrogen has to be recycled, so that ground waters become less polluted. A tax on meat will aid the switch from carnivorous to vegetarian diets.

Fighting global warming requires much research & development into cleaner and energy-saving technology for the production of steel, concrete and petrochemicals, but also into curbing CO₂-emissions of electricity companies and vehicles. More use must be made of energy taxes, tradable emission permits, energy-saving industry standards and subsidies for CO₂-capture en storage (sequestration). Deforestation must be forbidden and forestry must be done in a sustainable fashion. More research is needed into safe nuclear reactors and safe means of disposal of nuclear waste to find out whether nuclear energy really is a safe CO₂-free alternative to fossil energy.

6.2. Rescue Plan for the Bottom Billion

Paul Collier argues in his bestseller *The Bottom Billion* that the manner in which foreign aid is given to developing countries must be completely reformed. The World Bank and many developing agencies have for years stressed the importance of 'good governance', which implies that foreign aid is only given to those developing countries that are not corrupt and have trustworthy legal systems. Unfortunately, this excludes many states in sub-Saharan Africa where poorest people on our planet – the bottom billion – live. Such fragile states often have to cope with conflict and wars, typically about who gains control over precious natural resources such oil, diamonds, gold, silver and bauxite. Collier argues for investments in education, infrastructure, and humanitarian peace operations (realistically lasting ten to twenty years) where all attention is focused at getting young rebels useful job opportunities to make it less interesting for them to fight. Since many Asian countries have caught up rapidly in terms of income per capita, the poorest countries are in sub-Saharan Africa. Those countries have little access to sea or big rivers. Hence, Collier argues not only for long-lasting peace operations but also for big investments in sea ports, airports, rail and roads.

6.3. Global Green New Deal

The United Nations Environmental Programme has forcefully argued for a Global Green New Deal (Barbier, 2009; UNEP, 2009). Their plea is to invest 1% of global GDP in green infrastructure. The hope is that will help to revive the world economy and realize sustained and inclusive growth across the globe reducing poverty as well as carbon dependency and ecosystem degradation. The objective should be to direct the global fiscal stimulus at energy-efficient buildings and transport, and renewable energy. In developing countries the stimulus should invest in boosts to agricultural productivity, freshwater management, and sanitation. The world should also reverse perverse fuel subsidies in bio-fuel industry, for consumers and elsewhere. Carbon trading should be expanded to the global level via more inclusive Clean Development Mechanisms. It is fair to say that, at least in rhetoric, the United Nations has had some effect on the outcome of the 2009 G20 meeting.

6.4. Critique

Sachs does not seem to pay enough attention to the tyranny of corruption and vested interests. Progress can only be made if corporations, citizens and governments throughout the world tackle the problems facing our planet together. Sachs appears to be too optimistic over the chances of this happening. Of course, if the thousand people in this world with wealth exceeding one billion US \$, like Bill & Melinda Gates and Warren Buffett, get their act together, more than enough funds are available for basic health care (including combating aids, tuberculosis, and malaria) and clean water for the poorest, and a new Green Revolution. And if the US spends its money on development and environment instead of on weapons, there will definitely be plenty of funds for the plans put forward by Sachs. But the problem is not just lack of funds; it is also a problem of aid reaching the people who need it most.

It is very misleading for Sachs to suggest that his beloved Millennium-villages project can be scaled up easily by replicating it in villages across Africa. Although it may be possible to show spectacular success with 50 well-chosen villages, the negative experiences with many development policies indicate that it is difficult to have the same success in all villages in the poorest regions of the world. Sachs seems to trust too much in the power of various organization of the United Nations, the World Bank and other development agencies to come up with workable solutions.

To better the world is not just a question of throwing enough money at it. Everybody talks about corporate social responsibility and ambitious environmental policy, but this is insufficiently translated in effective action. Big multinationals still exploit the poorest families and their children in the poorest countries, cut down rainforests in an irresponsible manner, empty the oceans of their fish at an alarming rate, and neither invest nor encourage green small-scale projects. Especially the large business organizations need to be aware of their social responsibilities and act on it. Although individual firms may not have an incentive to act for fear of losing market share, all firms together in a particular incentive definitely do have an incentive to act to guarantee the long-run viability of their industry and the support of local populations. Clearly, industry standards enforced by international organizations can help a great deal in boosting corporate social responsibility at the global level.

The sad truth is that the interests of Western business corporations are simply too big and that politicians are inclined to focus at oncoming elections and do not have the guts to take the necessary measures. Paul Collier also seems to downplay the political reality in many donor countries and in receiving countries. Strong right-wing lobbies are keen to point out that it is ludicrous to send scarce funds to corrupt dictators without reaching the neediest in such fragile states. Although the Netherlands seems to reform their development policies in the way Collier suggests, it is not clear that populations of Western countries are convinced that funds go to long-lasting humanitarian peace operations in conflict zones rather than supporting corrupt dictators in the poorest states on earth.

7. Conclusion

The globe is changing in various respects very rapidly as well. The majority of the population in the world no longer lives in rural lands and villages, but in the cities. Although income per world citizen is rising rapidly, many citizens of sub-Saharan Africa are falling back and not benefiting from global development. However, the gap between the rich Western world and the rest of the developing world (mainly in Asia) is becoming smaller. As a result, the centre of economic power is moving from the US to China and India. One way of looking at this is that in 1950 a third of the world population lived in the rich countries whilst now this is less than a sixth. The number of citizens living in the Western developed countries stays around 1.2 billion during the next forty years, but the population of Asia will rise with 1.3 billion people during this period. Outside these existing and emerging economic power blocks is Africa.

In contrast to India, it has no access to big rivers and harbours and has to cope with a poor and badly interconnected road and rail network. Neither does Africa appear on the top 20 of biggest container ports in the world. From an economic perspective Africa is very remote from the rest of the world. The meagre revenues from exports imply that the resource-poor countries of Africa do not have the means to import high-quality technology and capital goods from more advanced countries. The resource-rich countries of Africa all too often squander their natural resources. The revenues from the sale of oil, diamonds, gold etcetera fuel wars, coups and corruption are seldom used to import advanced technology in order to upgrade domestic methods of production.

The structural causes of the many crises hitting the developing world and especially Africa will stay in force after the destructive forces of the current global financial crisis have ceased to operate. As soon as global demand for goods and world trade picks up, especially in Asia, primary commodity prices will rise rapidly. But during the global recession and financial crisis developing countries will have little financial means to force through reforms or to invest in the future development of their economies. The collapse of world trade destroys one of the few income sources for governments of the poorest countries, since they can hardly fall back on their interne markets, issue of government bonds or sale of reserves.

Developing countries are not only hit by environmental disasters, wars, collapse of primary commodity prices and food shortages, but also suffer big blows from the current global financial crisis. The capital flows to and foreign direct investments in the poorest countries are in danger of falling back drastically. Rich countries are less able to fulfil their foreign aid obligations. The global recession implies that the poorest countries find it tougher to export their products to the developed economies. Migrants will send less money home. Due to the global recession and the much lower revenues from the sale of natural resources, government budgets get out of control and developing countries will be saddled with high debts for years to come. The various global crises affect the poorest countries of our planet the most and, mostly, it is not even their fault.

Much more research is needed on the plight of developing nations, and especially on how the global financial crisis, global warming, the scramble for natural resources and food shortages affect the livelihood of the poorest people on earth. The challenge is not just an economic one; it is mainly one of rising to the challenge of effective and fair global governance. The questions addressed cannot be analyzed with an economic or scientific analysis alone, but requires the input of political scientists to understand how a new global deal can be struck which appeals not only to the developed countries but

also to the less developed countries. We therefore need more research on the impact of the global financial crisis on the poorest countries, on how the poorest nations can be helped to deal with the risk and uncertainties associated with global warming and the volatility of the prices of their main export commodities, on how global action can prevent conflict and war in the scramble for natural resources, on how the poorest nations can harness their natural resources by transforming them into productive physical and human capital, on how the burden of fighting climate change can be shared in a fair way, paying due regard to those who can be held most responsible for global warming, and on how food shortages can be relieved by better distribution and possibly investments in GM crops.

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