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Financing the Green Transformation with a Carbon-based Wealth Tax for Climate Protection – A Proposal*

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Summary

Wealth distribution and climate risks are two great challenges of our time. This paper proposes a new type of tax to correct the disparity of wealth distribution and help to finance (and accelerate) the green transition. Our proposal is a Carbon-based Wealth Tax (CWT) that should be levied on carbon-based (brown) wealth rather than carbon-intensive goods as the usual carbon tax would suggest which is often shown to be regressive. While the CWT re-corrects wealth distribution it raises revenue that could be used to subsidize the creation of green assets – by changing dynamic portfolio decisions and trig-

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* This webinar explains the proposal https://www.youtube.com/watch?v=IVzFAMLrVzk. The more technically oriented research paper on the Carbon-based Wealth Tax is available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4114243. Earlier versions of this paper have been presented at the Henry George School of Social Science, June 2022 and the 26th Forum for Macroeconomics and Macroeconomic Policies (FMM) Conference, Berlin, Germany, in October 2022. This work has benefited from insightful comments from Katherine Pratt, David Gamage, and Shi-Ling Hsu made at the Tax Policy Colloquium of the Loyola Law School. We would like to express our special thanks to Joao Paulo Braga for helping us with the harmonic estimations. The paper was recently also presented at La Sapienza University, and at an EU Conference with participants from the EU Commission. Some of the research reported here is based on the book by Unra Nyambuu and Willi Semmler: Sustainable Macroeconomics. Climate Risks and Energy Transitions, Springer Publishing House, 2023. We want to thank for productive discussions Thomas Fischermann, Reiner Hoffmann, Joao Braga, Juergen Zattler, Werner Roeger, Claudia Kemfert, Giacomo Corneo, Hans-Helmut Kotz, Michael Kuhn, Ibrahim Tahri, Stefan Mittnik, Timo Teraesvirta, and Dorothea Schaefer and colleagues at the IIASA, the New School for Social Research and the University of Bielefeld. We are also grateful for the extensive comments by Torben Klarl and an anonymous referee, both raising some important issues related to the model-guided as well as implementation challenges of our proposal. More extensive explanations of the technical background of this article, in particular on the dynamic portfolio theory, can be found in Semmler et al. (2024b).

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gering a reallocation of assets from brown to green ones. To demonstrate those effects stylized green and brown asset returns using US data are calibrated as low-frequency returns on US assets between 2010 and 2021. We find that such a tax and subsidy scheme as designed by a CWT may not adversely affect wealth evolution. The CWT is a feasible, effective, and fairer instrument for reducing carbon emissions, keeps wealth accumulation going, and supports a fair transition and control of sovereign debt dynamics.

Zusammenfassung

Vermögensverteilung und Klimarisiken sind zwei große Herausforderungen unserer Zeit. In diesem Papier wird eine neue Art von Steuer vorgeschlagen, um die Ungleichheit der Vermögensverteilung zu korrigieren und den grünen Wandel zu finanzieren (und zu beschleunigen). Unser Vorschlag ist eine kohlenstoffbasierte Vermögenssteuer (CWT), die auf kohlenstoffbasiertes (braunes) Vermögen erhoben werden sollte und nicht vorranging auf kohlenstoffintensive Güter, wie dies die übliche Kohlenstoffsteuer nahelegt, die sich oft als regressiv erweist. Während die CWT die Vermögensverteilung korrigiert, generiert sie Einnahmen, die zur Subventionierung der Schaffung grüner Vermögenswerte verwendet werden könnten – indem dynamische Portfolioentscheidungen geändert und eine Umverteilung von Vermögenswerten von braunen zu grünen Vermögenswerten ausgelöst wird. Um diese Auswirkungen zu demonstrieren, werden stilisierte Renditen grüner und brauner Vermögenswerte anhand von US-Daten als niedrigfrequente Renditen auf US-Vermögenswerte zwischen 2010 und 2021 kalibriert. Wir kommen zu dem Schluss, dass ein solches Steuer- und Subventionssystem, wie es von einer CWT konzipiert wird, die Vermögensentwicklung möglicherweise nicht negativ beeinflusst. Die CWT ist ein praktikables, effektives und gerechteres Instrument zur Reduzierung der Kohlendioxid-Emissionen. Sie hält die Vermögensbildung aufrecht und unterstützt einen gerechten Übergang und eine faire Kontrolle der Staatsverschuldungsdynamik.

JEL classification: G11, H23, Q58

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1. Introduction

In a recent article, Thomas Fischermann[1] pointed out that until now, the debates on a tax on wealth or on the super-rich was justified from the perspective of the recognition of the increasing wealth disparity[2] in many countries. In fact, it can be shown that the Gini Coefficient for wealth distribution in most of the advanced countries are worse than for income distribution. Indeed, there is plenty of academic theoretical and empirical work on this, early and prominent-

[1] See the German weekly newspaper DIE ZEIT, No 38, September 5, 2024. The English version can be found here: https://www.economicpolicyresearch.org/insights-blog/a-carbon-based-wealth-tax-for-climate-protection-a-proposal. See also the interview with Esther Duflo in DIE ZEIT Online, November 16, 2024.

[2] See Parker and Semmler (2024).

ly put forward by Thomas Piketty and his co-authors. But recently the debate turned to the issue of whether some wealth of a small group of the super-rich could be used to support the transition to a low-carbon economy.[3]

On the other hand, much academic work has shown that a carbon emission tax on economic activities or products (called carbon pricing), is a tax that needs to be very high to be effective but has quite adverse distributional consequences. There is usually a strong pass-through of a carbon emission tax to the buyers, for example, to the downstream producers and household consumers. This is essentially a consumption tax. Also, households with a high proportion of energy expenses in their budget are impacted most severely. Households with very high income are likely to cause much more CO_2 emissions whereas lower-income households pay a greater percentage of their income as carbon emission tax.[4]

Those price increases, due to carbon product taxes, directly affect the disposable real income of low and middle-income households. In recent studies, efforts focused on directed technical change, such as invention and innovation in renewable energy technology, seemed to be more effective, and face less popular unrest against recently, see Chen and Semmler (2024a). A price increase is felt by everybody, technology change is very sector-specific and creates less general popular unrest. Nordic countries such as Finland, Norway, Sweden, and Denmark seem to be more successful with the latter strategy, a technology-oriented strategy on decarbonization, see Chen and Semmler (2024a). We thus might want to support a carbon-based wealth tax (CWT) as more suitable way for a fair transition to a low-carbon economy.

2. Previous Proposals to Address Wealth Inequality

Traditionally, there have been made strong arguments against a capital or wealth tax.[5] As to that point, there is now a widespread public discussion on the

[3] An Oxfam report from October 28, 2024, writes: The top 1 percent wealthiest responsible for the same amount of carbon emissions as bottom 66 percent; see https://www.ctvnews.ca/climate-and-environment/top-1-per-cent-wealthiest-responsible-for-same-amount-of-carbon-emissions-as-bottom-66-per-cent-1.6652001#:~:text=According%20to%20the%20Oxfam%20report%2C%20a%20tax%20of,energy%20and%20a%20transit. Yet not all wealthy persons need to be taxed, as Zucman (2024) and Duflo (Interview with Viola Kiel, November 16, 2024, DIE ZEIT Online) suggest. In our proposal, we want to disincentivize the rich persons accumulating brown assets and instead incentivize them to accumulate green assets.

[4] See Kaenzig (2022).

[5] Traditionally the economic literature has maintained that optimality conditions imply a zero rate for capital tax, otherwise employment would be hurt. However, there have been recent challenges to this result. The canonical models of Chamley (1986) and Judd

rise of wealth disparities around the globe.[6] Proposals for correction of the rising wealth inequality are looming. It is well known that over some decades the wealth share of the top 5 percent of wealth owners, for example, is rising faster than the share of the rest of wealth owners, the former owning nowadays about 60 % or more of total wealth.

Traditionally there were in Europe some policy measures against that – but with little success. Traditionally European countries such as Norway, Spain, France, and Italy have a wealth tax on either personal wealth or on certain types of assets, such as real estate. Spain has a 3 % wealth tax and France has a mixture of personal wealth tax and tax on specific assets, roughly 1 and a half to 2 %, the former is an individual wealth tax, the latter a solidarity tax (recently), and a real estate tax. In the US the plan by Elizabeth Warren was a wealth tax of 2 % for wealth over and above $50 million.

Let us say an asset return (risk free rate plus equity premium) nowadays amounts roughly to 8 %, as Shiller has estimated historically. The remaining return would be in the case of Spain roughly 5 %, in France roughly 5 to 6 % and in the US 6 %. The before-tax return are roughly used as an average with respect to the expected returns and deductions. For the very wealthy there is a positive feedback loop – the higher the wealth, the greater the returns and the growth rates of wealth, due to information advantages, better collaterals for borrowing, higher saving rates, and greater research and management staff for generating returns.[7] Therefore the actually received returns can be quite above 8 % and the actual tax payments are usually much less than 2 %, and closer to zero; see Zucman, Interview, (2024) and Zucman (2024). At first sight, a percentage of tax on the returns of wealth owners appears as some loss of returns. But as will be shown total wealth evolution might not be affected much. As we can demonstrate, in a dynamic portfolio model, there might not even be a loss of asset accumulation in cases where we impose a CWT. As we will show below, the reduction of brown asset returns could be compensated by an increase in green assets

(1985) showed that the steady-state optimal capital taxation is zero when the long-run capital supply is infinitely elastic. Recent developments have cast doubts on such results. Saez and Stantcheva (2018) show how incorporating wealth into the utility function produces heterogeneity in wealth (unrelated to heterogeneity in labor earnings), invalidating the zero-capital tax result. Straub and Werning (2020) proved that intertemporal elasticity below one is already sufficient to produce a positive capital tax. Guvenen et al. (2019), in turn, demonstrated that agents can extract different returns from the asset market. This heterogeneity is enough to yield a rationale for wealth taxation since, in that view, it penalizes the idleness of asset holders. A referee has suggested one might think of the canonical models of Chamley (1986) and Judd (1985), by referring to capital with zero tax rate, as the limit case when there are no negative externalities, thus with green capital only.

6 See, https://wid.world/.

7 See Chappe and Semmler (2018).

and the wealth evolution might not decline faster, in fact, it may even improve with a CWT.[8]

3. Recent Motivations and Initiatives

The recent discussion went a step further connecting the wealth returns to climate change: "Tax the 3,000 richest people in the world!" demanded Nobel Prize-winning economist Esther Duflo at the IMF Spring Meeting in Washington. Surprisingly, she received enthusiastic support from a predominantly finance-minister audience from around the globe. Duflo, along with other influential economists like Gabriel Zucman and Thomas Piketty, advocate the above-mentioned proposal.[9] They propose a minimum tax on the assets of the world's richest people – say, 2 %. The revenue, which could amount to an extra $250 billion per year could be transferred to poorer countries to combat the effects of climate risks and finance an energy transition. It also could be used as collateral for climate-related borrowing or de-risking of loans to low-income countries.

Brazil's Finance Ministry is also very active in drawing proposals and advocating such taxes, repeatedly raising the issue in international meetings. Brazil was hosting the G20 meeting in Rio de Janeiro[10] on November 18 – 19 and will also host the World Climate Conference in Belém in 2025, where this discussion on taxing the super-rich might continue.[11] At previous G20 meetings, ministers from diverse countries like France, Spain, and South Africa had voiced their support already for taxes on the super-rich. Even Germany's Development Minister, Svenja Schulze, has also signed a declaration in favor of such measures.

Taxes on the super-wealthy would indeed be extremely fair (and climate-friendly): as the richest one percent of humanity currently emits as many greenhouse gasses as the poorest two-thirds of the global population. The poor, however, are the first to suffer the consequences of climate change. If such a tax were imposed, several practical questions would arise: who would guarantee that the money collected would truly be used to combat climate change? And how could

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[8] Through a CWT we would dis-incentivize the rich accumulating brown assets and instead incentivise them accumulting green assets.

[9] For a report on this proposal, see https://www.npr.org/2024/08/06/nx-s1-5064662/global-wealth-tax-g20-poverty-climate-change.

[10] President Lula stated in that G20 meeting: "Taxation of 2 % on the total assets of superrich individuals could generate funds of about $250 billion per year to be invested in facing up to social and environmental challenges all over the world."

[11] In Brazil, political packages are often designed to ensure that the rich do not oppose them. For example, President Lula da Silva's famous anti-hunger programs, which lifted millions out of poverty, would not have been possible without the tacit acceptance of industrialists, large landowners, and mine operators.

we prevent the age-old problem of the wealthy moving their capital to countries without such taxes? The proper answer is "tax harmonization" – that is, coordinated taxation across the main countries where the rich reside.

Without such minimum harmonization, Zucman's proposal probably won't work. However, in our original paper (see Bastos and Semmler, 2022) we are introducing a modified approach. We draw on traditional public finance principles and some political traditions, well alive also in Brazil. The public finance principle since Wicksell and Lindahl is the proportionality principle: Those who enjoy more public goods should pay higher taxes, which can be reversed: those who produce more public "bads" (for example destruction of the environment and release of greater CO_2 emission) should also pay more.

4. A New Proposal – A Carbon-Based Wealth Tax

Our new proposal is driven by several motivations. A tax and subsidy scheme that corrects the deterioration of wealth distribution, is a feasible, effective, and fairer instrument in speeding up the transition to a greener economy, and is helping to generate revenue for the public budget and control sovereign debt dynamics.[12] Technically, our proposal of a wealth tax for our CWT would not target the stock of assets, but the income derived from them, which we find less problematic. In this case, taxing income from carbon-based assets would have a similar effect to taxing the assets themselves but would be easier to implement. A wealth tax often presents many loopholes, whereas a tax on income from wealth and capital gains is typically easier and requires less information. However, the biggest challenge lies elsewhere: How do you differentiate between "brown" and "green" capital? At first glance, this seems like an insurmountable problem.[13] However recent advances have been made by economists in determining how much CO_2 is emitted by different industries and companies.

In the U.S., *under the Biden administration*, the Securities and Exchange Commission (SEC), and in the EU, the European Commission, were working on dis-

[12] A fundamental rationale for a CWT can indeed derived from the public finance literature. The proportionality principle in taxation, revived by the work of Richard Musgrave (Musgrave 1973), maintains that those who enjoy a higher proportion of public goods need to pay higher taxes. Viewed in reverse, this means that those who create a higher proportion of "public bads" – meaning negative externalities – need to pay a higher tax. Brown capital locks the economy into an unsustainable path. In that sense, it can be thought of as a public bad. The idea of "public bads" is also related to the joint production system where there are non-zero disposal costs (Hinrichsen & Krause 1981). In this case, the unwanted products – in our case, carbon emissions – entail a cost that is not acknowledged in the price system, making a strong case for taxation.

[13] Note that coal extraction with capture and sequestration (CCS) where then the CO_2 is eliminated could count also as "clean" asset, as a referee has pointed out.

closure requirements that will compel companies to report their CO_2 emissions – supported by the International Energy Agency (IEA) and the OECD. This idea is based on academic research. Patrick Bolton of Columbia Business School argues that large corporations, and also ESG firms (Environmental, Social, and Governance), should disclose their respective CO_2 emissions. According to his findings, this data is relatively easy to obtain.

In our proposal to tax asset flows, if the income from the brown assets is roughly 30 % of the income from assets this can subsidize the green assets. The net return from wealth, would of course fall in different countries: the remaining return in the case of Spain, France, and the US would be roughly 5 % (if we assume a normal asset return of 8 %). However, the return of the green assets at approximately 8 % would be higher than those 5 %, composed of risky and risk-free rates. *In an optimistic version*, these could be roughly 10 to 11 % if subsidized. The green assets would be preferred in portfolio decisions, generating over time a higher proportion of green assets in dynamic portfolios and financially supporting the decarbonization efforts.[14]

Though both the returns of green and brown assets are fluctuating over time, the brown assets fluctuate much more. This is shown in Figure 1 which is taken from Bastos and Semmler (2022). In that working paper we report harmonic estimations of returns on green and brown assets using the Fast Fourier Transform (FFT) of the time series (see also Chiarella et al. 2016). This way we can capture low-frequency movements on the returns, eliminating short-term noises that are usually disregarded in low-frequency portfolio decisions. What is used here is a sum of sine-cosine coefficients and the Sum of Squared Errors obtained from the harmonic estimations.

[14] A fraction of the tax revenue received is like to be allocated to low income countries as the Zucman-proposal suggests.

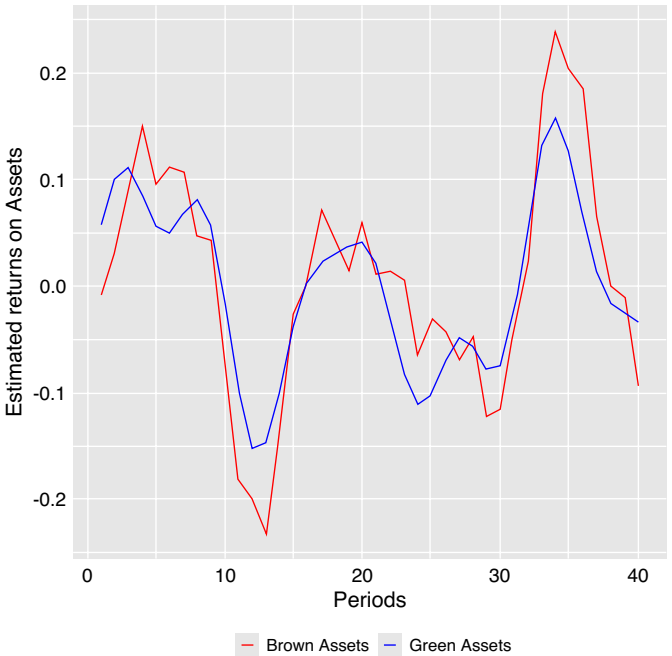

Figure 1: Harmonic estimations of green and brown asset returns

Quelle: Bastos and Semmler (2022).

Figure 1 plots both estimations of the low-frequency behavior of green and brown assets. As can be observed and consistent with other findings, brown assets are more volatile. On the other hand, green asset returns are more resilient to economic swings.

In Bastos and Semmler (2022) the dynamic portfolio optimization problem[15] is solved numerically using the Nonlinear Model Predictive Control (NMPC) algorithms discussed in Gruene et al. (2015) and the results are depicted in Fig-

[15] Note that we are using here a dynamic portfolio model of a Merton type and not the static portfolio theory of Markowitz. Also note this is not a representative agent model as in growth theory is used and that builds on infinite decision horizons. We work with finite decision horizons and stylize a prototypical model of large financial investment firms that reallocate assets when relative returns and volatility change and that take into account inflow and outflow of capital, see Chiarella et al. (2026). Though typically positive and negative (for example CO_2 emission) externalities are not taken into account in the standard Merton model, we have in a more detailed model also taken account of the externalities, see Semmler et al. (2024b). Of course the tax revenue from a CWT would slowly dissipate as the mix of energy sources moves more toward green energy, as one reviewer has observed.

ure 2. We undertake a simulation for 40 periods[16] for different tax regimes. In the Business-as-Usual (BAU) scenario, no tax is imposed. To evaluate the CWT's impact, we run the model for before and after-tax brown returns and subsidies for green returns. In Figure 2 we explore the wealth path scenarios for BAU, for a CWT of 20 % without and with subsidies and 40 % CWT with subsidies. This way we capture the influence of those magnitudes on the wealth trajectories depicted in Figure 2.

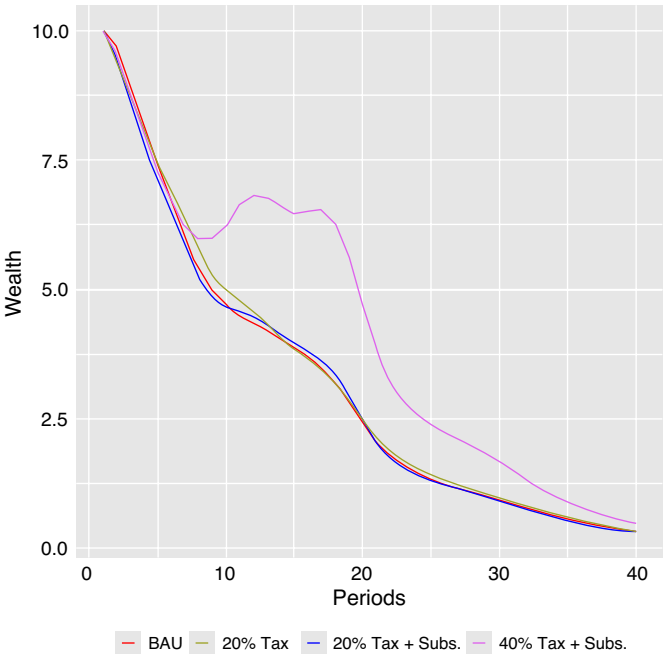

Figure 2: Evolution of total wealth after taxation and subsidies[17]

Quelle: Bastos and Semmler (2022).

An intuitive explanation for the dynamic results in the simulations of Figure 2 is: with those CWT on carbon-intensive assets the red line of Figure 1 shifts down and with subsidies the blue curve shifts up and substitution effects of green for brown assets set in. But there are more intricate mechanisms working. Figure 2 depicts the wealth dynamics, which is presumed to decline over time

[16] Note that periods are here discretization steps and not mapped into discrete time series steps as data are collected, a conversion that can be done with some further effort.

[17] Note: As observable we have chosen a parameterization of the model, using US financial market data, such that wealth will be depleted in finite time.

(with consumption reducing it more than it can rebuild through returns). We observe the following two cases:

- For a 20 % tax of CWT with or without subsidies for green assets, the result is not much different than what we get for the BAU case (the case of "business as usual", or no tax, see scenarios 1, 2 and 3). In the 20 % CWT tax case, without or with subsidies the wealth accumulation is not affected much but financial resources are shifted to decarbonization efforts and green assets, capturing the dynamic path. This means the red curve is shifting down, and the green curve shifting up by certain percentages in Figure 1.[18]
- When the CWT there is 40 % on income from carbon-based wealth, meaning returns remain roughly at 5 % percent, assuming a total average return of 8 %, then the red line holds, meaning that there are subsidies for green assets, scenario 4. There is now a greater wealth fraction of green assets, more resources shifted to decarbonization and to green asset holdings. Yet, overall the wealth is shrinking less than in the BAU case and the previous two cases of 20 % CWT without or with subsidies.

Though there are some more delicate specifications behind our simulation results, the above-stated results of the four scenarios appear reasonable.[19] However, one of the major issues is how to distinguish between green and brown assets. We can call this the identification problem, which should not be a self-defined declaration of companies, but publicly evaluated, monitored and enforced.

5. The Identification Problem and Policy Reinforcements

To identify brown and green assets, there is an idea developed by researchers that is more specific for advanced countries: the specific idea is to impose a substantial new tax on the super-rich – but without treating all assets equally for publicly listed companies. A distinction could be easily made between "brown" and "green" assets: oil fields, mining, steel production, factories producing internal combustion engines, and other CO_2-emitting industries, as well as coal and fossil-fuel-based electricity production, on the one hand, and climate-friendly wind farms, solar energy firms, and forest investments on the other. Income

[18] Note that brown capital could flow to other countries, but the international agreement of 2021 on a minimum tax on the super-rich with more than $1 Bill income requires a 15% across-country taxation.

[19] We have explored another scenario, namely when there is a 40% CWT and no subsidies. Wealth preservation is then kept on a higher level as compared to the first 3 cases. This is still somewhat a puzzling scenario since it preserves wealth better than other scenarios in the longer run. This is likely to be related to the parameter choice which may imply a strong (nonlinear) substitution effect.

from "brown" assets could be taxed heavily – possibly at rates as high as 20 % or more. The revenue generated would finance climate programs and could subsidize companies generating "green" assets. We thus have named this proposal the Carbon-based Wealth Tax (CWT) and the hope is that asset owners will shift from "brown" to "green" assets over time to optimize their tax burden. As mentioned, technically, the tax would not target the stock of assets but the income derived from the assets, which is less problematic. In this case, taxing income from carbon-based assets would have a similar effect to taxing the assets themselves, but it would be easier to implement. A wealth tax often presents many loopholes, whereas a tax on income from capital is typically easier and requires less information. As also mentioned, the biggest challenge lies in the distincion between "brown" and "green" capital. But recent advances have been made by economists in determining how much CO_2 is emitted by different industries and companies. This idea is partly based on academic research, with Patrick Bolton of Columbia Business School, who argues that large corporations, and also ESG firms (Environ- mental, Social, and Governance), should disclose their respective CO_2 emissions. According to his findings, this data is relatively easy to obtain. In the U.S., the Securities and Exchange Commission (SEC), and in the EU, the European Commission, are working on disclosure requirements that will compel companies to report their CO_2 emissions – supported by the International Energy Agency (IEA) and the OECD. Details of how the identification would be done can be found in Bastos and Semmler (2022).

Admittedly, the current proposal does not yet provide a comprehensive solution, as it assumes that all assets in which the rich invest are held by publicly listed companies that fall under some reporting requirements. There are also plenty of smaller, or less regulated companies in advanced, developing, and emerging markets that operate under significantly less transparency. In these cases, a sectoral distinction could be applied: small firms, even those not publicly traded, could still be taxed based on the emissions associated with their respective sectors. As research continues, it may become easier to distinguish between "brown" and "green" firms, sectors, and investment portfolios, following the sectoral distinctions[20], thus enabling the appropriate taxation of wealth investments.

6. Conclusions

Wealth disparities are an eminent problem in many countries, but historically a tax on the stock of wealth has shown mixed results for countries that have enacted a wealth tax. On the other hand, we have rising climate risks and the scarcity of public funds for the mitigation of climate change and adaptation to cli-

[20] In the US there are 430 sectors identifiable that can be ranked according to their carbon intensities, see Semmler and Chen (2024).

mate risks. In our proposal, we attempted to bridge those two acute problems by proposing the CWT. This appears not only fair for the correction of wealth disparities but can also provide effective finance for public budgets and help mitigate sovereign debt dynamics. Our CWT is not a penalty on productive enterprises and wealth that also takes care of the environment and climate risks, *but rather on those types of wealth that produce welfare-decreasing and destructive externalities*. Wealth accumulation does not necessarily decrease through the CWT, new wealth built up can be stimulated through the support of green wealth, such as carbon-free renewable energy creation and use.

Though a similar – but less fair – effect could also be generated by a carbon pricing of carbon-intensive products, and public revenue could also be raised by carbon pricing, the revenue being used for the green transition. However, implementing the CWT could generate funds more fairly and one could direct them toward technical change, to support invention and innovation in renewable energy technology.

This seems to be a more direct correction of externalities and it appears to be more effective. This strategy faces also less popular unrest against price increases as compared to a carbon emission tax, see Roy et al. (2024). A price increase through a carbon tax on products is felt by everybody, technology changes, however, are very sector-specific, creating less general populist unrest. Nordic countries such as Finland, Norway, Sweden, and Denmark, have also heavily funded the implementation of new energy technology through public subsidies. Those countries seem to be more successful with the latter strategy, see Roy et al. (2024). Funds for those new technologies can be raised by a CWT.

In our discussion with experts on those matters, the question is often raised that our proposal might fit the US but less so for European countries (like Germany, France, Italy, and Spain) where a larger number of firms are not listed in the stock market but are rather small or medium scale family firms. But in this case, the sectoral principle could be applied here where one knows in which sectors firms operate. Data on sectoral-based CO_2 emissions are well known and could be used for the distinction of brown and green assets. Going deeper into the standard industrial classifications, as input-output tables do,[21] may help to achieve this distinction.

Overall, our proposal has raised some important – but not completely resolved – issues related to both the model-guided part and implementation challenges of our proposal. Those cannot be sufficiently studied in this more popular version of our article. More extensive explanations of the technical background of this article, in particular on the dynamic portfolio theory, are still missing; its relation to long-run growth and business cycles, the role of technical

[21] See Chen and Semmler (2024).

progress, and how economic externalities should be built into the dynamic portfolio approach. Some of these issues are addressed in Chiarella et al. (2016) and Semmler et al. (2024b).

In addition, implementation challenges also need to be discussed further, taking into account emission intensities of firms and sectors, concerning the specific tax laws of countries. Moreover, the international capital mobility raises important issues concerning tax evasion through undetected capital mobility, a point that Zucman (2024) addresses. Much progress has been made on the border adjustment tax for a carbon tax on imported carbon-intensive products. Much progress has also been made on the capital mobility issue in general, for example on a global minimum tax of 15 % on assets over $ 1 Bill of income that has recently been agreed upon by several governments. Similar policies could apply in our case. Moreover, in case there exists also foreign income of wealth holders where the CO_2 emission of a company is not or cannot be disclosed, one could use as previously discussed the sectoral principle.[22]

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