Funding low-carbon investments in the absence of a carbon tax

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Abstract

Introducing a carbon tax is difficult, partly because it suggests that current generations have to make sacrifices for the benefit of future generations. However, the climate change externality can be corrected without such sacrifice. It is possible to set a carbon value, and use it to create “carbon certificates” that can be accepted as part of commercial banks legal reserves. These certificates can be distributed to low-carbon projects, and be exchanged by investors against concessional loans, reducing capital costs for low-carbon projects. Since issuing carbon certificates will increase the quantity of money, it will either lead to accelerated inflation or induce the central bank to raise interest rates. Low-carbon projects will thus have access to cheaper loans at the expense of either “regular” investors (in case of higher interest rates) or of lenders and depositors (in case of accelerated inflation). Within this scheme, mitigation expenditures are compensated by a reduction in regular investments, so that immediate consumption is maintained. It uses future generation wealth to pay for a hedge against climate change. This framework is not as efficient as a carbon tax but is politically easier to implement and represents an interesting step in the trajectory toward a low-carbon economy.

Introduction

Climate change is now widely recognized as a threat to the environment, economic growth, and social welfare. In response, many countries have set individual long term objectives or commitments in terms of future greenhouse gas (GHG) emissions. The European Union committed itself to reduce emissions by 20\% in 2020, relative to 1990 levels\textsuperscript{2}. France and the UK have a long term objective

\textsuperscript{1}The views expressed in this paper are the sole responsibility of the author. They do not necessarily reflect the views of the World Bank, its executive directors, or the countries they represent.

\textsuperscript{2}This target might become more stringent since the EU “Roadmap for moving to a low-carbon economy in 2050” has moved to an objective of at least 25\% reduction in GHG emissions by 2050.
of dividing by four their emissions by 2050. Collectively, the countries of the world have decided to aim for limiting global warming at $2^{\circ}$ C above pre-industrial global temperature. To do so, world emissions need to be divided by two by 2050 (O’Neill et al, 2010). These targets are very ambitious and require immediate and energetic political action.

Reaching these targets will require significant investments, in particular in energy, building, transport and end-use equipments. The World Development Report 2010 (WB, 2009) estimates that incremental costs of mitigation in developing countries could reach $140-$175 billion a year by 2030. Added to current needs, these costs lead to total financing needs of about $264-$563 billion over the same period. These numbers however pale in comparison to current global Gross Fixed Capital Formation (GFCF) which amounts to about US$11 trillion per year, suggesting that the challenge is less to increase global investments than to shift them toward low-carbon projects3. Doing so would be highly facilitated by attributing a price to carbon emissions. The High-level Advisory Group on Climate Change Financing (AGF, 2010) indeed emphasized the importance of a carbon price in the range of US$20-US$25 per ton of CO$_2$ equivalent in 2020 to succeed in leveraging US$100 billion per year dedicated to climate finance.

Beyond its impacts on low-carbon investment4, attributing a price to carbon emissions can help coordinating the ambitious transition toward a low-carbon economy. This price can also influence household behaviors, change optimal production processes, and help local authorities coordinate their action. Since climate change is an environmental externality, it can theoretically be solved in an optimal way by internalizing the externality with a carbon price (Nordhaus, 1994; Rezai et al, 2009). Moreover, because climate change is not the only externality in the economic system (Hallegatte et al, 2011), additional measures are needed to deal with other market failures, such as a R&D subsidy to cope with knowledge spill-over.

It appears attractive to create this carbon price through the introduction of a carbon tax. Its advantages include universal applicability, simplicity, efficacy, and low set-up costs due to existing administrative institutions. But the carbon tax suffers from a lack of political acceptability, as illustrated by the failure of its introduction in France in 2010. Two main difficulties have to be overcome. The first difficulty relates to intragenerational equity, since a carbon tax may have negative redistributive effects between contemporary businesses and households. Indeed, correcting the externality can be done in such a way that it maximizes the social welfare (aggregated over all individuals and discounted over time), but it may decrease the welfare of some individuals (in other terms, it is not Pareto improving).5 Zero-cost lump-sum inter-individual transfers are required to make a welfare-maximizing solution Pareto-improving (see for instance Harberger, 1978). In spite of

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3The proportional increase in investment needs is different depending on the considered sector; it is for instance likely to be relatively larger in the energy sector.

4By introducing a price for carbon, the profitability of "regular" capital falls, because it now has to pay for its carbon emissions. Low carbon capital becomes more profitable and is able to obtain investment funds from the market more easily.

5In fact, correcting one externality always increases welfare only if there is only one externality. In presence of multiple externalities, correcting one of them can reduce welfare (Lipsey and Lancaster, 1956).
technical difficulties (Kanbur, 2010), past experience in fossil fuel subsidy removal has shown that these distributional effects can be compensated through ad hoc measures or pre-existing safety nets (Hope and Singh, 1995).

The second difficulty arises from intergenerational distributive impacts and is more complicated to tackle. Indeed, the perceived necessity to pay now for an expensive transition in exchange for remote future benefits is one of the obstacles to the implementation of ambitious climate policies. In a period of economic crisis, this trade-off may appear particularly unappealing to voters and decision-makers.

As a consequence of this political unacceptability — that can be understood as a government failure — a carbon tax⁶ appears unrealistic in the current context and other tools may have to be used to address the climate change issue, at least in the short-term. In particular, several initiatives have been developed to shift global (public and private) investments toward low-carbon projects in the absence of a carbon price. Even though this is a second-best option, it represents a significant progress compared to a business-as-usual scenario.

Private initiatives are essential in seeking out and implementing least-cost options for climate mitigation. They however require public policies to establish the incentive frameworks necessary to catalyze high levels of private investments. Today low-carbon projects suffer from a lack of funding because of market failures affecting innovation and dissemination of new technologies, high risk perceptions due to uncertainties about future climate policies and carbon prices, and excess upfront costs that make them unable to offer returns that are commensurate with their (perceived) risk. The challenge is to convince investors to change the technical content of their projects by providing them with cheaper capital, e.g. by using limited public resources as leverage for private capital. World Bank et al (2011) lists innovative instruments that have been proposed do to so: subsidies on fossil fuel use can be redirected to public climate finance; market-based instruments for international aviation and maritime bunker fuels can be used as an innovative source of climate finance; carbon offset markets can play an important role; and there are significant opportunities for Multilateral Development Banks to mobilize resources through new pooled financing arrangements (see for instance the Climate Investments Funds (CIFs) and Global Environment Fund (GEF)).

This paper proposes another approach to provide cheaper capital to low-carbon projects, through the use of differentiated interest rates. The interest of this solution is that it can be designed in a way that avoids intergenerational distributive impacts and is thus more politically acceptable than other options. Since GHG emissions and climate change are an uncorrected negative externality, climate change mitigation can be Pareto-improving — with all generations benefiting from action — provided that intergenerational transfers are implemented (Sinn, 2007; Rezai et al, 2009). Our proposal is based on the idea that such transfers are possible through manipulation of the interest rate. Even though it comes at the expense of aggregate efficiency (efficiency being measured using

⁶A carbon market with full auctioning of allowances, and covering all economic sectors, is also an unrealistic option in the short-run.
social welfare), this option is however easier to implement because it is Pareto-improving\(^7\) compared with a business-as-usual scenario.

In practice, the carbon externality can be corrected by mitigation expenditures and investments, at the cost of a reduced total economic output over the short-run. The intergenerational distributional impacts of mitigation actions can then be prevented, and the welfare cost for current generations canceled, if total investments are reduced such that immediate consumption is not affected\(^8\). On the one hand, such an action would impact negatively future generations, by providing them with less capital. On the other hand, it would benefit them through lower climate change impacts, while protecting the consumption of current generation.\(^9\)

To do so, it is possible to manipulate interest rates so that capital becomes more expensive for carbon-emitting investments and consumption is encouraged. In addition, low-carbon investments could benefit from lower interest rates (i.e., lower capital cost), to provide an incentive to reduce GHG emissions\(^{10}\). From a welfare maximization perspective, this solution is suboptimal because the carbon externality is internalized only in the cost of capital, and not in all relevant decisions. Also, the impact on discounted social welfare of these intergenerational transfers is ambiguous (e.g., this impact depends on the discount rate and on the form of the utility function). This option is nevertheless potentially able to bring the economy closer to its social-welfare frontier, reducing the welfare consequences of the carbon externality\(^{11}\).

This paper proposes an institutional framework in which low-carbon projects have access to cheaper loans. This framework can be set up in a single country, at the European level, or even at the international level.\(^{12}\)

**Carbon certificates as a tool to finance low-carbon projects**

The first step would be to set a carbon value. However it would not be applied directly to all prices in the economy through a carbon tax: it would be used to value new assets that we call *carbon certificates*. These carbon certificates would have a fixed face value and would be considered as legal reserve assets that can be used by commercial banks to respect legal-reserve regulatory constraints. They would be created and allocated by an independent monitoring unit to low-carbon project investors at the beginning of their project, the number of certificates depending on the project

\(^{13}\)This solution is Pareto-improving only if intragenerational distributional effects can be compensated through *ad hoc* measures or pre-existing safety nets.

\(^{8}\)Even though production \(Y\) is affected by \(\Delta Y\), consumption \(C\) is maintained by reducing investment \(I\) by \(\Delta Y\).

\(^{9}\)The welfare derived from consumption would be preserved, even though the structure of consumption would be modified by changes in relative prices.

\(^{10}\)The increase in low-carbon investments (and their extra-costs relative to regular projects) would be compensated by a decrease in regular investments.

\(^{11}\) Note that this paper does not touch upon the choice of mitigation targets, but deals only with ways of reaching a pre-determined target. These two questions are related, for instance through the discount rate that influences the weight of future climate change impacts on current decisions.

\(^{12}\)Application at the international level combined with a reform of the international monetary system is discussed in Hourcade et al (2011).
contribution to carbon emissions mitigation. This poses a problem of metric to monitor, control and verify projects, which we address briefly in Box 1. The independent monitoring unit would also fix a lifetime to the certificates, as a function of the project category.

**Box 1: The need for MRV standards.**
Measuring the contribution of a project to GHG emission reduction is extremely difficult, as suggested by the Clean Development Mechanism (CDM) experience (Schneider, 2009). Accurate project-based accounting of avoided emissions on a case by case basis is hardly feasible or very costly to perform. Avoided emissions are indeed necessarily calculated from a controversial baseline, and indirect effects of investments cannot be fully integrated in projects’ appraisal (Shalizi and Lecocq, 2009). Using avoided carbon emission as bank reserves requires a very high standard of measurement and verification that has not been met with CDMs.

A more robust alternative approach is to define a taxonomy of low-carbon projects and conventionally attribute a number of carbon certificates to each type of projects, regardless of whether the project is “additional” or not. For instance, a photovoltaic electric plan would be allocated a number of certificates as a function of its production capacity and the average carbon content of electricity production in the country. In the same way, an urban public transportation investment (e.g. a new metro line) would receive certificates as a function of the expected number of passengers, its electricity consumption, and the average carbon content of electricity production in the country. Using such a typology of projects will make it unnecessary to carry out a detailed analysis of each project. It allows simplifying procedures, reduces transaction costs and project uncertainty, and mitigates fraud risks. The entire scheme is however dependent on a well-defined typology and on appropriate rules and procedures. In particular, the procedures need to be able to adjust for new information and technical change (e.g., be able to accommodate a new way of producing renewable energy).

As depicted in Fig. 1, an investor who has been allocated carbon certificates can give them to a bank in exchange for a concessional loan. The bank would provide such a loan because it can then use the certificates as a reserve asset to reduce its capital costs and respect legal-reserve regulatory constraints.
Legal reserve requirements are an instrument in the hands of central banks to control money supply, in addition to their open-market operations that target a given short-term interest rate (European Central Bank, 2011; Federal Reserve Bank of San Francisco, 2011; Bank of England, 2011): it sets the minimum reserves each commercial bank must hold at the central bank as a counterpart to customer deposits and notes. Let $r$ equal the required reserves-deposits ratio, $e$ the excess reserves-deposits ratio and $c$ the currency-deposits ratio. The amount of money $M_1$ (currency plus checkable deposits) is then proportional to $MB$ (Monetary Base) through the money multiplier $m$ (Mishkin, 2010):

$$M_1 = m \cdot MB$$

with \( m = \frac{1 + c}{r + e + c} \) (1)

If reserves $MB$ are exogenously increased by carbon certificates, and if the central bank maintain its target short-term interest rate ($\bar{i}$) then banks will expand deposits $M_1$ through additional loans, unless bank customers withdraw currency (i.e., an increase in $c$), or banks decide to keep these reserves as excess reserves (i.e., an increase in $e$). If $c$, $e$, $r$ and $\bar{i}$ remain unchanged, then an increase in $MB$ by $x\%$ translates into an increase in $M_1$ by $x\%$. Attributing carbon certificates to low-carbon projects would thus increase $MB$, and in turn increase $M_1$ (if $\Delta MB = C$ where $C$ are carbon certificates in the central bank, then $(M_1 + \Delta M_1) = m \cdot (MB + \Delta MB)$ and $\Delta M_1 = m \cdot C$). Since legal reserves influence demand for $MB$ (even if $r$ remains unchanged), they are one propagation channel for monetary policy that targets a given short-term interest rate (i.e. the price of $MB$).

We claim that using legal reserves would be an efficient tool to finance mitigation. For a commercial bank, receiving carbon certificates from a project investor allows increasing legal reserves and the amount of loans, thereby increasing revenues (Box 2 gives an example of the potential gains for both the investor and the commercial bank). This system thus provides a strong incentive for commercial bank to fund low-carbon projects with lower-rate loans. Accordingly, the lower the reserve ratio $r$, the more additional loans can be made for each carbon certificate. When $r$ is very low, or in the most extreme case when $r = 0$ like in the UK, banks are not constrained by reserve requirements, however loans are limited by the Basel III ratios (for instance, the capital ratio sets the maximum risk-weighted assets a bank can hold as a counterpart of its capital). In this case, carbon certificates just provide the bank with free liquidities, but the Basel III ratios might be deteriorated if low-carbon investments have a higher risk than regular investments.
Box 2: Example of a transaction with carbon certificates.

Suppose a low-carbon project is entitled to $100 in certificates (e.g., $20/tCO₂·5tCO₂) and needs an investment of $4000. The investor gives the $100 certificates to a commercial bank, which can gradually put them in its central bank account along with the project completion. If the reserve ratio \( r \) is 10%, then the commercial bank can issue $1000 “for free,” and only needs to take $1000 from other loans (thus reducing its opportunity cost). Let \( i \) be the interest rate. A “surplus,” equal to \( i \times 1000 \), has to be shared between the bank and the investor: a part of the $1000 will be lent for free to the investor, thus reducing the loan real interest rate \( i_r \), and the rest will be lent by the bank to other projects at the interest rate \( i \). If \( i_r = \frac{3000}{4000} \times i \) (i.e., the bank lends $1000 for free to the investor) then all the surplus goes to the investor; on the contrary if \( i_r = i \) the whole surplus goes to the bank. The loan real interest rate will then be defined as \( 0.75i < i_r < i \).

Carbon certificates are not redeemable, i.e., they cannot be sold to the central bank and their face value only comes from their status as legal reserve. However, since carbon certificates allow banks to increase their revenues, a use value can be attributed to them. If a project was to be financed by savings or equity only, the investor would be allowed to sell certificates to a commercial bank, or to another low-carbon investor who needs to borrow from a commercial bank. This mechanism would provide a financial support to low-carbon projects, even when no loan is needed. Note that there is no reason why the certificates use value should be equal to their face value (i.e., the legal carbon price, which determines the value of carbon certificates as legal reserves assets). The selling price of certificates among investors would reflect the value they attach to an access to concessional loans, or the value of additional reserves for commercial banks.

The distribution of carbon certificates will create money to finance low-carbon investment. The quantity of additional money is given by the legal carbon value and the number of available projects. To control this money creation, a limit on the number of certificates could be introduced, or the number of certificates conventionally attributed to various projects could be adjusted. Accordingly, this framework can only be instituted in a country where the Central Bank is able to implement efficient monetary policies. Also, confidence in monetary policy must be high enough to eliminate expectations of run-away inflation.

Of course, this mechanism is no magic and does not make low-carbon investments possible for free. There is indeed an additional cost of these projects, relative to the projects that would be implemented in the absence of GHG constraints, and this additional cost can be felt through accelerated inflation due to increased money creation. Whether or not the Central Bank reacts to prevent or counter this additional inflation will determine who pays for the mitigation policy. Note that this scheme would not modify monetary policies or central banking procedures (or ask them to take into account environmental issues), so it is unlikely to meet an opposition from Central Bankers.

If the Central Bank increases its inflation target and leaves the nominal short-term interest rate constant, an “inflation tax” will finance low-carbon projects at the expense of lenders and depositors. The scenario of an increased inflation target has been suggested in Blanchard et al.
(2010), who question the low inflation policy which has been adopted by central banks for over a decade, and suggest that a four percent inflation rate might not be more costly than a two percent rate. Moreover, in Europe, this additional inflation could be seen as a way out of the 2011 debt crisis, and generate more activity in the current situation of underemployment and underutilization of production capacities.\textsuperscript{13}

If increased inflation is seen as unacceptable or undesirable, several additional policies can be implemented by the Central Bank:

(i) In order to reduce $M_1$ (see Eq.(1)), legal reserve ratios $r$ can be increased. In that case, banks have to decrease the amount of loans they provide, except for low-carbon projects that deliver carbon certificates. This solution increases borrowing rates for regular projects. Regular-project investors consequently pay for low-carbon projects through more expensive loans.

(ii) But since most central banks follow an inflation-targeting strategy (Bernanke and Mishkin, 1997), the introduction of carbon certificates would induce them to anticipate an increase in inflation\textsuperscript{14} and to increase nominal interest rates (increased $i$). In that case, the cost of capital is higher for all projects, except for low-carbon projects that are granted concessional loans in exchange for carbon certificates. Hence, as in (i), regular investors pay for the low-carbon projects.

In these last two cases, this scheme amounts to creating differentiated interest rates, low-carbon projects benefiting from lower capital costs than regular projects. In reality, the additional cost of low-carbon projects is likely to be financed by a combination of increased economic activity, accelerated inflation, and higher capital cost for regular projects.

\textbf{Conclusion}

Eventually, this framework would have a redistributive impact among generations. Since it increases interest rates for carbon-emitting projects, it uses future generations' wealth to pay for a hedge against a potentially dangerous climate change. In other words, reducing conventional investment in favor of consumption and mitigation is a way of shifting the costs of reducing emissions from the current generation to future generations, who will benefit from reduced climate change impacts.

An intragenerational distribution effect, which depends on whether inflation is increased or interest rates for regular projects are raised, might also be observed. But the immediate, first order effect would be much milder than those of a carbon tax, that affects all economic actors rather than investors only.

Of course, the creation of carbon certificates is not as efficient as a carbon tax since it does not address directly consumption behaviors: it only internalizes part of the carbon externality through

\textsuperscript{13} However, accelerated inflation will have a negative effect on the exchange rate. This effect can in turn decrease the attractiveness for investors, with consequences on employment and growth, and carbon leakage. These international aspects require further research to assess their significance.

\textsuperscript{14} Note that if inflation increase is a surprise, the central banks would react afterwards but increase interest rates anyway, in order to lower inflation to its target.
differentiated capital costs. In other words, the aggregate welfare cost of reaching the same target is higher than with a carbon tax. Also, it would focus efforts toward capital-intensive solutions, which have no reason to be the most efficient and are impaired by rebound effects. Given the amount of capital needed to shift investments towards clean technologies in energy, building, transport and end-use equipment, it has however the merit of developing these technologies and facilitating these investments, even in absence of a carbon tax.

This scheme cannot but interplay with monetary policies and public budget constraints, especially in the current financial and economic crisis. Carbon externalities (which are a transfer from future to current generations, see for instance Chichilnisky et al. (1995)) should be a component of the broader reflection on the sustainability of public and private debts and the related pressure on current consumption levels. Also, any action on interest rates should be included in the design of short term monetary policies — especially in the current European and American context — , and Keynesian mechanisms need to be taken into account to assess the consequence of such a policy. In a context of economic crisis, the certificates could increase money creation (therefore increasing low-carbon investments) and, if central banks do not act to compensate for this additional money creation through “sterilization” actions, this policy could also act as a “green stimulus” policy (Zenghelis, 2011). In times of economic growth, the central bank can increase its rate to avoid undesired inflation. Choices concerning low-carbon investments can thus be separated from choices concerning monetary policy: creating carbon certificates does not constrain monetary policy, but shifts investments toward low-carbon projects.

Finally, it might be time to move away from what economists have presented as the “optimal” policy, that is a uniform carbon tax, which appears politically compromised over the short term, at least in many countries. The scheme proposed here is a second-best solution that does not act on all possible levers. But it seems easier to implement than a carbon tax, because its direct distributional impact on households and businesses appears milder. What justifies the introduction of this second-best option is more a policy failure than a market failure, namely the lack of political acceptability of a carbon tax. The introduction of carbon certificates as legal reserve instruments and the creation of differentiated interest rates for low-carbon projects may appear as an interesting first step in the trajectory toward a low-carbon economy.

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