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Modelling policy packages with combined climate, social, and macroeconomic goals: the Swedish case

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ABSTRACT

Backlashes to climate policy have raised the interest in policy packages that can simultaneously reduce emissions effectively, handle distributional effects, and reverse contemporary trends towards increased socio-economic inequalities. In this paper, we use Sweden as an example to study the effect of policy packages with combined climate, social, and macroeconomic goals. While Sweden has historically been considered a climate leader with a strong welfare state, income inequality has grown considerably. In recent years, the country has experienced a roll-back of climate policy, following debates concerning high fuel prices. Among the policy changes are reduced energy taxes on gasoline and diesel. We use the macro-econometric model E3ME, combined with micro-data for different income groups, to compare the effects of the reduced fuel taxes with other policy measures, using a similar fiscal amount. Results show that income support can compensate for high fuel prices more efficiently, while avoiding increased emissions. We further compare the effects of policy packages that combine a raised fuel tax or a progressive tax with recycling schemes. Fuel tax packages with recycling to dividends, green subsidies and public welfare can improve mitigation significantly, compensate for distributional effects, and have beneficial effects on the economy. Using a progressive tax to finance green subsidies and public welfare can combine mitigation with reduced income inequality, enhanced employment and economic growth. In both cases, deficit funding of green investments enhances policy performance.

Key policy insights

- Income support is more efficient than a reduced fuel tax in order to compensate households for increased fuel costs, avoiding increase in emissions, but with equal or enhanced effects on GDP and employment.
- Combining fuel taxes with recycling to dividends, green subsidies or public welfare can increase mitigation considerably, avoid undesired distributional effects, and maintain or enhance employment and economic growth.
- Using progressive taxation to finance green subsidies as well as spending on public welfare can combine mitigation with reduced income inequality, enhanced employment and economic growth.

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1. Introduction

The climate crisis is interconnected with a social trajectory characterized by growing inequalities (Piketty, 2014), democratic tensions (Castells, 2018), and rising support for right-wing populist and climate sceptic forces (Scheiring et al., 2024). The development has resulted in a politicization of the climate issue (Marquardt & Lederer, 2022), including movements like the Yellow Vests, elections of climate denying leaders such as Donald Trump (Böhmelt, 2021), and climate policy backlashes (Patterson, 2023).

Sweden's recent history provides an interesting case of this development (Ergon et al., 2025). Historically, Sweden has been considered as a strong welfare state and a leader in climate policy (Esping-Andersen, 1990; Karlson, 2021; OECD, 2025). Swedish greenhouse gas (GHG) emissions have decreased by 33% since 1990 (SEPA, 2025). Meanwhile, the Swedish welfare system has weakened (Blomqvist & Palme, 2020). Income inequalities have grown by 50% since 1990, measured as Gini coefficient (SFPC, 2024). Alongside these changes, popular support for traditional political parties has eroded, while support for the radical right-wing Sweden Democrats has grown (Rydgren & van der Meiden, 2019). In the lead-up to the 2022 national elections, three centre-right parties opened for collaboration with the Sweden Democrats (Aylott & Bolin, 2023). As energy prices surged in Europe after the pandemic and the Ukraine war, this became a salient issue. The four parties ran election campaigns blaming high prices on Swedish climate and energy policy, emphasizing the effects for common people, and promising to lower the prices on gasoline and diesel. Following an election victory, the four parties agreed on a government programme (Moderaterna et al., 2022), resulting in a roll-back of Swedish climate policy (OECD, 2025; SCPC, 2024). Energy taxes on gasoline and diesel have been reduced, motivated by effects e.g. on low-income households and rural populations (Swedish Government, 2023 and 2024), environmental budgets cut, and several key policy instruments weakened, including the Swedish biofuel mandate (SCPC, 2024). Departing from historical trends, Swedish GHG emissions grew by 7% in 2024, including a 22% increase in the transport sector (SEPA, 2025).

Such developments in Sweden and elsewhere have driven new interest in just transitions (García-García et al., 2020), policy acceptance (Heyen & Wicki, 2024), and policy packages (van den Bergh et al., 2021) that address the distributional effects of climate mitigation (Konc et al., 2022; Markkanen & Anger-Kraavi, 2019), and/or more widely combine climate transformations with social goals (Dixson-Declève et al., 2022). Studies indicate that perceived justice and fairness is critical for policy acceptance (Jagers et al., 2017; Matti et al., 2022; Mestre-Andrés et al., 2021), and that general trends of high or growing inequality can hamper support for climate action (Bakaki et al., 2022; Furceri et al., 2023). Carbon prices may place an extra burden on low-income groups and rural populations (Klenert & Mattauch, 2016), and justice concerns are a prevalent reason behind negative attitudes (Savin et al., 2020). Such problems may be alleviated by revenue recycling (Budolfson et al., 2021). Compensatory schemes may enhance the support for climate policy (Ewald et al., 2022; Konc et al., 2022; Lindvall et al., 2024), but support also depends on mitigation efficiency and the specific purpose of revenue recycling (Ejelöv et al., 2025; Mestre-Andrés et al., 2021). Furthermore, compensation for mitigation policies may do little to reverse broader trends towards growing inequality. For instance, environmental taxes constitute a small fraction of total taxation (OECD, 2024). To decisively cope with growing socio-economic inequality, wider agendas including e.g. taxes on income and wealth (Mattauch et al., 2022) may be required. Studies indicate that progressive taxes can help to reduce both GHG emissions and inequality (Owen & Barrett, 2020) and that the dual goals may have synergistic effects (Allen et al., 2019). The mitigating effects, however, may be jeopardized if redistribution simply shifts emissions from high to low-income groups. Moreover, Büchs et al. (2021) find that the mitigation effects of tax & dividend schemes may be enhanced considerably if recycling is geared towards green subsidies and combined with green investments.

In this paper we use the climate policy rollback in Sweden as a real-world example to explore policy packages with combined climate, social, and macroeconomic goals. We focus on the effects of reduced energy taxes on gasoline and diesel, and do not consider the effects of other parts of the rollback. The tax has been reduced several times since 2023, with the largest cut expected to have a long-term budgetary effect of 8 billion Swedish Crowns (SEK) per year, corresponding to 730 million euros (Swedish Government, 2023). We use the macro-econometric model E3ME (Cambridge Econometrics, 2022) to compare the environmental, distributional, and macroeconomic effects of the reduced fuel tax with alternative policy measures and packages that would utilize the same fiscal amount. Distributional studies often rely on microsimulation tools (Büchs et al., 2021; Owen & Barrett, 2020). Micro-models enable detailed analysis of short-term distributional effects, but lack the capacity of macroeconomic models to catch dynamic effects on the economy, energy systems, and the environment. Recently, agent-based models (Castro et al., 2020) have been used to analyse feedback between distributional effects and policy acceptance (Konc et al., 2022; Savin et al., 2023). In this paper we focus on combined environmental, distributional, and macroeconomic effects, and extend an established macro-econometric model (E3ME) with distributional treatment, utilizing detailed microdata for Sweden.

Based on the climate policy roll-back in Sweden, the article aims to: (1) compare the effects of lowered energy taxes on gasoline and diesel, amounting to SEK 8 billion, on GHG emissions, GDP, employment, and socio-economic inequality, with other policy measures using the same fiscal amount; and (2) model the effects of a similar raise in fuel taxes, and a limited set of policy packages that might better promote combined climate, social, and macroeconomic goals.

The article answers the following questions: What are the effects of the lowered fuel taxes on GHG emissions, GDP, employment, and distribution? How do these effects compare to those of alternative policy measures, such as green subsidies, lump-sum payments, or increased spending on public welfare? What would be the effects of policy packages that combine a raised fuel tax, or a progressive tax reform, with the alternative policy measures?

We proceed in section 2 to describe E3ME and the modelled scenarios. In section 3 we present the results. Finally, we discuss the results and their implications in section 4.

2. Methods and material

2.1. The E3ME model

E3ME is a global energy, environment and economy (E3) model, based on post-Keynesian theory and econometric estimations of macroeconomic relationships. The model was developed through the EU Research Framework Programmes (Cambridge Econometrics, 2022), and has been used to assess various effects of climate policy (Kiss-Dobronyi et al., 2023; Mercure et al., 2019; Pollitt et al., 2014).

E3ME breaks the world down into 71 regions, with up to 70 sectors in each region, and consumption into 41 (COICOP) categories. Input-output tables link sectors, while bilateral trade matrices link regions. The model is demand-driven but supply-constrained and provides channels between producing sectors and final demand. Firms are assumed to adjust their supply to meet demand. This process is subject to constraints, such as in labour and product markets, that feed back to prices and investment decisions.

The model's behaviour differs from that of computable general equilibrium (CGE) models (Mercure et al., 2019). Behavioural parameters are estimated using historical data, while money supply is assumed to be fully endogenous (Pollitt & Mercure, 2018). Importantly, the post-Keynesian framework implies a possibility of spare capacity, meaning that modelled policies can increase output and employment, if utilizing spare capacities (Pollitt & Mercure, 2018).

The model contains endogenous links between energy, environment and economy. Energy consumption is represented in economic and physical terms set to match. Furthermore, the model contains bottom-up modules simulating Future Technology Transformations (FTT) for several key energy users, including in the power (Mercure, 2012), heat (Knobloch et al., 2021), and transportation (Knobloch et al., 2020) sectors.

The model's database covers the period 1970–2019 annually, drawing on data from Eurostat, OECD, IEA and other national and international sources. These data are used to estimate the model's econometric parameters using methods developed in Hendry et al. (1984) and Engle and Granger (1987). The full model manual (Cambridge Econometrics, 2022) is available on the model website (www.e3me.com), and a complete list of equations is provided in Mercure et al. (2018).

2.2. Distributional treatment

To enhance the ability of E3ME to approximate distributional effects, a method developed by Rečka et al. (2022) has been applied. This method divides households into decile groups, using cross-sectional microdata of income structures and consumption patterns for each group. This paper uses income data for Swedish households from 2020 (Statistics Sweden, 2024), and consumption data from the Swedish Household Budget Surveys for 2006–2009 (Statistics Sweden, 2010). Swedish household surveys after 2009 have suffered from lack of participation. While a new survey was done in 2021, it was performed during the Covid 19 pandemic, uses new methods and is not yet official statistics (Statistics Sweden, 2024). After consultations with Statistics Sweden, we have refrained from use it.

The model uses vectors to represent components of disposable incomes for the decile groups (e.g. shares of total wages, taxes, etcetera), and one matrix to represent consumption patterns for the decile groups, divided into 41 consumption categories (e.g. shares of total consumption expenditures spent on different categories). The income vectors enable changes at the macro level (e.g. in wages and taxes) to be linked to changes in disposable income for the decile groups. Two methods are then combined to calculate changes in consumption: (i) for most consumption categories, changes are calculated using historical consumption patterns and income elasticities derived at a macro level; (ii) for energy carriers, such as gasoline and diesel, changes are derived at a macro level, i.e. in E3ME's energy and FTT modules. Furthermore, consumption of gasoline and diesel is calibrated to estimates on price elasticity for car travel in Sweden (Pyddoke et al., 2021; Pyddoke & Swärdh, 2015). Price elasticity is assumed to be -0.2 in the short run, approaching -0.5 in the long run. For more information on the distributional treatment, see Supplementary Material (S1) and Rečka et al. (2022).

The method we apply enables approximations of changes in disposable income and consumption patterns across income deciles. The model is thus able to capture distributional effects of, for instance, a fuel tax, or recycling schemes, including feed-backs at a macro level. The latter is important, as consumption patterns and saving rates vary across deciles, e.g. low-income groups will likely spend more on consumption, while high-income groups will likely save more. The approach has its shortcomings. Links between the distributional treatment and model equations at the macro-level are limited, including e.g. for wages and employment. Furthermore, the treatment does not reflect heterogeneities within the decile groups. This may be important when considering the effects of high fuel prices. Low-income groups tend to have less access to cars and may thus, on average, be less impacted by a raised fuel tax than high-income groups. However, those who are dependent on cars may be more severely impacted (NIER, 2023; Pyddoke et al., 2021; Swärdh et al., 2023). Nevertheless, the approach can approximate distributional effects, and enrich the knowledge gained by micro-simulation models by adding dynamic and macro-scale effects modelled by E3ME.

2.3. Scenarios

We use three sets of policy scenarios for Sweden to model effects on GHG emissions, GDP, employment, disposable income, and consumption expenditure until 2035. All scenarios assume policy changes to be implemented in 2023, and are compared with a baseline scenario assuming no policy changes (see 2.3.4).

2.3.1. Alternative policy measures

In the first set, we compare the effects of five individual policy measures (see Table 1). The first scenario represents a reduced energy tax on gasoline and diesel. The fuel tax is reduced by SEK 8 billion in 2023, and then kept at the same level in constant prices. While this paper focus on the principle effects of a single tax cut, it could be noted that total fuel tax cuts in 2023–2025 amount to more than SEK 15 billion (Swedish Government, 2022; Swedish Government, 2023; Swedish Government, 2024). In future studies, it would be interesting to examine the effects of the total tax cuts. Modelling indicate that effects on emissions scale roughly linearly, i.e. a SEK 16 billion cut have twice the effect of a SEK 8 billion cut. It is assumed that the tax cut is financed by deficit, and does not impact other government spending. This is a simplification, but makes comparisons easier. It could be added that total budgets in the relevant years were in fact running on deficit, arguably both due to this reform and other increased spending, such as on defence. The fuel tax reforms were introduced with negative fiscal impacts acknowledged, but without references to other reforms making up for those impacts.

The other scenarios represent the effects of not reducing the fuel tax, and instead using the same fiscal amount (SEK 8 billion) on four alternative policy measures: (i) subsidizing purchases of EVs; (ii) lump sum

Table 1. Policy scenarios.

Policy scenario	Fiscal effect
Set 1: Alternative policy measures	
Reduced fuel tax	-8 billion SEK (deficit)
EV subsidies	-8 billion SEK (deficit)
Lump sums	-8 billion SEK (deficit)
Reduced income tax	-8 billion SEK (deficit)
Public welfare	-8 billion SEK (deficit)
Set 2: Fuel tax packages	
Raised fuel tax	+8 billion SEK (surplus)
Fuel tax + lump sums (T&D)	±8 billion SEK (budget neutral)
Fuel tax + EV subsidies	±8 billion SEK (budget neutral)
Fuel tax + public welfare	±8 billion SEK (budget neutral)
T&D + EV + public welfare	±8 billion SEK (budget neutral)
T&D + EV + public welfare deficit	-8 billion SEK (deficit)
Set 3: Progressive tax packages	
Progressive tax reform (PT)	+8 billion SEK (surplus)
PT + EV subsidies	±8 billion SEK (budget neutral)
PT + public welfare	±8 billion SEK (budget neutral)
PT + EV + public welfare	±8 billion SEK (budget neutral)
PT + EV + public welfare deficit	-8 billion SEK (deficit)

payments; (iii) reducing income tax; and (iv) increasing spending on public welfare. We again assume deficit funding. In effect, the scenarios thus compare different ways of spending SEK 8 billion through deficit.

Subsidizing EVs is chosen as an alternative mitigation measure targeting the transportation sector, which causes 31% of Swedish GHG emissions (SEPA, 2025), and is critical for reaching Swedish climate targets. 6% of the Swedish car fleet were EVs in 2023 (Transport Analysis, 2024). The subsidy can be viewed as a way to help car-dependent households to transition away from the use of fossil fuels. Budget and mid-class EVs are subsidized, with levels adjusted to equal SEK 8 billion in constant prices. The level of the subsidy is thus gradually lowered as sales increase.

Lump sum payments are chosen to represent straightforward support to households and can be general or directed to specific decile groups. We model three distributions: (i) equal payments to all decile groups; (ii) equal payments to groups 1–7; and (iii) 1–3 respectively. In each case, SEK 8 billion is used (constant prices).

Reducing income tax is chosen as an alternative method to support households. Income taxes are reduced by SEK 8 billion in 2023, corresponding to 0.22% reduction of the tax rate, then kept at constant level. The share of taxes paid by each decile group is not changed, i.e. taxes are lowered proportionally to current levels.

Increasing spending on public welfare is chosen for two reasons: welfare sectors have low carbon intensity, and extended public welfare may contribute to reduced inequality. Half of the money is channelled to public education, and half to public healthcare. Total spending is increased by SEK 8 billion from 2023 (constant prices). It should be noted that E3ME is only able to capture economic activities related to these sectors. The model may thus underestimate total impacts on e.g. GDP, because it is unable to capture human capital growth and other effects.

2.3.2. Fuel tax packages

In the second set we compare the effects of a raised fuel tax with policy packages using the tax revenues in different ways (see Table 1). The packages can be understood as different ways to compensate for the distributional effects, and enhance the mitigation effects, of a raised fuel tax.

In the first scenario, the fuel tax is raised instead of lowered, with SEK 8 billion, thus generating a government surplus. In the second scenario, called tax & dividend (T&D), we raise the fuel tax, and recycle the tax revenues to lump sum payments. We model three distributions of lump sums: (i) equal lump sums to all deciles; (ii) equal lump sums to decile group 1–7; (iii) and to group 1–3. In all cases total lump sums equals tax revenues, i.e. the scenarios are budget neutral. In the third scenario (fuel tax + EV subsidy), we raise the fuel tax, and recycle the revenues to subsidies of EVs. In the fourth scenario (fuel tax + public welfare), we raise the fuel tax, and recycle the revenues to increase spending on public welfare. In the fifth scenario, we raise the fuel tax, and mix the three types of revenue recycling. We model seven combinations, with one third or two thirds of the revenues going to either lump sums payments, EV subsidies, or spending on public welfare. In all cases, lump sum payments are directed to decile group 1-7. Finally, in the sixth scenario, we also assume that an additional SEK 8 billion in deficit funding is available, and can be used for green investments. The money is spent on EV subsidies, and five combinations of fuel tax recycling are modelled, from all going to dividends, to all going to public welfare.

2.3.3. Progressive tax packages

In the third set we use a progressive tax reform instead of a raised fuel tax in order to generate revenues (see Table 1). This can be thought of in terms of policy packages focusing on reducing socio-economic inequality more broadly, rather than simply compensating for the distributional effects of mitigation measures.

The first scenario represents a progressive tax reform (PT), targeting the top income decile. One rationale behind this choice is that the growing income shares of the top decile have been a key feature of the rise in inequality in Sweden (SFPC, 2024). Another rationale is that the top decile is responsible for considerably larger consumption-based GHG emissions than other income groups (Chancel, 2022). A tax focusing on the top income decile might thus reduce socio-economic inequality, target high emitters, and generate revenues to finance climate mitigation (Mattauch et al., 2022). The progressive tax is constructed by combining a raised income tax with equal lump sum payments to decile groups 1–9. The tax rate and lump sums are set so that SEK 8 billion in revenues remains after lump sum recycling in 2023. The package thus generates government surplus and progressive redistribution.

In the second scenario (PT + EV subsidies), we use the revenues from the progressive tax reform to subsidize EVs. In the third scenario (PT + public welfare), we instead use the revenues to increase spending on public welfare. In the fourth scenario (PT + EV subsidies + public welfare), we use half of the revenues to subsidize EVs, and half to increase spending on public welfare. Finally, in the fifth scenario, we again assume that deficit funding can be used for green investments. EV subsidies are financed by deficit, and all revenues from the progressive tax reform are spent on public welfare.

2.3.4. Baseline

All policy scenarios are compared to a baseline scenario assuming no policy changes. Historical data for key variables are obtained from Eurostat (2021), except for energy use data, which are sourced from the IEA's World Energy Balances (2022a). Data on the Swedish vehicle fleet has been updated using the most recent available data from Transport Analysis (2024). The baseline scenario is calibrated with established forecasts, including IMF's World Economic Outlook (2022), the European Commission's Ageing Report (2021), and IEA's World Energy Outlook (2022b). Furthermore, it is assumed that ETS prices in the EU follow the recommendations on harmonized price trajectories set by the European Commission (2023). Consequently, the baseline scenario does not take the possible effects of strengthened EU policies, such as Fit for 55 (European Council, 2023), into account. This may be a limitation, e.g. as a baseline including EU ETS 2 could alter some results towards the end of the modelling period. Sweden already has a carbon tax including the transportation sector (Swedish Government, 2025), and it is not yet clear how EU ETS 2 will be implemented, and what will happen with the Swedish carbon tax.

3. Results

The following sections summarize the results (see S2 in Supplementary Material for details).

3.1. Alternative policy measures

The results of the first scenario set, comparing a reduced fuel tax with alternative policy measures, are summarized in Figure 1. The fuel tax reduction increases territorial emissions by 150 kt CO_2 the first year, approaching 0.4 Mt CO_2 after five years. The change is driven by a gradual increase in road travel demand and, to a lesser

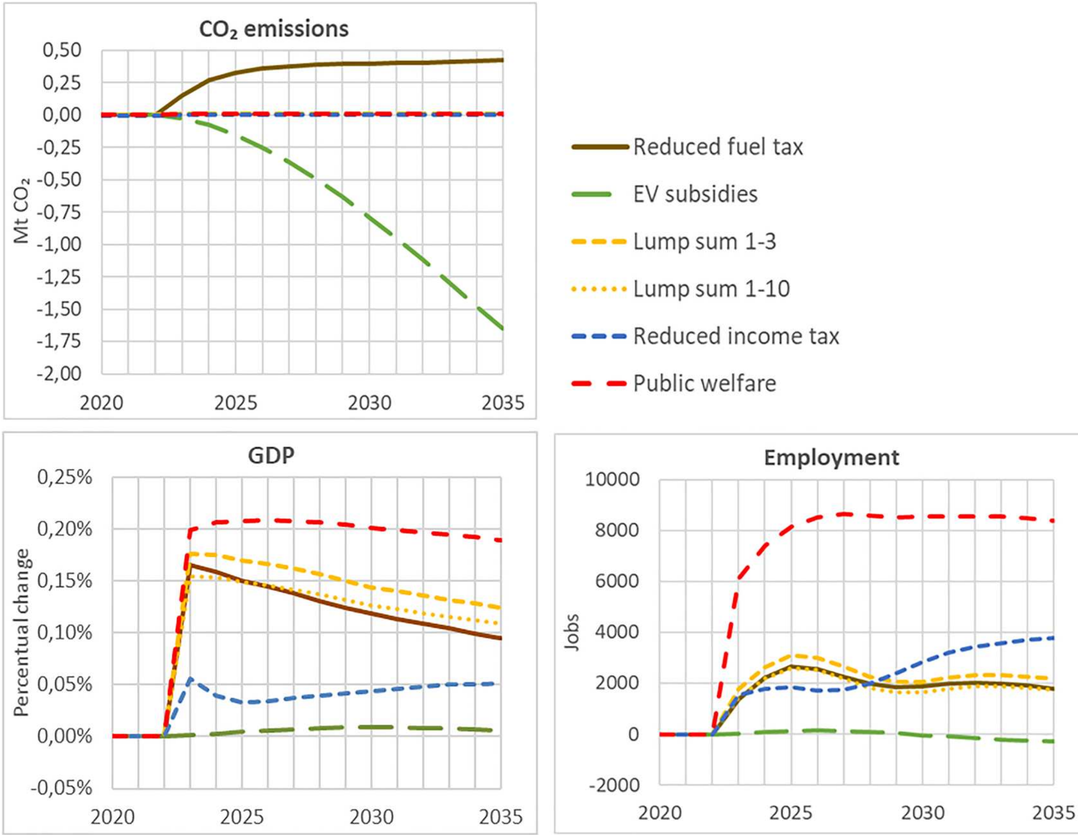

Figure 1. Effects of a reduced fuel tax and alternative policy measures, on territorial CO_2-emissions, GDP, and employment. All effects in the figures are compared with the baseline scenario.

extent, slower uptake of EVs. GDP is initially lifted by 0.17%, largely due to increased consumption, in particular of fossil fuels, but also more widely, with gradually declining effects. Effects on employment are positive but modest, in the order of 1400–2500 jobs.

The effects of the alternative policy measures differ considerably from those of the reduced fuel tax. Emissions grow marginally for lump sum payments, reduced income tax and spending on public welfare (1–10 kt CO_2), due to much lower increase in use of fossil fuels. Subsidizing EVs has considerable mitigation effects, with yearly emissions reduced by 1.7 Mt CO_2 by 2035, driven by the faster adoption of EVs, and reduced use of fossil fuels. The effects are four times larger (and with a flipped sign) than those of a reduced fuel tax.

Spending the SEK 8 billion on public welfare lifts GDP (0.21% initially) more than a reduced fuel tax, with GDP boosted by increase of both public and private consumption. The policy measure also results in a significant increase in employment, 6100–8600 jobs, largely, but not exclusively, in the education and healthcare sectors. Lump sum payments result in a comparable boost in GDP as a reduced fuel tax, driven by increased private consumption. The boost is largest (0.18% initially) if payments are directed towards decile groups 1-3, as low-income earners use all incomes for consumption. A reduced income tax has less positive effect on GDP (0.06% initially), likely as a result of wage adjustments. EV subsidies have low effects on GDP (0.01% in the long run). Also, while lump sum payments and reduced income tax have modestly positive effects on employment (1000–4000 jobs), subsidizing EVs has small effects. We attribute this to the fact that EV subsidies promote technology shift, i.e. sales of EVs increase significantly, while overall car sales increase only slightly, with no significant effects on GDP and employment.

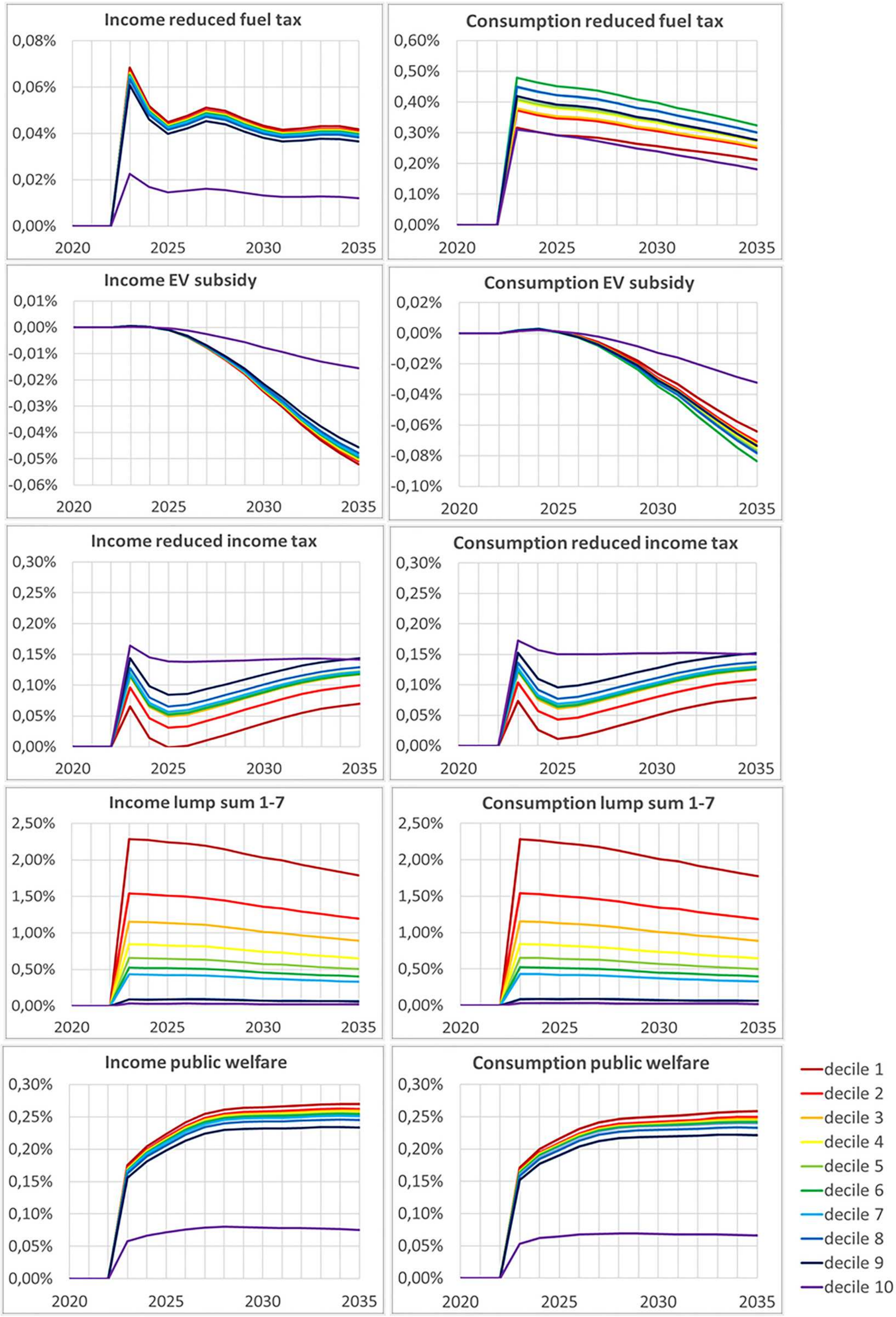

Figure 2. Average percentual effects of a reduced fuel tax and four alternative policy measures, on disposable income (left), and total consumption expenditure (right), for households in the ten income deciles.

Distributional effects are compared in Figure 2. The reduced fuel tax raises disposable incomes marginally (<0.07%), influenced by higher GDP and lower fuel prices. Consumption expenditures, however, are lifted significantly (0.2–0.5%). Mid and high-income households (decile 5–9) benefit most, as they spend the largest shares of incomes on driving. It should be noted that these are average effects. Low-income households have less access to cars (Pyddoke & Swärdh, 2015), but those who are dependent on cars would likely benefit most.

In comparison, spending the SEK 8 billion on EV subsidies have small but negative effects (<0.1%) on disposable incomes and consumption levels, with increasingly less spent on fossil fuels, and more on other consumption. Again, these are average effects. Subsidies are initially spread out over 90,000 EVs, adding to 1.5 million cars by 2035. The reduced income tax raises incomes among all deciles (0.1–0.2%), but with regressive effects due to its construction (larger tax cuts for high-income households). Lump sum payments and spending on public welfare have both larger and progressive effects. Spending on public welfare boosts average incomes by 0.2%−0.3% among all decile groups, except for the top decile (likely due to its large share of capital incomes). Half of the lift occurs within the education and healthcare sectors, and half is due to dynamic effects, and spread out over sectors. Lump sum payments have by far the most progressive effects. Equal lump sum payments to all deciles raise disposable incomes for low-income groups with 0.6%−1.6%, while lump sum payments targeted towards deciles 1–3 raise incomes for low-income groups with 2.0%−5.2%. Crucially, the effects of lump sum payments on consumption expenditures are larger or much larger than those of a reduced fuel tax up to the fifth decile for equal payments to all deciles, and up to the seventh decile for payments to deciles 1–7. This is important, as it shows the potential of lump sum payments to compensate for the distributional effects of increased fuel costs.

3.2. Fuel tax packages

The results of the policy packages based on a raised fuel tax are summarized in Figure 3 (left hand diagrams). Without revenue recycling a raised fuel tax has declining but significantly negative effects on GDP (−0.17% initially), negative effects on employment (1300–2500 jobs), while it reduces yearly emissions with 0.4 Mt CO_2 in the long run. Recycling revenues to lump sums (T&D) or spending on public welfare have a similar effect on territorial emissions, but wipe out the negative impacts on GDP and employment. T&D improves GDP slightly (0–0.02%), while spending on public welfare raises GDP by 0.08% and creates 4700–6400 jobs. Recycling to EV subsidies only marginally improves GDP or employment when compared with the raised fuel tax, but has an effect on emissions that is five times larger (2 Mt CO_2 per year by 2035).

Distributional effects are summarized in Figure 4. A raised fuel tax would have small negative effects on disposable income, but significant negative effects on consumption expenditures (0.3–0.5% initially), with average mid and high-income households affected most. Again, it should be noted that low-income households dependent on cars are likely more severely affected. Recycling to EV subsidies does not change the pattern much. Recycling to spending on public welfare raises average incomes for all decile groups (0.03–0.21%), but fails to compensate most decile groups for the average effects of a raised fuel tax. Recycling to lump sum payments (T&D) has the largest progressive effects. Recycling to decile 1–7 (T&D 1–7) boosts disposable income among low-income households with 1–2.2%, and compensates all income groups up to the seventh decile for the average effects of the raised fuel tax. Recycling to all deciles compensates the effects up to the fifth decile, while recycling to decile 1–3 boosts consumption among low-income groups with 2.2%–4.8% – far more than the 0.3%–0.4% reduction resulting from the raised fuel tax.

When modelling combinations of recycling to lump sum payments, EV subsidies and spending on public welfare, we find that a combination with two thirds directed to lump sums and one third to EV subsidies combines enhanced mitigation with progressive distributional effects, while having minor negative effects on GDP and employment (Figure 3, left hand, and Figure 4, bottom). The policy package (0.7 T&D + 0.3 EV subsidies) reduces yearly emissions with 1.2 Mt CO_2 by 2035, three times as much as the raised fuel tax. Disposable incomes for decile groups 1–7 are raised with 0.2–1.4%, compensating average effects of the raised fuel tax up to the sixth decile. Effects on employment and GDP are small, with GDP reduced by 0.02% in the long run. Directing more revenues to EV subsidies enhances effects on emissions, but has less progressive

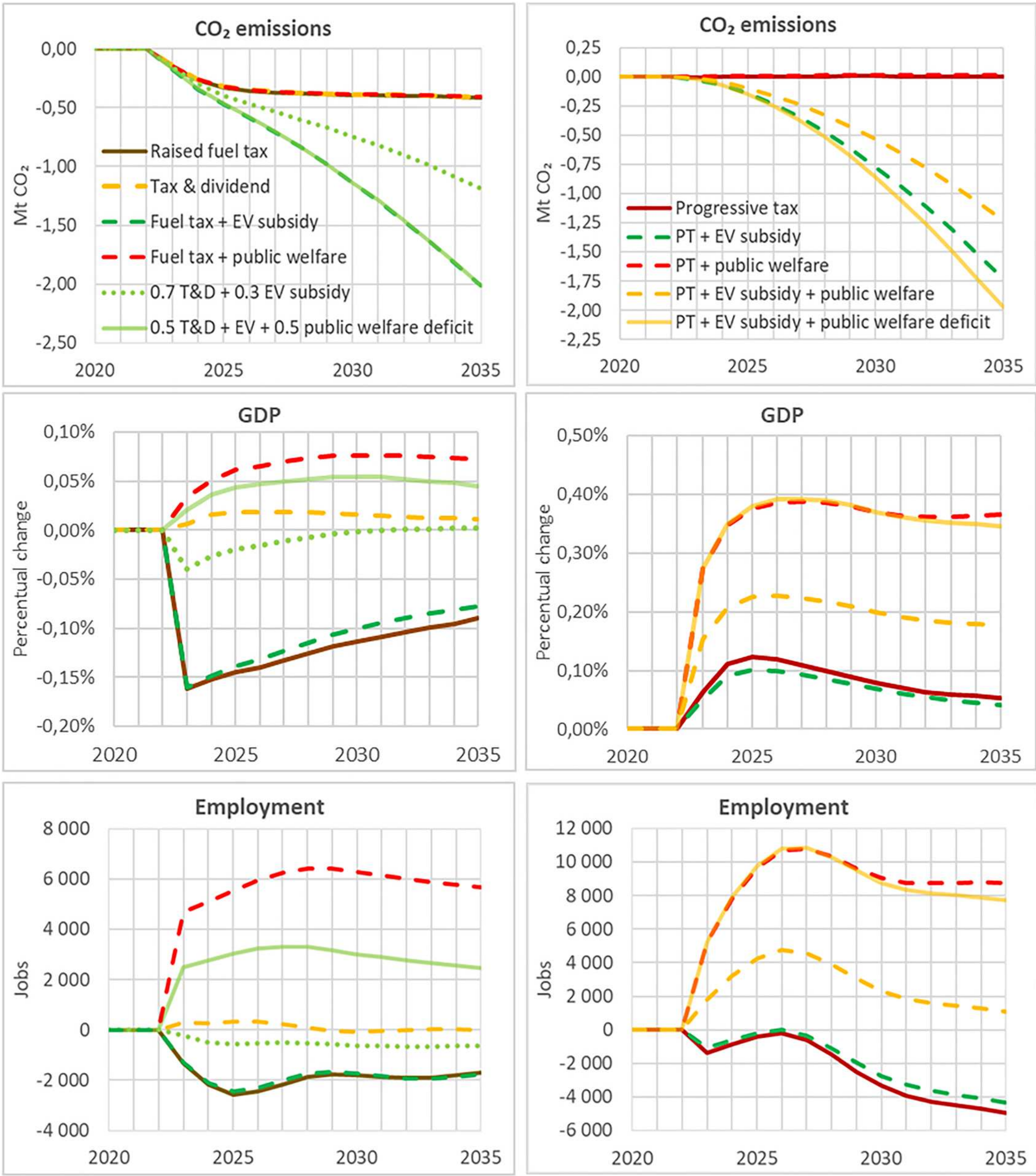

Figure 3. Effects of a raised fuel tax and policy packages with recycling schemes (left), and of policy packages including a progressive tax reform (right), on territorial CO_2-emissions, GDP, and employment.

effects, and more negative impacts on GDP. Directing more revenues to spending on public welfare boosts GDP and employment, but gives less room to compensate for near-term distributional effects of a raised fuel tax. Adding deficit funding of EV subsidies raises opportunities for mitigation, redistribution and the economy. The package with half revenues directed to dividends, and half to public welfare (0.5 T&D + EV + 0.5 public welfare) is included in Figure 3 (left hand). The package increases GDP by 0.05%, creates 2,500-3,300 jobs, and compensates average effects of a raised fuel tax up to the sixth decile, while reducing emissions by 2 Mt CO_2 by 2035.

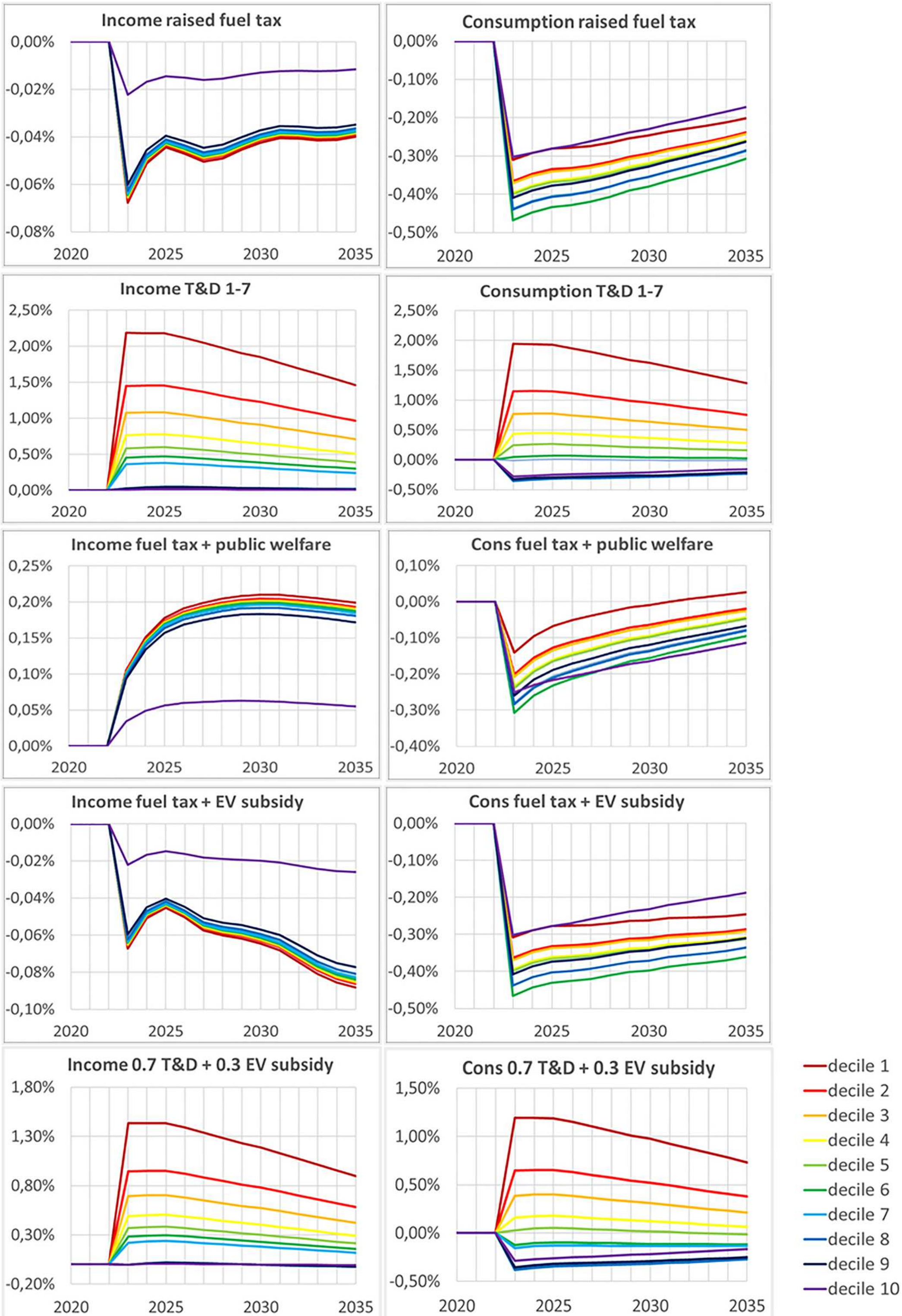

Figure 4. Average percentual effects of a raised fuel tax and policy packages using different recycling schemes, on disposable income (left), and total consumption expenditure (right), for households in the ten income deciles.

3.3. Progressive tax packages

The results for the policy packages built on a progressive tax reform are summarized in Figure 3 (right hand). The reform itself has negligible effects on territorial emissions (<1 kt CO_2). The package using all revenues for spending on public welfare (PT + public welfare) also has marginal effects on emissions (1–4 kt CO_2). It should be emphasized that effects on consumption-based emissions may be larger, and that better modelling of income elasticities may result in larger effects. The policy package using all revenues for EV subsidies (PT + EV subsidies), however, has substantial effects on territorial emissions, reducing them by 1.7 Mt CO_2 by 2035. The mixed package (PT + EV + public welfare), using half of the revenues for EV subsidies, and half for public welfare, also has considerable mitigation effects, reaching 1.2 Mt CO_2 by 2035. The packages using all or half the revenues for public welfare have substantial effects on the economy, boosting GDP with 0.15-0.4%, and creating 5,200-10,900 and 1,100-4,800 jobs respectively. The package using all revenues on EV subsidies has smaller and mixed effects, raising GDP slightly, but with modest, negative effects on employment. Adding deficit funding of EV subsidies to the mixed package enhances mitigation, and lifts GDP and employment further, with yearly emissions reduced by 2.0 Mt CO_2 by 2035, and GDP raised by 0.3–0.4%.

Distributional effects are shown in Figure 5. The packages raise disposable incomes for low-income groups with 0.5–2.5%. Spending the tax revenues on public welfare, or public welfare and EV subsidies, has the largest progressive effects. In these cases, disposable incomes increase for all income groups except for the top decile. The progressive tax reform by itself lowers disposable income for the top decile by 0.25%. However, positive effects on GDP reduces the losses to 0.1-0.2% for the packages where revenues are recycled to public welfare.

4. Discussion and conclusions

8 billion Swedish crowns (730 million euros) can be spent in diverse ways, with decisively different effects on emissions, GDP, employment, and socio-economic inequality. The results show that several other policy

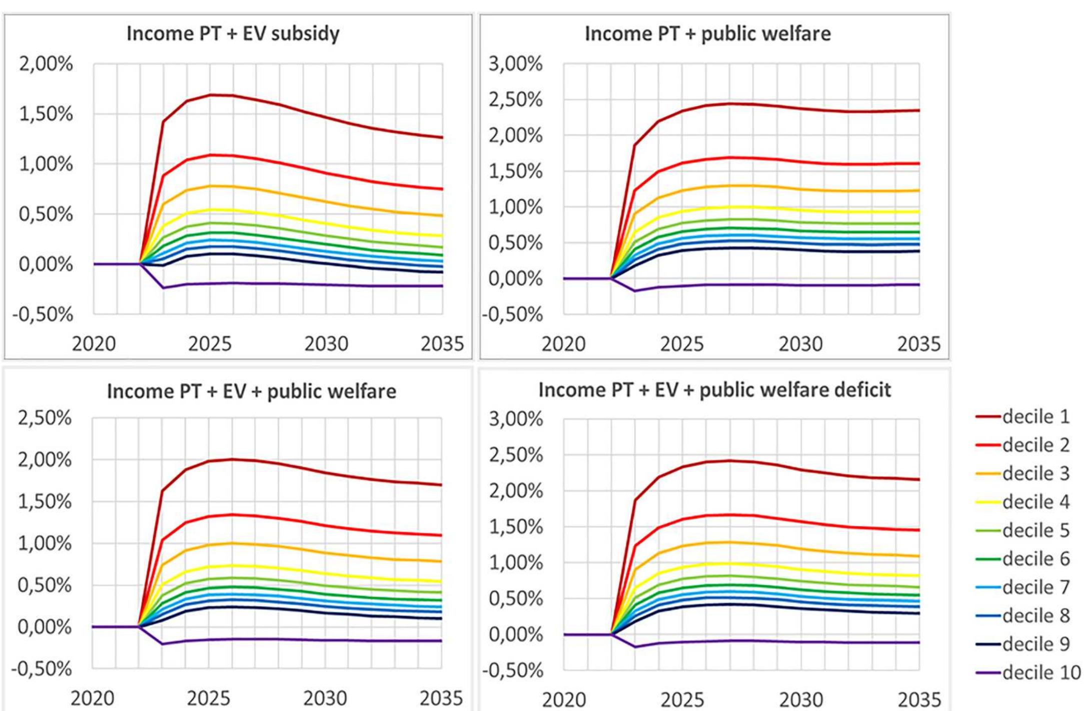

Figure 5. Average percentual effects of policy packages including a progressive tax reform on disposable income, for households in the ten income deciles.

decisions have effects that may be more desirable than a reduced fuel tax, in terms of mitigation, as well as improving macroeconomic and social indicators. Spending the same fiscal amount on public welfare is significantly better for GDP and employment, and spending it on subsidizing EVs reduces emissions considerably more than a reduced fuel tax raises them. Importantly, lump sum payments can compensate for high fuel prices and lead to more equal distributions of incomes, with equal effects on GDP as a reduced fuel tax. It could also be noted that the increase in GDP from spending on public welfare raises territorial CO_2 emissions only marginally.

The results also show considerable opportunities to construct policy packages with combined benefits for social and climate goals. Firstly: there are plenty of options to construct dividend schemes that counter distributional effects of raised fuel taxes. Secondly, by combining such schemes with other tools, such as subsidizing low-carbon alternatives, the combined effects can be considerable, boosting emission reductions, compensating losers of mitigation policies, and reducing inequality, while maintaining or even enhancing GDP and employment. If deficit funding can be used for green investments, abilities can be extended further, with significant positive effects on the economy. Thirdly, policy packages can also be constructed using progressive tax reforms. Such packages have the potential to reduce socio-economic inequality, while mitigation is financed by groups with large financial capacities and, on average, large carbon footprints. If revenues are used to subsidize low-carbon alternatives, such packages can have similar mitigation effects as schemes using fuel taxes. By adding spending on public welfare, significant positive effects on emissions, GDP, employment and socio-economic inequality can be achieved. While these results are based upon the Swedish case, we argue that they are of wider interest. As a former frontrunner in climate policy, now experiencing backlash, Sweden's challenges can provide insights for other industrialized nations. Efforts to decarbonize the transport sector using carbon pricing are approaching in the EU. Revenue recycling and construction of policy packages with dual climate and social goals may thus be of key importance.

It is also important to consider the limitations of the results. Despite improvements, the ability of E3ME to model distributional effects is restricted. The model does not catch heterogeneities within decile groups, and feedback between the distributional treatment and model equations at the macro level is limited. Furthermore, we have only modelled a limited number of stylized policy measures. Including other policy instruments might have considerably larger effects, on both emissions and inequality. For instance, the largest effects on emissions in this study are in the order of 2.0 Mt CO_2. Currently, this amounts to 4.5% of Sweden's territorial emissions. Moreover, the modelled policy packages use a fiscal amount of SEK 8 billion. This is a small part of Swedish GDP, in the order of 0.13%. For instance, even the most beneficial effects on socio-economic inequality reduces the Gini coefficient with 0.003-0.004. Simultaneously, the Gini coefficient for disposable income in Sweden has grown from 0.23 to 0.34 since 1990 (SFPC, 2024). To reverse such trends, more decisive measures are thus needed.

To conclude, the results highlight a potential to construct policy packages with desirable effects on emissions, GDP, employment and socio-economic inequality. While E3ME has its limitations as a macro-econometric model, the results highlight interesting routes for further research. We identify several such options: (1) modelling broader sets of policy packages, including more mitigation measures and e.g. taxes on capital and wealth; (2) cross-country comparisons; (3) refined distributional treatment; and (4) studying the effects of sequencing of policies in different packages (Herrmann & Savin, 2017). Studies along these lines may further help the construction of policy packages with even more desirable social, environmental and economic effects.

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Data availability statement

E3ME and connected data that support the findings of this study are available from Cambridge Econometrics (https://www.camecon.com/). Restrictions may apply to the availability of these data, which were used under license for this study. Specific Swedish data are included in the reference list.

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