Israel Public Policy Institute

HEINRICH BÖLL STIFTUNG TEL AVIV

Policy Paper

Leaving No One Behind

Carbon Pricing in Israel: Distributional Consequences across Households

Jan Steckel & Leonard Missbach

Beyond Carbon: Shaping the Transition to a Low-Carbon Economy Perspectives from Israel and Germany

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Leaving No One Behind

Carbon Pricing in Israel: Distributional Consequences across Households

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About the Project

This policy paper was written in the framework of the project "Beyond Carbon: Shaping the Transition to a Low-Carbon Economy - Perspectives from Israel and Germany".

The project, which includes the publication of a series of policy analyses and execution of experts' workshops, sets out to promote dialog and exchange of knowledge between experts from Germany and Israel regarding the transition to a low emissions society.

The project was conceptualized and executed by the Israel Public Policy Institute (IPPI) and the Heinrich Böll Foundation Tel Aviv with generous support by the Climate Fund of the German Federal Foreign O ice, represented by the German Embassy Tel Aviv.

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Israel Public Policy Institute

Israel Public Policy Institute (IPPI)

The Israel Public Policy Institute (IPPI) is an independent policy think-and-do-tank and a multi-stakeholder dialog platform at the intersection of society, technology and the environment. Through its research activities, knowledge sharing, networking and public outreach, IPPI contributes to the innovation of public policy with the goal of understanding, guiding, and advancing the transformation process of our societies towards a sustainable and democratic future. IPPI works with a global network of actors from government, academia, civil society, and the private sector to foster international and interdisciplinary crosspollination of ideas and experiences.

HEINRICH BÖLL STIFTUNG TEL AVIV

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The Heinrich Böll Foundation is an independent global think-and-do-tank for green visions. With its international network of 33 international offices, the foundation works with well over 100 project partners in more than 60 countries. The foundation's work in Israel focuses on fostering democracy, promoting environmental sustainability, advancing gender equality, and promoting dialog and exchange of knowledge between public policy experts and institutions from Israel and Germany.

DIALOG ישראלי גרמני

German-Israeli Dialog Program of the Heinrich Böll Foundation

The German-Israeli Dialog Program of the Heinrich Böll Foundation was established to foster cooperation and exchange of knowledge between public policy communities from Germany and Israel with the aim of generating new actionable insights in support of democratic values and sustainable development. The program is home for a range of projects and activities that provide unique collaborative spaces for researchers and practitioners from government, academia, tech and civil society to meet, debate and formulate innovative policy-oriented solutions to societal questions and challenges shared by both countries.

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Executive Summary

Carbon pricing has increasingly gained attention across public debates in Israel, Germany and other European countries, as it is considered an efficient policy instrument for reducing carbon emissions across large parts of the economy. Putting a price on CO_2 emissions helps to correct a significant market failure, which occurs when the polluting actors do not pay for the damage caused by the carbon emissions of their economic activities. Charging emitters per ton of the CO_2 emissions embedded in their consumption sets an incentive to reduce emission-intensive behaviors and transition to sustainable, more climate-friendly practices. In the UK, for example, carbon pricing has been effective. According to a 2018 OECD report (OECD 2018), carbon pricing led to a 58% reduction in emissions in the electricity sector and a 25% reduction in emissions in the overall economy.

Accordingly, carbon pricing has become a common policy instrument around the world, especially among OECD countries. Of the 185 signatories to the Paris Agreement, 96 countries, which account for 55% of global greenhouse gas emissions, indicated that they use, or plan to use carbon pricing as a tool to meet their emission reduction goals (Ramstein et al. 2019). 92% of countries in the OECD, of which Israel has been a member since 2010, have a carbon pricing mechanism in place in order to reduce carbon emissions (carbon pricing, emissions trading or a combination of both), i.e. all countries except Turkey, Australia and Israel. To keep up with Israel's commitment in the framework of the Paris Agreement, Israeli policymakers are currently looking to advance a national carbon pricing plan that will support the decarbonization process of the Israeli economy.

While there are various forms of carbon pricing mechanisms, including different mixes of taxes, levies, and emissions trading systems, putting a price on carbon would also have economic consequences for individual households. Thus, a carbon price can be a highly sensitive and politically delicate task, particularly in times of a global epidemic and economic turmoil. Its introduction thus requires a transparent and inclusive design which addresses the potential adverse economic effects on households. Against this background, the following paper aims to provide decision makers and experts with tangible findings and insights on which segments of the population in Israel might be negatively impacted by a carbon pricing reform. It can help to address socially unbalanced outcomes as part of the planning process.

Examining how different types of Israeli households would be impacted by a carbon pricing reform, the analysis presented in this paper reveals that if no further policy measures are taken, a carbon price in Israel will have regressive distributional outcomes: In relation to their total expenditures, low-income households would be more adversely impacted by the higher costs associated with carbon pricing than richer households. In addition, Arab households, rural households or households that own (and use) a car would be affected to a greater extent than other households.

In order to advance a balanced and effective carbon pricing scheme in Israel, one that affords protection for lower income households, some of the generated revenues could minimize the additional cost burdens through the introduction of redistribution mechanisms. As demonstrated by the different scenarios presented in this paper, lump-sum transfers (diverted from the carbon pricing revenues) could lead to progressive outcomes. In addition, this paper contains information on subsidy schemes, for instance on electricity prices, public transportation and food, which would ultimately alleviate unintended distributional consequences.

1.Introduction

This paper analyzes how households would be impacted by introducing an ILS 140 / ton CO_2 (tCO_2) carbon price. It uses the recent Household Budget Survey from 2018 compiled by the Israeli Central Bureau of Statistics (CBS). It is based on representative survey data covering the monthly expenditures of 8,792 Israeli households. We merge this data with multi-regional input-output-data from GTAP (Global Trade Analysis Project) 10 (2019) to calculate sector-specific carbon intensities, which allows deriving a household-specific carbon footprint based on each household's specific expenditure basket.[1]

We calculate a household-specific burden, indicating the cost increment in comparison to total household expenditures. Throughout this study, 'burden from carbon pricing' refers to the additional financial burden (relative to their total household expenditure) that arises for any household when consuming the same amount of goods consumed prior to the introduction of a carbon price. This paper also therefore does not take into account behavioral responses of households, e.g. shifts to practices and consumption of goods that are less carbon-intensive.

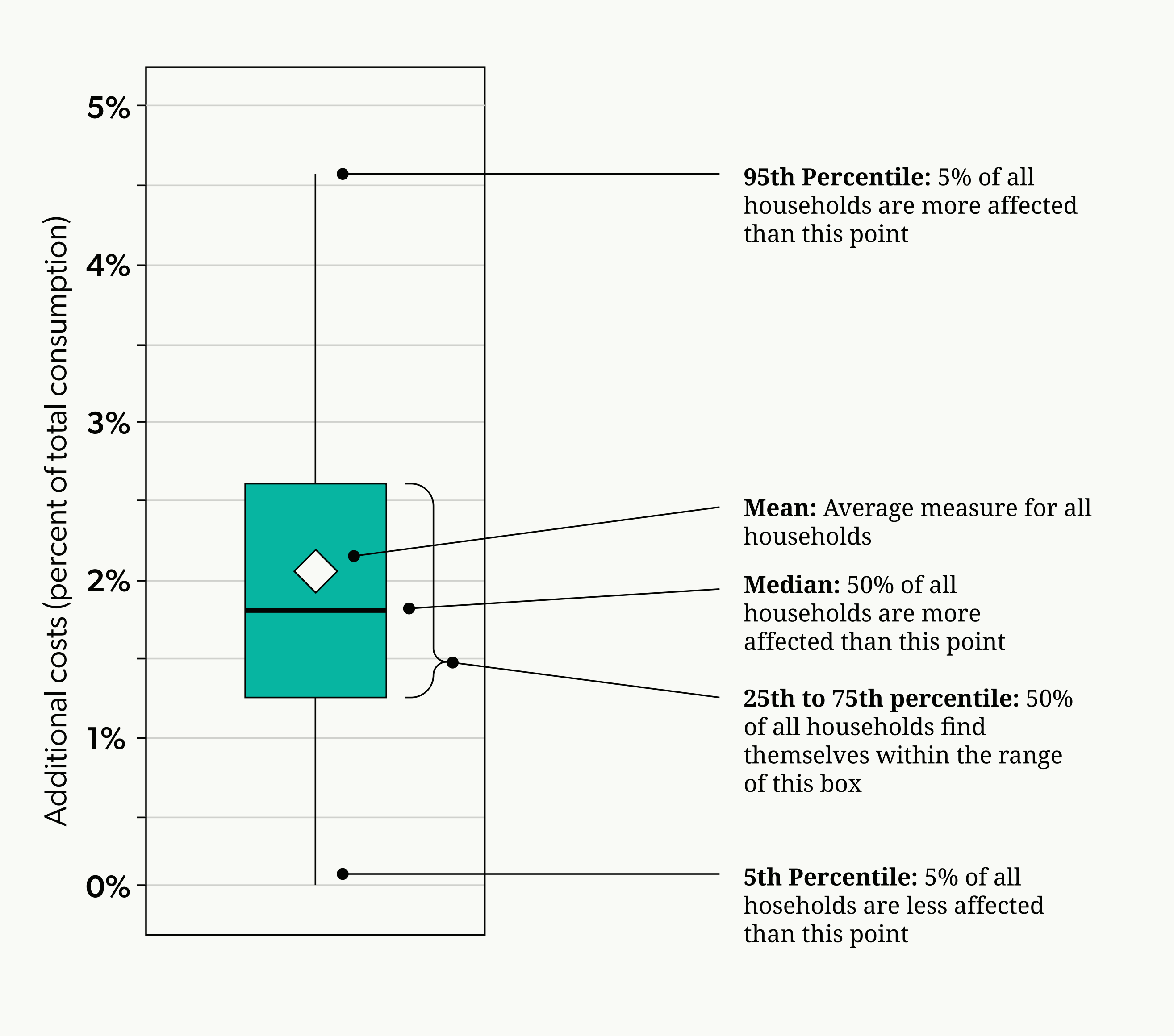
The paper displays most of its results with the help of boxplots. Figure 1 supports the reading of boxplots, which display multiple information: the mean depicts by how much any household would be affected on average, which is suitable for a comparison of large groups of households. However, averages are sensitive to outliers. Thus, comparing median values of different groups is usually more robust. Fifty percent of households are more affected than the median, 50 percent of households are less affected than the median.

Comparing mean and median values of carbon pricing incidents allows comparing groups of households (e.g. sorted by income) with each other. In order to understand the distribution within groups, it is useful to look into within-group percentiles. Groups, which incorporate a greater range between the 5th and the 95th (or the 25th and the 75th) percentile, are more heterogeneous than other groups. That is, within this group households differ from each other more strongly than households in other groups.

> **Throughout this study, 'burden from carbon pricing' refers to the additional financial burden (relative to their total household expenditure) that arises for any household when consuming the same amount of goods consumed prior to the introduction of a carbon price.**

[1] Underlying data are subject to specific license agreements and cannot be shared freely, but processed data can be made available by the authors upon reasonable request.

Figure 1.
Interpretation of Boxplots in this Study



Information on the interpretation of boxplots presented throughout this study. Boxplots are suitable for displaying distributional outcomes. The range from the bottom whisker to the upper whisker contains 90% of all households. The range within the box contains 50% of all households. Five percent of all households show higher values than the upper bound of the upper whisker. Five percent of all households show lower values than the lower bound of the lower whisker.

2. Scope of Analysis

This analysis aims to assess distributional consequences of carbon pricing in Israel. It affords an understanding of which segments of the population would be more affected than others, enabling an investigation of possible avenues of action. In addition, this type of analysis helps us examine different redistribution mechanisms. By focusing on distributional consequences of households, this analysis disregards impacts on businesses and industries as well as macroeconomic and fiscal implications.

The study focuses on overnight effects and thus ignores behavioral effects of carbon pricing, that is, households switching to less carbon-intensive consumption over time. It does not investigate consumption shifts and associated factors, such as technological change, the accessibility of low-carbon substitutes and changes in prices or consumer behavior. Long-term adjustments to carbon pricing are not part of this study. For example, altering the energy mix of the Israeli economy will almost certainly lead to different sectoral carbon intensities.

Results in this study serve as an approximation of additional costs that Israeli households would face. Actual costs could differ due to regional and temporal price fluctuations, activities in informal markets or technological shifts. We include a detailed methodological discussion including potential limitations and sensitivity analyses at the end of this paper.

2.1. Carbon Pricing Incidence

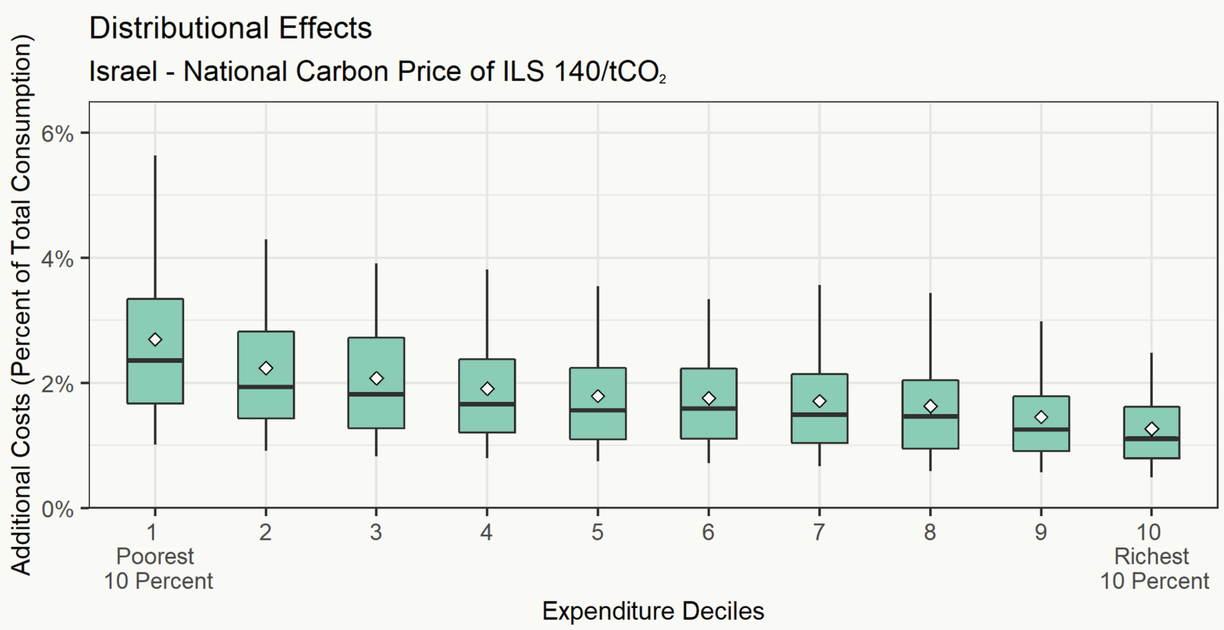
Figure 2 displays the additional costs induced by a carbon price of ILS 140 per ton CO_2.[2] We assume that price increases are passed on to households[3], and group households in deciles by total per capita expenditures.[4] That is, in Figure 2, the most left-hand boxplot shows results for the poorest 10% of Israeli households, while the most right-hand boxplot shows the richest 10%.

According to our analysis, a carbon price in Israel would be regressive, affecting poor households more strongly than richer households. This follows from comparing mean and median additional costs for different expenditure deciles. On average, to comply with additional costs imposed by a carbon price, households in the poorest decile would need to allocate 2.7% of their current total expenditures[5] to acquire the same amount of goods they consumed without this policy. In comparison, households from the richest decile would require an additional 1.3% of their total expenditures. At the median, the additional costs imposed by a carbon price are 2.4% and 1.1%, respectively.

Additionally, comparing the upper ends of the boxes in Figure 2 shows that a carbon price would affect poorer households more heterogeneously than richer households. The most affected 25% of the poorest households would have to pay at least 3.3% of their total expenditures, while the most affected 25% of rich households would have to pay at least 1.6%. Five percent of the poorest households would have to pay more than 5.6% of their total expenditures, if no compensation scheme was in place.

[2] Note that this analysis is linear. Absolute additional costs would change linearly with differing carbon prices, e.g. prices lower than ILS 140 per tCO_2. In relative terms, distributional consequences would not be affected.
[3] Note that the effects shown here are independent of the carbon pricing instrument, e.g. a tax or an emissions trading scheme.
[4] See Figure 14 (Methodological Discussion) in which we group households in deciles by total income.
[5] We show absolute additional costs in Figure 15 (Methodological Discussion).

Figure 2.
Burden from Carbon Pricing over Expenditure Deciles



Additional costs on households induced by a carbon price of ILS 140/tCO_2 in relation to total household expenditures (Y-axis) over expenditure deciles (X-axis). The first decile includes those 10% of households with least total expenditures per capita. The 10th decile includes those 10% of households with highest total expenditures per capita. An additional cost of 1% indicates that a household would require an additional 1% of its actual expenditure budget in order to buy the same amount of goods bought prior to the price increase. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

3. Underlying Reasons

In this section, we look into potential drivers of regressive distributional effects following implementation a carbon price, including the share of energy expenditures, differences in the geographical scope, ethnicity and car ownership.

3.1. Energy Expenditures

To explain the outcome it is first important to understand the different products households consume.

Households directly demand carbon-intensive energy goods, including electricity, transportation and cooking fuels. Direct energy consumption is usually carbon intensive. Carbon pricing is hence likely to most strongly affect those households which allocate a relatively large share of expenditures to energy.

In addition, depending on their budget and preferences, households buy different types of food, durable goods and services, which also cause (a different amount of) emissions accumulated throughout their production process. Consuming these goods results in indirect energy use of households.

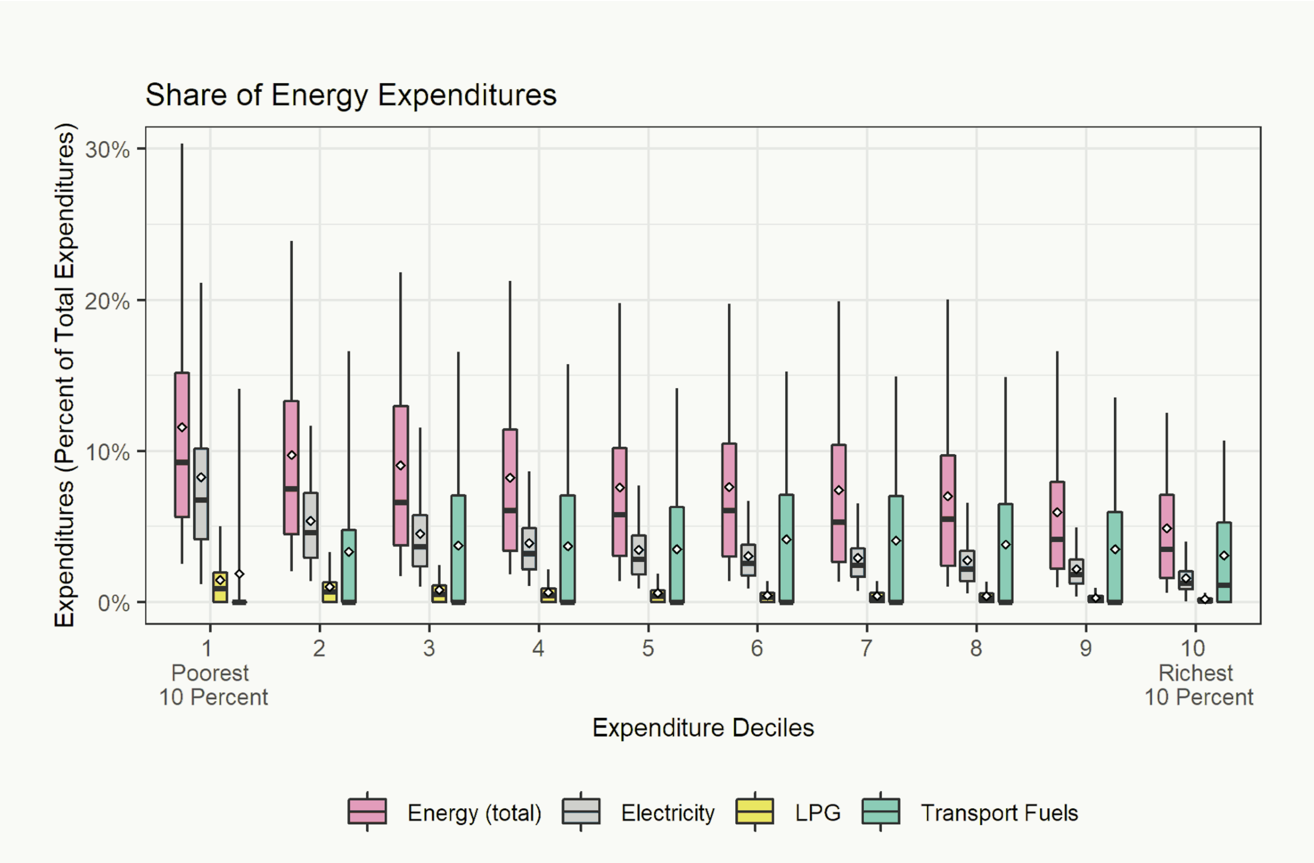
Figure 3 depicts how much households spend on energy in comparison to their total expenditures. The share of overall expenditures on energy (red bars in Figure 3) is larger for poor households. Households with higher levels of expenditures spend relatively less on energy. In addition, 25% of the poorest households spend more than 15% of their expenditures on energy with five percent of households spending more than 30% on energy. The finding that poor households spend a relatively larger share on carbon-intensive products helps explain the regressive outcome of a carbon price.

25% of the poorest households spend more than 15% of their expenditures on energy with five percent of households spending more than 30% on energy.

However, expenditures on transportation fuels (green bars in Figure 3) indicate that most low-income households do not spend money on transportation fuels.[6] This might be of importance for sectoral policies. If a carbon price was applied to the transport sector only, the distributional outcome would be slightly progressive.

Figure 3.

Energy Expenditure Share over Expenditure Deciles



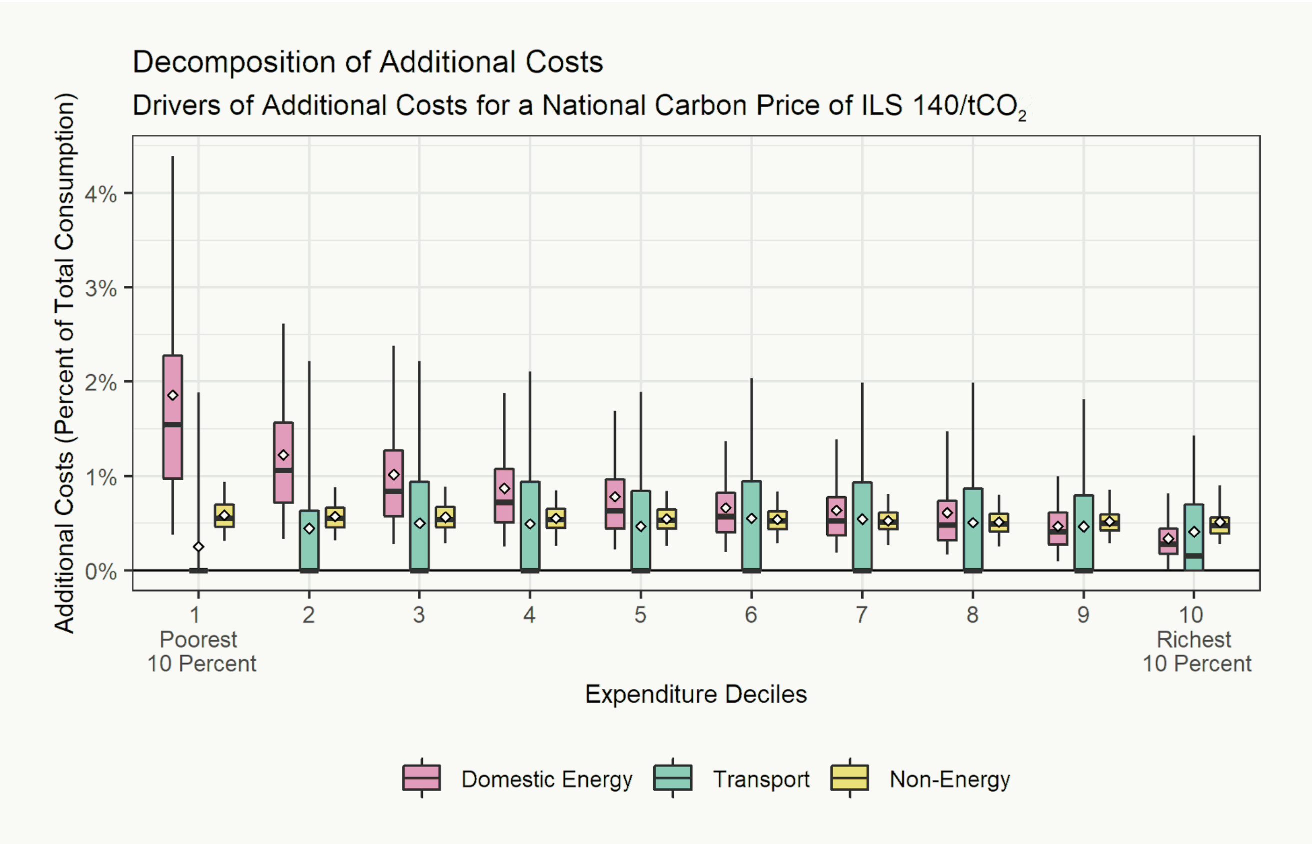
Share of expenditures on energy in percent of total consumption expenditures (Y-axis) over expenditure deciles (X-axis). LPG refers to either gas in household tanks or supplied through a gas line consumed directly by households. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019)

6 Peculiarities of the transport sector will be addressed in a separate section on car ownership and expenditures on transport fuels.

Figure 4 shows the drivers of additional costs by clustering consumption in categories of domestic energy (expenditures on electricity, gas and heating), transport (transport fuels), and non-energy (goods and services that are mostly associated with indirect household energy use). This figure reinforces the finding that domestic energy use is a driver of regressive distributional outcomes. The consumption of other final goods and services that do not incorporate direct energy consumption is slightly regressive. The poorest households would on average (at the median) face 0.57% (0.55%) higher costs on food, goods and services compared to 0.51% (0.47%) additional costs for the richest households. This might be explained by a relatively larger share among the richest households spent on services, which are usually less carbon-intensive than food products and consumption of goods.

> This figure reinforces the finding that domestic energy use is a driver of regressive distributional outcomes.

Figure 4.
Decomposition of Additional Costs over Expenditure Deciles



Additional costs to households induced by a carbon price of ILS 140/tCO_2 as a share of total household expenditures (Y-axis) over expenditure deciles (X-axis). Costs are segmented by type of usage. Domestic Energy refers to spending on electricity, gas and heating. Transport refers to transport fuels. Non-Energy refers to expenditures on other final goods and services. Data: Household Budget Survey 2018, Israeli Central Bureau of Statistics (2019), GTAP 10 (GTAP 2019)

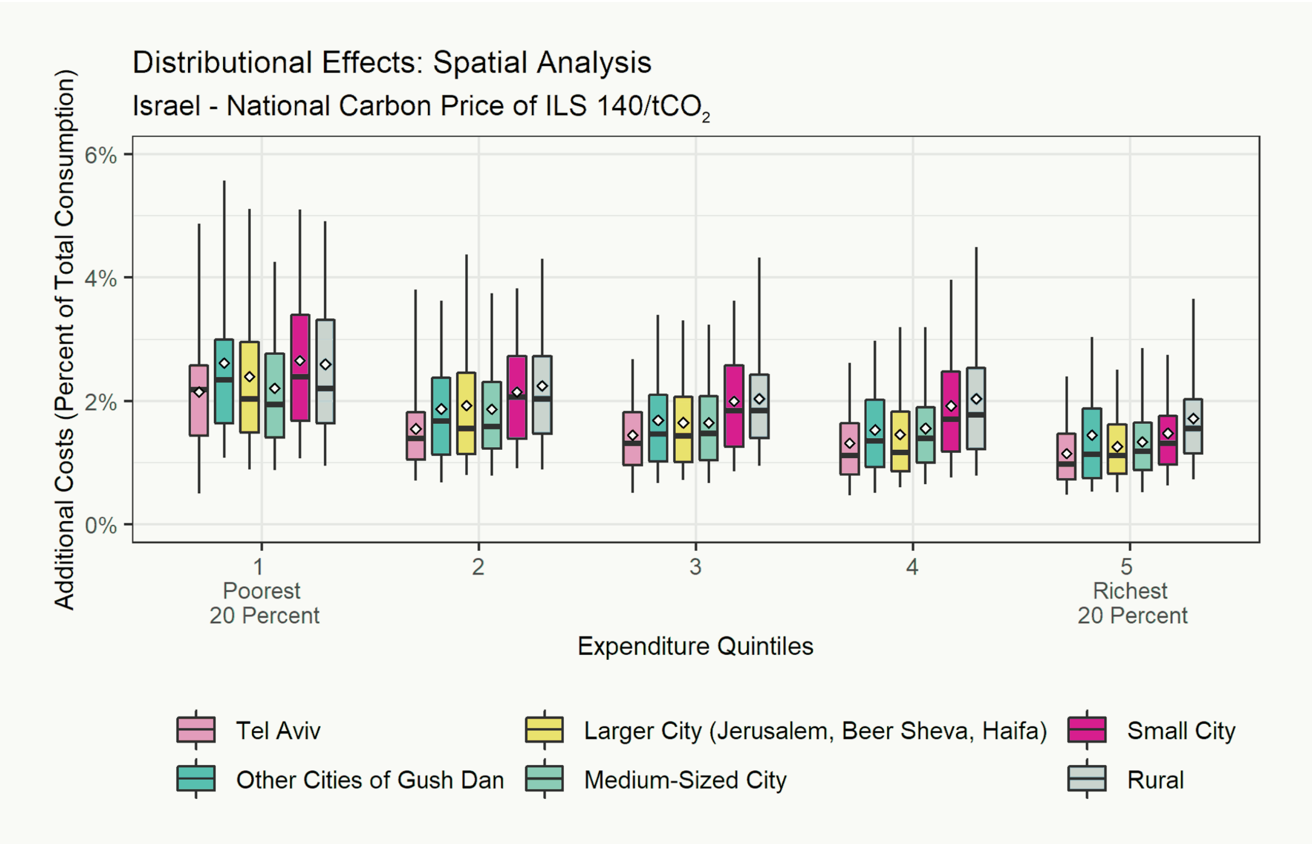
3.2. Geographical Scope

Figure 5 compares additional costs with regard to expenditures and location. On average, households in rural areas would be most affected by a carbon price. Households in Tel Aviv or other larger cities, such as Jerusalem, Be'er-Sheva or Haifa would generally be less affected than households in smaller cities or rural areas throughout all income groups. A carbon price would impose higher costs on households in Gush Dan cities such as Ashdod, Netanya, Rishon LeZion or Petah Tikva than on households in Tel Aviv, possibly resulting from greater commuting distances and thus higher transportation costs.

A carbon price would impose higher costs on households in Gush Dan cities such as Ashdod, Netanya, Rishon LeZion or Petah Tikva than on households in Tel Aviv, possibly resulting from greater commuting distances and thus higher transportation costs.

Figure 5.

Burden from Carbon Pricing over Expenditure Quintiles, segmented by Household Location



Additional costs on households induced by a carbon price of ILS 140/tCO_2 as a share of total household expenditures (Y-axis) over expenditure quintiles (X-axis). The first quintile includes those 20% of Israeli households with the least total expenditures per capita. The fifth quintile includes those 20% of Israeli households with highest total expenditures per capita. Nationwide quintiles are then segmented with regard to the location of households. Segments do not show an equal number of households. ‘Other Cities in Gush Dan’ comprises Ashdod, Netanya, Rishon LeZion and Petah Tikva. ‘Medium-Sized City’ refers to cities with 50,000 to 200,000 inhabitants. ‘Small City’ refers to cities with 10,000 to 50,000 inhabitants. Households located in places with up to 10,000 inhabitants are clustered as ‘Rural.’ Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

Figure 6 provides a more detailed picture, comparing households by sub-districts. Sub-districts are ordered by average additional costs to households.

The comparison of the distributional effects of a carbon tax in terms of additional costs per household according to sub-districts clearly illustrates that households in Israel's metropolitan center (Gush Dan) are least affected, while households in smaller rural towns are more strongly affected.

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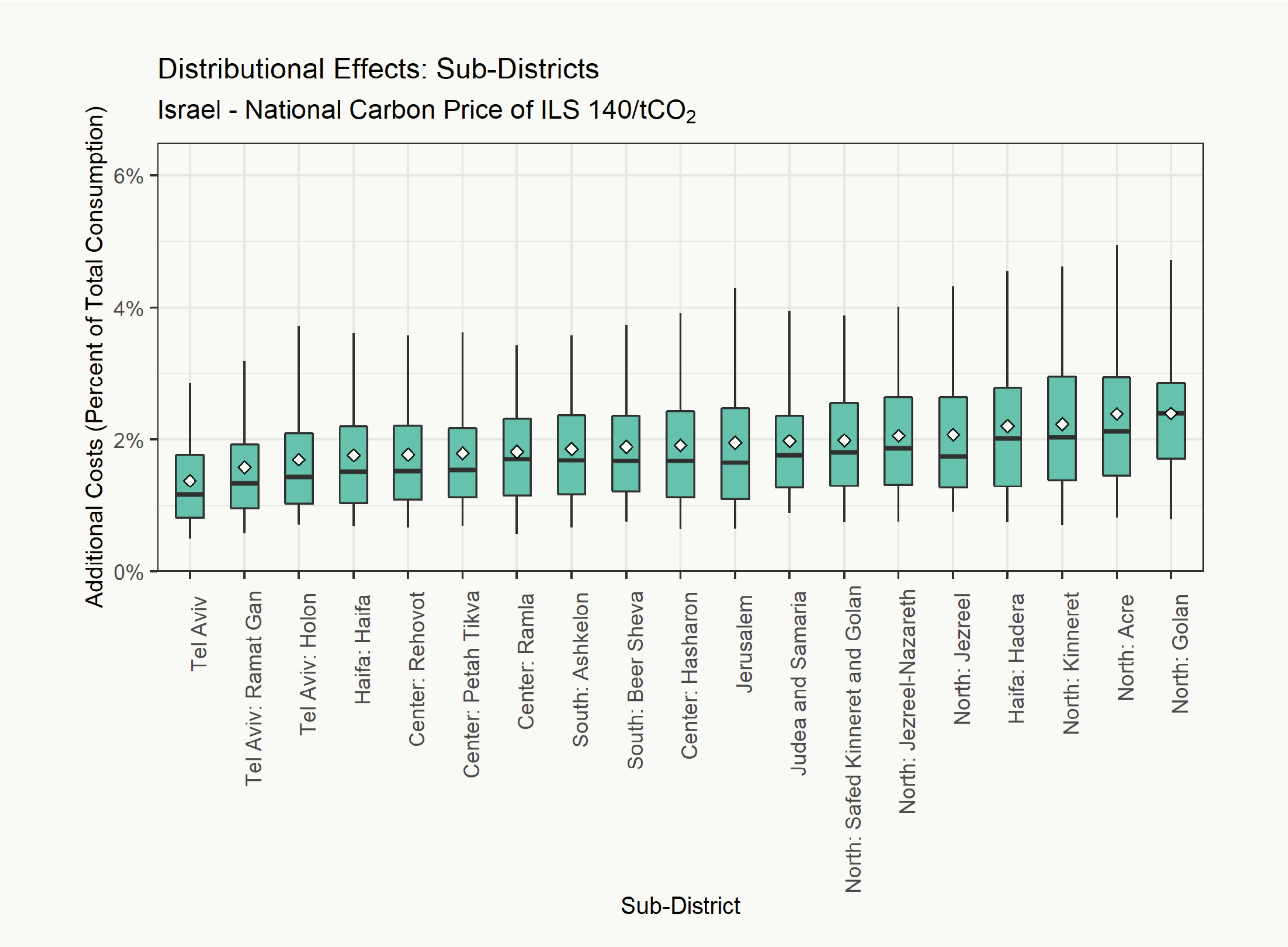
Figure 6.

Burden from Carbon Pricing over Sub-Districts



Additional costs to households induced by a carbon price of ILS 140 /tCO_2 in relation to total household expenditures (Y-axis) over 34 Israeli sub-districts. Each sub-district displays all households that are assigned to the respective sub-district. Districts are ordered by average costs. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

3.3. Ethnicity

Figure 7 differentiates Israeli households by expenditure level, religious group or ethnicity. Throughout all income groups, Arab households would face higher additional costs from carbon pricing than Jewish households (household classifications as in Central Bureau of Statistics 2019). Religious Jewish (Orthodox) households are least affected in relative terms. One potential explanation might be that those households are less likely to own cars.[7]

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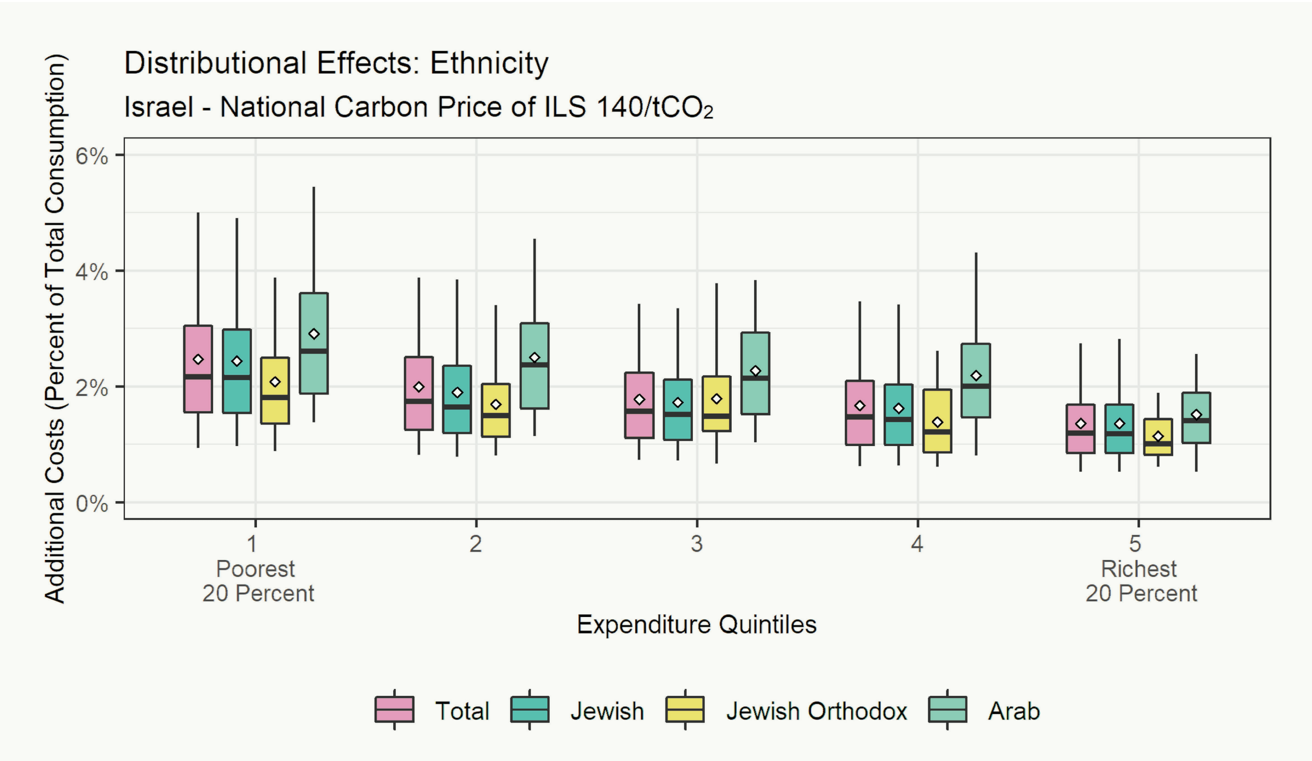
Figure 7.
Burden from Carbon Pricing over Expenditure Quintiles, segmented by Household Ethnicity



Additional costs on households induced by a carbon price of ILS 140/tCO_2 as a share of total household expenditures (Y-axis) over expenditure quintiles (X-axis). The first quintile includes those 20% of Israeli households with least total expenditures per capita. The fifth quintile includes those 20% of Israeli households with highest total expenditures per capita. Nationwide quintiles are then segmented with regard to ethnicity of households, referring to their religion as stated in the household survey. Segments do not comprise an equal number of households. 'Jewish Orthodox' is differentiated from 'Jewish.' However, 'Jewish' includes Jewish households that reported living a 'traditional' lifestyle. 'Arab' refers to households that self-reported to be Arabs. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

7 The Household Budget Survey does not contain information on floor space, which would be a proxy for heating demand. A comprehensive test on the number of rooms available for each household suggests that living in larger places is unlikely to explain these results, since we find no meaningful difference between Jewish secular and Jewish Orthodox households in this regard. Besides, Arab households are more likely to live in households with fewer rooms.

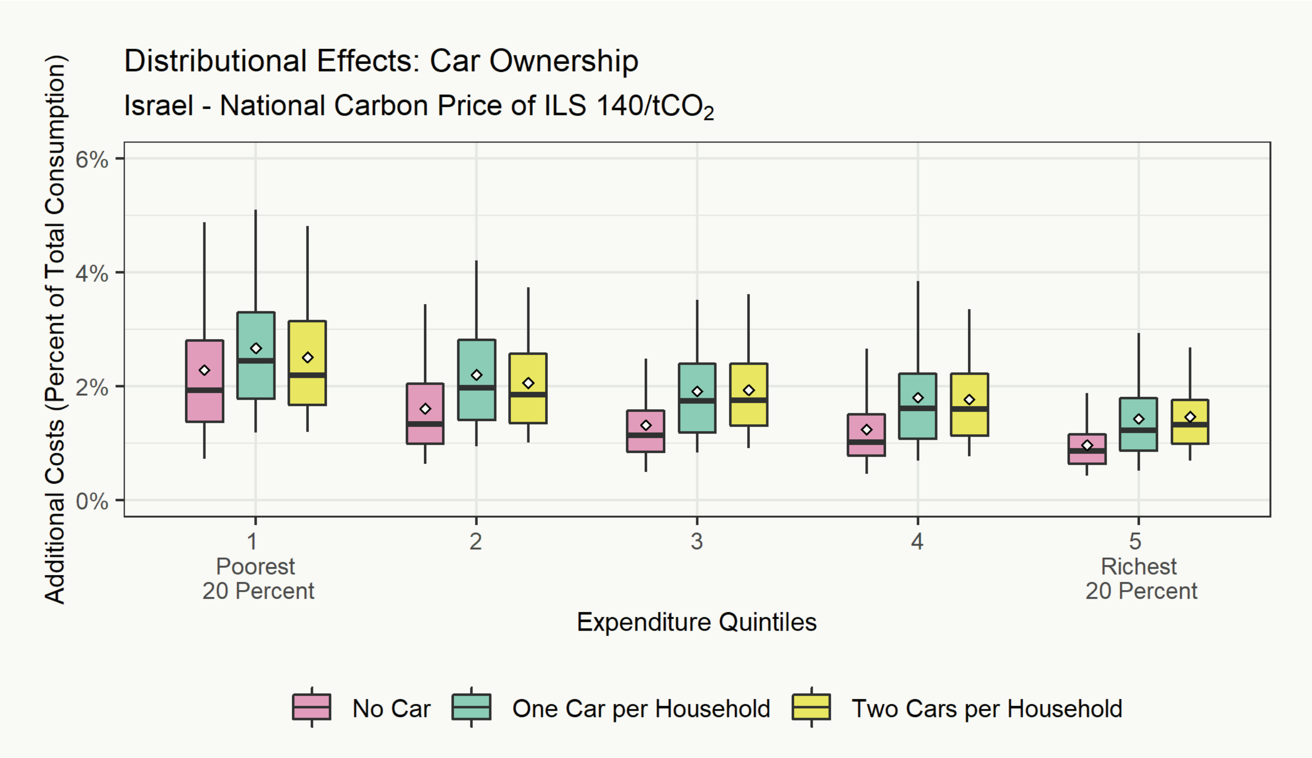
3.4. Car Ownership and Transportation Fuels

Figure 8 suggests that differences in car ownership and related expenditures on transportation fuels are a key factor accounting for why households are affected differently by a carbon price. Members of households that do not own a car are unlikely to commute by car, and hence are less affected by a price increase in transportation fuels.[8] Consequently, households without cars are least affected across all expenditure quintiles.

Members of households that do not own a car are unlikely to commute by car, and hence are less affected by a price increase in transportation fuels.

Figure 8.

Burden from Carbon Pricing over Expenditure Quintiles, segmented by Car Ownership



Additional costs on households induced by a carbon price of ILS 140/tCO_2 as a share of total household expenditures (Y-axis) over expenditure quintiles (X-axis). The first quintile includes those 20% of Israeli households with least total expenditures per capita. The fifth quintile includes those 20% of Israeli households with highest total expenditures per capita. Nationwide quintiles are then segmented with regard to the number of cars owned by each household. Segments comprise a different number of households. In the data, there are no households with more than two cars. Note that these additional costs refer to a cross-sector carbon price, and are not limited to the transport sector. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

8 Note that for this analysis we did not have information on individual commuting distances, which have helped to make analyses more precise.

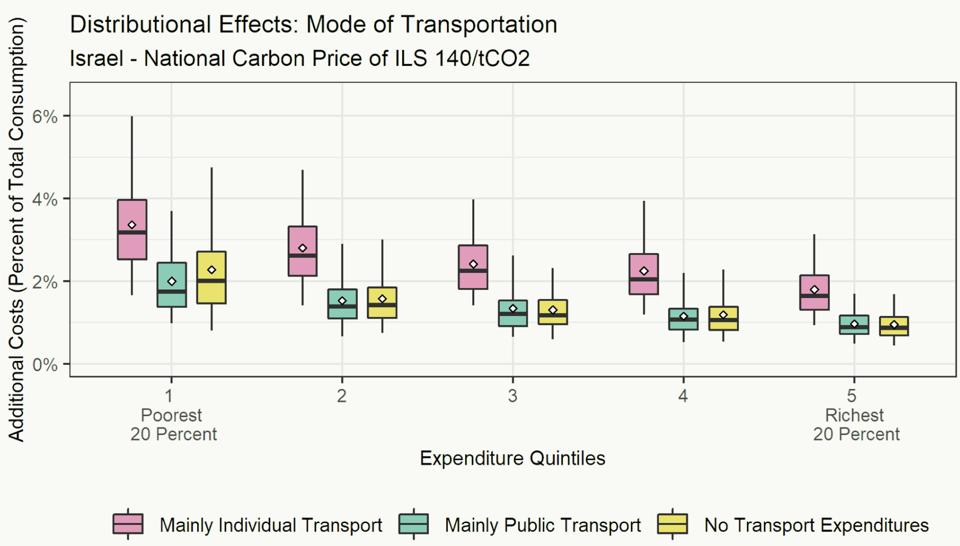
3.4.1 Household Expenditure on Transport Fuels

This part of the analysis draws mainly on the relevance of expenditures on transport fuels in order to explain distributional consequences of carbon pricing. In this context, we point out that the household data embodies some noteworthy features with regard to expenditures on transport fuels. For instance, we find that a large share of the households in our sample, which indicate owning at least one car, report expenditures neither on transport fuels nor on public transportation. These irregularities may be accounted for by statistical reporting particularities (expenditures lower than ILS 30 per month are not recorded), leased vehicles and households using company cars (with companies covering all costs). They do, however, not affect the validity of the overall results.

Carbon pricing may result in higher fuel costs in the public transportation sector as well, which could then be channeled to individuals who rarely use cars. In Figure 9, households are clustered with respect to their total expenditures as well as to their preferred mode of transportation. Households are considered to use *Mainly Individual Transport*, if they report non-zero expenditures on transport fuels greater than expenditures on public transport. Accordingly, households qualify as using *Mainly Public Transport*, if they report non-zero expenditures on public transport greater than expenditures on transport fuels. This figure suggests that car ownership and associated fuel consumption distinguishes highly affected households from less affected households across expenditure quintiles.

Figure 9.

Burden from Carbon Pricing over Expenditure Quintiles, segmented by favored Mode of Transportation

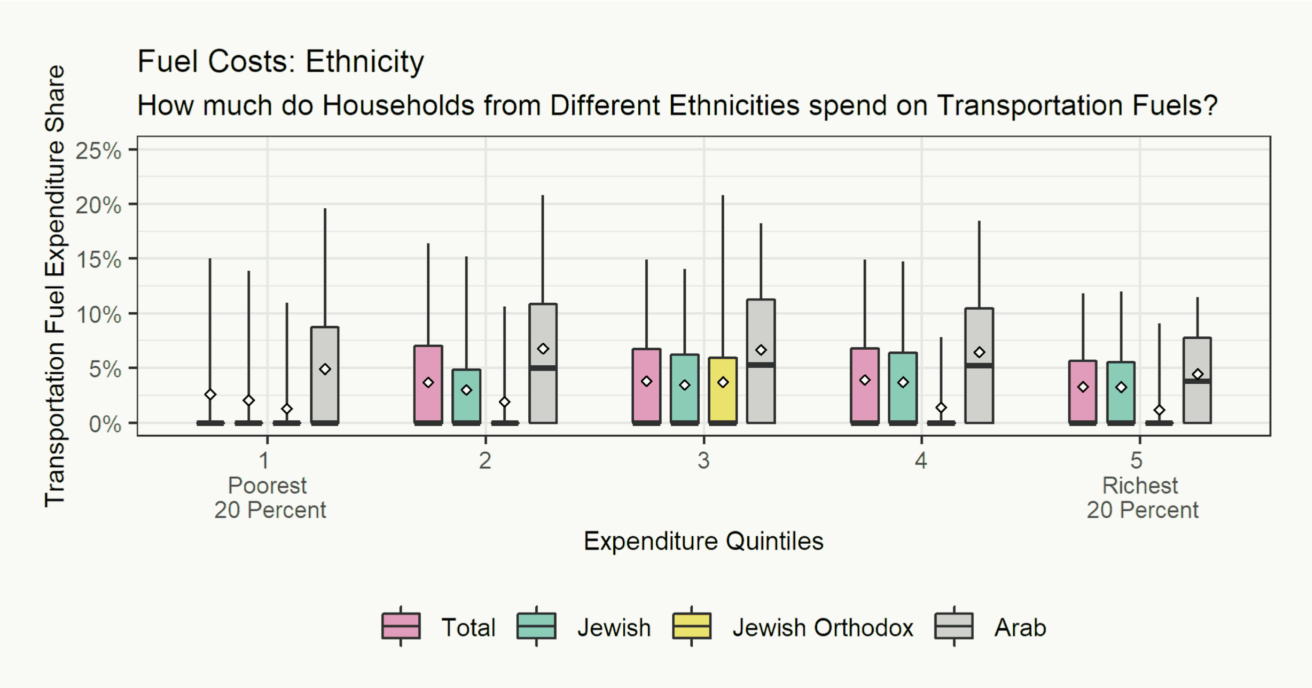


Additional costs on households induced by a carbon price of 140 ILS/tCO_2 as a share of total household expenditures (Y-axis) over expenditure quintiles (X-axis). The first quintile includes those 20% of Israeli households with the least total expenditures per capita. The fifth quintile includes those 20% of Israeli households with the highest total expenditures per capita. Nationwide quintiles are then segmented with regard to the preferred mode of transportation, which is derived by comparing the share of fuel costs to the expenditure share on public transportation. Segments do not comprise an equal number of households. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

Adding to Figure 7, Figure 10 provides an indication on differing levels of additional costs among religious / ethnic groups. Throughout all income groups, Arab households spend most on liquid fuels in comparison to their total household expenditures than other groups. At least 50% of Jewish Orthodox households across all income groups spend nothing on transportation fuels, which might help to explain their relative low levels of additional costs.[9]

Throughout all income groups, Arab households spend most on liquid fuels in comparison to their total household expenditures than other groups.

Figure 10.
Share of Transportation Fuel Costs of Total Expenditures over Expenditure Quintiles, segmented by Ethnicity



Transport fuel expenditure shares of total household expenditures (Y-axis) over expenditure quintiles (X-axis). The first quintile includes those 20% of Israeli households with e total expenditures per capita. The fifth quintile includes those 20% of Israeli households with the highest total expenditures per capita. Nationwide quintiles are then segmented with regard to the ethnicity of households, referring to their religion. 'Jewish Orthodox' is differentiated from 'Jewish.' However, 'Jewish' includes Jewish households that reported living a 'traditional' lifestyle. 'Arab' refers to households that self-reported as Arab. Note that this figure includes all households, regardless of car ownership or favored mode of transportation. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

9 We checked for probable differences among ethnic groups with regard to not reporting fuel (or public transport) expenditures despite owning a car. Jewish secular households are more likely to neglect reporting this budget item, resulting in relatively higher reported expenditure shares of fuel costs in this group, with the exception of those whose fuel expenses are figured into car-rental cost, or who receive gasoline as an employment benefit. However, this phenomenon does not help to explain differences between Arab and Jewish Orthodox households, which are similarly unlikely to report fuel expenditures in the case of car ownership. Higher shares of expenditures on transport fuels are thus likely to drive discrepancies between the different groups.

4. Compensation Schemes

Revenues from carbon pricing could - at least partially - be redistributed to households, e.g., by lowering existing taxes or by providing targeted subsidies. This could in turn increase public acceptance of carbon pricing. Table 1 lists various conceivable compensation schemes that we will discuss below.[10]

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Table 1.
Redistribution Scenarios in this Study

Instrument	Value	Share of Revenues	Analysis shown in:
Partial Lump-Sum Transfer	ILS 2000 per household per year	79%	Figure 11
Partial Lump-Sum Transfer	ILS 100 per capita per year	12.6%	Figure 11
Partial Lump-Sum Transfer	ILS 500 per capita per year	63%	Figure 11
Full Lump-Sum Transfer	ILS 795 per capita per year	100%	Figure 11
Electricity Subsidy	62% of electricity price	100%	Figure 12
Full Public Transport Subsidy	100% of expenditures on public transportation	24%	Figure 12
VAT Removal on Basic Products	100% VAT expenditures on basic goods	19%	Figure 12
50% VAT Reduction on Food	9.5% VAT on food products	93%	Figure 12

Transport fuel expenditure shares of total household expenditures (Y-axis) over expenditure quintiles (X-axis). The first quintile includes those 20% of Israeli households with e total expenditures per capita. The fifth quintile includes those 20% of Israeli households with the highest total expenditures per capita. Nationwide quintiles are then segmented with regard to the ethnicity of households, referring to their religion. 'Jewish Orthodox' is differentiated from 'Jewish.' However, 'Jewish' includes Jewish households that reported living a 'traditional' lifestyle. 'Arab' refers to households that self-reported as Arab. Note that this figure includes all households, regardless of car ownership or favored mode of transportation. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

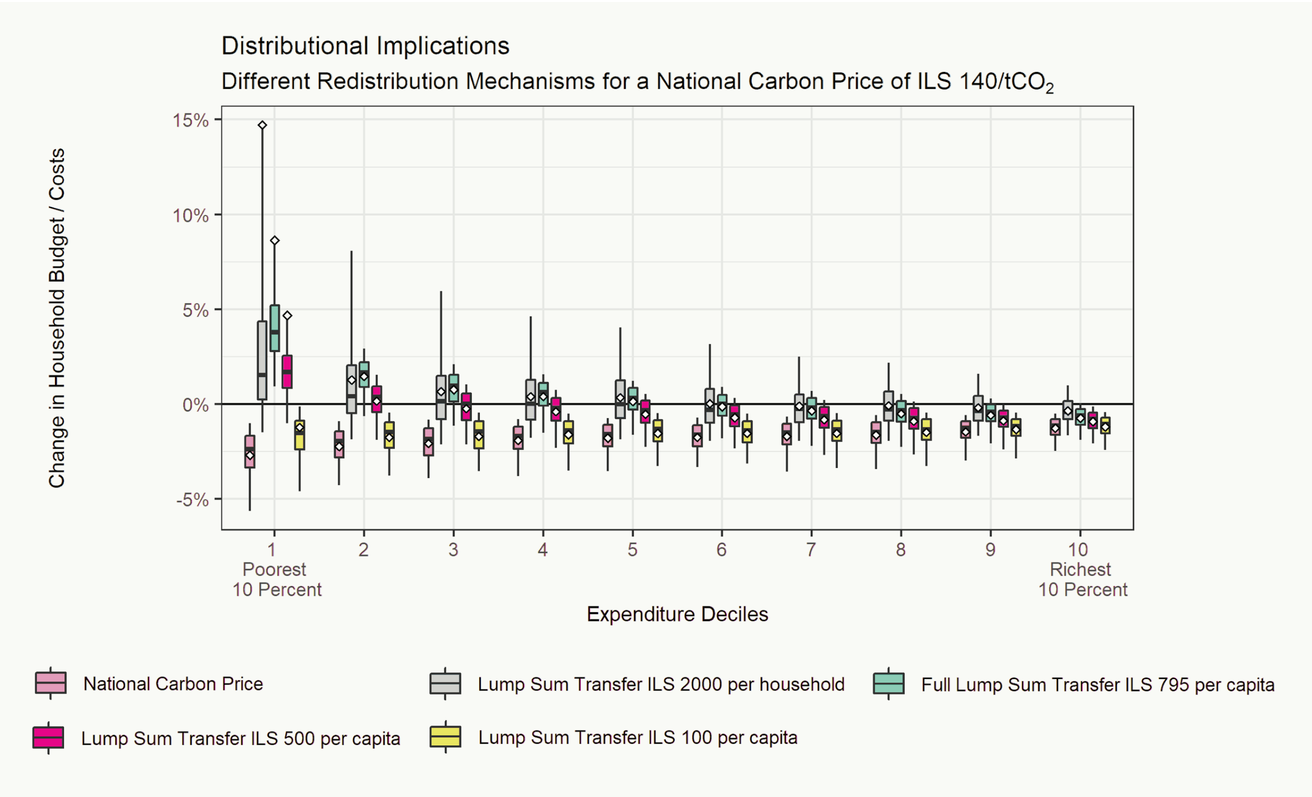
10 Note that this is not a comprehensive list.

4.1. Lump-Sum Transfers

Figure 11 displays changes in household consumption budgets following a lump-sum transfer. In the case of per capita transfer schemes, every person would receive a certain transfer, regardless of age, income, occupation or ethnicity, possibly financed from carbon pricing revenues generated.

Redistributing 79% of revenues[11] to citizens via a household lump-sum transfer would make a carbon price in Israel progressive. In case of a full per capita lump-sum transfer, the poorest members of Israeli society would be fully compensated,[12] while the resulting outcome would still be neutral in terms of additional costs for the median of middle-income households. On average, the richest households would be affected by 0.7% of their total expenditures.

Figure 11.
Change in Household Budget / Costs over Expenditure Deciles for Different Lump-Sum Transfers



Changes in household budget / costs as a share of total expenditures (Y-axis) over expenditure deciles (X-axis). The first decile includes those 10% of households with the least total expenditures per capita. The 10th decile includes those 10% of households with the highest total expenditures per capita. Positive values refer to additional budget gains (as percentage of the household expenditure) available for consumption. Negative values refer to additional expenditures that a household would require in order to buy the same amount of goods they bought prior to the price increase. Lump-sum transfers are added to national carbon price incidents. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

11 Revenues calculated for this study may differ from actual revenues. See Methodological Discussion for details.

12 Note that for the poorest decile this is not only true for the median of households, but covers the entire distribution, i.e. at least 95% of this income decile.

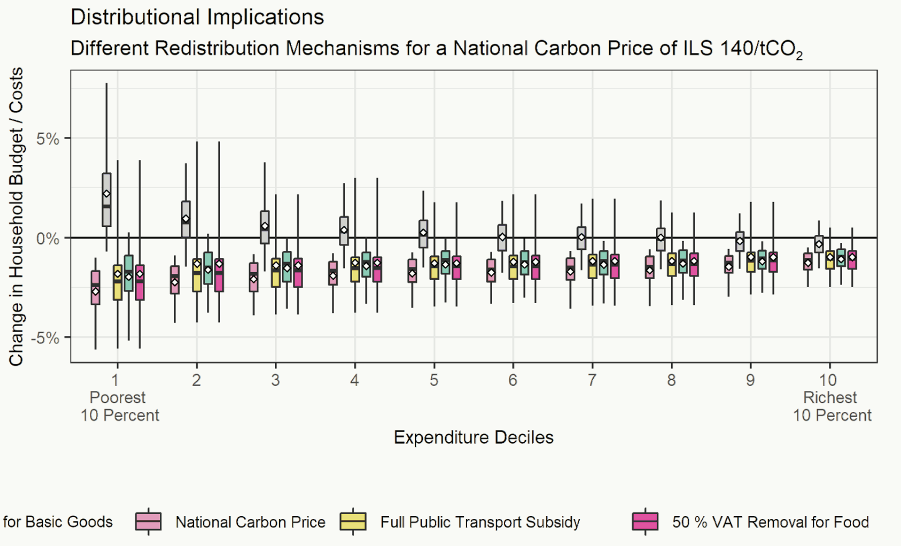
4.2. Other Compensation Schemes

Instead of lump-sum transfer to households, compensation schemes could also entail tax cuts or specific subsidies. Figure 12 shows the results for the following policy scenarios:

- **Electricity Subsidy -** Application of carbon pricing revenues to fully subsidize residential electricity use.
- **Full Public Transport Subsidy -** Application of carbon pricing revenues to fully subsidize household expenditures on public transportation.
- **VAT Exemption for Basic Goods -** Carbon pricing revenues are used to remove the value added tax (VAT) of 17% on staple food items, such as bread, butter, milk and cheese.[13]
- **50% VAT Reduction for Food -** Carbon pricing revenues are used to lower the VAT on all food products by 50%.

Expenditures on electricity comprise the largest share of energy expenses for poor households. Redistributing carbon pricing revenues by lowering electricity prices would thus be highly progressive, as most low-and-middle-income households would benefit from this policy. Other policies, such as subsidizing public transportation or lowering VAT on basic goods or food would not fully eliminate regressivity, but would be beneficial for some of the poorest households. Note that our analyses at this point ignore behavioral effects. Subsidies or tax cuts can be expected to lead to changes in demand of particular goods and services.

Figure 12.
Change in Household Budget / Costs over Expenditure Deciles for Selected Subsidies and Tax Cuts



Changes in household budget / costs as a share of total expenditures (Y-axis) over expenditure deciles (X-axis). The first decile includes those 10% of households with lowest total expenditures per capita. The 10th decile includes those 10% of households with highest total expenditures per capita. Positive values refer to additional budget available for consumption. Negative values refer to additional expenditures that a household would require in order to buy the same amount of goods purchased prior to the price increase. 'Electricity Subsidy' refers to using carbon pricing revenues to lower electricity prices by 66%. 'Full Public Transport Subsidy' refers to compensating households for public transportation spending. 'Full VAT Exemption for Basic Goods' refers to removing the VAT on basic goods, such as bread, milk and cheese. '50% VAT Reduction on Food' refers to cutting the existing VAT on all food products by half. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

[13] Note that this is in addition to the existing price caps.

5. Typical Households

The consequences of carbon pricing are heterogeneous across households that adhere to different lifestyles and consumption patterns. In this section, we define 12 "typical" households that reflect different parts of Israeli society. We display modelling outcomes for a carbon price of ILS 140/tCO_2, complete VAT exemption on basic goods, a 50% VAT cut on food as well as various lump-sum transfer schemes. In Table 2, we display estimations for twelve different household types, each of which is an attempt to model typical household profiles. The table lists median expenditures and costs in ILS and refers to yearly levels of consumption.

'Change in Consumption (I)' lists the change in available household budget resulting from a carbon price of ILS 140/tCO_2 and a lump-sum transfer as indicated in the respective column - given that the household follows a consumption pattern identical to its practice prior to the implementation of a carbon price. 'Lump-Sum Transfer (I)' refers to per capita transfers with one exception: the last column indicates a lump-sum transfer of ILS 2,000 per household.

The consequences of carbon pricing are heterogeneous across households that adhere to different lifestyles and consumption patterns. In this section, we define 12 "typical" households that reflect different parts of Israeli society.

'Change in Consumption (I+II)' adds a VAT exemption on basic goods to the revenues from a lump-sum transfer. 'Change in Consumption (I+III)' adds a 50% VAT reduction on food. Figures in rows indicating 'Change in Consumption [%]' refer to absolute changes [ILS] as a share of total expenditures [ILS].

It is noteworthy that redistributing revenues by a 50% cut in VAT on food and by a lump-sum transfer of ILS 200 per capita or ILS 500 per capita is unlikely to be revenue-neutral. Both redistributive policies in combination are unlikely to be fully financed by carbon pricing revenues.

This analysis shows that lump-sum transfers are unlikely to fully compensate the household examples we chose. A transfer of ILS 500 per capita does however lower each household's burden to less than 1% of total expenditures. Low-income and ultra-Orthodox households would likely benefit economically from this policy, while Arab households would still face a burden equivalent to 1.8% of their total expenditures.

Table 2.
Incident Analysis of Typical Households

	Two-adult, three-child two-car household in the Gush Dan area, high income (richer than at least 80% of all households)				**Two-adult, three-child, two-car household in the Gush Dan area, average income (richer than at least 20%, poorer than at least 20% of all households)**				**Two-adult, three-child, two-car household in a rural area, average income (richer than at least 20%, poorer than at least 20% of all households)**			
Total Expenditures	510,372				235,164				235,008			
Share of Energy Expenditures	4.1%				2.6%				2.7%			
Total Energy Expenditures	21,036				6,000				6,4200			
Electricity	7,284				5,460				5,988			
Transport Fuels	13,212				*0				*0			
Natural Gas	540				540				* 432			
CO_2-Price	ILS 140 / tCO_2											
Direct + Indirect Costs	-6,088				-3,140				-3,976			
Lump-Sum Transfer (I)	0	100	500	2,000	0	100	500	2,000	0	100	500	2,000
LST Total	0	500	1,000	2,000	0	500	2,500	2,000	0	500	2,500	2,000
Change in Consumption (I)	-6,088	-5,588	-3,588	-4,088	-3,140	-2,640	-640	-1,140	-3,976	-3,476	-1,476	-1,976
Change [%] in Consumption (I)	-1.19%	-1.09%	-0.70%	-0.80%	-1.34%	-1.12%	-0.27%	-0.48%	-1.69%	-1.48%	-0.63%	-0.84%
VAT-Exemption (Basic Goods) (II)	1,025				629				654			
Change in Consumption (I+II)	-5,063	-4,563	-2,563	-3,063	-2,511	-2,011	-11	-511	-3,322	-2,822	-822	-1,322
Change (%) in Consumption (I+II)	-0.99%	-0.89%	-0.50%	-0.60%	-1.07%	-0.85%	-0.00%	-0.22%	-1.41%	-1.20%	-0.35%	-0.56%
50% VAT Exemption (Food) (III)	4,891				3,001				2,989			
Change in Consumption (I+III)	-1,197	-697	1,303	803	-139	361	2,361	1,861	-987	-487	1,513	1,013
Change (%) in Consumption (I+III)	-0.23%	-0.14%	0.26%	0.16%	-0.06%	0.15%	1.00%	0.79%	-0.42%	-0.21%	0.64%	0.43%

	Two-adult household (no children), head of household[14] is older than 67, outside Gush Dan, lower income (poorer than at least 60% of (all households				Two-adult household (no children) head of household is younger than 40, in Gush Dan, low-middle income (poorer than at least 40% of all house-(holds				Two-adult household (no children), head of household is younger than 40, outside Gush Dan, low-middle income (poorer than at least 40% of all house-(holds			
Total Expenditures	47,640				75,312				70,932			
Share of Energy Expenditures	6.3%				3.1%				3.8%			
Total Energy Expenditures	2,988				2,304				2,688			
Electricity	2,388				1,848				2,388			
Transport Fuels	0				0				0			
Natural Gas	600				456				300			
CO_2-Price	ILS 140 / tCO_2											
Direct + Indirect Costs	-872				-821				-946			
Lump-Sum Transfer (I)	0	100	500	2,000	0	100	500	2,000	0	100	500	2,000
LST Total	0	200	1,000	2,000	0	200	1,000	2,000	0	200	1,000	2,000
Change in Consumption (I)	-870	-670	130	1,130	-821	-621	179	1179	-946	-746	54	1054
Change (%) in Consumption (I)	-1.83%	-1.41%	0.27%	2.37%	-1.09%	-0.82%	0.24%	1.57%	-1.33%	-1.05%	0.08%	1.49%
VAT Exemption (Basic Goods) (II)	356				241				218			
Change in Consumption (I+II)	-515	-315	485	1,485	-580	-380	420	1,420	-728	-528	272	1272
Change (%) in Consumption (I+II)	-1.08%	-0.66%	1.02%	3.12%	-0.77%	-0.50%	0.56%	1.89%	-1.03%	-0.74%	0.38%	1.79%
50% VAT Reduction (Food) (III)	1,094				1,249				969			
Change in Consumption (I+III)	224	424	1,224	2,224	422	622	1,422	2,422	23	223	1023	2023
Change (%) in Consumption (I+III)	0.47%	0.89%	2.57%	4.67%	0.56%	0.83%	1.89%	3.22%	0.03%	0.31%	1.44%	2.85%

14 This term refers to the person in a household providing the largest share of household income (ראש משק בית כלכלי).

	Two-adults, three-child, two-car household, outside Gush Dan in a large or medium-sized city, average income (richer than at least 20%, poorer than at least (20% of all households				**Two-adult, three-child, one-car household outside Gush Dan in a large or medium-sized city, low income (poorer than at (least 80% of all households**				**Two-adult, seven-child, no-car household in the Gush Dan area, ultra-Orthodox**			
Total Expenditures	211,380				93,384				213,780			
Share of Energy Expenditures	2.8%				5.1%				4.2%			
Total Energy Expenditures	5,916				4,728				9,048			
Electricity	5,376				4,188				8,244			
Transport Fuels	*0				*0				0			
Natural Gas	540				540				804			
CO_2 Price	ILS 140 / tCO_2											
Direct + Indirect Costs	-3,141				-1,641				-2,697			
Lump-Sum Transfer (I)	0	100	500	2,000	0	100	500	2,000	0	100	500	2,000
LST Total	0	500	2,500	2,000	0	500	2,500	2,000	0	900	4,500	2,000
Change in Consumption (I)	-3141	-2641	-641	-1141	-1,641	-1,141	859	359	-2,697	-1,797	1,803	-697
Change (%) in Consumption (I)	-1.49%	-1.25%	-0.30%	-0.54%	-1.76%	-1.22%	0.92%	0.38%	-1.26%	-0.84%	0.84%	-0.33%
VAT Exemption (Basic Goods) (II)	656				249				753			
Change in Consumption (I+II)	-2485	-1985	15	-485	-1,392	-892	1,108	608	-1,944	-1,044	2,556	56
Change (%) in Consumption (I+II)	-1.18%	-0.94%	0.01%	-0.23%	-1.49%	-0.95%	1.19%	0.65%	-0.91%	-0.49%	1.20%	0.03%
50% VAT Reduction (Food) (III)	3,155				1,066				2,989			
Change in Consumption (I+III)	14	514	2514	2014	-575	-75	1,925	1,425	292	1,192	4,792	2,292
Change (%) in Consumption (I+III)	0.01%	0.24%	1.19%	0.95%	-0.62%	-0.08%	2.06%	1.53%	0.14%	0.56%	2.24%	1.07%

	Two-adult, seven-child house-hold, outside the Gush Dan area, ultra-Orthodox				Two-adult, three-child household, in an urban area, Arab				Two-adult, four-child household **in a rural area, Arab			
Total Expenditures	122,124				148,860				281,136			
Share of Energy Expenditures	4.5%				11.3%				17.2%			
Total Energy Expenditures	5,496				16,848				48,396			
Electricity	4,776				5,952				5,976			
Transport Fuels	0				10,380				41,388			
Natural Gas	720				516				1,032			
CO_2 Price	ILS 140 / tCO_2											
Direct + Indirect Costs	-1,952				-3,600				-8,186			
Lump-Sum Transfer (I)	0	100	500	2,000	0	100	500	2,000	0	100	500	2,000
LST Total	0	900	4,500	2,000	0	500	2,500	2,000	0	600	3,000	2,000
Change in Consumption (I)	-1,952	-1,052	2,548	48	-3,600	-3,100	-1,100	-1,600	-8,186	-7,586	-5,186	-6,186
Change (%) in Consumption (I)	-1.60%	-0.86%	2.09%	0.04%	-2.42%	-2.08%	-0.73%	1.07%	-2.91%	-2.70%	-1.84%	-2.20%
VAT Exemption (Basic Goods) (II)	610				575				977			
Change in Consumption (I+II)	-1,342	-442	3,158	658	-3,025	-2,525	-525	-1,025	-7,210	-6,610	-4,210	-5,210
Change (%) in Consumption (I+II)	-1.10%	-0.36%	2.59%	0.54%	-2.03%	-1.70%	-0.35%	-0.69%	-2.56%	-2.35%	-1.50%	-1.85%
50% VAT Reduction (Food) (III)	2,420				3,476				6,090			
Change in Consumption (I+III)	468	1,368	4,968	2,468	-124	376	2,376	1,876	-2,096	-1,496	904	-96
Change (%) in Consumption (I+III)	0.38%	1.12%	4.07%	2.02%	-0.08%	0.25%	1.60%	1.26%	-0.75%	-0.53%	0.32%	-0.03%

Carbon pricing incidents for households with specific characteristics. If not stated differently, this table depicts numbers in ILS and accounts for yearly expenditure levels. Figures indicating 'Change in Consumption' refer to numbers as a share of total household expenditures. Estimates show weighted median values. Scenario I includes a lump-sum transfer as indicated. Scenario II includes a full VAT exemption on basic goods. Scenario III includes a 50% VAT reduction on food.

* Note that we show median values. That is, at least 50% of households matching this household profile do not consume (or report expenditures on) transport fuels, despite owning cars. See section on car ownership and expenditures on transportation fuels for details.

** Note that the sample size for this household profile is exceptionally low.

Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

6. Methodological Discussion

This section touches upon methodological considerations, which are important for interpreting the results of this study.

For this study, we combine two datasets. First, the Israeli Household Budget Survey 2018, including information on households as well as highly disaggregated data on consumption expenditures. The survey lists monthly expenditures of 1,102 different consumption items for 8,792 households which, together, represent 97 percent of the Israeli population. Second, we use multi-regional input-output (MRIO) data from the GTAP database (GTAP 2019) to calculate 65 sector-specific carbon intensities indicating the emissions that can be attributed to one unit of money spent in this sector.[15]

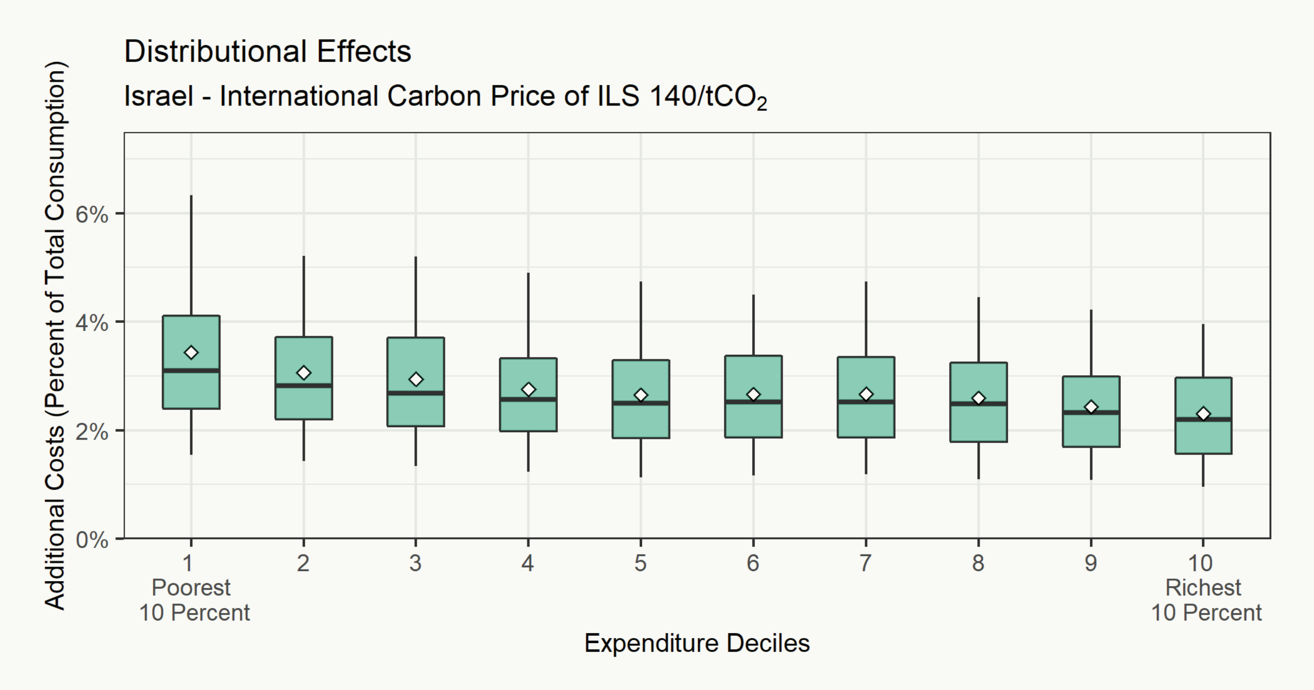
Our analysis includes inter-sectoral trade linkages in order to assess embedded sectoral emissions. For instance, emissions associated with wheat include emissions stemming from fuel and electricity used in the process of wheat production. In a third step, we match the 1,102 disaggregated consumption items from the household budget survey to 65 sectors. We assign a sector-specific carbon intensity to each sector, which allows us to derive an embedded carbon footprint by multiplying household expenditures within a sector by its respective carbon intensity.[16]

We usually refer to a National Carbon Price, that is, we study the effects of implementing a carbon price in Israel. Our method considers that price changes do not apply for imported goods. Goods that are exported are, however, subject to a carbon tax. We assume that there is no border-tax adjustment in place. Figure 13 provides a sensitivity analysis that projects the effect of applying the carbon price in Israel to imported goods and services as well.

15 Note that in this study, we focus on national carbon footprints, i.e. we model a carbon price in Israel without any carbon border adjustments.

16 Note that on average, each Israeli's consumption is associated with carbon emissions of 6.5 tCO_2 per year.

Figure 13.
Burden from an International Carbon Price over Expenditure Deciles



Additional costs on households induced by an international carbon price of ILS 140/tCO_2 as a share of total household expenditures (Y-axis) over expenditure deciles (X-axis). A one percent additional cost indicates that a household would require an additional 1% of its actual expenditure budget in order to buy the same amount of goods purchased prior to the price increase. This analysis incorporates international emissions embedded in Israeli consumption. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

Derivation of a carbon footprint enables us to calculate a carbon pricing incident, multiplying the carbon footprint by a carbon price of ILS 140/ tCO_2. This lays the foundation for the assessment of household-group-specific cost burdens of carbon pricing as carried out in this analysis. This analysis embodies certain strengths and weaknesses, which we will discuss in the following.

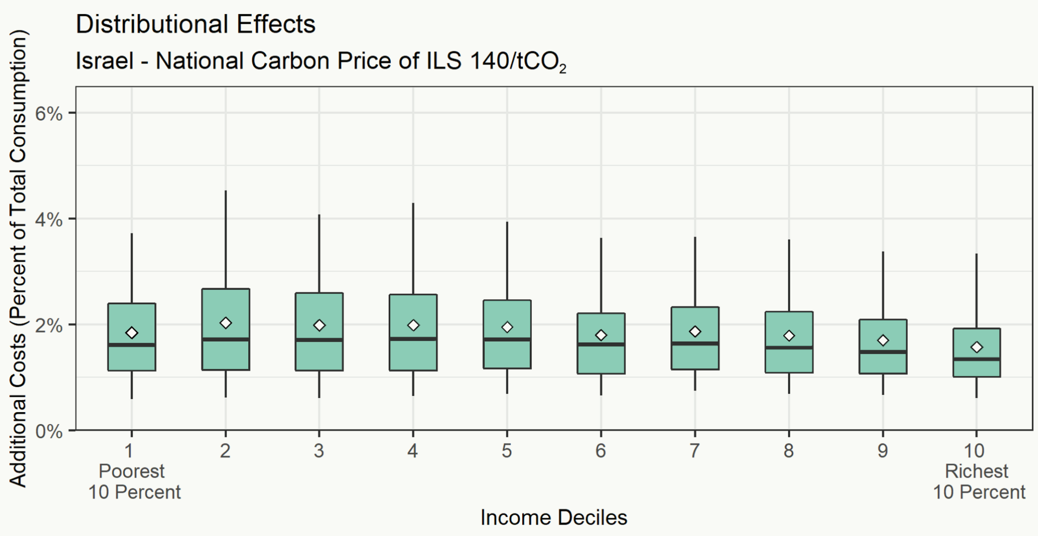
The incident analysis presented here provides only a rough indication of actual additional costs for specific households for several reasons. First, it ignores behavioral effects, e.g. households switching to less carbon-intensive goods when facing higher costs for these goods. Second, we base our calculations on expenditures, rather than on consumed quantities. Fluctuations of prices, status consumption and regional price differences might bias our results. Third, the analysis is limited to carbon intensities covering only 65 sectors. That is, it does not account for differentiations between single-product types. Fourth, our analysis may suffer from inherent data problems, such as underreporting, recall biases or seasonally differing consumption patterns. Fifth, the assumption that firms will eventually shift all additional costs proportionally to their customers is debatable.

It is difficult to derive estimates of expected revenues from carbon pricing directly from this analysis as our household expenditure survey-based data do not capture all emissions. According to the International Energy Agency (IEA 2020), Israel emitted 64 Mt CO_2 in 2017 (20 Mt CO_2 from coal, 24 Mt CO_2 from oil and 20 Mt CO_2 from natural gas). GTAP accounts for embedded domestic emissions of 44.6 Mt CO_2 in 65 sectors. In this analysis, we assign emissions from 42 sectors, attributing 41 Mt CO_2 to households. (Our estimation method does, however, induce embedded emissions of households equaling 48.6 Mt CO_2). Pricing this amount of emissions would lead to revenues of ILS 6.8 billion per year. Throughout this study, 'revenues' refers to this particular estimation from household data. This might differ from actual revenues. For instance, taking IEA estimates would yield revenues of ILS 8.9 billion per year. Note that revenues are likely to change after inducing a carbon price, whether due to changes in consumption or to changes in prices.

The underlying sectoral data used to calculate sectoral carbon intensities in this analysis are based on GTAP 10. Whilst GTAP allows to calculate indirect emissions, it refers to data from 2014. Usually, it can be assumed that sectoral intensities do not change dramatically in the short term, i.e. matching this data with household data for 2018 is methodologically acceptable. However, recent shifts in the Israeli electricity mix towards an increasing share of natural gas at the costs of (carbon-intensive) coal have lowered the CO_2 emissions intensity in the electricity and heat sector. CO_2 emissions dropped from 39 Mt CO_2 in 2014 to 34 Mt CO_2 in 2018 and the CO_2 intensity of the Israeli energy mix dropped from 3 tCO_2/ton of oil equivalent (toe) to 2.7 tCO_2/toe (IEA 2020). Estimates of additional costs resulting from a carbon price may be biased upwards and thus be considered as an upper approximation. However, the presented incident analysis is suitable for assessing distributional consequences of carbon pricing, e.g. which segments of population would be more proportionally affected than others. Consequently, it allows investigating possible channels and mechanisms for that.

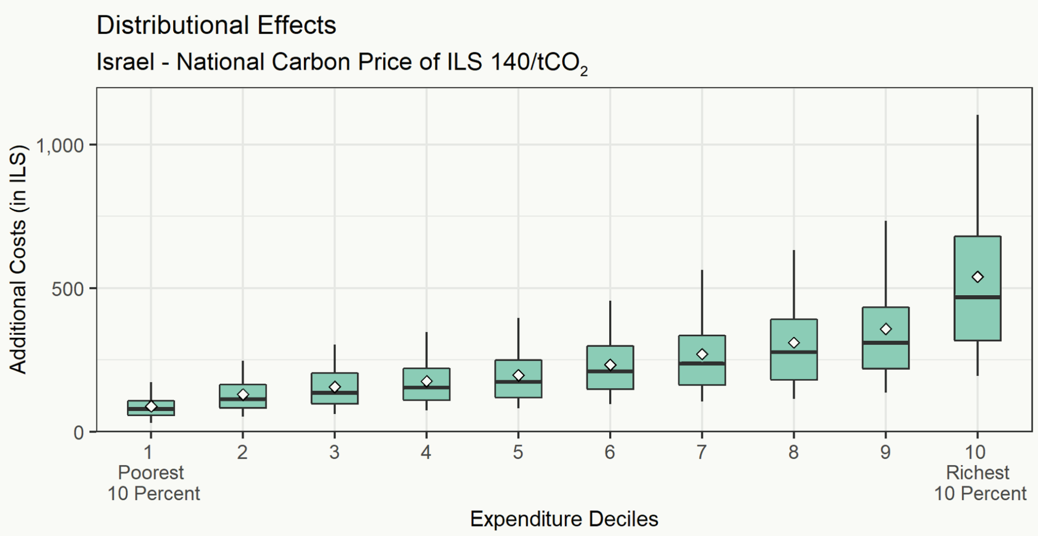
Note that in this study, we present expenditure deciles. It is thus disposable income and not overall income that we use as a welfare indicator. However, expenditures are inconclusive indicators of available financial resources, and their source, i.e. income or savings. A representation of burden from carbon pricing over income deciles can be found in Figure 14. Figure 15 shows absolute additional costs to households in ILS. Note that income data from household surveys is usually regarded to be less valid, since households might not be willing to report openly. In particular, income from labor in informal economies is unlikely to appear in household budget surveys. Note, in addition, that it is not clear how per capita income was derived from the data.

Figure 14.
Burden from Carbon Pricing over Income Deciles



Additional costs on households induced by a carbon price of ILS 140/tCO_2 as a share of total household consumption expenditures (Y-axis) over household income deciles (X-axis). The first decile includes those 10% of households with least total household income. The 10th decile includes those 10% of households with highest total household income. Deciles are directly obtained from the underlying household data. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

Figure 15.
Absolute Burden from Carbon Pricing over Expenditure Deciles



Additional costs on households induced by a carbon price of ILS 140/tCO_2 in ILS (Y-axis) over expenditure deciles (X-axis). The first decile includes those 10% of households with least total expenditures per capita. The 10th decile includes those 10% of households with highest total expenditures per capital. Additional costs of ILS 100 indicate that a household would require an additional ILS 100 in order to buy the same amount of goods bought prior to the price increase. Data: Household Budget Survey 2018 (Central Bureau of Statistics Israel 2019), GTAP 10 (GTAP 2019)

7. Concluding Remarks

Carbon pricing is considered an efficient policy instrument for the reduction of greenhouse gas emissions. While there are various mechanisms for carbon pricing, it is clear that any scheme is likely to have negative economic effects on households. In order to foster public support for the energy transition, it is thus vital to obtain an understanding regarding which segments of the population might be especially affected by such a reform and address socially unbalanced outcomes via redistribution mechanisms.

This paper provides an analysis of the potential economic impact of a carbon price on Israeli households to support the Israeli debate regarding potential carbon pricing instruments. Assuming a carbon price of ILS 140/tCO_2, its aim is to assess distributional consequences of carbon pricing across Israeli households and provide a more accurate picture concerning the potential impact on the Israeli public, including which segments of the population would be more affected than others.

Using the Household Budget Survey from 2018 compiled by the Israeli Central Bureau of Statistics, this analysis provides an overview of household-specific burden from carbon pricing. Specifically, “burden” refers to the additional costs (in relation to total expenditures) that would arise for Israeli households when consuming the same amount of goods that had been consumed prior to the introduction of a carbon price.

As demonstrated throughout this paper, the consequences of carbon pricing in Israel would be heterogeneous across households, which adhere to different lifestyles and consumption patterns. Examining multiple Israeli households, which reflect different parts of the Israeli society, it becomes clear that if a carbon price were to be introduced with no further policy measures, it would have regressive distributional outcomes: In relation to their total expenditures, poorer households would be more affected than richer ones. In addition, Arab households, rural households and households that own (and use) a car would be affected to a greater extent than other households.

Using some of the revenues generated from carbon pricing to compensate affected households via redistribution mechanisms could help in addressing potential regressive effects and might even lead to progressive outcomes in some of the cases, as follows from this paper’s results.

> **In order to foster public support for the energy transition, it is thus vital to obtain an understanding regarding which segments of the population might be negatively impacted by such a reform and address socially unbalanced outcomes via redistribution mechanisms.**

We hope that this publication contributes to the Israeli debate and planning process in anticipation of a carbon pricing policy, and help decision-makers to design a fair carbon pricing plan in a way that supports the effort of decarbonizing the Israeli economy while leaving no one behind.

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