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Climate Change and Economic Theory -- A Neo-Ricardian Approach to the Economy of Climate Protection

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Abstract: The Stern Review (2007) is the most comprehensive work to date on anthropogenic climate change from an economic perspective. It caused a general uproar because for the first time a renowned economist recommended the rapid implementation of expensive measures against climate change because hesitation would be even more expensive in the future. Nonetheless, the Stern Review moves in the familiar orbit of neoclassical theory, which supplanted classical theory (Smith, Ricardo, Marx) towards the end of the 19th century and is still dominant in academia today. Neoclassicism has made many contributions to environmental economics, but it seems to fail in the face of climate change. Ecological economics, which has been on the rise since the 1980s and works with the concept of entropy borrowed from physics, has not made any progress here either. If one understands environmental problems as disturbances of natural cycles (of water, carbon, nitrogen, etc.), then in dealing with them one will give preference to an economic theory that also regards the economic process as a material cycle. Piero Sraffa's theory, which follows on from the classical theory, is of this kind. It makes it possible to integrate the carbon cycle into an economic model that includes trading in emission rights with the participation of CO_2 sinks. The model shows that this trade does not generate extra profits, but cuts the profits of CO_2 emitters. It also shows that all CO_2-intensive products would have to be much more expensive in a CO_2-neutral economy than they are today.

Keywords: Climate Change, Future Generations, Carbon Cycle, Emission Rights, Sraffa, Circular Economy

1. Introduction

More than a hundred years ago, the Swedish chemist Arrhenius recognised that the CO_2 in the Earth's atmosphere attenuates the re-radiation of heat into space. The more CO_2 the air contains, the warmer it is on Earth. Although this fact was known, huge quantities of coal, oil and natural gas were burned carelessly until the 1990s. As a result, the CO_2 content of the air has increased by 36% (from 280 ppm to 380 ppm) in less than 60 years, with negative consequences that are already noticeable today. If global CO_2 emissions were to continue to increase unchecked, the average temperature could rise by 5 to 6°C. This would lead to catastrophes, the extent of which cannot yet be predicted. But it is certain that the countries of the South would suffer the most.

The biosphere, which has provided a reliable basis of existence for millions of animal and plant species and, for the last 100,000 years, also for homo sapiens, owes its durability to the cycles of water, carbon, nitrogen and other vital material cycles. Most agrarian civilisations have made use of these cycles without interfering with them. The Industrial Revolution shifted human activity to production processes that cannot be incorporated into any natural cycle. The characteristic expression of this mode of economy is the neoclassical production function, which specifies which quantities of the "factors of production" labour (L) and capital (K) go into the production of a quantity Y of an unspecified product: Y = f(L, K). Production is seen here as a one-way street from L and K to Y. What undesirable by-products arise in the process, where the labour and capital come from, whether and how often the production process can be repeated - these questions are not adressed. An ecological economy in the true sense of the word cannot be content with inserting natural resources as additional factors of production into the neoclassical production function and otherwise leave everything as it is. Rather, it must conceive

of an ecolo-gical economy as a cycle that repeats itself from year to year or at longer intervals and is capable of recycling all unwanted by-products and waste.

This requirement is met by a theory that goes back to Piero Sraffa [1]. In the following section, I will first examine the neoclassical response to the climate crisis. Then I will outline Sraffa's price theory, and I will try to apply this theory to the economy of climate protection.

2. The Neoclassical Response to the Climate Crisis

In the face of climate change, neoclassical economists are turning to the welfare economics of Cecil Pigou, which emerged in the 1920s. This is based on neoclassical principles, but is in sharp contrast to today's neoliberalism. Pigou saw the task of economic theory as improving the living conditions of people, especially the socially weak and considered state intervention necessary to maximise social welfare. Neoclassical environmental economics, which has emerged since the 1970s, has adopted Pigou's concept of internalising externalities through taxes or subsidies. This concept has worked well for local and temporary environmental problems. But climate change is of a very different kind. Nicholas Stern, the editor of the well-known Stern Review, which stands on the ground of neoclassicism, admits then: “The special features of the climate-change externality pose difficult questions for the standard welfare-economic approach to policy” [2].

On behalf of the UN, hundreds of economists and other scientists have worked for years to produce a comprehensive report entitled "The Economics of Climate Change", which is usually cited after the publisher as the "Stern Review". This report caused a sensation because in it, for the first time, a renowned economist argued that hesitation in climate protection would be much more costly in the future than the rapid implementation of effective measures against climate change. The economists who worked on the Stern Review were faced with the difficult task of valuing the damage predicted by climate researchers in monetary terms. Then they had to try to compare the costs of measures in the present with their benefits in the future (cost-benefit analysis). If one assumes that our earth will be inhabited by humans for at least another 100,000 years, and that the benefits of all people living today and in the future can be added up to a total benefit, then it is actually clear that no measure that prevents future catastrophic weather events, famines and floods can be too expensive for our affluent society.

But most neoclassical economists see it differently. They refer to the "nature of man" and claim that man always has a preference for the present. Translated into colloquial language: man is impatient by nature and loves to eat too much in the present, even if he has to starve for it later. This view, which goes back to Boehm-Bawerk [3], was originally intended to apply only to a single individual who maximises his utility over his entire life. In the context of climate change, however, it is now applied to the whole of humanity and to all future generations. And if the utility of goods is smaller the later they are consumed, then, according to the theory, the future damages caused by climate change should also have less weight than similar damages in the present. The future damages may therefore be "discounted". According to the principle of discounting and at a discount rate of 2%, damage that occurs in 35 years is only half as great as the same damage in the present. Because Nicholas Stern set the discount rate lower than usual, he concluded that the cost-benefit analysis clearly favours early, large-scale action on climate change. Some neoclassical economists have agreed with him unreservedly [4], others have strongly disagreed [5].

Despite these differences in result, Stern deviates only slightly from the usual neoclassical paths in his method. He is guided by the so-called Ramsey rule, in which the discount rate, growth rate and time preference rate are linked. This rule was first published by Frank P. Ramsey in 1928 and later found its way into neoclassical growth theory. It is designed to answer the question of what proportion of national income a society should save and invest in its capital stock in order to achieve an optimal supply of consumption goods for the present and all future generations.

Nicholas Stern clearly states that extending the theory of time preference from individual lives to generational succession is incompatible with ethical principles. He does want to guarantee each future generation an equal benefit as the present one, but only if it exists. Therefore, he replaces the rate of time preference with a new quantity that has a completely different meaning but is intended to occupy the same place in the Ramsey rule. This quantity refers to the possibility of a gigantic cata-strophe that would wipe out the entire human race. For the probability of such an event, he arbitrarily assumes a value that at first seems small, namely 0.1% per year. Stern believes that with this assumption he has put discounting on a sound ethical footing. He writes: "Valuing the benefit of future generations less can only be ethically justified if the existence of those generations is uncertain" [6]. But if one takes a closer look, this approach also becomes ethically questionable. For here, too, the present generation wants to derive an advantage from being there earlier. The injustice we do to future generations is now excused by the fact that the existence of these generations is not one hundred percent certain.

If one does not want to bring the possibility of human extinction into play and aims for zero economic growth in the long run, then the Ramsey rule no longer provides a reason for discounting future climate-related damages. But then the usual methods of cost-benefit analysis are no longer applicable. In a working group of the IPCC (Intergovernmental Panel on Climate Change), no agreement could be reached on the question of whether a cost-benefit analysis of global climate change is possible at all [7]. Three main lines emerged in the debate: the first two lines agree that they adhere to the cost-benefit analysis with discounting. However, they differ in the level of the discount rate assumed. The third line assumes the impossibility of a realistic benefit

calculation for the future and proposes to first set a long-term climate goal and then optimise the path to this goal [8].

In order to determine an overriding goal of climate policy independently of questionable cost-benefit calculations, one should start from the fact that the current settlement structure of peoples has evolved over centuries, and that specific adaptations to the environment in all inhabited areas were able to ensure a sufficient supply of food and drinking water until half a century ago. Unchecked global warming would change the environment in many places to such an extent that adaptation would no longer be possible. This leads to the goal of preventing a warming of more than 1.5°C at all costs. How much it would cost humanity if this target were missed cannot be calculated, nor does it have to be.

3. The Trading of Emission Rights

Scarcity is a key concept in neoclassical theory. In the well-known textbook by Paul Samuelson it says at the beginning: "Economics covers all kinds of topics. But at the core it is devoted to understanding how society allocates its scarce resources" [9]. But the problem of climate change has nothing to do with the scarcity of anything. Therefore, in order to design measures of climate protection in the neoclassical spirit, one has to invent a new commodity that can be kept artificially scarce. This commodity consists of the right to emit a certain amount of CO_2. The Kyoto Protocol allows intergovernmental trade of these rights. Within the EU, a set of rules for trading emission rights between companies has been in place since 2005. The EU's Emissions Trading Scheme (ETS) requires all heavy industry and energy companies based in the EU to hold government-issued emission allowances (permits) for their CO_2 emissions above a certain threshold. If they emit less CO_2, they are allowed to sell their emission permits to other companies.

Once trading in CO_2 emission rights was established, the word "CO_2 neutral" soon came into use. A product or transport service can now be called CO_2 neutral if the provider has bought the corresponding rights for its CO_2 emissions on the market for emission rights. Some suppliers, e.g. airlines, let customers decide whether they want to ease their conscience by paying a surcharge. If the surcharges discouraged flying, it would be good. But since the prices for emissions are far too low, the same applies to these surcharges. Offering "CO_2 -neutral" flights is therefore nothing more than a marketing method to persuade environmentally conscious people to fly despite their concerns.

Electric rail transport companies are now also adorning themselves with the label CO_2 -neutral. It is true that the energy consumption per passenger is much lower than for car journeys, but that does not make rail transport CO_2 -neutral, even if the electricity comes only from hydroelectric power plants. This is because those who consume large amounts of "clean" electricity force the other consumers to switch to electricity from other sources.

For emissions trading to actually bring about a reduction in emissions, the price of emission rights must be stable at a high level. However, this was far from the case in the EU, as the price of CO_2 fluctuated between € 10 and € 25 per tonne [10]. In contrast, a rough model calculation for Switzerland showed that the price would have to be much higher, namely 245 € per tonne, for CO_2 emissions to fall by 20% from 2010 to 2020 [11]. Stern admits: "It was difficult to ensure scarcity in the EU ETS market. As a result, the EU's emissions reduction in Phase 1 was estimated to be only 1%" [12].

The Kyoto Protocol also aims at climate-friendly development of developing and emerging countries and links this goal to emissions trading of industrialised countries. This is justified with the following argument. Saving one tonne of CO_2 is more expensive in rich countries than in poor countries. With the same costs, therefore, a greater benefit in terms of climate protection could be achieved in a poor country than in a rich country. It therefore makes sense for CO_2 emitters in industrialised countries to buy emission rights and for the proceeds to be used to finance climate protection projects in developing countries. This is the idea behind the Clean Development Mechanism (CDM).

One objection to this is that the reasons for the cost differences are not questioned here. The most important reason is the difference in wage levels. In order to compare costs in different currency areas, one must also calculate with exchange rates that only partially reflect reality, because they are also influenced by currency speculation. This is why, for example, the temptation for Switzerland to buy itself out of the commitment to climate protection in its own country is particularly great because of the overvaluation of its currency. In the end, there would be a conflict of interests between climate protection and social progress, because the lower the wages in a developing country, the more one could do for climate protection.

One example of the integration of ETS and CDM is a project with which the Dutch power companies finance reforestation in the highlands and on the coast of Ecuador [13]. Under the EU's ETS, electricity companies have to pay a price for their emissions, which is derived from emissions trading within the EU. With the countervalue, they have private landowners in Ecuador plant monocultures of pine and eucalyptus, because these trees grow the fastest. The choice of precisely these tree species is to be rejected for ecological reasons. And the area that is afforested depends on the costs. If wages rise, less will be afforested. The next section proposes a trading system that avoids this dilemma.

4. The Goal of a Fair CO_2-Neutral World Economy

CO_2 neutrality, properly understood, is a property that cannot be attributed to individual products at all, but only to an entire economic system. The economy of a country without any foreign trade would be CO_2 -neutral if all the CO_2 emitted within its borders were absorbed by vegetation (forest, urban greenery) in the same country. In view of

global trade, however, the predicate "CO_2 neutral" can logically only be awarded to the entire global economy. Therefore, the following definition should apply here:

The global economy is CO_2 -neutral if all the emitted CO_2 is absorbed by the vegetation on the Earth's land mass.

With this in mind, I would like to answer, as a first approximation, the question of the magnitude of price premiums that would justify the label "CO_2 neutral". To do this, one can compare the prices of goods in the pre-Kyoto world with the prices of goods in a CO_2 -neutral world. In such a world, all sovereign states would have committed themselves to participate in an ETS in which emission rights would not be issued by industrialised states, as in the EU ETS, but by rainforest states and other states on whose territory more CO_2 is absorbed than emitted. Furthermore, the ecological goal should be linked to the goal of fair trade. An international trade system is said to be fair if the same profit rate can be achieved in all regions and in all industries with the same wages (the distribution of income in the individual countries is not the issue here). But in a capitalist system without a CO_2 tax, processes with high CO_2 emissions are usually more profitable than processes producing the same goods with no or low CO_2 emissions, and are therefore favoured. This competitive disadvantage is to be corrected by the CO_2 tax, which flows to the CO_2 sinks. The following two questions are addressed:

1. how high does the CO_2 tax have to be to make an international capitalist production system fair and CO_2-neutral?

2) How does the CO_2 tax change prices?

The model considered here is inspired by Sraffa's wheat-iron model, which in turn has some analogy with Marx's "scheme of simple reproduction" [14]. Marx assumes that all commodities can be divided into three categories: Means of Production, Means of Consumption of the Workers, and Luxury Goods, and that the economy is accordingly divided into three broad divisions. But while Marx calculates with "values" of the constant and variable capital employed, Sraffa inserts material quantities of certain goods into his scheme. He calls these goods wheat and iron, but one can also, following Marx, think of an ensemble of many means of consumption or production. Later, he extends the illustrative basic model to a model with any number of branches and goods, which can only be analysed with mathematical tools that were not yet available in the 19th century [15]. As the title of his book “Production of Commodities by Means of Commodities” indicates, Sraffa considers an economy whose means of production are commodities that it produces itself. The simple examples with which he begins already make the peculiarity of his approach clear. This consists in the fact that prices are not determined by supply and demand, but by the requirement of the repeatability of the economic process based on the division of labour and the assumption of a uniform rate of profit in all branches.

Sraffa begins by looking at a model of a very simple capitalist economy in which one branch produces only wheat and one branch only iron. Iron is understood here as simple iron tools that wear out after a year. The workers are not paid with money, but with wheat. The quantitative assumptions are kept particularly simple for didactic purposes. The transformation of the means of production into products in the course of a year is then described by the following scheme [26]:

$$280 \text{ t wheat} + 12 \text{ t iron} \rightarrow 575 \text{ t wheat}$$

$$120 \text{ t wheat} + 8 \text{ t iron} \rightarrow 20 \text{ t iron}$$

Assuming that capital is always invested where it brings the highest profit, the profit rates in both branches equalise. With prices p_1 for wheat and p_2 for iron, the rate of profit r must satisfy the following equations:

$$(1 + r)(280p_1 + 12p_{2)} = 575\ p_1$$

$$(1 + r)(120p_1 + 8p_2) = 20\ p_2$$

The solution of this problem is r = 0.25 with any pair of prices with ratio 1: 15.

Now let us assume that there is mechanised and traditional agriculture. The latter is practised by subsistence farmers who also manage a piece of forest sustainably, so that their farms act as CO_2 sinks. Mechanised agriculture and the iron industry are sources of CO_2. The system of these three industries shall be described by the following scheme:

$$270 \text{ t wheat} + 9 \text{ t iron} \rightarrow 450 \text{ t wheat} + 10 \text{ t } CO_2$$

$$90 \text{ t wheat} + 7 \text{ t iron} \rightarrow 20 \text{ t iron} + 90 \text{ t } CO_2$$

$$720 \text{ t wheat} + 100 \text{ t } CO_2 \rightarrow 720 \text{ t wheat}$$

In this system, emission and absorption of CO_2 balance each other out. The quantities of wheat on the left, minus the necessary seed in the first and third branches, are a measure of the number of people working in each branch. The specific numerical ratios thus include, among other things, the assumption that traditional agriculture employs about twice as many people as iron industry and mechanised agriculture combined.

We first examine the situation in which CO_2 is ignored. The first two branches can then be considered on their own, and the equations for rate of profit and prices are:

$$(1 + r)(270p_1 + 9p_{2)} = 450\ p_1$$

$$(1 + r)(90\ p_1 + 7p_2) = 20\ p_2$$

With the convention $p_1 = 10$, the solution is:

$$r = 0.25,\ p_1 = 10,\ p_2 = 100$$

Now follows the corresponding calculation for the case that the CO_2 sources have to pay a levy to the CO_2 sinks. The amount of the levy for 1 t CO_2 is denoted here by p_3. This levy creates an incentive to save CO_2, and at the same time it is intended to ensure that subsistence farmers can participate in the prosperity that the industrialised countries enjoy through the use of fossil energy. This goal can be represented

by the requirement of equal profit rates in all three branches. If this is fulfilled, then the equations are:

$$(1 + r)(270p_1 + 9p_{2)} = 450\ p_1 - 10\ p_3$$

$$(1 + r)(90\ p_1 + 7p_2) = 20\ p_2 - 90\ p_3$$

$$(1 + r)\ 720p_1 = 720\ p_1 + 100\ p_3$$

With the convention $p_1 = 10$ we get the solution

$$r = 0.112,\ p_1 = 10,\ p_2 = 141.5,\ p_3 = 8.06$$

It can thus be seen that a trading scheme in which CO_2 sources and sinks can participate on an equal footing cuts the profits of the CO_2-emitting industries very severely. The profit rate has been reduced from 25% to around 11% because part of the profits are transferred to subsistence farmers. In addition, prices are forced that are very different from the prices in an economy with free emission of CO_2. The price of the commodity whose production generates a lot of CO_2 is about 42% higher than before. Price premiums of this magnitude would encourage the transition to production methods and lifestyles that have less impact on the climate. At the same time, transfer payments to countries where CO_2 is absorbed could serve to fight poverty there.

Since an alternative to capitalism is not yet in sight, it has been shown here how the protection of forests and the climate could work in a strictly regulated capitalist system without degrading rainforest nations to supplicants. If Evo Morales, the former president of Bolivia, objected that "the forests and indigenous peoples are not for sale", such concerns are without foundation. It is not a question of selling the rainforest. All that is being demanded is that the CO_2 emitted and absorbed be measured, and that the measured amounts be accounted for in international trade. The rights of indigenous peoples would not be affected by this; on the contrary, their habitat would be better protected than ever before.

5. Conclusions

Trading in CO_2 emission rights can bring about a significant reduction in emissions if their price is stable at a high level. But neoclassical theory, from which the concept of emission rights was born, fails when faced with the task of determining an adequate price. This paper proposed Sraffa's neo-Ricardian theory as an alternative. Because it views the economy as a circular system, the cycle of CO_2 can be integrated into a simple model in which CO_2 sources and sinks interact. It turns out that all CO_2 -intensive products would have to be much more expensive in a CO_2 -neutral economy than they are today.

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