Carbon Trading and Non-Permanency of Agricultural Sequestration:

Institutional Design and the Choice of Working Rules

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Abstract:

The institutional development of a domestic carbon trading institution in Canada that includes carbon off-sets must address the problems of providing the appropriate incentives to generate carbon reductions and removals and the problem of non-permanency of sequestered carbon. The paper analyzes two rule sets to address these problems and estimates the economic impact of these sets.

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When Canada ratified the Kyoto Protocol in December 2002, the country committed to decrease its Greenhouse Gas (GHG) emissions by 6% below its 1990 level. It is estimated that this commitment will require Canada to decrease emissions by 270 megatonnes (Mt) per year during the first commitment period 2008 to 2012 (Government of Canada 2002). Carbon emission trading institutions have been identified, both internationally and domestically, as being a cost effective mechanism for supplying carbon emission reductions (UNFCCC 1997, Perman et al 2003, Randall 1983).

The Canadian Climate Change Plan (Government of Canada 2002) is promoting the establishment of a domestic emission trading (DET) institution for carbon. The demand for carbon credits will be from three sources: large final emitters (LFEs), the Climate Fund, and other Canadians and industrial sectors. Under this scheme the LFEs will have a reduction target of 45 Mt per year. This will be instituted through a regulatory system based on industrial intensity targets. Industries are able to fulfill their commitment by reducing their own emissions, purchasing credits from other LFEs, purchasing off-set credits, or purchasing international credits.

The Climate Fund is a market-base institution that will purchase carbon reductions on behalf of the Government of Canada. This fund will purchase credits from either the domestic market or international emission reductions. The

carbon fund is expected to purchase between 75 and 115 Mt of reductions per year.

The final source of demand for credits will be individuals, other industrial sectors and the NGO community. It is expected that these groups will purchase carbon credits from the DET system.

The supply of credits going into the DET system will be from the industries in the LFEs. Those firms that have surpassed their intensity target as specified in the industry covenant will be given credits. These credits can be sold to interested parties who are willing to offer a high enough price for them.

The government of Canada has also allowed for the development of off-set credits (Government of Canada 2005). Off-set credits are carbon reductions or removals that are generated by industrial sectors that are not covered by regulations. This provides a mechanism so that all industrial sectors can participate and have an incentive to reduce or remove carbon. This allows for the least cost providers of carbon removals or reductions to generate cost-effective credits for the LFEs or the Climate Fund. It is anticipated that the agricultural sector will be able to provide cost effective credits to the market.

The problem investigated in this paper is the institutional mechanisms that can be used to take into account the non-permanency problem of carbon sequestered by the agriculture sector. The non-permanency issue deals with the ability of carbon that has been sequestered in a sink to be reversed back into the atmosphere. More specifically, the paper will investigate the economic impact of alternative institutional rules that can be used to address this issue.

Institutions, Workability, and Working Rules

J.R. Commons viewed institutions as being problem centered (Rutherford 1983). He defined institutions "as collective action in control of individual action" (Commons 1961, 61). The DET system, as an institution, must address the problem of having the LFEs supply 45 Mt of carbon reductions to the Canadian inventory. In addition, the institution must address the problem of non-permanency in carbon sequestration from the agriculture and forestry sectors. This latter issue can be addressed by the set of working rules that the institution chooses with respect to the granting and trading of credits.

The basic unit of analysis for Commons was the transaction and he classified these as: rationing, managerial, and bargaining (Commons 1961, Commons 1931). These different types of transactions were defined using both legal and functional criteria. The rationing transaction is between a legal superior and legal inferior and allocates wealth or opportunity. The initial allocation of intensity targets across the LFEs, as well as the total amount to reduce, 45 Mt, are rationing transactions (Thomassin 2006).

The criterion that Commons used to evaluate an institution was workability. Workability as a criterion has both an efficiency and distributional aspect to it. The working rules of the institution must be such that the trades in the DET system have a degree of efficient associated with them and the rules must ensure that the distribution of the benefits and the costs are acceptable. The efficiency of the institution will be a function of the rationing transaction, i.e. the

allocation of the intensity targets, as well as the working rules that will generate the incentives for individuals to participate in the DET system.

The working rules associated with the generation of off-set credits include the use of project documents to identify carbon reductions and removals. The project document will include a change in management, a quantification protocol to measure the change in carbon, a monitoring protocol, third party verification, and finally the issuance of credits. For carbon sequestration projects, producers can elect to receive either permanent credits or temporary credits. The difference between these types of credits is the property rights associated with them.

The bargaining transaction is between two legal equals and functions to exchange property rights. Each type of credit, permanent or temporary, will have a different price because the property rights being traded are different. Under the current rule set, all project costs are allocated to the producer and this has an impact on the incentive for agricultural producers to participate in the DET system. Finally, the working rules associated with permanent credits and temporary credits will have an impact on the economic valuation of producer projects. This impact will be investigated below.

Problem of Non-Permanency

Articles 3.3. and 3.4 in the Kyoto Protocol recognize that forestry and agricultural management practices can sequester carbon into terrestrial reservoirs and that these reservoirs can play a role for a country to meet its commitment (UNFCCC 1997). Canada is hoping that carbon sequestration in

the agriculture and forestry sectors will play a substantial role in helping the country meet its commitment.

As identified above, the problem with terrestrial carbon storage is the possibility of having the reservoir of carbon reverse back into the atmosphere. Carbon reversals can occur for several reasons. For example, a fire or insect infestation could reverse a store of carbon in the forestry sector. The opportunities for natural causes to release the reservoir of agricultural carbon are less. In most cases, carbon reversals in agriculture will occur from producer decisions.

To address the problem of carbon reversals the Program Authority (PA), which is part of the DET system, will allow agricultural producers to choose the type of credit they would like to receive when they propose an off-set project. There choice in credit is either a permanent credit or a temporary credit. The property rights associated with each are different as well as the working rules. The choice or working rules with each type of credit will have an impact on the value of the project proposed by the producers.

Permanent Off-Set Credits versus Temporary Credits

If a producer elects to generate permanent off-set credits (OC) from their carbon sequestration project then they must adhere to a particular project structure which is defined by the PA. The PA has declared that OCs generated by carbon sequestration will have attached to it a liability period that will require the producer to store the carbon in the reservoir for a particular period of time. If the carbon is released during this liability period, the producer is liable for the

reversal and must replace the released carbon by submitting to the PA the equivalent number of permanent credits. The liability period starts when the first credit is allocated and will end some years (X) after the final credit has been allocated. For example, a producer could submit to the PA a project proposal that would change the crop management on the farm from conventional tillage to no-till. No-till as a management practice sequesters carbon into the soil. Within the project document the liability period could be defined as 20 years, where the producer will receive OCs for the first ten years of the project and during the final ten years of the project the producer has to continue the practice and keep the carbon stored in the soil but receives no OCs for doing so.

The value of a carbon sequestration project that acquires OCs is given by equation 1. The first term takes into account the present value of the revenue generated from the selling of credits. The second term estimates the present value of the costs of the project. The costs associated with this project include the following: (1) the initial cost of switching from conventional to no-till, (2) the cost of maintaining the reservoir both during the revenue period and the liability period, (3) the transaction costs associated with having the project accepted by the PA, monitoring the carbon accumulation, verification costs, and issuance costs, and (4) the liability costs of replacing any credits that are reversed during the liability period of the project. It should be noted that the timeframe for both the revenue generating period and the liability period have not been defined as of yet and will be determined by the PA when the project document is submitted. The working rules that will determine the length of these two periods will have a

major impact on the value of the project, the incentive for producers to participate, and will impact the “workability” of the institution.

$$PVPOC = \sum_{t=0}^{n} \left\langle \frac{RPOC}{(1+r)^t} \right\rangle - \sum_{t=0}^{m} \left(\frac{IC}{(1+r)^t} + \frac{MC_t}{(1+r)^t} + \frac{MVR_t}{(1+r)^t} + \frac{LC_t}{(1+r)^t} \right) \qquad \text{eq.1}$$

Where:

PVPOC	= present value of the OC project
RPOC	= revenue generated by the OC
IC	= initial cost of the OC project
MC	= maintenance cost of the OC project
MVR	= monitoring, verification, and registration costs
LC	= liability cost of replacing the OC during the liability period
r	= real discount rate
t	= time
n	= end of the revenue period
m	= end of liability period

OCs will only be granted to producer’s ex-post to the carbon sequestration. In other words, OCs will only be issued after the amount of carbon sequestered has been monitored and a third party has verified that this particular amount has been stored. This approach to the allocation of OCs guarantees to the buyer that they are buying a permanent carbon reduction. Given that the property rights being traded are for a permanent OC, these credits will sell for the same price as other carbon reductions from either the off-set system or the DET system. This occurs because the producer takes on the liability during the liability period and the federal government takes on the liability after the producer liability has ended.

After the producer liability period is over, the producer can release the carbon from the reservoir at no cost. In this case, the government is responsible

for the release of carbon through its greenhouse gas inventory system. The value of this government liability should be estimated to take into account the social cost of these projects. The value of the government liability is given by the equation below (eq. 2).

$$PVGL = \sum_{t=m+1}^{\alpha} \frac{OCRC}{(1+r)^{m+1}} \qquad \text{eq. 2}$$

Where:

PVGL = present value of the government liability
OCRC = OC replacement cost
r = real discount rate
t = time
m = PP liability period
m+1 = year the government liability begins
α = infinity

For the same project producers could elect to receive temporary credits (TCs). In this case, the PA will have to define working rules to identify the accumulation and crediting periods over which TC will be granted. When a producer elects to receive TCs they will receive TCs for both the newly accumulated carbon as well as for any carbon that has been maintained in the soil. For example, the producer could have a 20 year project where carbon is accumulated for the first 10 years and then the producer would receive TCs for maintaining the carbon for years 11 to 20. In this example, after the first year the producer would receive 1 TC, in year 2 he would receive 2 TCs, as long as he maintained the practice, until the end of year 10 when he would be receiving 10 TCs. From years 11 to 20 the producer would receive 10 TCs per year as maintenance as long as he continued the practice. The length of time that a

producer can receive incremental increases in carbon and the number of years they can receive TCs for maintenance will be determined by the PA. Again, these are rule sets that will impact the value of the agriculture project.

The reason that the producer is receiving TCs for maintenance is because of the property rights that are being allocated. A TC provides a one year deferment of a carbon commitment. If the producer stores the carbon for 2 years, then he should receive 3 TCs , one at the end of the first year and two at the end of the second year. This is because they are only one year deferments.

If a producer elects for TCs, then the project value can be estimated with the equation below (3).

$$PVTC = \sum_{t=0}^{G} \left\langle \frac{RTC}{(1+r)^t} \right\rangle - \sum_{t=0}^{G} \left(\frac{IC}{(1+r)^t} + \frac{MC}{(1+r)^t} + \frac{MVR_t}{(1+r)^t} \right) \qquad \text{eq. 3}$$

Where:

PVTC	= present value of a TC project
RTC	= revenue generated by the TC project
IC	= initial cost of the TC project
MC	= maintenance cost of the TC project
MVR	= monitoring, verification, and registration costs
r	= real discount rate
t	= time
G	= crediting period

One issue that must be addressed is the possible value of TCs. One method of estimating this value is to view the purchase of a TC as a one year delay in purchasing a permanent OC. Given this, the value of a TC can be estimated as follows (eq. 4):

$$PTC_t = POC_t - \frac{POC_{t+1}}{(1+r)^{t+1}} \qquad \text{eq. 3}$$

Where:

PTC_t = price of a TC in any period t.
POC_t = price of a permanent offset credit at time t
POC_{t+1} = price of a permanent offset credit at time t+1
r = Real discount rate

As with OCs, TCs will only be granted ex-post. In this case, there is no producer liability or government liability. Neither of these liabilities exist because the property rights generated are only for a one year deferment of a carbon commitment. This lack of producer liability provides producers with greater management flexibility because they are not locked into any long-term management plan.

Scenarios and Results

For the OCs, the working rules of the institution can effect both the period over which credits can be received and the length of the liability period. In order to estimate the impact of how changes in these values impact the net present value of the project, the following scenario was evaluated.

In the scenario it was assumed that a prairie grain producer was converting from conventional tillage to no-till. The expected carbon yield in this situation was assumed to be 1.1. tonnes of carbon dioxide equivalents (CO_{2e}). The price of an OC was assumed to be $15 per tonne, the transaction costs were assumed to be $1.00 per credit, while maintenance costs were $1.00 per hectare. It was also assumed that the producer was going to maintain the project for the

full length of the liability period. Finally, a 3 percent real discount rate was used and it was assumed that OCs are received at end of each year.

The results of the analysis are given in figure 1. In this analysis the revenue period is varied from 5 to 15 years while the liability period is varied from 20 to 35 years. The results provide the net present value (NPV) of the project, given these various working rules, for one hectare of land. As can be seen in the figure, the major determinate of the NPV is the length of the revenue period. Increasing the liability from 20 to 35 years decreases the NPV of the project but has less of an impact than the length of the revenue period.

Figure 2 provides an estimate of the NPV of the government liability of an OC project with different revenue periods and liability periods. The government liability was estimated assuming that the government became liable for the OCs the year after the producer liability ended. This would be the maximum liability for the government. As expected, the length of the producer's liability period had a large impact on the government liability. Similarly, the length of the revenue period had an impact because this determines the number OCs that the government would have to replace.

The final figure looks at the trade-offs between various accumulation and crediting periods for TCs (Figure 3). In this case, the length of the accumulation period and the length of the crediting period have a reinforcing impact on NPV. As both of these periods increase, the NPV of the project increases dramatically.

Conclusions

The working rules that will be adopted by the Program Authority (PA) with respect to the length of the revenue and liability periods of a permanent off-set credit (OC) will have an impact on the NPV of the producer's project. In this case the length of the revenue period plays a more important role. These working rules will impact the incentives that producers will have for participating in the DET system.

Choices made by the PA with respect to the working rules of the OCs also impacts NPV of the government's liability. The longer the producer liability the lower is the value of the government liability. This demonstrates the distributional impacts on various segments of society as working rules are changed. This is one element that would have to be taken into account when analyzing the workability of the institution.

The working rules associated with temporary credits (TCs) affect the accumulation and the crediting periods of this instrument. As one increases the accumulation and crediting period, the NPV of the project increases substantially. The length of these periods in the working rules will impact the incentives for producers to participate in the institution.

Finally, the choice between OCs and TCs by producers will depend on the relative NPV of the two types of credits given the same project. Government mandated that the choice of credits should be financially neutral, however, the choice of the working rules will have an impact on the financial incentives for the different types of credits.

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Figure 1: Impact of Different Revenue and Liability Periods on the Net Present Value of a Project with Permanent Offset Credits

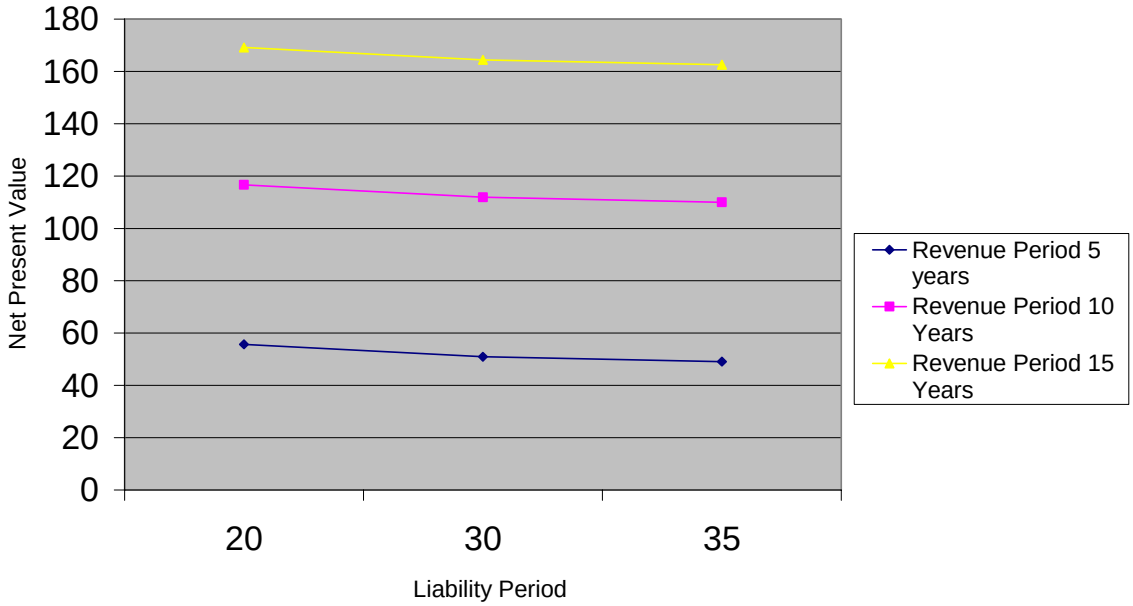

Figure 2: Net Present Value of Government Liability for Various Revenue and Liability Periods

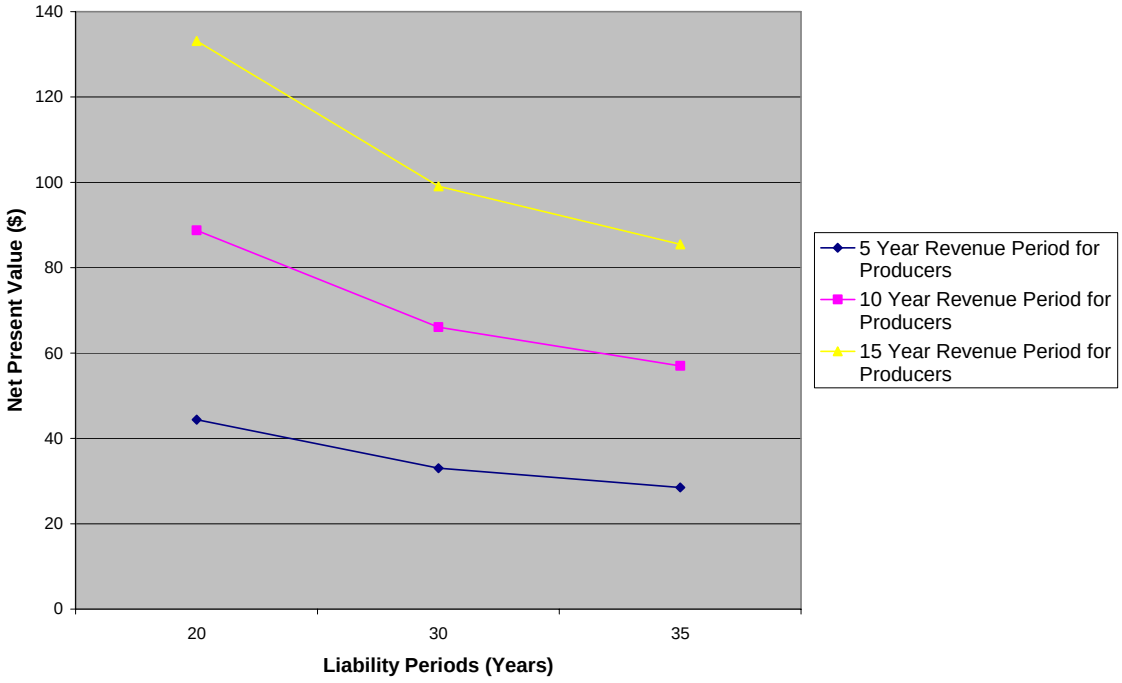

Figure 3: Net Present Value of a Temporary Credit Project with Different Accumulation and Crediting Periods