Resource Depletion, Climate Change, and Economic Growth- Summary

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The 20th century witnessed a quadrupling in global population, a 20-fold increase in global economic output, and an even greater increase in the use of natural resources. As a result, the human footprint on the natural world is now vastly greater than ever before. Human economic activity now has the power to influence major planetary systems, prompting some scientists to note that we may be moving into a new epoch, from Holocene to "Anthropocene." In light of these pressures, this paper explores important questions relating to the relationship between resource depletion, climate change, and economic growth in the coming century.

Are Current Patterns of Growth Sustainable?

More than a quarter of the world's land surface has been degraded, as a result of soil erosion, salinization, nutrient depletion, and desertification. Water withdrawals tripled in the past 50 years. The current rate of species extinction is 100–1,000 times higher than in prehuman days. Environmental damage already imposes a deadweight loss to the economy approaching 10 percent of GDP in many emerging economies—even before adding likely impacts from climate change.

Whether current patterns of economic activity are "sustainable" depends on the extent to which depletion of natural forms of capital is compensated for by the accumulation of other forms of capital. In countries such as China and the United States, where resource depletion has been accompanied by a large accumulation of human and manmade capital stock, simple first-order analysis suggests that growth is "sustainable." But studies so far have looked only at a limited range of natural resources, assumed a high degree of substitution among different types of capital, and failed to account for uncertainty associated with threshold effects or catastrophic

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irreversible change. The weight of evidence is increasingly suggesting that current patterns cannot continue.

When savings rates are adjusted to take account of resource depletion, many low-income countries, especially those dependent on natural resource exploitation, show a worrisome trend. Calculations show that "genuine savings" in Sub-Saharan Africa became negative in 2004 and remained highly negative throughout the decade, implying that consumption levels were not sustainable. About 30 countries have now institutionalized such "natural wealth" accounting, although most of them focus almost exclusively on the depletion of mineral and energy assets rather than on a more complete set of resources, including forests, clean water and air, and ecosystem and atmospheric services.

In the coming years, the scale and impact of resource depletion is expected to grow, as the number of people in the global "middle class"—those able to afford a private motor vehicle, electrical appliances, and a diet that includes meat daily—rises from 2 billion in 2010 to 5 billion by 2030. Left unchecked, evidence suggests that current patterns of resource use will lead to dangerous climate change and reduced economic growth. Unpredictable threshold effects are likely, and the impact will be felt differentially across countries, with the bottom half of the income distribution suffering most.

The Unique Challenge of Climate Change

A number of characteristics of climate change—its global nature, its intergenerational impact and disproportionate impact on the poor, its uncertainty and associated massive downside risks—combine to make it an unparalleled challenge for global collective action. It is also crucially significant in that successfully addressing it will go a long way toward addressing other environmental problems, such as air pollution, soil degradation, water risks, and the loss of forest, natural habitats, and biodiversity. For these reasons, this paper focuses on climate change, examining several main issues.

First, conventional cost-benefit analysis of climate change action has contributed to a relatively cautious approach to early action today. But new evidence is suggesting that the costs of inaction may have been underestimated and the costs of action overestimated, because relatively high discount rates have trivialized adverse impacts in the distant future.

Ethicists and economists have been in disagreement over discount rates for decades. Although the costs of climate action are much smaller than the costs of inaction, they must be borne now, whereas the costs of inaction are some decades away. Conventional discounting suggests that strong action is not warranted. Mainstream economists have traditionally argued that empirical evidence from consumer behavior and interest rates argues for a discount rate of perhaps 6 percent. The Stern Report of 2006 brought credibility to arguments for a much lower discount rate. The difference is enormous: under a 6 percent discount rate, $100 a century from now is worth only 25 cents today, whereas under the 1.3 percent discount rate proposed by Lord Stern, it is worth 100 times as much ($25).

Second, estimates of the costs of climate change are limited by the modeling capabilities of dealing with potentially catastrophic impacts with unknown probabilities and timing. Under existing models, costs range from 1 percent to 10 percent of GDP for a 3°C increase and up to 20 percent of GDP for a 5°C increase. These temperatures, once believed highly unlikely, are now regarded as realistic by the end of this century. But such temperatures may involve discontinuities, triggered by ice melt, tropical forest die-back, and ocean acidification, for example, which would multiply impacts substantially. These discontinuities are omitted from current economic models. In addition, many of the "existence" and "amenity" losses embodied in an extreme climate change world cannot be captured in monetary terms.

The Costs and Benefits of Green Growth

Third, models need to be adjusted to incorporate new understanding of the dynamic transition path towards a low-carbon economy. Most analysis suggests that additional annual investments of about 2–3 percent of GDP would be required to limit atmospheric greenhouse gas concentrations to 450 parts per million, the level required to give a 50 percent chance of limiting the global temperature rise to 2°C. Most models assume that such investment would be a burden on the economy. Reductions in growth have been estimated to be on the order of 0.2 percent per year, with global GDP in 2050 projected to be 5–6 percent lower than it would be in a world without climate change.

But new empirical and theoretical insights suggest that the costs of action on climate change may be overestimated. Smart policies to shift the economy toward decarbonization can actually promote a stronger, more innovative, and more resilient economy, for three main reasons:

- *Resource efficiency*. Numerous win-win gains that would benefit both efficiency and the environment are being left unexploited, as a result of a range of barriers, rigidities, and market imperfections. Evidence suggests that nearly half of the emissions reductions required by 2030 would be economically justified even in the absence of any environmental concerns. When local environmental co-benefits in the form of pollution reduction are included, these investments become even more attractive. New understanding from psychology and behavioral economics helps explain why these opportunities remain unexploited and how rising concerns about resource depletion can help unlock these constraints.
- *Directed technical change.* Smart, market-based environmental policies, coupled with public-private partnerships in technology research, can trigger innovation and investment that can create new markets, jobs, and economic growth. Many traditional computable general equilibrium models assume exogenous technology, with no learning; in these models, the costs to growth of action on environmental problems can be substantial. But the evidence is clear that technology responds quickly to price and policy shifts. Empirical model have demonstrated that clearer policy signals on the needed move toward a greener economy—for example, a unilateral commitment by the European Union to increase its greenhouse gas emissions reduction target by 50 percent—would lead to higher investment, growth, and competitiveness.
- *New understanding of investment*. Studies of investment decisions suggest that options theory has better predictive value than maximization of net present value in explaining how decisions are made. Concerns about the possible future impact of climate change on returns, compounded by growing belief by the business community that policy action to address climate change will occur in the future, is leading to concerns about "stranded assets," a reduction in the appetite for investment, and a plea for a consistent long-term policy framework.

These insights help provide substance to the concept of "green growth" that has been popularized. At root, its distinctive insight is that environmental problems can be turned to good advantage through smart market-based environmental policies, which trigger innovation and investment, which in turn can create new markets, jobs, and economic growth. This realization may help explain why more than 50 developing countries are now imposing costs on themselves—through mechanisms such as feed-in tariffs and renewable energy standards—that at first sight seem not to be in their country's narrow interest. China, for example, introduced cap and trade policies for CO_2 emissions on a pilot basis in 2013, with a nationwide program planned for 2015.

All of the above argue for early action on climate change and suggest that the approach to cost-benefit analysis will need to change if it is to be truly helpful in guiding decisions on climate change.

Policies and Politics of Low-Carbon Growth

Short-termism on the part of most governments and businesses, coupled with the challenge of highly complex collective action at the global level, make the task ahead very difficult. Exploring policies with near-term economic and political gains, such as the following, will be essential:

1. *Removing subsidies on fossil fuels.* Subsidies on fossil fuel production and consumption amount to nearly half a trillion dollars a year; subsidies encouraging overuse of water, overfishing, and excessively intensive agriculture amount to another half a trillion dollars. Smart governments are showing that the poor can be compensated for abolishing these subsidies.
2. *Pricing carbon.* Market-based mechanisms can be significantly more cost-effective than regulatory regimes, as demonstrated by permit trading for sulfur dioxide in the United States in the 1990s. The long-term prospects for carbon markets remain strong, as a result of the sheer need to act soon to prevent a catastrophe, and a number of countries and regions are introducing trading schemes in that anticipation.
3. *Climbing the marginal abatement curve:* Addressing other market failures. Information asymmetry, coordination failures (the need for networks), imperfections in capital

markets and R&D, and the existence of substantial co-benefits in the form of other environmental benefits are all market failures that are discouraging action on climate change. They must be addressed through a portfolio of policies such as emissions standards; "nudge" policies, such as labeling, certification schemes, and power use monitors, are also proving effective.

4. *Increasing international cooperation*. Today's global governance structures are ill equipped to deliver the urgent actions required. Solutions are much more likely with smaller numbers of powerful players, including private companies. An explosion in such "club" arrangements should be expected—and encouraged—to address not only climate change but also the much broader issue of resource risks in the coming decades.
5. *Facilitating citizen voice through the marketplace*. New technologies and protocols for measuring emissions, certification schemes, commodity roundtables, environmental auditing, voluntary disclosure schemes, and integrated financial-environmental accounts are enabling green companies and products to distinguish themselves and are slowly transforming supply chains among leading companies.

If such policies are to be successful, the case for action needs to be reframed from a focus on uncertainties, costs, and burdens, to a focus on risk management, investments, and opportunities.