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Fixing long-term price paths for fossil energy – the optimal incentive for limiting global warming

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Abstract

Neither a gradually rising carbon tax nor emission trading schemes can ensure that the costs of emitting greenhouse gases, in particular CO_2, will steadily rise faster than the general price level. If, e.g., global fossil energy prices decline faster than a carbon tax or the emission permit price rises, then the final good and its use become cheaper. Since the prices of fossil energy as well as CO_2 emission permit prices belong to the most unstable prices in the global economy, carbon taxes and trading schemes cannot anchor the *long-term expectation* that the effective emission costs for firms and households will rise continuously. Such an expectation, however, is a prerequisite for steadily growing investment in energy efficiency and/or renewable energy because the profits from such investments consist of the saved fossil energy costs ("opportunity profits").

This paper presents an alternative approach: The EU sets a path of steadily rising prices of crude oil, coal and natural gas by skimming off the difference between the EU target price and the respective world market price through a monthly adjusted quantity tax. Instead of the prices of fossil raw materials, the (implicit) quantity tax should fluctuate. In this way, the uncertainty about future price developments of crude oil, coal and natural gas and, hence, of the effective emission costs would be eliminated. Firms and households could calculate the profitability of investments in avoiding carbon emissions. At the same time, such a tax would ensure a uniform European carbon price in all sectors, provided the initial level of the price paths of crude oil, coal and natural gas account for the different CO_2 intensities of these types of fossil energy. Given the size of the EU import bill for fossil energy, the amount of potential receipts of such an implicit and flexible CO_2 tax would be (very) huge.

JEL: G12, Q01, Q54

Stephan Schulmeister

Fixing long-term price paths for fossil energy – the optimal incentive for limiting global warming*)

1. Introduction

At present, the two most important challenges of European policy are leading the economy out of the deepest crisis since the Great Depression and fighting climate change. Both challenges call for the realization of great investment programs (as part of a Green Deal) which would reduce greenhouse gas emissions and strengthen economic growth at the same time. Examples of such "mega-projects" are the *thermal refurbishment of the whole stock of buildings in the EU*, *the construction of a high-speed railways net across Europe*, the *transition from fossil energy to emission-free cars* and to *hydrogen technologies in industrial production* and the necessary investments in the *additional production of renewable energy*.[1])

However, the potential of a (transitory) "green growth" towards a circular economy can only be efficiently utilized if the costs of greenhouse gas emissions and, hence, the prices of fossil energy as the most important source of CO_2 emissions rise steadily and faster than the general price level – simply because the profits from investments in energy efficiency and/or in renewable energy consist of the saved fossil energy costs ("opportunity profits").

Recently, the renowned Harvard professor Jeffrey Frankel summed up the problem of how to incentivize the reduction of greenhouse gas emissions: "(….) the policy that will move us closest to achieving global environmental targets (….) is to raise the price of emitting carbon dioxide and other greenhouse gases. (….) it would be great if policymakers could commit to a century-long rising path for the carbon price. People could then plan far ahead. Firms would know with certainty the penalty for building long-lasting coal-fired power plants. (….) What is critical, though, is quickly to establish the expectation that the price of carbon will follow a generally rising path in the future." (*Frankel*, 2020).

The crucial point is *anchoring the expectations of all actors* that the price of CO_2 emissions will *never again become cheaper*. However, as long as there is uncertainty about the future

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[1]) *Wildauer – Leitch – Kapeller* (2020) provide an compact overview of the most recent projections of greenhouse gas emissions and estimate the additional investments in the EU necessary for and consistent with limiting the global temperature rise to 1.5°C .

price development of oil, coal and natural gas (or of CO_2 emission permits), even a permanently rising CO_2 tax (or rising floors of permit prices) cannot make sure that emission costs for the individual polluter will also steadily increase. This would, e.g., not be the case if fossil energy prices decline stronger than the CO_2 tax rises (or if emission permit prices fall strongly). As actors know from decades of experience that fossil energy prices fluctuate widely, even a stepwise rising carbon tax cannot anchor the expectation that the costs of emitting CO_2 will permanently increase (and, hence, also the profits from avoiding emissions).

The basic reason for that is simple: The effective cost of emitting CO_2 consists of the *overall price* of the good, the use of which causes emissions as a *"by-product"*. Even if households or firms paid separately a gradually rising carbon tax for their emissions, the incentive to reduce emissions would not be sufficient as long as they can expect/speculate that they will be compensated by a decline in the other price components, i.e., the global fossil energy prices. By the same token, the wide fluctuations of carbon emission permit prices weaken the willingness to invest in the reduction of CO_2 as one cannot rely on its profitability.[2])

The relevance of this problem for establishing the *expectation* that emitting CO_2 will become steadily more expensive, depends on the volatility of prices of fossil energy, in particular of crude oil, and of CO_2 emission permits, respectively. Take fuel prices as example: Even though fuel taxes - a special form of a carbon tax - in Europe comprise roughly 50% of the overall fuel price, the latter declined *three times* by roughly 30% in the past 12 years due to even stronger declines in crude oil prices (2004/2008, 2009/2012 as well as in March 2020 – figure 4).

As neither (rising) carbon taxes nor emission trading schemes can sufficiently incentivize the necessary investments in a permanent reduction of carbon emissions, this paper presents an alternative approach: The EU sets a path of steadily rising prices (e.g., by 5% per year) of crude oil, coal and natural gas by skimming off the difference between the EU target price and the respective world market price through a monthly adjusted quantity tax (as this paper deals with the concept as such and not its implementation, it is assumed that all member states unanimously support the introduction of the price path). Instead of the prices of fossil raw materials, the (implicit) quantity tax should fluctuate. In this way, the uncertainty about future emission costs would be eliminated. Firms and households could calculate the profitability of investments in avoiding them. Such a tax would ensure a uniform European carbon price in all sectors, provided the initial level of the price paths of crude oil, coal and natural gas account for the different CO_2 intensities of these types of fossil energy. Given the size of the EU import bill for fossil energy, the amount of potential receipts from such an implicit and flexible CO_2 tax would be (very) huge.

The paper is structured as follows: The next section deals with the contradiction between the particularly long time horizons of "green investments" and the instability of those prices which determine to a large extent the profitability of these investments, i.e., the prices of fossil

[2]) The problem of uncertainty about the effective carbon emission costs is even bigger in the case of emission trading schemes as compared to carbon taxes as actors can know the carbon tax rate but not the future emission permit prices (*Aldy – Armitage*, 2020).

energy as well as of carbon emission permits. Then, I discuss the reasons why the conventional way of CO_2 pricing through trading schemes or carbon taxes cannot incentivize a sustained reduction of carbon emissions. The final section deals with the alternative approach of fixing long-term price paths for crude oil, coal and natural gas.

2. Time horizon of "green investments", oil price fluctuations and global warming

The following fact massively exacerbates the uncertainty problem: Investments in energy efficiency or in renewable energy only pay for themselves after many years (thermal refurbishment of buildings, diffusion of e-cars including supply networks, etc.) or even decades (development of hydrogen technology in industry or of a trans-European network of high-speed trains as a prerequisite for a radical restriction of air traffic, etc.). An ecological investment offensive therefore requires *maximum long-term planning security*.

At the same time, market prices do not include the "external costs" caused by production and consumption. It is up to policymakers to have these costs "internalised". As regards global warming (the greatest externality of all times), emissions of greenhouse gases, in particular of CO_2, have to be priced, either through carbon taxes emission permits.

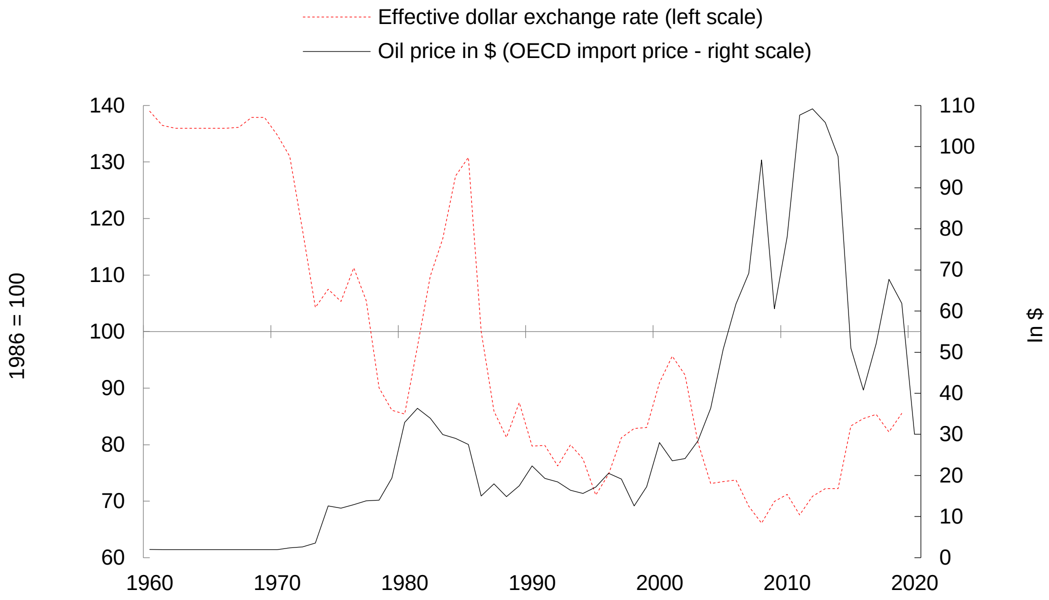
The market failure of disregarding environmental costs is exacerbated by a second market failure typical for asset prices in general, and, hence, also for the prices of crude oil or of CO_2 permits: They fluctuate in a sequence of bull and bear markets, i.e., they deviate widely from their "fundamentals". Between 1973 and 1982, e.g., the price of crude oil rose from $3.6 to $36.3 per barrel, mainly due to the two "oil price shocks" in 1973 and 1979, respectively. In both cases, OPEC took advantage of political turbulences in the Middle East (Yom-Kippur-War in 1973 and the coming to power of the Ayatollahs in Iran in 1979) to "retaliate" for the preceding dollar depreciations 1971/73 and 1976/79, respectively (*Schulmeister*, 2000).

Triggered by the global recession 1980/82, oil prices fell by more than 50% between 1980 and 1985. The related income effect for oil producers was, however, to a large extent compensated by the rising value of the dollar (figure 1). When the dollar started to fall again, Saudi-Arabia flooded the oil market with additional supply to restore production discipline within the OPEC cartel. The whole strategy failed and oil prices stagnated at a low level for roughly 15 years (figure 1).

After the recession of 2001, oil prices started to boom, fostered by strong growth (particularly in emerging market economies) and facilitated by the falling dollar exchange rate: Based on annual data, oil prices more than quadrupled between 2001 and 2011, interrupted by a sharp fall during the Great Recession (figure 2 shows oil price dynamics based on daily data).

Between mid 2014 and end 2015, oil prices declined by roughly 70%, mainly caused by the emergence of additional supply stemming from fracking technologies. Prices recovered as did the global economy between 2016 and 2018 but then fell again. When negotiations between Saudi-Arabia and Russia broke down over oil production reductions in late 2019, Saudi-Arabia returned to her strategy of 1986, i.e., flooding the market with additional oil supply to "punish" Russia with unsustainably low oil prices (as a side-effect, oil production in the US through fracking become unprofitable). As a result, prices fell to their lowest levels in decades. In April 2020, OPEC, Russia and other oil producers reached an agreement over production cuts, yet oil prices have remained low and will probably stay low for some time, not least because of the Corona crisis and its impact on the global economy.

Figure 1: Dollar exchange rate and oil price fluctuations



Source: OECD, IMF

The sketch above indicates that important turning points in oil price trends are triggered by economic and political events ("fundamentals" in a broad sense). But why do the subsequent upward or downward trends last so long? The phenomenon of "overshooting" is one of the most characteristic features of asset price dynamics in general and can be explained in the following way (taking the oil price as example).

Like other speculative prices, (futures) prices of crude oil (but also of CO_2 emission permits) fluctuate almost always around "underlying" trends (figures 2 and 3).[3]) The phenomenon of "trending" repeats itself across different time scales ("self-similarity"). E.g., there occur trends based on tick or minute data as well as trends based on daily data.

"Technical" or "algo(rithmic)" trading aims at exploiting the trending of asset prices. In the case of *trend-following* moving average models, a trader would open a long position (buy)

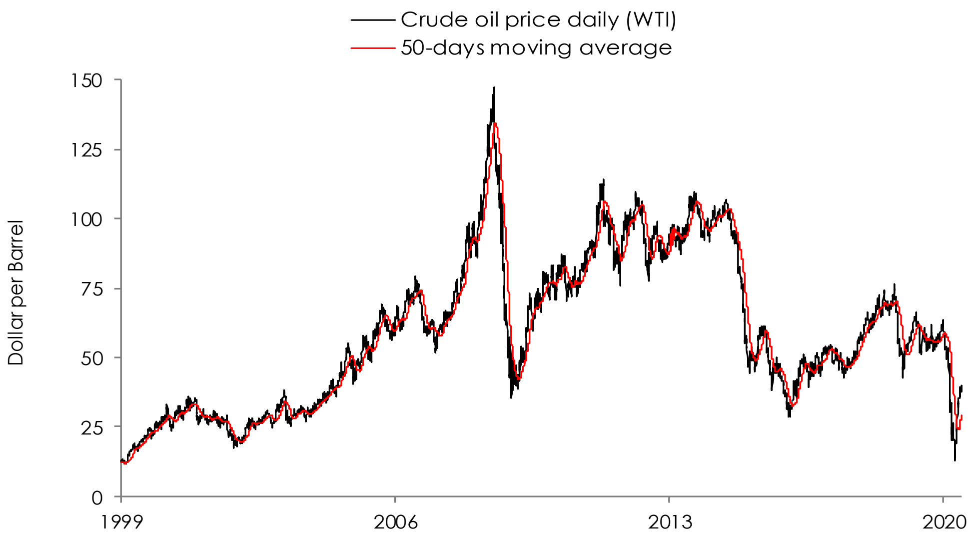
[3]) Empirical research on the role of technical trading in asset price dynamics in general is documented in *Schulmeister* (2009 and 2018, chapter 9), as regards commodities prices, in particular oil prices, in *Schulmeister*, 2012.

when the current price crosses the MA (moving average) line from below and sells when the opposite occurs (figures 2 and 3). By contrast, *contrarian* models try to profit from trend reversals and, hence, change open positions when a trend "loses momentum".

Technical models are applied to price data of almost any frequency. Due to the increasing use of intraday data, algo trading has become the most important driver of the rising "speed" of trading and the related boom in the volume of financial transactions.

There operates an interaction between trending of asset prices and algo trading. On the one hand, traders use different models to exploit price runs, on the other hand, the aggregate behaviour of all models strengthen and lengthen the price runs.

Figure 2: Trending and speculation in the crude oil futures market



Source: NYMEX

Long-term price trends result from the following process. "Mini-trends" (e.g., based on minute data) add up to one trend based on 10-minute data. Several of these trends accumulate to one trend based on hourly data, and so on. Over an extended period of time (often several years), upwards (downward) trends last longer than counter-movements, causing the price to rise (fall) in a stepwise process (figure 2 shows how oil price trends based on daily data accumulate to bull markets and bear markets).

Through the concurrence of both types of market failure in the dynamics of fossil energy prices, i.e., disregarding environmental costs and "overshooting", the problem of global warming reached a life-threatening dimension. In spite of the warnings of climate researchers against the extent of the problem (at the latest since the 1970s), governments could not reach binding agreements to reduce global greenhouse gas emissions consistent with limiting global warming to 2°C compared to pre-industrial levels (even though the Paris treaty of 2015 reached a general commitment to the targets, it left out control and enforcement mechanisms).

As a consequence, most countries have adopted national climate strategies. As regards the key issue of pricing CO_2 emissions, there is broad consensus that this should be done through either emission trading schemes or carbon taxes.[4]) Unfortunately, neither of them can establish a path of steadily rising CO_2 prices and, hence, can anchor the respective expectations.

3. Emission pricing through trading emission permits

The impossibility of anchoring the expectation of steadily rising CO_2 emission prices through cap-and-trade schemes can be illustrated using the EU system as example: It was introduced in 2005 and covers the main CO_2 emitters from industry such as steel, paper, chemical or cement producers as well as power generators and (EU internal) flights which together account for about 45% of all CO_2 emissions in the EU.[5])

In theory, emission trading is an optimal control instrument: CO_2 emissions are limited by the volume of permits and this cap is gradually reduced. A uniform price is formed on the permit exchanges, which ensures that the emissions take place where their benefit is greatest: A company that needs more certificates because of a good business situation and/or specifically high costs of emission reduction measures buys them via the exchange from another company that has a surplus. These transactions constitute *compliance transactions*.

In order for emissions trading to create incentives to invest in the CO_2 reduction (sufficient to meet the Paris climate targets), the permit price should rise steadily – at least it should not widely fluctuate. This, however, is actually the case: Since the introduction of the EU Emission Trading System (ETS) in 2005, the price for the emission of one ton of CO_2 has been fluctuating between €32.3 and €3.1 (figure 3). Moreover, between 2011 and 2017 the price was at such a low level that it did not create an incentive to invest in reducing emissions.

This disaster has two main causes. First, the amount of certificates must be fixed in advance for a longer period. This organisational necessity leads to misallocations and thus "wrong" CO_2 prices due to the fundamental uncertainty about the medium-term economic development. E.g., the financial crisis was - of course - not foreseen, resulting in an oversupply of emission permits so that their price fell to below €10 in 2009 and further to below €5 by 2013 (figure 3).

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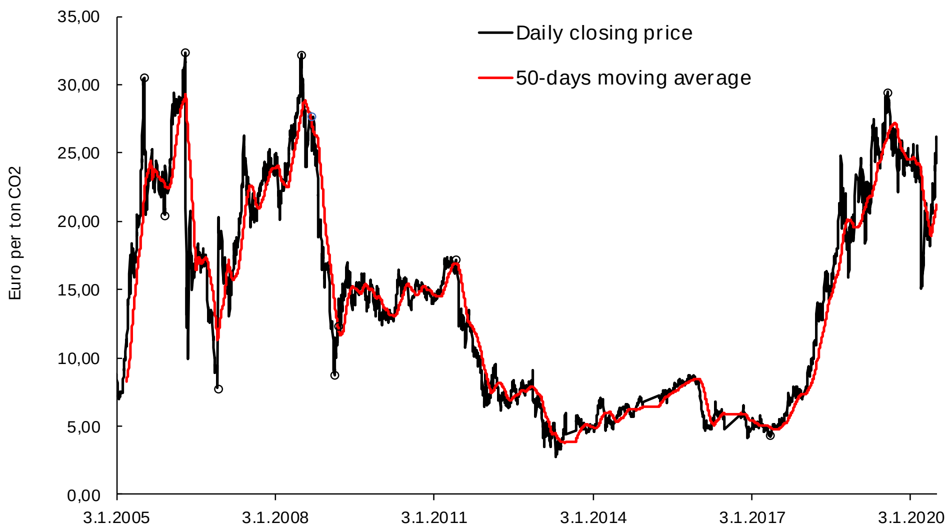
[4]) The general issue of carbon pricing is analysed in *Edenhofer et al* (2019), *Guttman* (2018), *Köppl – Schleicher – Schratzenstaller*, 2019, *OECD* (2018), *Sachverständigenrat* (2019) and in the report of the *Stiglitz-Stern-Commission* (2017).

[5]) For an overview of the EU Emissions Trading System see *Schleicher et. al*., 2015, *Marcu et al*., 2020, *European Environment Agency*, 2020, and *Ellerman et al*., 2016. A summary of emissions trading worldwide is *ICAP*, 2018. The microstructure of carbon emission markets is discussed in *Kachi – Frerk*, 2013, and *Mizrach – Otsubo*, 2014. The importance of (destabilizing) speculation in the spot and derivatives markets of EU emission allowances is examined by *Berta et. al.* 2017.

Figure 3: Fluctuations of the futures price of EU CO_2 emission allowances



Source: Intercontinental Exchange (ICE)

The "Market Stability Reserve" (introduced in 2019) to manage the supply of allowances should stabilize emission prices. In fact, the announcement of the gradual reduction of "allowances in circulation" until 2030 certainly contributed to the rise of the CO_2 emission price between early 2017 and mid 2019. However, it is difficult, if not impossible, in practice to adjust the supply to short-term developments. E.g., after mid 2019, emission prices started to decline again (due to the weakening of the global economy), plummeted after the outbreak of the Corona crisis to 15 € in March 2020 and recovered somewhat afterwards.

Second, financial actors on the CO_2 permit exchanges "interpose" themselves between companies with a surplus or deficit of permits and use the derivatives based on permit futures prices as vehicles for speculation. Thus, since 2010, 99% of all permit transactions have been carried out in derivatives and only 1% in genuine certificates (hedging can therefore only play a minor role). Already in 2012, the total CO_2 transactions volume (including derivatives) of all actors was more than 33 times higher than the companies' "compliance needs" (*Berta et al.*, 2017) Moreover, the CO_2 price dynamics shows the pattern typical for speculative prices in general: Short-term trends, which are exploited by algorithmic trading, accumulate into longer-term bull or bear markets (figures 2 and 3).[6])

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[6]) The properties common to speculative assets are: They can easily and almost permanently be traded, at least in derivatives markets (as in the case of commodities), the supply is fixed over the short run and might be shrinking over the long run (as with bitcoins or CO_2 permits). In the respective markets, professional players trade with amateurs. In some cases, the latter buy or sell the respective asset for reasons of their business in the real economy (e.g., exporters/importers or tourists in the foreign exchange market or industrial or energy companies in the CO_2 emission

The participating industrial and energy corporations whose CO_2 emissions should be optimally allocated by the system, have to accept permit prices resulting from speculative derivative transactions of "financial investors" (traders). The latter take into account of course also "news" about the fundamentals, but mainly as a trigger for short-term price movements, which are exploited and reinforced at the same time by technical trading systems (figures 2 and 3 show a particularly simple 50-days-MA-system as explained in section 2 - the trading systems used today are much more complex, but all of them aim at exploiting the "trending" of asset prices).

4. Emission pricing through carbon taxes

In all EU countries there has long been a tax on fuels. It is equivalent to a tax on CO_2 emissions caused by fuel consumption since there prevails a fixed relationship between the quantity of fuel consumed and the related CO_2 emissions. [7])

In Germany, e.g., the tax on diesel is 47 cents per litre. Since the burning of one litre diesel produces 2.65 kg CO_2, the diesel tax burdens the emission of one ton of CO_2 by roughly 180 € (= 0.47/2.65 per kg). This is much more than in most planned or – like in Sweden or Switzerland – already implemented (general) carbon taxes (see *Kettner – Kletzan-Slamanig*, 2017).[8]

Due to the extent of fluctuations in the world market price of crude oil, phases of marked price reductions for petrol, diesel and heating oil are inevitable despite a CO_2 tax (even as high as 180 € per ton). This also applies if the CO_2 tax would be raised gradually, given the extent of the instability of fossil energy prices.

A concrete example illustrates the issue: Between 2004 and 2008 and between 2009 and 2012, the price of crude oil rose dramatically and with it the price of fuels, heating oil and natural gas (figures 2 and 4 – figure 4 shows the price of Brent crude oil and diesel in Germany in € - the latter rose to more than € 1.50). However, the oil bull market was followed by a bear market, and the diesel price fell again to only about € 1 in 2009 as well as in 2016. As a consequence, the demand for (diesel- consuming) SUVs picked up again and investments in CO_2 reductions, which were profitable at an oil price of € 70 (and more), turned into "sunk investments". The same repeats itself at present: Due to the oil price collapse, the diesel price in Germany fell to roughly € 0.9 and ecological investments become "ex post" unprofitable.

The combination of low price elasticity of both, demand and supply in oil markets, with frequent demand and supply shocks cause sharp oil price changes which are then reinforced by technical speculation (the trading volume of "paper barrels" is many times

market). As a group, the professional traders are the winners and the amateurs the losers (trading derivatives is a zero-sum-game – *Schulmeister*, 2018, chapter 9).

[7]) An overview of carbon taxes of CO_2-emissions from energy use in 42 countries can be found in *OECD* (2018). *Kirchner et al.* (2018) analyse the macroeconomic and distributional effects of CO_2 taxes for Austria.

[8]) In fact, fuel taxes compensate also for other externalities like air pollution and noise as well as for the wear and tear of infrastructure. However, in this paper I focus on the effective costs of CO_2 emissions for households and enterprises.

greater than global oil production). Under these conditions even rising carbon tax rates cannot anchor the expectation of steadily rising paths of the price of CO_2 emissions.

Rather the opposite: the more the EU (and other countries) succeed in reducing the consumption of fossil energy, the more likely it is that world oil prices will fall, which in turn will counteract the increase in the price of fossil energy through CO_2 taxes.

Regardless of this "rebound effect", new drops in oil prices are likely because even small increases in global supply (e.g. stemming from "undisciplined" OPEC countries or other oil producers such as Brazil, Guyana, Norway, Canada and the US) and/or a weakening of demand (e.g., due to a recession or a financial crisis) trigger significant price declines. The recent oil price collapse triggered by rising supply from Saudi-Arabia and declining demand (due to the corona virus crisis) is the most drastic example. Thus, the short-term volatility of fossil energy prices dampens the willingness to invest in CO_2-saving technologies.

These investments are further dis-incentivized by the long-term outlook for fossil energy prices: Due to the diminished OPEC market power, the tensions between OPEC and other oil producing countries, the emergence of new suppliers and the rise in supply from the US once the oil price exceeds the threshold for fracking to be profitable (roughly $ 50 per barrel) as well as due to the slow-down of economic growth, oil prices will probably remain lower than over the past 20 years (it seems therefore highly improbable that all important producers will succeed in reducing oil supply in a coordinated manner to push prices on a higher level and keeping them there, seems).

As regards climate change, the basic structural problem is as follows: The global reserves of fossil energy are much larger than the global "CO_2 budget" - if a climate catastrophe is to be avoided, the reserves must not be exhausted. This excess supply will exert a permanent downward pressure on fossil energy prices.[9])

5. Fixing long-term rising paths of fossil energy prices

If neither emission trading schemes nor carbon taxes can ensure that emitting CO_2 becomes permanently more expensive, and if anchoring such an expectation is a precondition for steadily raising the (expected) profitability of ecologically necessary investments, how then could a rising path of fossil energy prices be achieved?

Instead of taxing the CO_2 content of oil, coal and natural gas, the EU should set a path with steadily rising prices for these energy sources (initially for about 20 years) and skim off the

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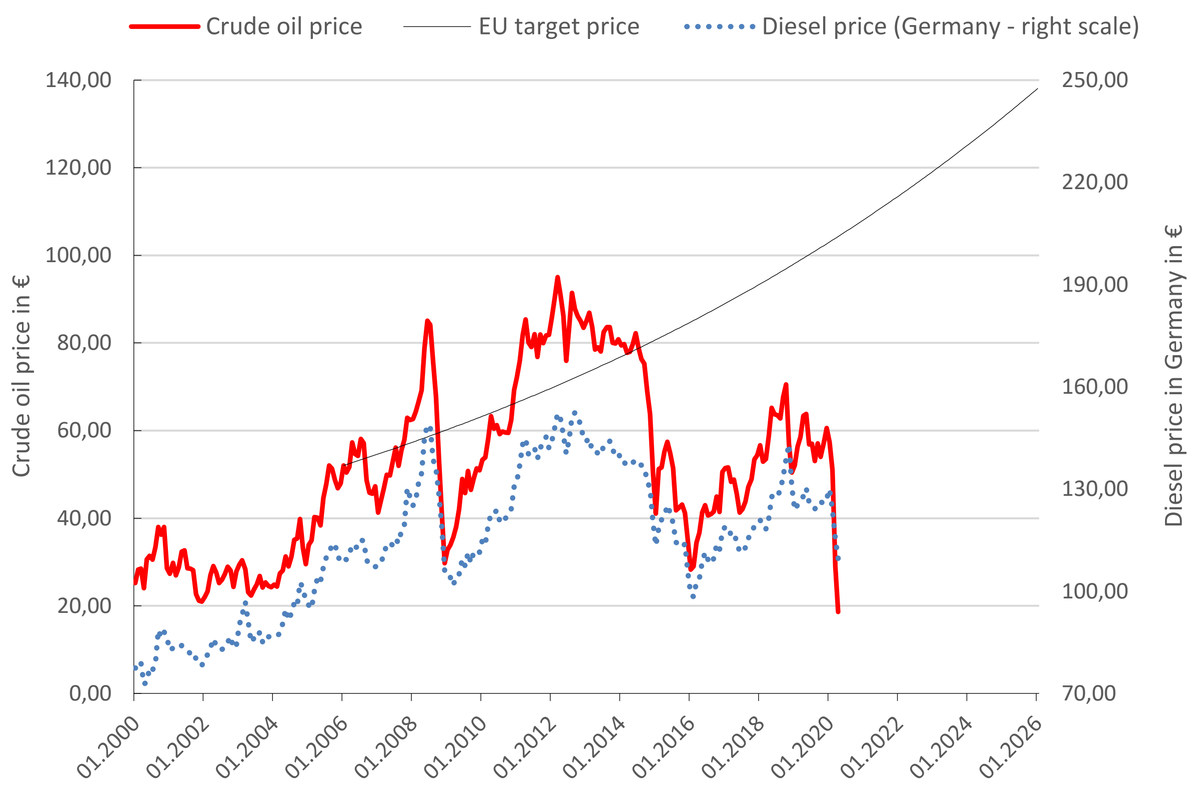
[9]) The carbon budget refers to that amount of greenhouse gas (GHG) emissions which is consistent with limiting global warming to certain temperature hikes. Based on model calculations by the Intergovernmental Panel on Climate Change (*IPCC*, 2018), the Mercator Research Institute visualizes in its "carbon clock" that the global carbon budget would be depleted in 2027 (1.5°C scenario) or in 2045 (2°C scenario), respectively, if emissions would continue to rise as in the past (https://www.mcc-berlin.net/en/research/co2-budget.html). The situation differs by countries. Austria, e.g., has since 1950 spent already almost 80% of its carbon budget (*Meyer – Steininger*, 2017). For a documentation of the discrepancy between countries' planned fossil fuel production and global production levels consistent with limiting warming to 1.5°C or 2°C see http://productiongap.org.

difference between the EU target price and the respective world market price by means of a monthly adjusted quantity tax - instead of the prices of fossil raw materials, the (implicit) quantity tax should fluctuate. Hence, this tax can be conceived as a (implicit) carbon tax just constructed differently. At the same time, such a tax would ensure a uniform European carbon price in all sectors since any unit of crude oil, coal and natural gas contains a certain amount of CO_2.

Figure 4: Price incentives for CO_2-reduction – market versus target prices



Target price path: Crude oil prices in the EU rise by 3 percentage points faster than target inflation, i.e., by 5% per year (fictitiously from January 1, 2006).

Here is a thought experiment using the example of crude oil to illustrate the working of such a price and tax regime. On January 1, 2006 the following regulation came into force in the EU: Starting from the (then) current oil price (Brent) of 52.0 €, the price valid within the EU would rise along a predetermined path by 5% per year (just 3 percentage points higher than target inflation). This rate of change would be much smaller than the fluctuations realised since then, but it is *always positive* – and everybody knows it in advance.

As a result of a second bear market, the oil price fell from €95.0 to €28.3 between March 2012 and January 2016, while the diesel price in Germany fell from €1.52 to €0.99 (figure 2).

However, the EU guideline price for oil would be € 84.8 in January 2016. For February 2016, (the EU oil tax would thus amount to 56.5 € - 84.8 minus 28.3 - per barrel, about twice the oil bill (the figures are for illustrative purposes only; if an EU price path had actually been introduced, the world market price of oil would have developed differently, most probably, it would have been dampened further). The (final) diesel price in Germany would have risen continuously, though probably slightly slower than the oil price but certainly faster and more steadily than the general price level.

If one considers that the EU had to pay a total of € 414.5 billion in 2016 for energy imports - almost exclusively fossil - it becomes clear: Such a fossil energy tax could yield more than € 500 billion in the medium and long run (depending on the "start price") and its returns would increase at an above-average rate. On the one hand, the EU target price is rising, while on the other hand the EU's climate policy is curbing its energy imports and thus world market prices. As a consequence, the price spread will rise over the long run and, hence, also tax receipts, causing a lasting change in the distribution of oil, coal and natural gas income: These are primarily "rentier incomes" for the owners of the fossil energy reservoirs. Whenever oil prices, e.g., rose in the past, the producing countries, but also the oil companies, made extra ("windfall") profits. By constantly increasing the price *itself*, the EU is dampening its import demand and, hence, world market prices. As result, part of the "rents" of fossil energy producers would be diverted to the EU and, hence, into the budgets of the Member States (tax receipts could be distributed according to the national CO_2 emissions, provided they are – mainly – used for investments in the reduction of CO_2 emissions, another part of tax receipts could go to the EU budget as "own resources").

Technically, the implementation of such a flexible quantity tax would be simple in the "digital age": Based on the difference between the EU target price and the world market price, the tax per unit of quantity of oil, coal and natural gas valid in the following month is determined at the end of each month by the EU Commission and paid in the Member States by producers and importers of fossil energy in the EU.

The levels from which the crude oil, coal and natural gas price paths start as well as their (identical) annual growth rate have to be determined in a political process (which will certainly be complicated): The higher is the priority given to incentivizing investments and consumption behaviour consistent with limiting climate change, the higher should be the initial price levels as well as their growth rate. As overcoming the economic and ecological crisis calls for massive and sustained investments in the transition towards a new energy system, it is clear that the price paths should not start from the presently low price levels.[10])

[10]) On the occasion of the recent oil price collapse, *Schleicher – Steininger* (2020) propose an "energy price stabilization mechanism", in particular for crude oil which would be consistent with the intentions of the European Green Deal. Oil prices should be stabilized within a price corridor, starting with a lower limit of $ 80 per barrel and an upper limit of $ 100. Corridor limit prices should rise by 3% per year. If the market price (Brent) is lower than the minimum price, producers and importers of crude oil should pay the difference as a duty into a stabilization fund. If the market price exceeds the upper limit, producers and importers would be paid the difference out of the fund. Clearly, the basic rationale of the Schleicher-Steininger-proposal is the same as the concept presented in this paper.

Of course, the "pace" of the price paths should be adapted to developments at greater intervals, but since a reduction in the price of fossil energy is ruled out, the following holds: the earlier an investment is made, the greater is its profit. Such a system of pricing fossil energy would therefore initiate a long-lasting investment boom in avoiding CO_2 emissions.

Goods imported into the EU would be subject to an analogous energy tax (border carbon adjustment tax – for a discussion of such a concept and of the related issues see *Krenek – Sommer – Schratzenstaller*, 2019; the EU Commission recently mentioned such a tax as possible source for its budget). Since EU price paths "internalise" the environmental costs of fossil fuel consumption and apply also to domestic supply, such a levy would not contradict the rules of the World Trade Organisation (WTO). As long as no comparable CO_2 taxes exist in the EU's trading partners, EU exports would have to be relieved from the EU fossil energy tax paid (analogous to VAT).[11])

As the proposed concept just replaces an explicit and fixed carbon tax with an implicit and flexible tax, competition would remain in force in all markets - the extent to which producers or importers of fossil energy pass on the tax to their customers is up to them.[12])

Technically, it would be far easier to implement just three flexible quantity taxes on oil, coal and natural gas than managing the complex and bureaucratic EU emissions trading scheme (not to speak about extending it to transport and housing).

What would be the most important price and investment effects of EU target prices for fossil energies? All goods and services would become more expensive within the EU to the extent that fossil energy is used in their production - from fuels including kerosene to plastic products. Products produced with renewable energy or less energy would become relatively cheaper.

The investment effects would be most significant: Since owners of single-family homes, housing cooperatives etc. *know* how much heating costs they could save by making buildings more energy-efficient, they would expand their investments accordingly (however, in case of privately owned residential buildings one would need additional rules to overcome the "owner-tenant-dilemma"). The mandatory price paths would relieve car companies of a

[11]) The taxation of the fossil energy content of imports should adopt a pragmatic approach. It would focus on energy intensive products like steel, chemicals, cement, paper, etc. For each category, the "standard" energy input per unit is estimated. The amount of the border adjustment tax is then calculated as the quantity of energy content times the difference between the world market price of crude oil, coal or natural gas and the respective EU target prices. If non-fossil energy is used in the production process this has to be documented (the administration of a border adjustment tax does not differ between an conventional carbon tax and a price-path-system implemented through an implicit and flexible carbon tax).

[12]) A recent study for the German Council of Economic Experts ("Sachverständigenrat") on the options for pricing CO_2 emissions recommends the introduction of a German carbon tax or of a "National Emissions Trading System for Transport and Heating". However, in either system policy interventions are necessary: "A carbon tax needs to be assessed and adjusted frequently in order to achieve the targets of the EU emissions sharing decision. A German emissions trading scheme requires a price collar to facilitate investments and to prevent extreme price fluctuations." (*Edenhofer et al.*, 2019, p. 15). The "Sachverständigenrat" endorsed this procedure (*Sachverständigenrat*, 2019, chapter 4). If policy has to intervene anyway, why not do so in such a way as to ensure a reliable price path of fossil energy and, hence, of CO_2 emissions?

large part of the risk of long-term investments in the development of electric vehicles and hydrogen-driven trucks. The same holds true for the still more complex and expensive transition from fossil to "green" energy in industrial production, in particular based on hydrogen technologies.

In any case, even though steadily rising fossil energy prices are not a sufficient condition for successful fighting global warming, it seems to be a necessary condition for incentivizing all those projects which will enable the transition towards a fundamentally new energy system as part of a circular economy.[13])

The incentive for investing in the reduction of CO_2 emissions through rising price paths of crude oil, coal and natural gas should be strengthened by using part of the (enormous) returns from the fossil energy tax for long-term large-scale projects (another part should offset the burden of energy price increases on low-income groups).[14]) These projects include the thermal refurbishment (isolation, photovoltaics, heat pumps) of the entire building stock in the EU, the creation of a trans-European network for high-speed trains, the switch to electric cars and to hydrogen technology, especially in the most energy-intensive industries (steel, paper, basic chemicals, building materials), investments in power production from renewable sources and in local public transportation systems.

Such a Green Deal would stabilize economic growth in the EU and improve the environment at the same time. By reducing unemployment and atypical employment, and with it the (fear of) poverty, the transition towards a circular economy would also strengthen the European Social Model and, hence, the integrative forces within the EU.[15])

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[13]) *Köppl – Schleicher* (2018) demonstrate that any sustainable strategy of fighting climate change calls for an approach "that covers the full energy value chain from the required functionalities for mechanical, thermal and specific electric energy services via application and transformation technologies up to primary energy." A path of rising fossil energy prices as proposed in this paper can be considered as basic price incentive for "integrating all components of a newly structured energy system" (quotes from the Abstract of *Köppl – Schleicher,* 2018*). Schleicher – Steininger* (2018) concretize the main components of an efficient carbon management.

Setting rising price paths of other raw materials would incentivize other investments on the (long) road towards a circular economy, in particular investments in a more efficient waste management. Also the profitability of these "green" investments cannot be estimated with sufficient reliability due to the price instability of the raw materials to be recycled.

[14]) To mitigate the fluctuations of tax earnings and to account for negative tax payments (in the – improbable - case fossil energy prices exceed the respective EU target prices) tax authorities could and should establish a buffer fund. Even though the instability of the fossil energy tax earnings will constitute a new challenge for tax authorities, its disadvantages seem to be far smaller than the disadvantages of fluctuating fossil energy prices. The recent oil price collapse illustrates this issue. Low fossil energy prices would once again reward climate-damaging behaviour and would turn investments in the reduction of CO_2 emissions ex post into "sunk investments". For the same reason, the fossil energy tax should be adjusted to world market prices every month. If this would be only done once a year, fuel prices might fall by 10%, 20% or even 30% and stay low until they jump up again due to the adjustment of the quantity tax (as would be the case if oil prices stay low for some months after a collapse).

[15]) The imminent problem of how COVID-19 fiscal recovery packages could contribute to mitigating global warming at the same time is discussed in recent papers by *Hepburn et al,* (2020), and *Köppl et al.* (2020).

6. Concluding remarks

The paper proposes a new approach to pricing CO_2 emissions: Setting a path of steadily rising prices of crude oil, coal and natural gas by skimming off the difference between the EU target price and the respective world market price through a monthly adjusted quantity tax. Instead of the prices of fossil raw materials, the (implicit) quantity tax should fluctuate. In this way, the uncertainty about future price developments of crude oil, coal and natural gas and, hence, of the effective emission costs would be eliminated. Firms and households could calculate the profitability of investments in avoiding carbon emissions. At the same time, such a tax would ensure a uniform European carbon price in all sectors.

The arguments in favour of such a price path are as follows. First, climate change represents the biggest threat to the living conditions of mankind. Second, fighting global warming calls for a continuous reduction of CO_2 emissions through saving on energy consumption and through investing in energy efficiency as well as in renewable energy production. Third, a steady rise in "green investments" can only be achieved if enterprises and households firmly expect that the effective emission costs will rise continuously since the profits from such investments consist of the saved energy costs. Fourth, neither carbon taxes nor emission trading schemes can establish such an expectation as the prices of fossil energy as well as of CO_2 emission permits belong to the most unstable prices in the global economy.

At first glance, fixing a path of steadily rising fossil energy prices by means of economic policy might appear as falling back to a "centrally planned economy". However, if one takes into consideration the causes of global warming, the specific conditions in the markets for fossil energy and CO_2 emission permits as well as the theory of externalities and public goods, then the proposal should appear worth being discussed. The global natural environment is the most valuable public good of mankind. Confronted with the threat of its destruction, the courage to escape from conventional modes of thinking should not be lacking.

References

Aldy, Joseph E., Armitage, Sarah, “The Cost-Effectiveness Implications of Carbon Price Certainty”, AEA Papers and Proceedings, American Economic Review, May 2020, 113-118.

Berta, Nathalie, Gautherat, Emmanuelle, Gun, Ozgur, „Transactions in the European carbon market: a bubble of compliance in a whirlpool of speculation“, Cambridge Journal of Economics, 41, 2017, 575-593.

Edenhofer, Ottmar, Flachsland, Christian, Kalkuhl, Matthias, Knopf, Brigitte, Pahle, Michael, Optionen für eine CO_2-Preisreform, MCC-PIK-Expertise für den Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Mercator Research Institute on Global Commons and Climate Change (MCC), Potsdam-Institut für Klimaforschung (PIK), Berlin, Juli 2019.

Ellermann, A. Denny, Marcantonini, Claudio, Zaklan, Aleksander, „The European Union Emissions Trading System: Ten Years and Counting”, Review of Environmental Economics and Policy, vol. 10 (1), Winter 2016, 89-107.

European Environment Agency, The EU Emissions Trading System in 2019: trends and projections, Copenhagen, 2020 (forthcoming).

Frankel, Jeffrey, “The Best Tool to Fight Climate Change”, Project Syndicate, January 20, 2020, https://www.project-syndicate.org/commentary/higher-carbon-price-best-tool-to-fight-climate-change-by-jeffrey-frankel-2020-01

Guttmann, Robert, Eco-Capitalism – Carbon Money, Climate Finance and Sustainable Development, Palgrave Macmillan, 2018.

Hepburn, Cameron, O’Callaghan, Brian, Stern, Nicholas, Stiglitz, Joseph, Zanghelis, Dimitri, “Will COVI-19 fiscal recovery packages accelerate or retard progress on climate change?”, Oxford Review of Economic Policy, Vol. 36 (1), 2020 (forthcoming).

ICAP (International Carbon Action Partnership), Emissions Trading Worldwide: Status Report 2018. Berlin 2018.

IPCC (Intergovernmental Panel on Climate Change), Special Report: Global Warming of 1.5°C, October 2018 (https://www.ipcc.ch/sr15).

Climate Change 2014 - Synthesis Report. Cambridge, UK: Cambridge University Press, 2014.

Kachi, Aki, Frerk, Michel, Carbon Market Oversight Primer, International Carbon Action Partnership (ICAP), Berlin 2013.

Kettner, Claudia, Kletzan-Slamanig, Daniela, "Carbon taxation in EU Member States: evidence from the transport sector," in: Weishaar, Stefan E., Kreiser, Larry, Milne, Janet E., Ashiabor, Hope, Mehling, Michael (eds.), The Green Market Transition, chapter 2, 17-29, Edward Elgar Publishing, 2018.

Kirchner, Mathias, Sommer, Mark, Kettner-Marx, Claudia, Kletzan-Slamanig, Daniela, Köberl, Katharina, Kratena, Kurt CO_2 Tax Scenarios for Austria - Impacts on Household Income Groups, CO_2 Emissions, and the Economy, WIFO Working Paper 558, February 2018

Köppl, Angela, Schleicher, Stefan, What Will Make Energy Systems Sustainable? WIFO Working Paper No. 566, June 2018.

Köppl, Angela, Schleicher, Stefan, Schratzenstaller, Margit, Policy Brief: Fragen und Fakten zur Bepreisung von Treibhausgasemissionen, WIFO, November 2019.

Köppl, Angela, Schleicher, Stefan, Schratzenstaller, Margit, Steininger, Karl W., COVID-19, Klimawandel und Konjunkturpakete, WIFO Research Brief 1/2020, April 2020.

Krenek, Alexander, Sommer, Mark, Schratzenstaller, Margit, Sustainability-oriented Future EU Funding A European Border Carbon Adjustment, WIFO Working Paper 587, 2019.

Marcu, Andrei, Vangenechten, Domien, Alberola, Olsen, Jahn, Emilie, Caneill, Jean-Yves, Schleicher, Stefan, de Rafael, Roman, 2020 State of the EU ETS Report, ERCTS, Wegener Center, ICIS, I4CE, ecoact (eds.), 2009.

Meyer, Lukas, Steininger, Karl, Das Treibhausgas-Budget für Österreich, Wegener Center für Klima und Globalen Wandel, Karl-Franzens-Universität Graz, Oktober 2017.

Mizrach, Bruce, Otsubo, Yoichi, The market microstructure of the European Climate exchange, Journal of Banking & Finance, Vol. 39, February 2014, 107-116.

OECD, Effective Carbon Rates 2018 - Pricing Carbon Emissions Through Taxes and Emissions Trading, Paris, September 2018

Sachverständigenrat, Aufbruch zu einer neuen Klimapolitik, Sondergutachten, Juli 2019.

Schleicher, Stefan, Marcu Andrei, Köppl, Angela, Schneider, Jürgen, Elkerbout, Milan, Türk, Andreas, Zeitlberger, Alexander, Scanning the Options for a Structural Reform of the EU Emissions Trading System, CEPS Special Report, No. 107, May 2015

Schleicher, Stefan, Steininger, Karl, Energiepreis-Stabilisierungsmechanismus, Memo, Wegener Center für Klima und Globalen Wandel, Karl-Franzens-Universität Graz, März 2020.

Schleicher, Stefan, Steininger Karl, Dekarbonisierung und Carbon Management für Österreich, Wegener Center für Klima und Globalen Wandel, Karl-Franzens-Universität Graz, November 2018.

Schulmeister, Stephan, „Globalization without global money: the double role of the dollar as national currency and as world currency", Journal of Post Keynesian Economics, 2000, 22(3), 365-395.

Schulmeister, Stephan, "Profitability of technical stock trading: Has it moved from daily to intraday data?", Review of Financial Economics, 2009, vol. 18, issue 4, 190-201.

Schulmeister, Stephan, Technical Trading and Commodity Price Fluctuations, WIFO Study, 2012.

Schulmeister, Stephan, Der Weg zur Prosperität, ecowin, Salzburg, 2018.

Stiglitz-Stern-Commission, Report of the High-Level Commission on Carbon Prices, International Bank for Reconstruction and Development and International Development Association/The World Bank, May 29, 2017.

Wildauer, Rafael, Leitch, Stuart, Kapeller, Jakob, How to boost the European Green Deal's scale and ambition, Foundation for European progressive studies, Arbeiterkammer, Renner-Institut (eds.), 2020.

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