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From burden-sharing to opportunity-sharing: unlocking the climate negotiations

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In conventional thinking on climate negotiations, traditional fossil fuel-based economic growth is coupled with carbon emissions, thus mitigation has been regarded as a burden on economic growth. The scarcity within the global emission budget and the interpretation of climate change as 'global public goods' have led climate change negotiations into a burden-sharing deadlock. However, some recent economics studies suggest that mitigation could actually promote *local* economic growth opportunities; consequently increasing the incentives for unilateral mitigation actions. This article highlights the implications for the strategies of unlocking the climate negotiations deadlock. Following an explanation of how climate change negotiations have led to a burden-sharing game and have become a deadlock, some new ways of thinking (based on the emerging literature) are used to suggest how mitigation could promote *local* economic growth.

Policy relevance

One policy implication is the need to change the current mindset in global climate change negotiations. The current framing of burden-sharing can be abandoned in favour of opportunity-sharing. This more positive approach will stimulate progress on climate action. Therefore, green growth should be situated at the heart of post-2020 climate change regime. A new two-track architecture is proposed for achieving the transformation as a combined top-down and bottom-up approach. A lower legally binding target based on equity principles of common but differentiated responsibilities (CBDR) could form a more politically realistic and inclusive basis for participation. To complement this, a green growth club would promote a higher voluntary global ambition and accelerate mitigation.

Keywords: climate negotiations; green growth; low-carbon transition; mitigation; post-2020 climate regime

1. Introduction

Since the Industrial Revolution, modern economic growth has been coupled with high carbon emissions. The accumulation of anthropogenic GHG emissions (which date back to the Industrial Revolution) has already had an impact on the present climate. To avoid a catastrophic level of climate change, urgent actions are required to reduce global carbon emissions to meet the 2 °C or below target (relative to pre-industrial levels). More than 100 countries have adopted this as a guiding principle for mitigation efforts. However, with economic growth based on fossil-fuel consumption, a cut in emissions can lead to a reduction in output and the sacrifice of economic growth. Without a substantial transformation in growth modes to decouple economic growth from carbon emissions, it would appear

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impossible to sustain economic growth while meeting the 2 °C target. The study by Meinshausen et al. (2009) estimated the future global GHG budgets for 2000–2049 in relation to the probability of exceeding the 2 °C target. With a 25–50% probability of exceeding the target, only 1000–1440 $GtCO_2$ can be emitted in this 50-year period. According to the German Advisory Council on Global Change (WBGU) (see WBGU Special Report, 2009), the implication for achieving the 2 °C target is a maximum GHG emission budget from 2010 to 2050 of only 750 $GtCO_2$. If the world annual emissions rate remains at the 2008 level, then the GHG emission ceiling will be reached within 25 years.

The limited budget for global carbon emissions gives rise to serious conflict about how to share the budget between Annex I and non-Annex I countries. Given the global emission budget, increases in one country's emissions can only be achieved at the expense of emissions from other countries (i.e. a zero-sum game). Developed countries, which represent 20% of the global population, have already completed their industrialization phase through a period of high consumption of fossil fuels and resources. For the remaining 80% of the global population, the potential to emulate the industrialization phase will certainly generate GHG emissions well in excess of the budget.

From an ethical basis, the demand by developing countries for carbon equity can be justified. Historical over-occupation of the atmosphere (a global common) by Annex I countries has not only reduced the development potential for developing countries, it has also forced the developing countries to suffer the negative consequences of carbon emissions.[1] Indeed, the limited budget for global carbon emissions makes carbon equity far from achievable, which in turn intensifies the conflict between the developed and developing worlds.

In addition to the scarcity created by the global emissions budget, the 'global public goods' characteristic is another key impediment for reaching a global climate change agreement.[2] According to conventional analyses of climate change, because the cost of emissions reduction is mainly *local* but the major benefits of mitigation efforts are shared *globally*, there is a strong incentive for all individual countries to become freeriders, expecting other countries to act first and do more – a case of the 'tragedy of commons' predicted by Hardin (1968).

Due to the limited budget and the 'global public goods' characteristics, the prospect of making progress in the international climate change negotiations is very dim. Nonetheless, the latest progress in economics research on climate change and 'green growth' shows that mitigation could actually have significant *local* benefits, and that unilateral mitigation could be incentive compatible. One conclusion from this line of research is that mitigation could be a source for growth, rather than a constraint. If this turns out to be the case, then international negotiation is no longer a game of burden sharing among countries, but a process of opportunity-sharing.

The objective of this article is to present how strategic thinking about green growth could contribute to solving the global climate change negotiation deadlock and to provide some policy recommendations on how to proceed from the *status quo*. The rest of the article is organized as follows. Section 2 shows that if conventional economics analysis is followed, then mitigation is inevitably treated as a burden on growth. A consequence of this is that climate change negotiations will become a deadlocked burden-sharing game. Section 3 compares and contrasts a range of new thinking on how mitigation could significantly benefit the local economy by driving it to a more competitive structure, and could consequently represent an opportunity to promote growth. Section 4 documents several real-world practices that seek to capture the opportunities of mitigation. Based on the previous analysis,

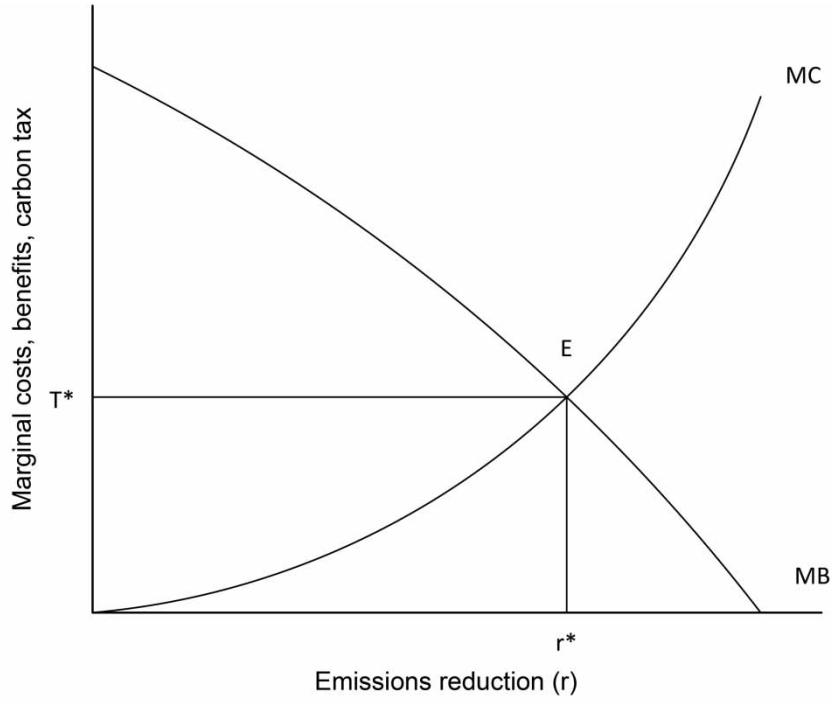
Section 5 considers a new two-track approach to transforming the negotiation from burden-sharing to opportunity-sharing. Section 6 provides some thoughts on common concerns. Section 7 draws together the key findings and implications.

2. How global negotiation become a burden-sharing game

Economics treats climate change as a case of public good, and mitigation actions incur *local* costs but *global* benefits (see, e.g., Pindyck & Rubinfeld, 2012). Works by Nordhaus (1993), Stern (2007), and Garnaut (2008) provide comprehensive reviews of the benefits and costs of mitigation.

The typical economic analysis of climate change takes the following form: global climate change is harmful and the catastrophic consequences should be avoided by reducing global emissions. Nonetheless, because it is not costless to mitigate, there is a need to find the most economically efficient global mitigation level. The optimal global emissions reduction is the point at which marginal cost equals marginal benefit of mitigation (Nordhaus, 1993; see Figure 1).

Garnaut (2008) made efforts to specify the benefits and costs of mitigation. The benefits from mitigation are defined as the damages of climate change avoided. There are four types of benefits:



Efficient policy comes at point E, where marginal cost of further emission reduction (MC) equals marginal benefit of emissions reductions in slowing climate change (MB). T* is the efficient carbon tax while r* is the efficient reduction rates.

Figure 1 Marginal Costs and Benefits of Greenhouse-Gas Emissions Controls

- *Type 1: currently measurable*. These effects are typically measured as the impact of climate change on gross domestic product (GDP) or consumption.
- *Type 2: market impacts not readily measurable*. This is similar to Type 1, but not amenable to measurement with the current state of knowledge.
- *Type 3: insurance value against high damage*. Since the damage resulting from climate change is uncertain, large financial commitments for insurance are needed against low-probability but high-impact events.
- *Type 4: non-market impacts*. This type of benefit is more difficult to conceptualize and quantify, and is related to the concept of welfare; for instance, the valuation of environmental amenity, long-established communities and social structures built around particular patterns of climate, etc.

The benefits are illustrated in Figure 2. The top curve represents 'utility without climate change', but, as a result of the impacts of climate change, the utility would decrease to the bottom curve if no mitigation action were taken. Mitigation would increase the utility, moving the utility curve upwards.

However, mitigation is also costly. There are two types of costs: (1) increased inputs to mitigation, including inputs of new equipment, technology, labour, etc.; (2) a decrease in outputs. Since the existing economic growth mode is heavily based on the burning of fossil fuel, which generates emissions, the reduction of emissions is likely to reduce output. The costs of mitigation can be calculated for various levels and rates of reductions in emissions.

Garnaut (2008) provides a graphical representation of benefits and costs. As shown in Figure 3, the utility curve without mitigation is above the utility curve with mitigation in the early years. Mitigation has a net cost. However, the mitigation utility curve may rise above the utility curve in the absence of mitigation in the later years – and generate a net benefit. By comparing benefits and costs of mitigation, Stern (2007) reached the similar conclusion that 'the benefits of strong, early action on climate change outweigh the costs'.

These (and other) pioneering works have greatly enhanced the academic exploration and public understanding of climate change. However, the limitation of the analytical framework impedes a

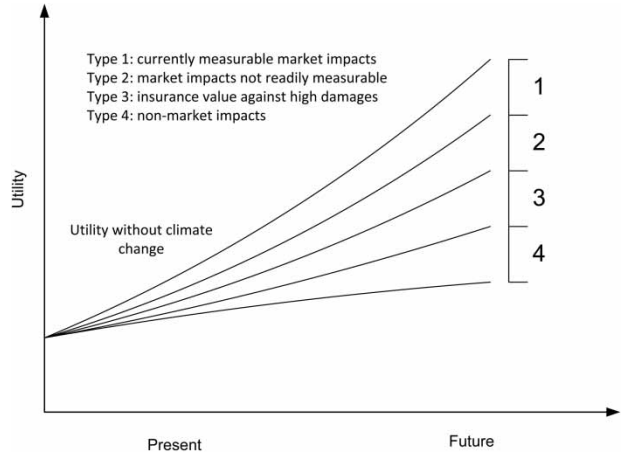


Figure 2 Four types of climate impacts

Source: The Garnaut Climate Change Review: Final Report © Commonwealth of Australia 2008. Garnaut (2008, p. 10).

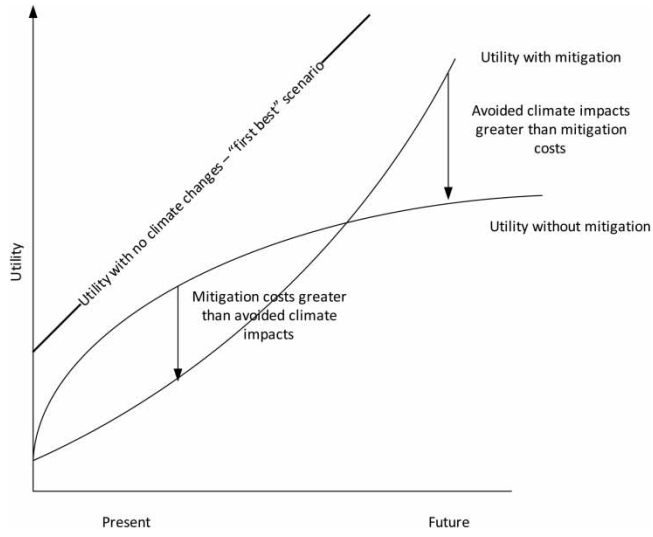


Figure 3 Utility with, or without mitigation, or without climate change
Source: The Garnaut Climate Change Review: Final Report © Commonwealth of Australia 2008. Based on Figure 1.4 in Garnaut (2008, p. 16).

better understanding of the nature and consequences of mitigation in two distinct ways. First, at the theoretical level, the benefits of mitigation are defined as the avoided damage of climate change. Theoretically, this definition excludes the possibility that mitigation might drive the economy into a more competitive structure characterized by lower carbon emissions with a utility level even higher than 'utility without climate change' scenario. Consequently, mitigation has become a kind of action undertaken to avoid damage, rather than to explore new opportunity. The utility with mitigation – no matter how decisive the action to be taken – could never be greater than the assumed 'utility without the damage of climate change' (see Figure 3).

Second, in the policy arena, because the predicted benefits of collective actions are primarily global but the cost is local,[3] all countries have strong incentives to be freeriders, leading to a large problem of coordination.[4] Consequently, global mitigation has become a burden-sharing game among all parties. Every country is concerned with its 'fair share' in the global burden. Different countries have different interpretations about 'fairness', and this lack of agreement hinders progress in international negotiations. Nonetheless, if local benefits (such as local economic growth) of mitigation could be properly predicted and demonstrated, then the incentive for mitigation by individual countries would become a self-interested behaviour.

3. Advances in economics of climate change with new implications

As argued in the previous section, the limitations of the conventional approach are rooted in the 'global public goods' interpretation of climate changes; i.e. benefits are primarily global, difficult to measure, and only accrue in the long term, while the economic costs are local, tangible, and have to

be paid in the short term. This asymmetry in benefits and costs leads to a reluctance of individual countries to take a lead in implementing mitigation policies.

The key question here is: 'Will mitigation lead to local, easily measurable, and short term benefits, not just a co-benefit, but new economic growth opportunities?'[5]

In recent years, a new line of thinking has been emerging – showing that mitigation could have benefits well beyond amenities, and unilateral mitigation could promote *local* economic growth.[6] Consequently, it has a promising policy implication for addressing the current stalemate in international climate negotiations.

At the theoretic frontier at least three research agendas have emerged, including the modified macroeconomic growth model represented by Hallegatte, Heal, Fay, and Treguer (2012), the directed technical change model by Acemoglu, Aghion, Bursztyn, and Hemous (2012), and models based on Adam Smith's notion of evolution of the division of labour and economic structure (see Shi & Zhang, 2012). The common feature in these three approaches is the argument that mitigation will benefit local economy in a measurable way in the short term. They differ in their respective choice of mechanism for channelling mitigation into economic growth opportunities.

The first research trajectory is represented by the work of Hallegatte et al. (2012). Based on a Solow-type macroeconomic growth model, they developed a conceptual framework to show that green growth is about making growth processes resources-efficient, cleaner, and more resilient, without necessarily slowing them. Their argument is that a better natural environment will positively affect economic growth in five channels. These five channels include increasing the quality of production factors; shifting the production frontier by correcting market failure in innovation and diffusion of knowledge; making the economy more efficient by correcting market failures to get closer to the production frontier with existing technology; increasing resilience to environmental shocks; and increasing the job content and poverty alleviation characteristics of growth. In their model, the natural environment is itself a production factor, and is also a factor that enhances physical, human capital, and technological progress. Moreover, environmental policy can help to correct market failure and move the actual output close to the production frontier. Needless to say, more research is needed to identify the transmission mechanism and the magnitude of these five channels to make this model useful for policy analysis.

The second, more microeconomics-oriented line of research is represented by the directed technical change model of Acemoglu et al. (2012). By using an endogenous innovation growth model they show that government interventions (a combination of carbon taxes and research subsidies) could redirect private investments towards green technologies. They posit that, providing that 'clean' and 'dirty' inputs are sufficiently substitutable, a temporary government intervention could result in permanent shifting from 'dirty' inputs to 'clean' inputs. The dynamic story is that government intervention will have a short-term cost, but the long-term 'green growth' rates could catch up the 'non-green growth' rates; i.e. the overall growth will be unaffected. Regarding timing, if immediate action is taken, then the catch-up period will be shorter. On the other hand, if action is delayed, the costs of intervention will be greater, and the catch-up period will be longer.

The third line follows Adam Smith's notion of specialization and division of labour (Smith, 1776; Young, 1928) and its modern incarnation of infra-marginal analysis (see Yang, 2001). In contrast to marginal analysis, which focuses on resource allocation in a given structure, infra-marginal analysis focuses on the optimal structure of specialization and the division of labour to achieve organizational

efficiency. From an infra-marginal perspective, the conventional marginal analysis only captures a specific case of many potential structures of division of labour and is incapable of modelling structural change to the division of labour resulting from mitigation policies. Consequently, conventional economic analysis fails to predict the evolution of economic structures following a reduction in emissions.

Based on Shi and Yang (1995), Shi and Zhang (2012) constructed an infra-marginal general equilibrium model to explore the evolution of economic structure following government policies on emissions mitigation and environment. They assumed two substitutable energies to produce an identical final product – one a 'dirty' energy that emits CO_2 and the other a 'clean' energy that does not. The 'clean' energy was costly at the early stage as its roundabout production chain had not yet been developed. In a *laissez-faire* environment without stringent policies on emissions mitigation and environment, the external environment cost of 'dirty' energy was not included in its price and dirty energy dominated the 'clean' energy. Consequently, without government policies the 'clean' energy did not appear in equilibrium. However, government policies (e.g. emission cap, carbon pricing, regulation, removal of fossil fuel subsidy, high environmental standard) acted as a catalyst to promote the emergence of 'clean' energy by equalizing the after-policies costs of the 'clean' energy and 'dirty' energy. This is similar to the conventional analysis of climate change. The unique feature of the model lies in its evolutionary mechanism of the 'clean' energy sector. With market expansion and transaction efficiency improvement through institutional innovation, the market structure in the 'clean' energy sector will automatically jump to a higher level of division of labour through further specialization and therefore higher productivity. Putting this story in the context of global competitiveness suggests that economies that take tough emission reduction measures and establish sound systems will be forerunners in transforming to the more competitive low-carbon economy. Jaeger et al. (2011), independently, also come to a similar conclusion to Shi and Zhang (2012). A research agenda on climate change and green growth along the infra-marginal approach is currently being developed.[7]

Although coming from different perspectives, a common feature of these three research agendas is their similar conclusion that mitigation efforts could generate additional benefits for the local economy. This could be achieved via several different routes: incremental benefits on physical and human capital, technological progress; driving the economy closer to the production frontier; stimulating the investment in 'clean' technology; or acting as a catalyst on the evolution of economic structure. Compared to the conventional approach, these different strands of research challenge the 'global public goods' interpretation of mitigation policies by arguing that the benefits of mitigation are internal to the participating countries in the form of promoting new economic growth opportunities.

Among these three approaches, the first two are within the neoclassical framework in which mitigation is treated as the 'second best' solution; i.e. in terms of welfare, mitigation will be better than the case without mitigation but always worse than the 'first best' case without climate change at all. On the other hand, Shi and Zhang's (2012) approach is more radical in that it predicts a different economic structure in terms of the division of labour that might emerge following mitigation policies. This model is reminiscent of Schumpeter's 'creative destruction' concept in which interruptions or pivotal events drive the economy to a more competitive structure. Consequently, in terms of welfare, mitigation might represent an opportunity to move the economy to a better structure that exceeds the existing structure's 'first best' case without climate changes. Another notable feature of this approach is that mitigation is the driver to promote the emergence of a new economic structure, rather than a co-benefit of reducing climate change costs in the long term. Jaeger et al.

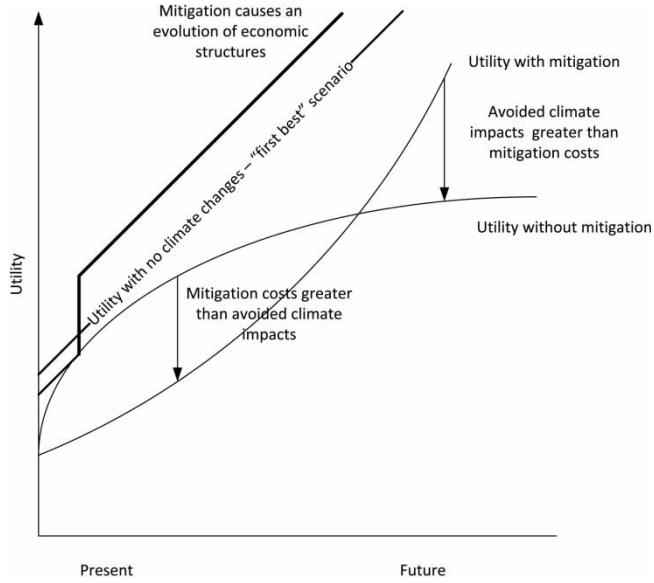


Figure 4 Utilities in different approaches

Source: The Garnaut Climate Change Review: Final Report © Commonwealth of Australia 2008. Based on Figures 1.3 & 1.4 in Garnaut (2008).

(2011) also predicted a similar infra-marginal structural effect of mitigation from a different approach.

The difference in these approaches might be illustrated in a figure similar to Figure 3. In Figure 4, the first two approaches predict a possible temporary decrease of utility due to mitigation costs. The incrementally better environment would then begin to promote economic growth above the case without mitigation, but still below the 'first best' case without climate changes. The third approach, however, predicts a possibility of drastic change, which causes the evolution of economic structure and the utility to jump above the existing structure's 'first best' solution.

An extension of Shi and Zhang (2012) adds an international trade dimension. The country first to unilaterally initiate an appropriate policy mix (e.g. emission cap, carbon pricing, regulation, high environment standard, removal of fossil fuel subsidy, etc.) would drive the emergence of a 'clean' energy sector. The evolution of the division of labour within the 'clean' energy sector will ultimately improve the productivity of the whole economy, leading to a gain in international competitiveness for the whole country. In turn, this might force its trading partners to invest in a transformation to a more competitive 'clean' energy structure. In other words, unilateral mitigation could lead to multilateral mitigation action (see Zhang, Zhang, & Shi, 2013). This story is similar to the historic events of free trade.

This new line of thinking has significant policy implications. First, this new approach suggests that if the evolution of economic structures is taken into account, then the benefits of mitigation could accrue to the implementing countries in the form of generating economic growth opportunities. Mitigation is no longer a practice of providing benefits to other countries. Instead, it is reframed to be compatible with self-interest. Consequently, unilateral mitigation could bring benefits for individual

countries. Second, in all three approaches, government policies on mitigation and environment are necessary to trigger the transformation from a high-carbon structure to a low-carbon structure. After the emergence of 'clean inputs/energy', it is assumed that the market will evolve by itself along the low-carbon trajectory. From this perspective, government intervention can serve as a catalyst to promote the emergence of new technology and/or the transformation of economic structure. These two implications are the theoretical foundations of our policy initiative of a new two-track framework, as presented in Section 5.

4. Real-world practices: decoupling economic growth from emissions

Compared to the slowly progressing economics of climate change, some policy makers and some members of the business community have taken swift action to seize the opportunity represented by emission reductions. More and more evidence suggests that emission reductions could have concrete benefits for growth.

The potential benefits of mitigation to economic growth (collectively called 'green growth') have been foreseen by several multilateral agencies. For example, in 2009, the Organisation for Economic Co-operation and Development (OECD) issued a 'Declaration on Green Growth' in which its member countries set forth a comprehensive green growth strategy. Under the EU's 'Europe 2020' initiative, innovation and green growth form the core of a strategy to increase the competitiveness of European countries. Meanwhile, the United Nations Conference on Sustainable Development 'Rio + 20' issued 'The Future We Want' to promote green growth.

Some evidence of green growth is emerging. The World Bank and China's Development Research Centre of the State Council (2012) showed that economic growth and carbon emissions and pollution have already begun to partially decouple. According to the United Nations Environment Programme (UNEP), the carbon intensity of the world economy (CO_2 emissions per unit of GDP) has dropped 23% since 1992. Since 1990, economic growth has increased faster than carbon emissions for both developed and developing countries, as represented by the five BRICS countries (Brazil, Russia, India, China, and South Africa), although the decoupling is much more complete in OECD countries (see Figure 5 which is sourced from OECD 2011). Gower, Pearce, and Raworth (2012) compared the growth in GDP and the growth in CO_2 emissions in G20 countries during the period 1991–2007 and concluded that, with the exception of Brazil and India, all other countries had experience of either 'relative decoupling' or 'absolute decoupling' (see Figure 6).

These global trends are also seen in evidence emerging from the two biggest emitters, the US and China. In both countries it has been demonstrated that economic growth can be partially decoupled from emissions, and that mitigation could potentially be a driver of technological progress and growth. During the period of China's 11th Five Year Plan (2006–2010), China's GDP grew by 11.2%, while its energy consumption increased by only 6.6%, about half of its economic growth rate. Energy intensity decreased by 19.1%. Some relevant pollutants decreased in absolute figures. For instance, SO_2 decreased by 3.64 million tons (−14.29%) and CO_2 by 1.76 million tons (−12.45%). More importantly, Chinese decision makers have recognized that fighting climate change represents a 'great opportunity' and have made a call in its official document (State Council, 2011) for the country to seize the opportunity of green growth.

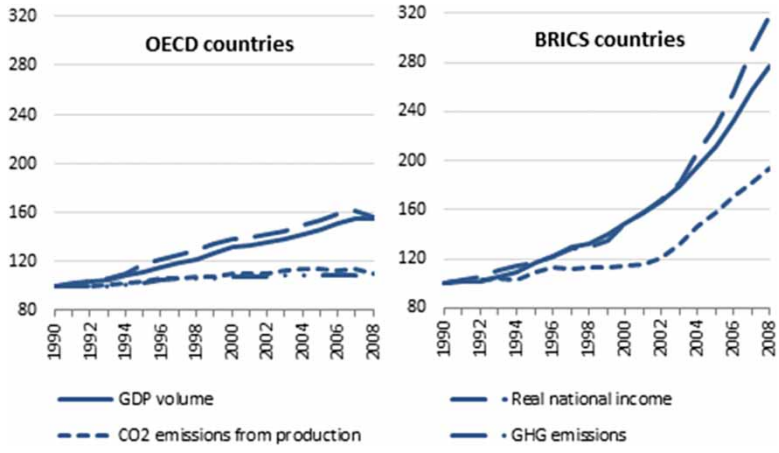


Figure 5 Decoupling economic growth from carbon emissions worldwide (index, 1990 = 1)
Source: OECD (2011).

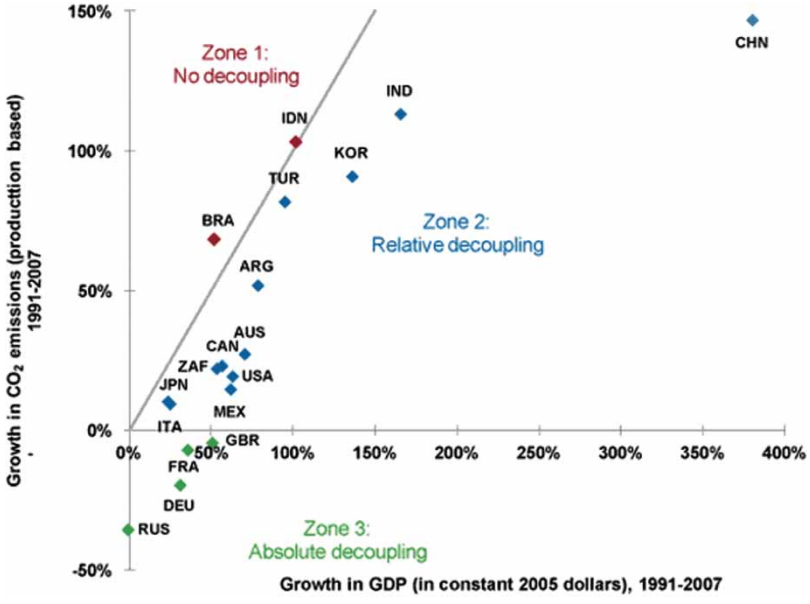


Figure 6 Decoupling of Growth in GDP and in CO_2 during 1991–2007
Source: Gower, Pearce, and Raworth (2012).

In the US, as the special envoy on climate change indicated, 'since 2006, according to the International Energy Agency, U.S. CO_2 emissions have fallen 7.7% . . . Meanwhile, the latest figures from the Energy Information Agency, for the four months ending in March (*2012, added by authors*), show that U.S. emissions are 14% lower than in 2005.'

5. A new two-track policy initiative

The previous two sections have highlighted that progress in economic thinking on climate change (green growth) has made a case for decisive governmental actions. This approach could actually promote local economic growth and therefore internalize the externality caused by GHG emissions. Some emerging evidence exists that suggests it is possible to partially decouple economic growth from carbon emissions. This provides confidence to unlock the deadlock in climate change negotiation.

However, there is one more 'catch-22' dilemma: the commencement of green growth requires catalytic action on mitigation from the government, while a risk-averse government needs convincing evidence of green growth to take the first step of mitigation.[8] At the present time green growth still largely exists as a vision and has not become a common reality with sufficient evidence. For this reason, governments might be reluctant to take firm emission reduction action. In turn, without initiatives from the government, evidence of the benefits of green growth is slow to accumulate.

To solve this dilemma, the 'loss aversion' theory of Kahneman and Tversky (1984) suggests that a lower mitigation target might be needed. A start might be made with an interim target of, say, 3 °C rather than the desirable 2 °C target. This might entice the majority of risk-averse individual countries to take mitigation action. Meanwhile, to address the 'emissions gap' to avoid the catastrophic consequence of the 3 °C target, a consensus and increased confidence needs to be constructed for green growth. This requires serious and complex policy coordination. Victor (2011) suggests that such complex coordination requires initially working in small groups (e.g. in the form of a club) rather than a global UN framework. Weischer, Morgan, and Patel (2012) also suggest establishing 'transformational clubs' to complement the United Nations Framework Convention on Climate Change (UNFCCC). In this section, a new policy initiative is presented – namely, a new two-track approach to achieve this objective.

The basic idea of the new two-track approach is to guarantee early action and introduce green growth mechanisms in the post-2020 regime by taking on the advantages of both top-down and bottom-up approaches. The legally binding UNFCCC (the first Pillar) mitigation would start from a relatively lower but politically realistic emission reduction target, while the green growth club (the second component) aims at higher voluntary global ambition. The two interactive systems are mutually reinforcing in promoting green growth and in the desire to eventually evolve towards the 2 °C target.

The new approach is different from the old two-track system in which Annex I and non-Annex I countries take different obligations.[9] The new two-track approach is applicable to all countries, but the 'common but differentiated responsibilities' (CBDR) principle is kept in a different form and becomes operational with a clearly defined emission reduction obligation for each country. Each country commits to two types of pledge, a legally binding low pledge in the UNFCCC, and a voluntary high pledge in the green growth club. It is optional for a country to decide whether or not to join the club. Nonetheless, those countries not joining the club would not be eligible for the exclusive benefits and rights of the club member countries.

The new two-track approach is an open and inclusive system. It can incorporate the merits of a variety of existing proposals and all issues in the old two-track system can continue to be discussed and negotiated, including finance, technology transfer, an international climate change fund, etc.

Specifically, in order to make this approach adequately respond to the challenges of climate negotiations, it consists of three pillars.

Pillar 1. Creating a legally binding global low target and disaggregating the global target among parties: CBDR becomes clearly defined.

The objective of Pillar 1 is to guarantee early action and introduce the institutional arrangements needed for green growth. For this purpose, the top-down element in the UNFCCC is essential to guarantee all countries take serious action. Otherwise, no individual country would experience realistic pressure to take action on emissions reduction, which is a prerequisite for green growth.

Two questions remain. The first is how to set the global target within the UNFCCC. It is proposed that an initial lower global target (i.e. larger global emission budget) be set in order to lower conflict between parties and make the essential early action politically acceptable to all countries, especially to major emitters. The rationale for why it is better to start with a higher degree target to achieve the 2 °C target is discussed in Section 6. The second question is how to disaggregate the global legally binding target. It should be an open question to be addressed through negotiation. In addition to the widely accepted *per capita* principle, some specific factors can also be taken into account to make the allocation more acceptable.[10]

Once each country's pledge has become legally binding within the UNFCCC, an 'emissions account' can be introduced as a tool for measurement and international collaboration. Each country's account consists of three concepts: (1) an emissions entitlement (equivalent of how much a country should reduce based on its real emission); (2) real emissions; and (3) acquired emission permits from international cooperation, including emission trading, joint implementation, the Clean Development Mechanism, etc. The account can then be established with the formula:

$$\begin{aligned}\text{Emission account balance} = (1)\ \text{emissions entitlement} - (2)\ \text{real emissions} \\ + (3)\ \text{acquired emission permits}\end{aligned} \tag{1}$$

The benefit of this strategy is that a country has various avenues by which to meet its legally binding pledge, as it can balance this through adjusting (2) real emissions and/or (3) acquired emission permits. This provides an effective mechanism for the global optimal allocation of resources. The formula suggests that real emissions is no longer the single criterion for measuring a country's efforts and its contribution to global emission reduction. A country with high real emissions could acquire more emission permits to maintain its emission reduction obligations.

Pillar 2. Establishing a 'green growth club'.

The objectives of green growth club are twofold: (1) to provide incentives for countries to reduce their emissions and activate green growth through international cooperation and (2) to address concerns about the 'consensus rule of procedure' in negotiations. The advantage of consensus rule is to provide protection to small countries to avoid manipulation by a few powerful countries over negotiation. Nonetheless, its disadvantage is that it can be ineffective. As noted by Stern (2012),

'negotiations are governed by a consensus rule of procedure, which, in effect, enables any small handful of determined countries to block progress'.

One strategy to maximize incentives and address concerns about consensus rule of procedure would be to design a green growth club using a normal club rule with rights and obligations. In this case the rights of membership would be designed to promote benefits to those joining, which include, but are not limited to, free trade and investment, technology transfer, the establishment and use of an international climate change fund, the use of established standards, etc.[11]

However, countries joining the club would also have to accept the obligation of introducing mechanisms of green growth within their own country. Such obligations might include making high voluntary emission reduction pledges, introducing stringent reduction policy and law, reducing/removing fossil-fuel subsidies, consolidating a competitive market system, etc. In order to encourage countries to join, and to ensure compliance, every member country needs to publicly announce its emission reduction pledge. This pledge must be subject to public scrutiny, and membership would be subject to periodic review. For those countries failing to meet their voluntary pledges, penalties, such as suspension of their membership, would apply.

This Pillar 2 proposal is very similar to the idea of 'transformational clubs' presented in Weischer et al. (2012). The current authors share the same position: (1) members should have an ambitious vision consistent with the latest scientific evidence on climate change; (2) clear conditions should exist for membership; (3) the club should provide significant benefits to members; and (4) a pathway should provide a way to start now and expand over time. A tighter connection with the between Pillar 1 and Pillar 2 is recommended. This would provide an additional incentive for emitters to join the club.

Pillar 3. Connecting the two pillars.

Although the pledges in the two Pillars have a different legal status, the two Pillars could be connected and mutually reinforcing. According to the emission account balance formula given above, the less a country emits, the more emission entitlements it can sell or the less it needs to buy. The emission reduction resulting from the club incentive (a reduction in real emissions, and consequently a positive emission balance) can be sold through a trading scheme in Pillar 1 (e.g. establishing an emission trade scheme within the UNFCCC framework) for a profit. Therefore, the new two-track approach provides an effective mechanism for low-carbon technological innovation and management improvement towards green growth.

6. Broader policy issues

In the previous section, a new two-track approach was proposed to address the current stalemate in climate negotiations, based both on the economics literature, which highlights the potential advantages of green growth, and on awareness of the challenges of triggering green growth to start. In this section, the proposed new two-track approach is considered in light of addressing three controversial policy issues.

6.1. To achieve 2 °C target, why not start with a higher degree?

A high target is desirable, and the 2 °C target is endorsed in the Copenhagen Accord. Ironically, one feasible way to achieve the 2 °C target is to start from a high degree. A target of 2 °C (750 $GtCO_2$) creates a very tight constraint on the global emission budget and is well below all countries' business-as-usual (BAU) emissions. During international negotiations, each country's primary objective is to fight for a bigger share of a given global emissions budget. Almost inevitably, this can lead to a deadlock that might lead to a higher degree outcome and a catastrophic result.[12] The alternative of starting from a lower target means a relatively larger global emission budget to allocate among all countries. This larger budget might alleviate conflicts between the parties. It could make early action politically acceptable to all countries, especially to the major emitters, and make it easier to introduce an institutional arrangement promoting green growth.[13] Ultimately, green growth should make the 2 °C target possible.

The literature highlights that government policy is just a catalyst and that green growth is a self-fulfilling process. A delay in initiating action could be costly and it is preferable to reach a global climate change agreement as early as possible, no matter what the specific temperature target is.[14] A target (rather than the slow progress in negotiations of *the* target) would provide a certainty crucial for both investors and consumers. This certainty is crucial for fostering green growth, and in turn crucial for solving climate change.

In this context, the proposed new two-track approach can be effective because it addresses risk aversion and provides incentives for swift action. Since the legally binding pledge is relatively low, the associated risks of action are low and essential early action can be guaranteed. Such no-regrets actions provide policy certainty, which should raise the confidence of both investors and consumers to jointly expand the green sector and speed up the transformation of industrial structures.[15] Similarly, a self-interested mechanism is established in which emission reductions are rewarded in two ways: (1) the more a country reduces, the more it can sell or the less it needs to buy; and (2) deep emission reductions facilitate green growth.

6.2. CBDR principle and the dual-track negotiation system

Given the different contributions to global climate change and the respective capabilities of different countries, CBDR is a fair principle and is the foundation of the UNFCCC. However, in practice, CBDR is subject to different interpretations, leading to deadlock in international negotiations. Under the Kyoto Protocol, the division between Annex I and non-Annex I countries in mitigation has caused several controversies. The Bali Road Map tried to put the CBDR principle into practice by including a dual-track negotiation system comprising the Convention track and the Kyoto Protocol track. Two *ad hoc* working groups (AWG-LCA and AWG-KP) were established to conduct negotiations on each track. It is fair to say that the debates on the effectiveness of this dual-track negotiation system in participating countries have not yet been settled.

In the proposed two-track approach, the CBDR principle can be operationalized by clearly defining each country's legally binding mitigation target at Pillar 1 and letting each country voluntarily choose a higher pledge at Pillar 2. For each country, the 'differentiated responsibilities' are clearly defined by its legally binding and disaggregated UNFCCC target. In this way, although the form of CBDR is changed, the substance of CBDR is kept.

6.3. Top-down or bottom-up?

The debate on top-down or bottom-up approaches is another deadlock in negotiations. For instance, in US politics, any agreement that requires actions by the US but not by the emerging economies would fail in the US Senate. In 1997, the Senate, by a vote of 95–0, passed the Byrd–Hagel resolution, declaring that the US should not accept commitments to reduce GHGs unless developing countries accepted such commitments as well (see Stern, 2012). Although other countries regard this stance as unjustified, it remains a real political barrier to reaching global agreement in a traditional way.

As a response, some have taken an extreme view and propose a bottom-up approach to replace the top-down approach within the UNFCCC. For instance, Stern (2012) has proposed a bottom-up flexible approach that starts with nationally derived policies, in which the pledges of an individual country are modified over time. Although the top-down UNFCCC approach has its problems, the solution does not reside in going from one extreme to the other. Instead, it may be possible to combine the advantages of the two approaches.

Top-down and bottom-up approaches can be considered complementary. Because there is a 2 °C global target, if all countries took a bottom-up approach, then the aggregate pledges of each country also need to be consistent with the global target of a top-down approach. The two approaches are also interdependent. Without the pressure from the UNFCCC top-down approach, ambitious bottom-up pledges are impossible.

A complete bottom-up approach is politically unrealistic. For instance, in the case of the US, the pressure from domestic politics would disappear in a bottom-up approach, but the international political pressure would increase dramatically if the US were to abandon its UNFCCC membership. Accordingly, bottom-up is not likely to be an 'art of the possible'.

A bottom-up approach with pledges modified over time is not so realistic. If it is hard to ask countries to raise their ambition under the UNFCCC, it is unlikely that it would be easier to modify a country's ambition with 'a six-month period after countries submitted initial offers in which other governments, experts, and civil society could react and urge for modification' as Stern (2012) has proposed. It is worth recalling how difficult it was to ask any country to raise its pledges in the Copenhagen Accord.

Finally, a bottom-up approach is incompatible with the establishment of a global carbon market. The value of carbon permits is determined by each country's reduction ambition. Some would argue that the world carbon market can still be established, as in this case different countries' carbon permits have different values and prices, and a carbon 'exchange rate' can be introduced. The risk of seeking to establish markets without a coordinated limit is that it would add complication and make transaction costs too high.

The proposed new two-track approach can effectively combine both top-down and bottom-up approaches. The Pillar 1 set a global target and each country's obligations in mitigation (a top-down approach), while Pillar 2 allows each country to determine its own pledges (a bottom-up approach). Such a combination appears to be both realistic and effective.

7. Conclusions

New policy recommendations have been provided in an attempt to unlock the deadlock in the current rounds of international climate change negotiation. The arguments are grounded in two ways.

First, the latest progress at the frontier of theoretical economics suggests that mitigation could stimulate the emergence of new technologies and/or new market structures that promote economic growth. This approach supplants the argument that mitigation has a negative impact on the economy. One exciting implication of this trajectory of research is that unilateral mitigation could bring substantial benefits to the local economy. This challenges the common mindset that mitigation necessarily has 'global public good' characteristics in which 'cost is local and benefit is global'. Since mitigation is incentive-compatible, the burden-sharing negotiations could become opportunity-sharing collaborations in the context of international negotiation in climate change. Accordingly, it is suggested that in order to establish an effective post-2020 climate change regime, the current negotiation needs a strategic transformation from burden sharing to opportunities sharing by putting green growth at the heart of the new regime.

Second, a practical policy initiative is provided as a new two-track approach to facilitate this strategic transformation. Starting from a less ambitious but legally binding UNFCCC emission target, combined with the creation of a voluntary Green Growth Club, it is argued that this new two-track approach could face far less resistance from individual countries in international negotiations, and could establish a mechanism for triggering green growth. In turn, this could encourage individual countries to take decisive early actions to mitigate. With sufficient local benefits emerging – supported by theoretical research and evidence – it is hoped that momentum would be established for more and more countries to voluntarily join the Green Growth Club. Ultimately, a relatively lower starting point with higher temperature could achieve the necessary 2 °C or below target.

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Notes

1. The Annex I countries account for 20% of the population, but produced 79% of cumulative emissions from 1875 to 2000; see, e.g., Brazil (1997), BASIC expert group (2011), and DRC (2009).
2. See, e.g., Barrett (1997).
3. Some authors (see a review paper by Bollen et al., 2009) indeed discussed the local co-benefits, but the so-called 'co-benefits' are not sufficiently big to substantially change the conventional benefit–cost story.

4. As Garnaut (2008) pointed out, the net benefit heavily depends on global multiple action. In other words, the net benefit is impossible in a unilateral mitigation scenario.
5. Garnaut (2008) implicitly raised an important idea on the substantial benefit from structure change: 'the models used for assessing the costs of mitigation and climate change depend critically on the assumptions that are fed into them about structural relationships in the economy . . . ' (Garnaut, 2008, p. xxiii). Unfortunately, the insight on structural changes resulting from mitigation cannot be properly dealt with using conventional economic tools. Therefore, the typical conclusion of a computable general equilibrium (CGE) model on mitigation and economic growth is something like this: mitigation would, more or less, negatively impact economic growth for some percentage points, but the cost is still affordable (e.g. Frontier Economics, 2008)
6. For instance, the updated Garnaut review concluded that 'the growth rate for Australian national income in the second half of the twenty-first century would be higher at the end of the century with mitigation than without . . . Strong mitigation was clearly in the national interest' (Garnaut, 2011, p. x).
7. See DRC Project Team (2013).
8. One challenge in implementation is that green growth is particularly beneficial over a longer period of time, so it is important for governments to consider longer timeframes in decision making. This could be a particular challenge in countries where planning is more explicitly linked to short political cycles.
9. The authors are not suggesting that the old two-track system is unfair to any particular countries or countries group, but the new two-track approach is relatively easier to implement.
10. See, e.g., BASIC experts (2012) and DRC (2009). Klinsky and Dowlatabadi (2009) used an applied ethics approach to categorize various proposals on international climate policies and their respective implications for distributive justice.
11. Research and policy initiatives are emerging to support the Green Growth Club initiatives. For example, The International Centre for Trade and Sustainable Development (ICTSD), the Global Green Growth Institute (GGGI), and the Peterson Institute for International Economics (PIEE) launched a project in 2012 designed to analyse the feasibility of a Sustainable Energy Trade Agreement (SETA) and to develop the concept into a detailed set of policy options that could serve as the basis for such an agreement. On 7 September 2012, before attending the APEC summit at Vladivostok, Russia, the deputy US trade representative Demetrios Marantis revealed that a 21-nation cluster would soon implement a mandate on cutting down import duties on 'green' technologies. Moreover, overcoming some of the policy and market failures that prevent the opportunity club being formed are being addressed at the 'sub-multilateral' level, such as through the Global Green Growth Forum (Danish/Korean-led, China as participant) and the Clean Energy Ministerial (US-led, China as participant).
12. According to the World Bank (2012), if immediate action is not taken to reduce emissions, global temperature is likely to rise by 4 °C.
13. Young (2011) surveyed the literature on the effectiveness of international environment regimes. One finding is that for success in the implementation of international regimes, the UNFCCC is likely to require the establishment and maintenance of maximum winning coalitions rather than minimum winning coalitions. A low start is such an effective regime.
14. This position is consistent with another interesting finding of Young (2011), in that multiple pathways can lead to success with many environment problems, and environment regimes are dynamic in that they change continuously after their initial formation.
15. Carruth, Dickerson, and Henley (2000) reviewed the literature investigating the relationship between investment flows and uncertainty. A general conclusion of their work is that increased uncertainty, at both aggregate and disaggregates levels, leads to lower investment rates.

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