

Reviewing role of market-based Instruments in addressing climate change

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Abstract

Objectives: In this paper we will critically review the reliability of Market-Based Instruments (Tradable permits and Pollution tax, and Hybrid Policies) to counter the problem of global climate change.

Methods/Statistical analysis: By doing a survey of literature, graphical analysis of the carbon footprint of countries and studying past experiences at global and regional level, we will try to find the basic prerequisites needed for a market-based policy to work. We will then see whether or not these prerequisites conform at the global level.

Findings: We find that though MBIs have shown positive results at the regional level, the governments of those regions played an indispensable role behind the success of these policy instruments. At the same time, MBIs at the global level implemented after Kyoto Protocol failed in their aim to curb the emissions. In fact the data suggests that the carbon emission of the world actually increased after the Kyoto Protocol was implemented. The World Bank data on CO₂ emissions also points towards carbon leakage from developed to developing countries. Hence, we agree with the general economic consensus that tradable permits and pollution tax can be powerful tools to curb emission at regional level. But, as the evidence suggest, we cannot rely on them to counter global climate change.

Application/Improvements: We propose that instead of relying on a single global policy, governments of regional trading blocs should establish their own MBI across the globe. Also, instead of carbon emissions, we must monitor the carbon footprint of nations so that leakages can be accounted for.

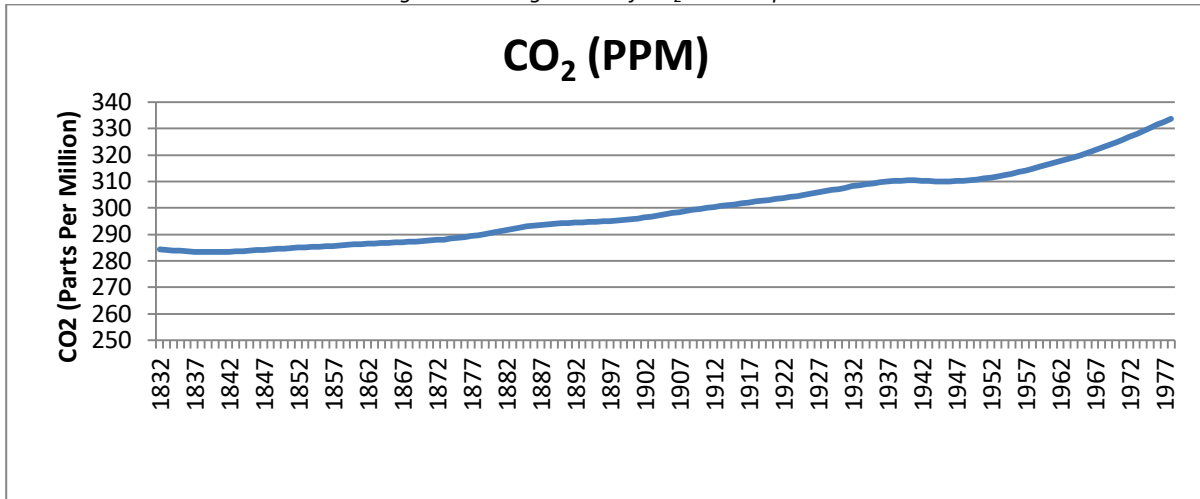
Keywords: Market-Based Instruments, Climate change, Global warming, CO₂ emissions, Kyoto Protocol.

1. Introduction

Climate change is defined as a change in the normal weather of Earth at a given space and time. It is different from day-to-day changes in weather. Usually, climate change takes place over millions of years, but extravagant use of fossil fuels have catalyzed the process. Earth is getting warmer at an unprecedented rate and if it continues we might face serious repercussions. There is a general consensus among scientist that human activities have led to substantial increase in greenhouse gasses (GHG) over the past century [1]. Figure 1 shows the level of average CO₂ PPM in the atmosphere from 1832 till 1978. The increasing trend in CO₂ level is clearly visible. The current level of CO₂ is even higher at 405.34 ppm.

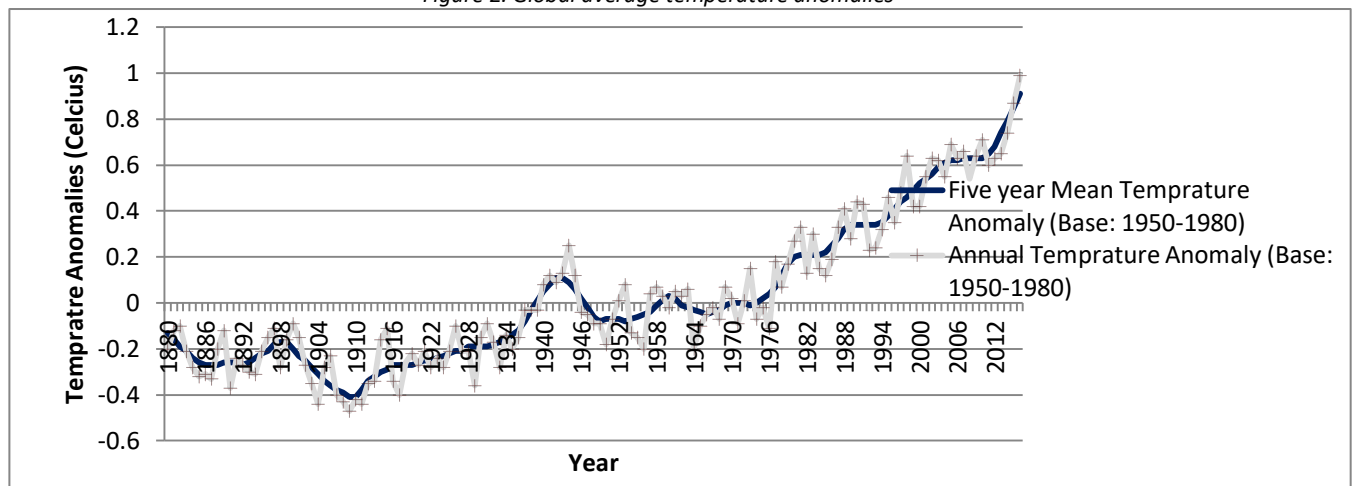
The problem with increasing GHG concentration is that it leads to a gradual increase in the temperature of the earth. Figure 2 shows the anomalies recorded in the earth's temperature from 1800 to 2016. It is clear that the planet is now warmer than it used to be in the 19th century. With therise in global temperatures, weather based natural disasters like flood, storms, and drought occurs more frequently. It is widely accepted that global warming is increasing sealevels across the world because with therise in global temperatures polar ice caps and glaciers melt much faster resulting in an overall rise in sea level. Also, warmer water tends to expand and occupy more space. Figure 3 shows that in just past 20 years sea level across the world has increased by 80 mm on an average. If the trend continues, hundreds of coastal cities will be flooded in the near future. Figures (1-3) show that we can't ignore the situation anymore. Climate change should not just be viewed as an environmental problem; rather it should be seen as a developmental and economic issue. One cannot talk about any kind of sustainable economic growth without addressing climate change.

Figure 1. Average levels of CO₂ in atmosphere



Source: Carbon dioxide in formation analysis centre

Figure 2. Global average temperature anomalies



Source: Global Climate Change (NASA)

It is estimated that average global sea level can increase by 3 to 4 feet by the end of this century. Apart from the loss of infrastructure and coastal property, lives of millions of people living near coastal areas are at risk. The effect of rising sea level on human migration is estimated to be 200 million [2]. Climate change could also drastically affect agriculture. It is estimated that if steps are not taken to curb emissions, agricultural productivity could fall dramatically [3]. This will affect the developing countries more since the majority of the population in developing countries is engaged in the agrarian sector. Climate change can reduce access to drinking water, negatively influence the health of poor people and pose a real threat to food security in many countries in Africa, Asia, and Latin America [4]. Having established the severity of the problem, we now move on to explore the solutions. According to analysis from the OECD, IPCC and McKinsey serious climate action will cost only a fraction of a percentage point of annual growth in world GDP. Doing nothing, by contrast, may lead to radically larger losses [5]. The problem is that mostly the polluters and the victims are separated (both by space as well as time). Generally, victims are not in a position to ask for compensation for the damage that is inflicted upon them. For this reason, most of the emissions of GHG go unabated. Hence, the polluters tend to over pollute the environment. This is a typical case of a negative externality. We must also acknowledge the fact that climate change is a global problem. Even if few countries decide to take serious action to control climate change, they will have to bear the cost, but the benefits will be shared by the world. Hence free riding becomes a significant concern when we talk of countering climate change. Economic theory provides two ways in which we can correct for over pollution of the environment. They are:

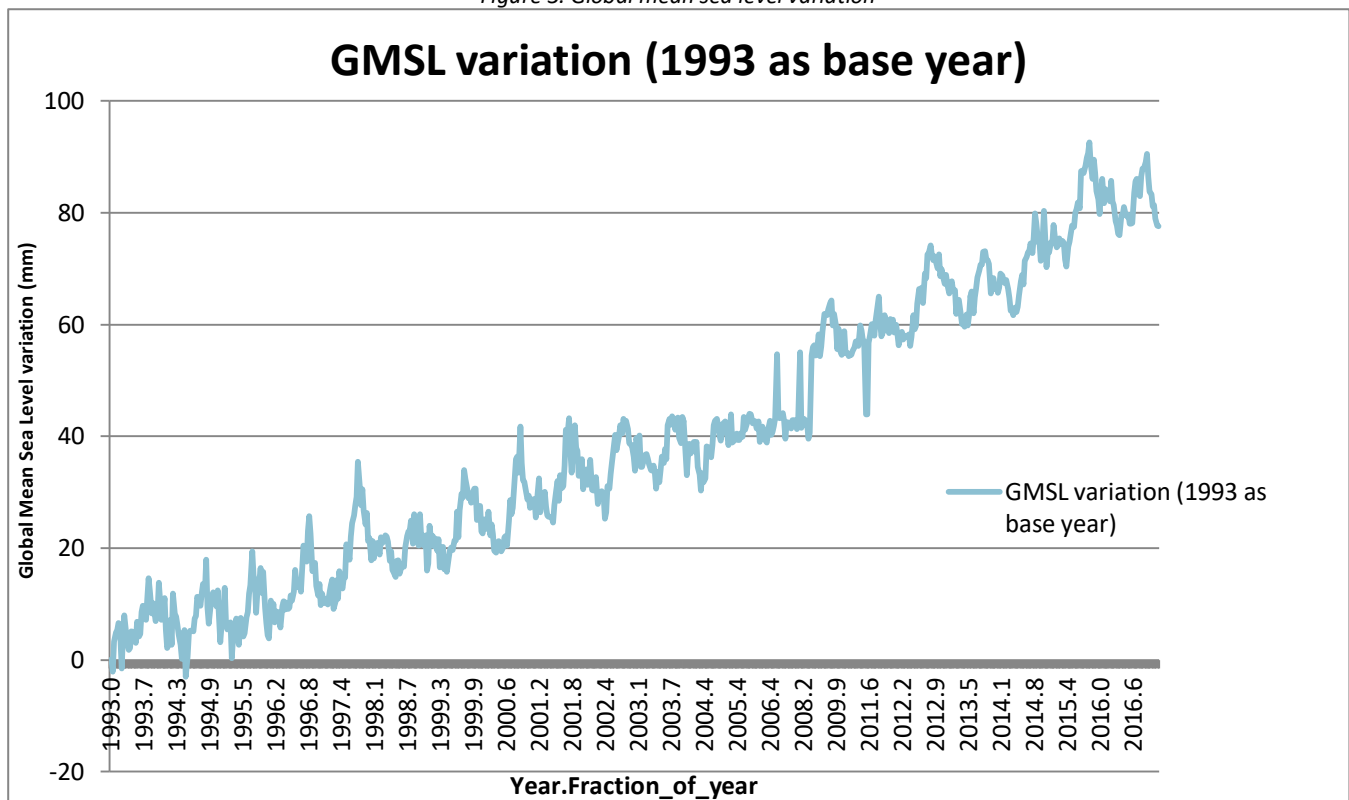
1. Command and Control (CAC)
2. Market-based Instruments (MBI)

Under CAC, the regulators decide the optimal level of pollution for each unit in concern (a unit can be a firm, industry or a region). Non-compliance is dealt with fines/punishments. For CAC to achieve an efficient level of pollution, the regulators must know the marginal abatement cost of every polluter [6]. This is a very stringent assumption. Therefore, CAC might not always give efficient results. On the other hand, MBI incentivises each polluting unit to decrease the pollution. The major market-based instruments that are used to address environmental pollution are:

1. Pollution tax/fees
2. Tradable pollution permits
3. Hybrid policies, a combination of tax and permits

In this essay, we will give a brief note on MBI and its effectiveness to combat climate change. In the next section, we explain how the MBI work. We will focus on major challenges that need to be addressed for MBI to work at a global level. We will also discuss the successes and failures of Kyoto Protocol. In section 3 we conclude.

Figure 3. Global mean sea level variation



Source: Global climate change NASA

2. A review of market-based Instruments to counter climate change

Instead of forcing polluters to reduce emissions, MBI provides incentives to pollute less. Assuming all firms are cost-minimizers, MBI can ensure that emission can take place at the level of static efficiency (where marginal abatement cost of reducing pollution equals marginal benefits from pollution). Blackman and Harrington (2000) showed that the MBIs are static efficient because they leave firms free to choose abatement technologies that minimize costs in their individual circumstances. Hence, naturally the firms are incentivised to go for the most efficient technology to abate pollution. Traditional economics literature gives three types of MBI.

2.1. Different types of market-based instruments

2.1.1. Tradable permits

The basic structure of tradable permit is that the government sets up a cap on the maximum level of pollution allowed for certain sectors. Once the cap is decided the firms are granted rights to emit a certain

amount of pollution such that the total amount of pollution is equal to the cap set by the government. These rights can be granted either by distributing tradable permits to the firms or by auctioning these permits in open markets. The firms exceeding the permissible limit are allowed to buy pollution permits from the firms which are polluting less than the permissible limits. It has been argued that permission permits can foster a move towards greener technology and less polluting inputs. This is because firms can actually make a profit out of polluting less. A problem with tradable permit market is that the results might not be efficient in cases of imperfect competition and high transaction cost. Blackman and Harrington (2000) claimed that design deficiencies and constraints on monitoring and enforcement can impede the effectiveness of permits in developing countries.

2.1.2. Pollution taxes/fees

Taxes can be imposed on either pollution by final products (like pollution from cars), or on polluting inputs. Firms having different marginal abatement cost may react differently to a pollution tax. If the tax rate is chosen in a way that is as high as the price would be in an emission trading scenario, then there would be no difference in emissions between tradable permits and pollution taxes [7]. Apart from reducing emissions, pollution taxation can also raise revenue, which can be further invested in promoting green technology and reducing emissions. Whether or not this will happen, depends on the political will, information constraints and transparency of the government.

2.1.3. Hybrid Instruments

Both price and quantity mechanisms have their own merits and demerits. In situations where the abatement cost is uncertain, the equilibrium under taxes and permits diverge [8]. Which instrument will be better than the other, then varies for different market situations and nature of pollutants. Roberts and Spence (1976) shows that under uncertainty, a combination of pricing and licensing instruments can reduce expected total social costs below the levels achievable with either of the instruments alone [9]. Goers et al., (2010) gave an example of one such hybrid instrument using certificates. The government issues certificates for pollution. Generally, the price of these certificates is a bit higher than the expected equilibrium price under tradable permits (this price is called the trigger price). If the actual market price exceeds the expected equilibrium price by a lot, then the companies always have an option to buy the certificates at trigger price from the governments, which can be seen as a tax per unit of emission. They show that under uncertainty, the efficiency loss under a hybrid instrument is much lesser than the welfare losses without this trigger mechanism. Furthermore, McKibbin and Wilcoxon (2006) argue that a hybrid system of long and short term emissions permits provides the best mechanism for providing credible long-term incentives to reduce emissions [10].

2.2. Regional/national experiences with market-based instruments

The USA implemented World's first pollution cap-and program in 1995. The SO₂ emissions from around 3200 coal plants were capped, and a market was created for government issued permits to emit SO₂. By 2007, annual emissions had declined below the program's nine million ton goal (a 43% reduction from 1990 levels). This was despite the fact that the electricity generation from coal-fired power plants increased more than 26% from 1990-2007 [11]. But the results for cap-and-trade programs have not been the same globally. The European Union Emission Trading Scheme is the largest cap-and-trade program. It is aimed at reducing CO₂ emissions from power plants and large manufacturing sites across Europe. The EU ETS emerged out of the failure of efforts throughout much of the 1990s to introduce a carbon tax in Europe and skepticism about the effectiveness of voluntary agreements [12]. Presently, there has been a lack of demand for these permits in European Markets. By 2013, there was a surplus of around two billion permits compared to actual emissions [13]. Such large surplus discourages firms from investing in green technology, thereby hampering the scheme's efficiency in combatting climate change. According to Aldy and Stavins (2012), the "congestion charges" in London, Singapore and Stockholm have reduced traffic congestions in busy urban centers, lowered air pollution and delivered net social benefits, whereas the British Columbia carbon tax has reduced CO₂ emissions since 2008 [14]. Tyagi (2016) showed that a carbon tax in India can reduce emissions significantly. He further claims that revenue generated from carbon taxes can help to decrease the other taxes permanently [15]. The regional results, on an average, seem promising. But the question is can we rely on MBI to address the problem of global climate change?

2.3. Are market-based instruments sufficient to address global climate changing?

Climate change is a global problem, and even if few nations seriously take up emission reduction policies, there is no guarantee that it will necessarily reduce global temperatures. There are several important reasons for us to believe that. First, an uneven implementation of MBIs across the globe is bound to create production cost differentials and hence pollution havens. This will lead to emission leakages from the regions where MBI is implemented to the regions where there is no such policy. The overall levels of pollution might not change or it may even increase. We will talk about leakages in more detail later. The second reason is, if we assume that some countries could counter climate change problem by themselves, even then the cost of mitigation will be borne by those countries only, but the benefits will be enjoyed by the whole world. Hence free riding becomes a major issue that needs to be addressed while working at a global level. The absence of an unbiased international government that can implement and overlook the market-based instruments at a global level escalates the problem. Also, even if a global program to mitigate climate change through market mechanisms is initiated, there is little justification that many countries would be willing to enter into these programs. Stavins (1997) rightly states that “despite the great theoretical advantages of market-based approaches to addressing global climate change, neither domestic political barriers nor international institutional impediments to implementing these and other instruments should be underestimated” [16].

We must also remember that without an international agency which can set up a global market for carbon trade, the transaction costs can be very high. In the presence of transaction costs if the initial allocation of permits is not the equilibrium allocation under no transaction costs the outcome would be inefficient [17]. Similarly, without a global government, implementation of a global carbon tax seems like a utopian vision. Another problem that must be addressed to mitigate climate change successfully is the fact that short-term reductions in emissions may have little to no effect in reducing climate change. McKibbin and Wilcoxon (2006) argued that to curb the ever rising emissions, a climate policy must establish credible long-term incentives for investments in new energy-sector capital and research and development. It is important that climate policies are conceived as long-term programs that will achieve a gradual transition to an emission-free economy on the time scale of a century [18].

2.4. Kyoto protocol, success or failure?

Kyoto Protocol is an international agreement under United Nations Framework Convention on Climate Change (UNFCCC), in which member countries commit to reduce GHG emissions under binding targets. The Protocol was adopted in Kyoto, Japan in 1997. The reason we are discussing Kyoto protocol in this essay is because it provided three market-based mechanisms to meet national targets. They are-

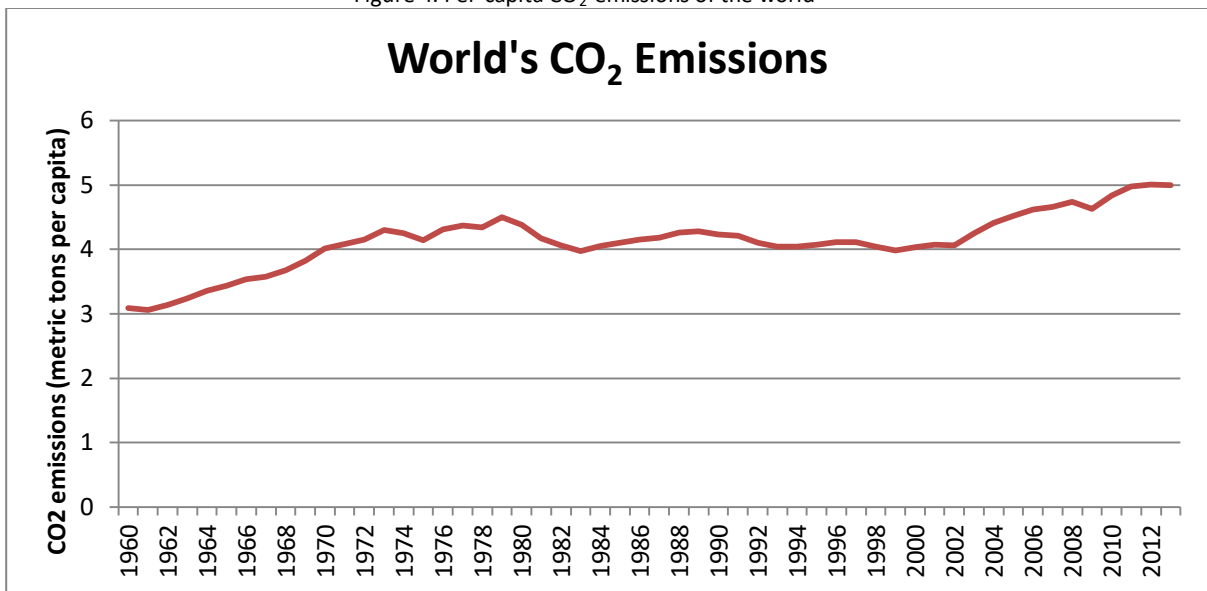
1. International Emission Trading. This mechanism is synonymous to tradable permit at the country level.
2. Clean Development Mechanism (CDM). This Kyoto mechanism incentivises the developed countries to implement an emission-reduction project in developing countries. By doing this, they can earn relaxation in their emission targets.
3. Joint Implementation. This mechanism allows a country to earn Emission Reduction Units (ERU's) if it runs an emission-reducing project in another country.

Kyoto has been one of the most important steps taken to reduce global GHG emissions. But it can hardly be cited as a successful case. Aichele and Felbermayr (2011) states that though committed Kyoto countries have reported a domestic reduction in emissions, countries carbon footprint has not declined. Rather they report an increase in the share of imported over domestic emissions by 17 percentage points [19] (Note that a country's carbon footprint is defined as the CO₂ emissions caused by domestic absorption activities). In Figure 4 we notice a steady increase in CO₂ emissions from 2002 onwards, after being stagnant for nearly a decade. Even during the commitment period of Kyoto, the emissions continued to rise.

If we further divide this figure between income groups, as defined by World Bank we will see that although the CO₂ emissions in the high-income, developed countries have decreased, it has increased in the middle-income countries and least developed countries. This indicates a carbon leakage from developed to the developing world as shown in Figure 5. Studies did show a positive carbon leakage from member countries to non-member countries during the commitment period of Kyoto [20-21]. These results are not surprising. Since only 40 countries signed the Kyoto Protocol, the non-member countries automatically became a sweet spot to set-up manufacturing sites of polluting industries.

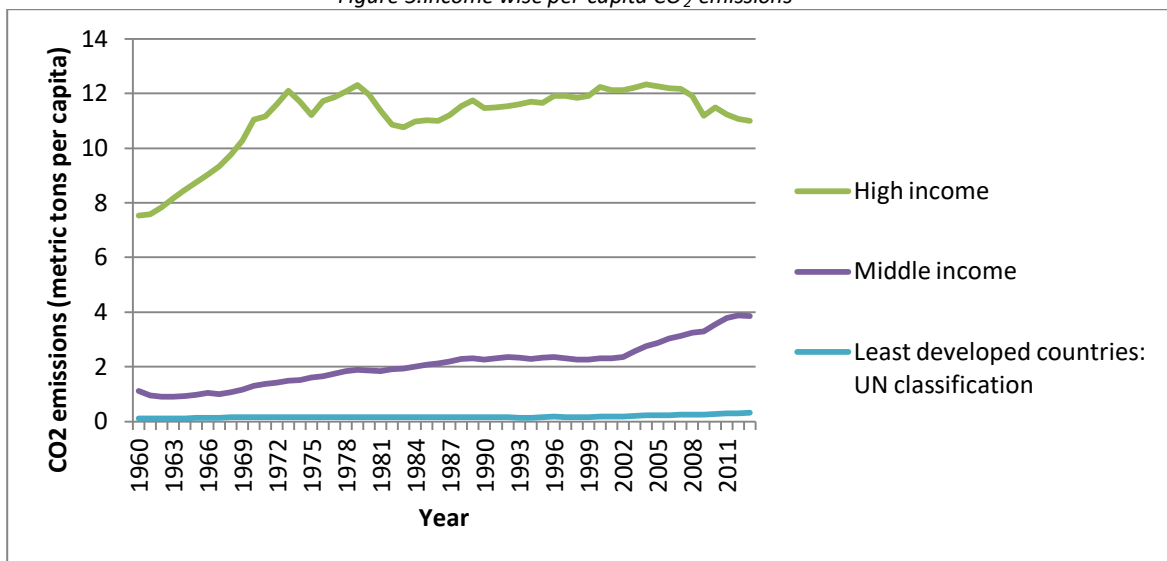
Another failure of Kyoto mechanisms was it failed to take into account the transaction costs of conducting trade in a global market. Michaelowa et al. (2003) showed that Clean Development Mechanism (CDM) and Joint Implementation (JI) were likely to entail considerable costs of baseline development, verification, and certification [22]. These costs make Kyoto less attractive when compared to domestic abatement options. Olsen (2007), reviewed nearly 200 articles on CDM and concluded that left to CDM, left to free market forces, does not significantly contribute to sustainable development [23]. We acknowledge the fact that Kyoto was an important first step towards a global market-based policy to counter climate change, but we now need a post-Kyoto global policy framework that can cover up the limitations of Kyoto. With this thought in mind, we move towards the conclusion of this essay.

Figure 4. Per-capita CO₂ emissions of the world



Source: World Bank

Figure 5. Income wise per-capita CO₂ emissions



Source: The World Bank

3. Conclusion

In this essay, we introduced the readers to the realities of climate change and the horrors it can bring with itself. We reviewed different types of MBI that can, at least in theory, bring down emissions of GHG efficiently. Theoretically, hybrid policies emerge out as a more efficient policy instrument, with uncertainty over abatement costs and benefits. Sadly, hybrid policies have not received as widespread attention in practice as in theory. We saw that regional experiences with MBI are more of less positive. But to counter climate change using MBI we need a global effort from all nations. Kyoto was a major first step but it had several caveats. We list two important limitations of Kyoto protocol here. First is the absence of a credible international government that could manage the working of this policy at a global level. Secondly, a large chunk of countries didn't adopt the protocol. That has led to carbon leakage from member countries to non-member countries. For global participation, we need to lay out clear incentives for all the countries. This task is easier said than done. It is unlikely that Russia and Canada would participate seriously because rising temperature is estimated to be beneficial for their Arctic climate [24]. Developed countries, like the US, are the major emitters of GHG. It is severely difficult and costly for them to reduce their emissions overnight. Similarly, a serious participation from developing countries will be a challenge since emission reductions can hamper their economic growth in the short-run and long term benefits are uncertain.

For any global market-based policy instrument to work, the least we need is an international government that can ensure the participation of most of the nations of the world and minimizes the transaction cost. Unless that is ensured, we cannot rely on any global market-based policy to counter worldwide climate change. Hence, we propose that instead of relying on a single global policy, regional trading blocs should establish their own MBI across the globe. These regional blocs (like South Asia or MENA region) governments might better be able to implement and overlook a market-based policy in their specific regions than a global institution. We also propose that instead of measuring the emissions of any nation we must move towards measuring the carbon footprints. By doing so, we will be in a much better position to control for the leakages and creation of pollution havens. Because there can be uncertainty present regarding cost and benefits, we also propose the use of hybrid MBI rather than permits and taxes alone.

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