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Discussion paper

A carbon footprint proportional to expenditure - a case for Norway?

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A carbon footprint proportional to expenditure - a case for Norway?

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Abstract

Assuming that emissions originate from the consumption of goods and services, we study the relationship between consumption-based per capita carbon footprint and per capita expenditure for Norway, using 2007 data. A two-region input-output model reveals that the consumption-based per capita carbon footprint is directly proportional to expenditure with an estimated elasticity close to unity. We show that this result is at least partly driven by a near zero-emission power sector, which leads to comparatively low emission intensities for domestically-produced goods and services.
Keywords: Carbon footprint, consumption, trade

1. Introduction

Climate change is a global threat that requires a global solution. Yet, existing solutions aiming to achieve carbon emission abatement, including the Kyoto protocol, regional treaties and national policies, fall short of being global. At present, these solutions primarily target domestic carbon emissions.

It has been shown in previous research (Baiocchi and Minx, 2010; Druckman and Jackson, 2009) that a sole focus on domestic emissions may lead to carbon leakage and tend to worsen the anthropogenic impact on the environment (Helm, 2012). Carbon leakage is rendered

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possible by and large because a focus on domestic emissions fails to address the emissions embedded in imported goods and services. By reallocating emission-intensive production to developing countries, developed countries have, to a large degree, been able to maintain or increase their standard of living without being accountable for the associated emissions. Goods and services are ultimately produced for consumption purposes and for this reason, it is essential to address the relationship between emissions related to the consumption of goods and services and the standard of living in a country in order to mitigate the threat of climate change.

Recent studies investigating emissions related to the consumption of goods and services (Baiocchi and Minx, 2010; Helm, 2012; Machadi et al., 2001; Peters et al., 2012; Peters and Hertwich, 2006; Steinberger et al., 2012) recommend a switch towards consumption-based policies to mitigate climate change.

Motivated by the stance that consumption drives emissions, we study here how Norwegians consume. In a consumption-based setting, a carbon footprint is the sum of the direct emissions from, e.g. driving a car or heating a house, and of the indirect carbon emissions embedded in consumed goods and services produced domestically or imported. A consumption-based carbon footprint thus accounts for all carbon emissions embedded in consumed goods, independently of where the good was produced. As a consequence, the consumption-based approach is more closely related to the standard of living in a country compared to the domestic-based approach.

Here, we estimate the relationship between consumption-based per capita carbon emissions and per capita expenditure using 2007 data. The distinction between domestic and consumption-based emissions is particularly relevant in the case of Norway, because of the country's specific characteristics (Peters and Hertwich, 2006). Import levels are significant and increasing (SSB, 2012b, 2013), which implies that a growing share of the consumption-based carbon footprint is related to imports. In addition, Norway has one of the cleanest power sector in the world, owing to an extensive use of hydropower. This implies that energy-intensive goods produced in Norway will have relatively low emission intensities. For these reasons, correcting domestic-based emissions for import is critical, as well as properly estimating the carbon embedded in imported goods and services. The focus in this study being solely on Norway, emissions embedded in exports are set aside.

The rest of the paper is structured as follows. The literature is reviewed in Section 2. The approach used for estimating a household carbon footprint is introduced in the theory section, followed by the description of the data in Section 4. A section related to the specific limitations of our approach comes next. Section 6 presents the relationship between consumption-based per capita carbon footprint and household expenditure. The dataset is then split between five categories; food, energy, clothing, transport and other goods and services, which implications are discussed in Section 7. Finally, Section 8 summarizes the results.

2. Literature review

The literature on the consumption-based carbon footprint is large[1]. For example, Girod and de Haan (2010) study how greenhouse gas emissions per capita evolve with increasing wealth at the household level in Switzerland. Golley and Meng (2012) investigate the per capita carbon dioxide emissions across households with increasing income levels in China. Peters et al. (2006) explore the relationship between household expenditure and environmental impact in Norway, and Weber and Matthews (2008) study the global and distributional aspects of household carbon footprint in the US. Cross-sectional studies generally conclude that there is a strong relationship between carbon emissions and expenditure (alternatively income)[2]. Overall, conclusions tend to indicate that if climate change mitigation is the final aim, consumption-based emissions have to be targeted in priority, at least as long as global cooperative efforts to mitigate climate change are not taking place. Other studies (Sinn, 2008; Hoel, 2012) however claim that a strict focus on demand while neglecting the supply side of non-renewable resources may result in a green paradox, where efforts to abate

[1]For an updated overview of the empirical literature, see Sato (2012).

[2]In the case of China, Golley and Meng (2012) find that, at higher income ranges, the carbon footprint increases more than proportionally with income.

emissions are offset, at least in the short term, by a faster rate of extraction of the fossil resources.

Studies investigating consumption-based emissions differ mainly in two aspects. First, the focus is on either a number of households (Golley and Meng, 2012; Weber and Matthews, 2008), on the mean population (Druckman and Jackson, 2009; Peters and Hertwich, 2006) or on nations (Steinberger et al., 2012). Here, we explore the variation in consumption-based per capita carbon footprint within Norway for various expenditure levels based on a household expenditure survey on over thousand households in 2007. Second, the literature also differs on how the carbon embedded in consumed goods and services is estimated. Several studies (e.g., Golley and Meng (2012)) estimate emissions embedded in traded goods and services using the domestic technology assumption, meaning that all imported goods and services are assumed to have been produced with the same technology as the technology used in the importing country. This typically introduces a bias in the results (Bouwmeester and Oosterhaven, 2013). Other authors (Druckman and Jackson, 2009; Peters and Hertwich, 2006; Weber and Matthews, 2008) apply a more detailed approach and estimate the carbon embodied in trade using a multi-regional input-output model with a limited number of regions. In the case of Norway, assuming that imported goods and services are produced with domestic technologies would typically underestimate the quantity of carbon embodied in the imported goods and services (Peters and Hertwich, 2006). In this study, we build on recent research (Andrew and Peters, 2013) and estimate the carbon embodied in trade using a two region approach (Norway, Rest of the World), in which emission intensities reflect the global carbon emissions to produce the final good or service.

Of the studies introduced in this literature review, these of Peters et al. (2006) and of Weber and Matthews (2008) are the most comparable. Peters et al. (2006) found a CO_2-expenditure elasticity of 0.88 using 1999-2001 data for Norway. Weber and Matthews (2008) suggest that the CO_2-expenditure elasticity in the United States was between 0.6 and 0.8 in 2004.

3. Theory

The consumption-based per capita carbon footprint consists of two parts; direct emissions (e.g. tailpipe emissions as the consumer drives a car) and indirect emissions. The latter comprises the emissions embedded in goods and services resulting from their production, as well as the emissions associated with the production of intermediary goods used in the production process (Golley and Meng, 2012). Goods and services consumed in Norway have either been produced in Norway or outside the country (referred to as RoW in the following equations). The distinction between domestic and imported goods is critical because imported goods may be produced with different production technologies, hence emission intensities may differ compared to goods and services produced domestically. Relying on the notation from Peters et al. (2006), a household's carbon footprint f_h^{total} can be expressed as:

$$f_h^{total} = f_h^{direct} + f_h^{indirect,Norway} + f_h^{indirect,RoW} \tag{1}$$

Direct emissions f_h^{direct} are obtained by multiplying direct carbon emitting activities measured in physical (e.g.: km driven in a year) or monetary units by their specific emission intensity. Based on the work of Druckman and Jackson (2009) and adjusted to suit our study, indirect emissions from goods and services produced in Norway can be calculated using the following equation:

$$f_h^{indirect,Norway} = u^{Norway} \cdot \Big((1-s) \cdot (y_h \cdot A^{Norway'})\Big) \tag{2}$$

where h stands for a particular household, u^{Norway} is a row vector of emission intensities for different goods and services for Norway, s is a vector of import coefficients, A^{Norway} is a concordance matrix[3] linking emission intensities to a household expenditure, and y_h is a row vector of a household expenditure on goods and services produced in Norway. The

[3] A concordance matrix is needed in our study to match different datasets relying on different classification systems (see Section 1.4).

expenditure vector y_h, measured in Norwegian kroner is unique to each household, while the other elements of Eq. (2) are held constant.

Similarly, indirect emissions embedded in imported goods and services and consumed by a Norwegian household can be calculated with:

$$f_h^{indirect,RoW} = u^{RoW} \cdot \left(s \cdot (y_h \cdot A^{RoW'}) \right) \tag{3}$$

Eq. (2) and (3) allow for the use of differing emission intensities across goods and services. In our case, the emission intensities reflect the global emissions related to the production of the good or service. For example, the production of chocolate in Norway relies on the use of cocoa, which had to be produced abroad and transported to Norway, thus embedding emissions. These emissions have to be reflected in the emission intensity of producing chocolate in Norway, which is the case in our study.

Finally, a household's needs grow with each additional member, although in a less than proportional way (Deaton and Muellbauer, 1980). In this study, the consumption-based per capita carbon footprint f_h^{total} is deflated using the OECD-modified equivalence scale (OECD, 2007) to account for the household structure and hence to obtain the per capita carbon footprint. This scale assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child. This means that a household with two adults and one child is modeled to need an expenditure of 1.8 times the expenditure of a household with one adult in order to guarantee the same standard of living.

4. Data

Data on household expenditures is based on Statistics Norway's survey of consumer expenditure 2007. This dataset contains information on expenditures on 183 final goods and services, classified according to the Classification of Individual Consumption According to Purpose model (UNSD, 2013a) for 1,081 households. Data related to the direct consumption of fuel, either in monetary (e.g.: money spent on electricity) or physical units (e.g.: km driven in a year), are multiplied by an emission coefficient to give the direct emissions.

Emission coefficients for e.g.: quantity of carbon released per km driven, are based on a variety of sources (SSB, 2005, 2009, 2012a).

In addition to the vector of household expenditures, several other datasets need to be combined to allow for the estimation of the indirect emissions. The vector of import coefficients used to split between consumption of Norwegian and non-Norwegian goods and services is estimated using symmetric input-output tables (IOT) for Norway (SSB, 2012b). IOT are available for 59 products times 59 activities organized by the so-called Classification of Products by Activity (EC, 2002). The share of import for each product is calculated as the quantity of imported input to supply a product divided by the total input necessary to supply the product.

Finally, emission intensities on 57 commodities were kindly provided by Glen Peters from the Center for International Climate and Environmental Research (CICERO). These emission intensities were calculated via the Global Trade Analysis Project 8 database (GTAP, 2013b), and are meant to reflect the global emissions associated with the whole supply chain of a product or a service. More specifically, the emission intensities take into account trade between 129 regions of the world, where the regions are allowed to have different production technologies[4]. The data on emission intensities is classified under the GSC2 classification system (GTAP, 2013a).

Since the datasets are organized according to different systems, concordance tables had to be created to link them to each other[5].

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[4]For a more detailed description on how these intensities were estimated, see Andrew and Peters (2013).

[5]For example, the concordance in goods between the COICOP and the GSC2 is possible via the intermediate use of the CPC ver. 1.0 classification system. The concordance in services between the COICOP and the GSC2 was made possible by first converting the COICOP categories to the CPC ver. 1.0 (UNSD, 2013b), further re-categorized under the ISIC ver. 3 (UNSD, 2013c) and finally mapped to the GSC2 system using the concordance established by Mastoris et al. (2001).

5. Limitations

Other papers (Andrew and Peters, 2013; Girod and de Haan, 2010; Peters, 2007; Peters and Hertwich, 2006; Weber, 2008; Weber and Matthews, 2008) have covered the limitations associated with studies exploring the environmental impact of household consumption. For this reason, the focus in this section will be on the specific issues related to the method chosen to estimate the consumption-based per capita carbon footprint.

The main drawback in using emission intensities obtained via the GTAP database is in the need for linkage between various databases organized according to different classification systems. The correspondence is unfortunately incomplete between the goods and services available in the survey of consumer expenditure and the list of commodities for which we obtained emission intensities. Additional links had to be introduced manually. In addition, some of the categories used in the household expenditure survey are linked to several commodities. For example, the category 01.1.1 (Bread and cereals) is linked to no less than 21 commodities, and proportions of the household expenditure spent on each GTAP category therefore had to be allocated manually. This process was done at the most disaggregated level in order to minimize the size of the error.

Another limitation of our approach lies in the necessary assumption that households adopt similar import behaviors for a given consumption item. For example, if one household consumes one kilogram of Norwegian potatoes and another household consumes one kilogram of imported potatoes, our approach will assume that both houses consume half a kilogram of Norwegian potatoes and half a kilogram of imported potatoes.

Moreover, the emissions embedded in a good are estimated using a financial accounting approach. Girod and de Haan (2010) observed in their work that using monetary units in estimating the environmental impact at the household level leads to an overestimated impact of marginal consumption and obviously, does not allow for a decoupling between income and environmental impact. Consequently, a doubling in expenditure on a given good corresponds to a doubling in the emissions from that good in our model. This limitation is minimized in the case of the direct emissions, considering our use of physical units to estimate the direct emissions whenever possible. However, this issue remains unaddressed in the case of the indirect emissions. In the scope of this study, a change in the relationship between consumption-based carbon emissions and expenditure will therefore be detected only if it results from different consumption bundles. However, a possible change in the carbon footprint-expenditure relationship due to differences in quality, i.e.: high-expenditure consumers may prefer to consume better instead of more, cannot be captured by our approach.

6. Results and discussion

Consumption-based per capita carbon footprints in Norway are plotted against per capita household expenditures in Fig. 1[6]. The plot is based on a cross-section for 2007.
The relationship between per capita carbon footprint and per capita expenditure seems close to linear. Therefore, we estimate a robust version of the following linear relationship:

$$y_i = \alpha + \beta x_i \tag{4}$$

where y_i is the carbon footprint per capita in tonnes CO_2 and x_i is the expenditure per capita measured in thousand Norwegian kroner. Accounting for heteroskedasticity, the model gives a coefficient of determination of .9. Alternative functional forms were tested on the data in order to obtain the best fit (see Table 1).
A quadratic function leads to a R^2 value of 0.9, however the quadratic term is not significant at even a 10% level. Adding a cubic term to this function only marginally increases the R^2. The quadratic and cubic terms are significant at a 5% level. However, since both coefficient are close to 0, we do not see a reason to pursue with this model. Finally, a log-linear is tested on the data. The β coefficient is of similar order of magnitude as the elasticity estimated on

[6] A total of nine observations (out of a total of 1,081) representing extreme values in per capita expenditure or in consumption-based per capita carbon footprint were identified as outliers by comparing their predicted values to their residual (Heij et al., 2004) and dropped from the analysis. Including these outliers in the analysis would only marginally impact the results presented thereafter.

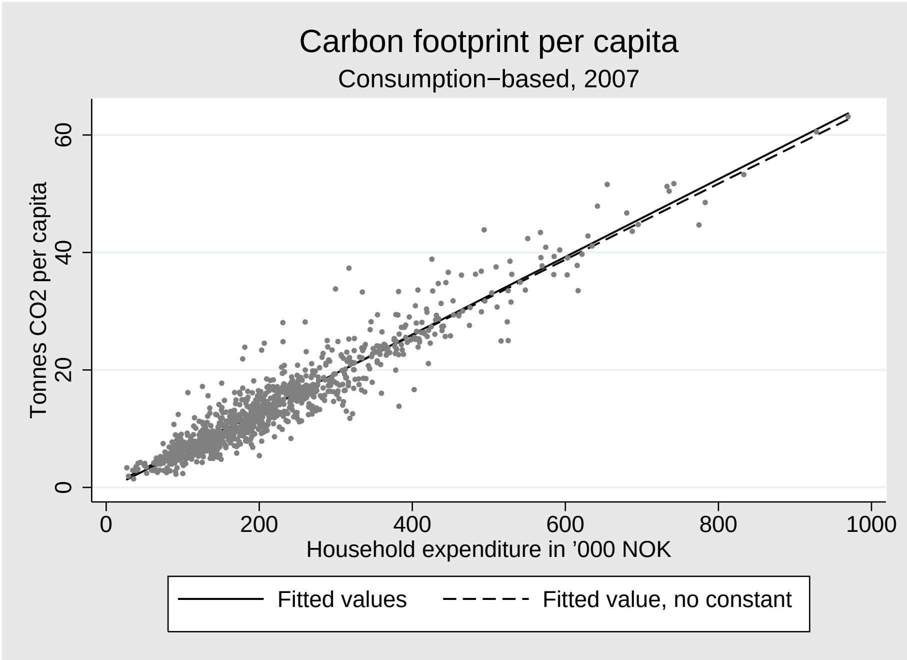

Figure 1: Per capita consumption-based carbon emissions plotted against household expenditure.

the linear model (see below). Hence, we decided to keep the linear model for the rest of the analysis.

The elasticity of a linear model can conveniently be obtained by using (Heij et al., 2004):

$$\varepsilon = \frac{dy}{dx}\frac{x}{y} \tag{5}$$

which leads to an estimated CO_2-expenditure mean elasticity of 1.03[7]. This result indicates that carbon is not only a normal good but also exactly at the border between a luxury and a necessity good. The size of the elasticity is striking because it exceeds the elasticity estimated by Peters et al. (2006) of 0.88. These estimates are however not directly comparable as they rely on different datasets and different approaches to correct the data for the household structure.

Present data and methods display a consumption-based per capita carbon footprint linear in per capita expenditure. Here, we go further and claim that the consumption-based per

[7]The 95% confidence interval ranges from 1.01 to 1.06.

Functional form	α	β	t_β	γ	t_γ	δ	t_δ	R^2
$y_i = \alpha + \beta x_i$	-0.44	0.07	83.7					0.9023
$\log(y_i) = \alpha + \beta \log(x_i)$	-2.88	1.02	80.2					0.8737
$y_i = \alpha + \beta x_i + \gamma x_i^2$	-0.26	0.07	34.7	0.00	0.8			0.9024
$y_i = \alpha + \beta x_i + \gamma x_i^2 + \delta x_i^3$	0.398	0.06	13.5	0.00	2.1	-0.00	-2.1	0.9027

Table 1: Testing various functional forms on the data: linerar, log-linear, quadratic and cubic function.

capita carbon footprint is *proportional* to per capita expenditure. This assertion is supported by noticing the small visual difference between the fitted line of the linear regression and a fitted line without constant seen on Fig. 1.

Based on the sample, consumption-based per capita emissions range from 5.9 tonnes of CO_2 (mean of first quintile in thousand Norwegian kroner) to 27.1 tonnes (mean of fifth quintile in thousand Norwegian kroner), with a mean of 14 tonnes (see appendix II). Splitting the data between domestic and imported emissions shows that both domestic (estimated mean elasticity of 0.89) and imported emissions (estimated mean elasticity of 1.22) are increasing with the household expenditure (see Fig. 2). The difference in estimated elasticities indicates that households with higher spending tend to consume from categories of goods and services which rely comparatively more on imports.

Direct emissions and indirect emissions resulting from the consumption of domestically produced goods and services account for 8 tonnes of CO_2 per capita on average. Indirect emissions embedded in imported goods consumed in Norway contribute to the remaining 6 tonnes of CO_2 per capita, or in other words, to 43% of the total emissions.

Our next step is to decompose the data into several subcategories in order to extract additional information on the relationship between consumption-based per capita carbon emissions and per capita expenditure. The selected subcategories are: *food*, *energy*, *transport*, *clothing* and *other goods and services.* Direct emissions from the consumption of diesel,

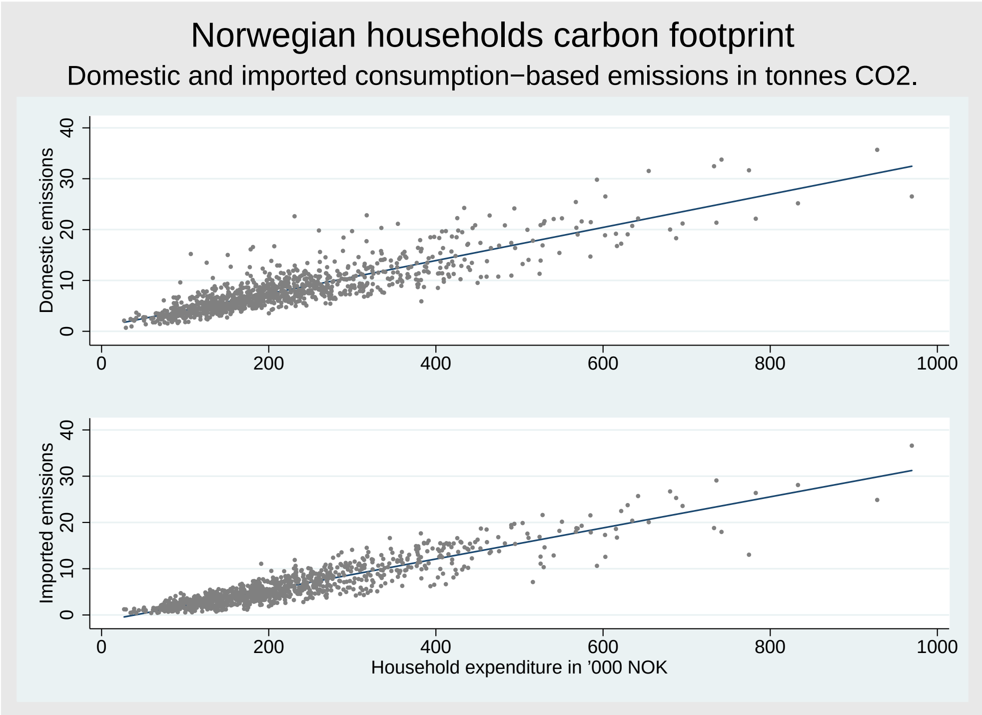

Figure 2: The carbon footprint of Norwegian households resulting from the consumption of domestically produced and imported goods and services.

gasoline, heating oil and gas products and from the use of electricity are included in the *energy* category. The category *transport* comprises the indirect emissions associated to per capita expenses on motor vehicles and parts, rail, water and air transport. *Clothing* covers not only what is generally associated to clothing, but also textiles used in houses for example. The final category *other goods and services* covers all remaining expenses, from recreational activities to telecommunication and financial services[8].

The overall relationship can reasonably be expected to lose its linear characteristic when these categories are explored separately. Taking the example of food, Engel's law (Deaton and Muellbauer, 1980) suggests that the proportion of the total expenditure (income) spent on food should fall as total expenditure (income) increases. This is verified in the data (see Fig. 3 and 4) and food is indeed declining in expenditure.

[8]Details on how each category was created is given in appendix I.

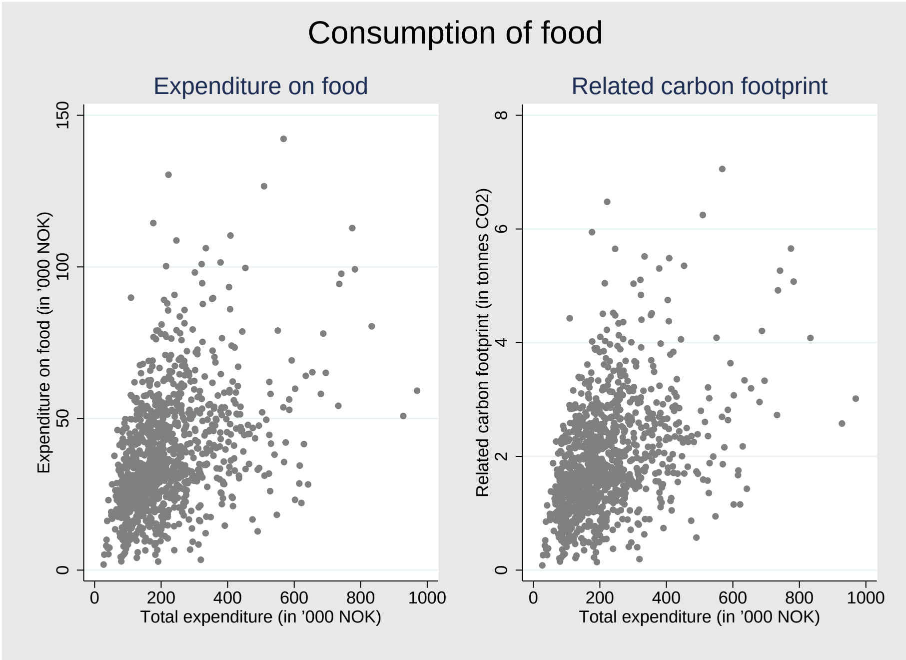

Figure 3: Expenditure on food as expenditure increases and related carbon footprint.

This figure indicates a strong correlation between expenditure on food and carbon footprint from the consumption of food. Part of this result may be the direct consequence of using financial accounting and assuming similar import behaviors. Although our approach may somewhat plague the data, the range in carbon footprints for a given level of expenditure reflects diversity in consumption habits. Therefore, our approach allows for a difference in consumption-based carbon footprints due to different consumption bundles, but not based on different consumption and import behaviors.

Table 2 shows the separately estimated expenditure and carbon elasticities for all categories. This table indicates that the demand is normal with respect to expenditure, which is expected given that goods and services are large aggregates in this study (Mas-Colell et al., 1995). The table indicates that *food* and *energy* are declining in expenditure, whereas *transport* is increasing in expenditure. Fig. 4 summarizes the shares of expenditure spent on each category and their related contribution to the carbon footprint for the first, third and

Category	Expenditure elasticity	Carbon elasticity
Food	0.37	0.37
Energy	0.14	0.29
Transport	1.60	1.14
Clothing	1.06	1.07
Other	1.02	1.21

Table 2: Expenditure and carbon elasticities for categories *food, energy, transport, clothing, other.*

fifth quintile of the dataset[9].

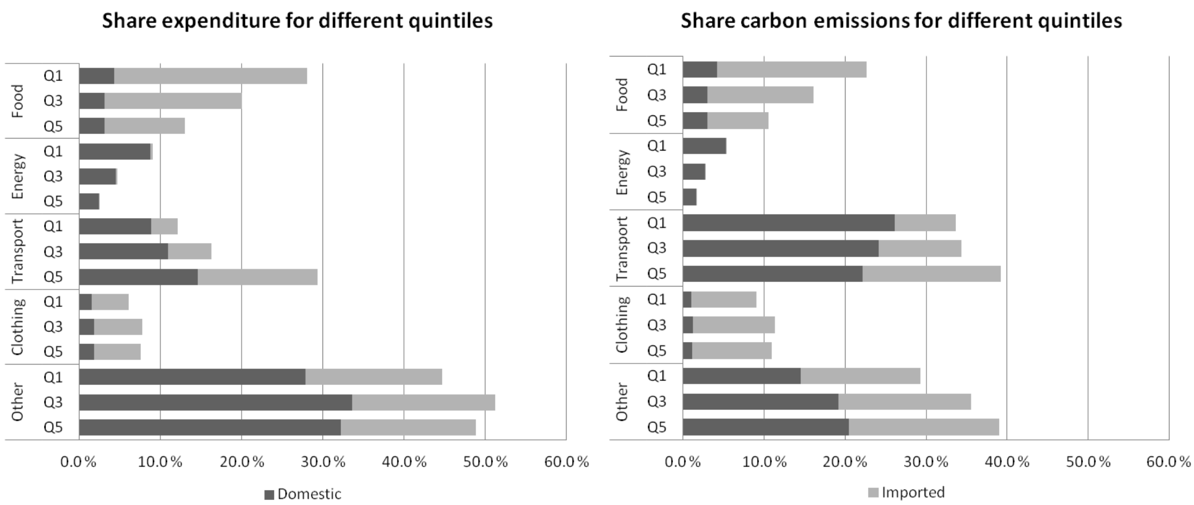

Figure 4: Share of household expenditure going to the five categories for different quintiles, as well as the related share of carbon emissions.

Large variation occurs between groups and quintiles. For instance, expenditure on *transport* ranges from 12.1% to 29.3% for the different quintiles, and the related contribution to the carbon footprint reaches between 33.6% and 39.3%. This result is partly driven by

[9]Detailed data is available in appendix II.

the consumption of petroleum products in private means of transportation. The opposite example is the group *clothing*. Spending on this category amounts to about 7% of the total expenditure regardless of the level of spending and its contribution to the carbon footprint is around 10%. The difference in carbon intensity is striking here. Norwegian clothes have lower carbon intensities than imported clothes[10], which is reflected in the data. Taking the example of Q1; 1.5% of the total expenditure on domestically-produced clothing contributed to 1% of the household's carbon footprint, whereas 4.6% of the household expenditure was spent on imported clothing with a contribution of 8% to the household's carbon footprint. Given that around 90% of the emissions embedded in the consumption of clothing occurs abroad (see Fig. 4), our findings suggest that a narrow focus on production-based emissions could potentially omit a large share of the emissions related to the consumption of goods and services from this sector. For some other sectors and categories of goods, trade seems to matter less. For example, the share of carbon imported in the *energy* category is limited.

7. Robustness checks

In our study we use a fixed low emission coefficient for the consumption of electricity. It can be argued that using average emissions from the consumption of electricity to estimate the consumption-based carbon footprint is misleading and that taking marginal emissions would be more accurate. The reasoning behind this argument is that as electricity consumption increases, e.g.: during cold weather events, Norway has less excess electricity to export to other countries or perhaps fossil-based electricity needs to be imported. Consequently, emissions associated to the consumption of electricity are much higher at the margin than at the average.

In an attempt to test and quantify the effect of this reasoning, we investigate what happens if we replace the carbon intensity for the electricity sector with an intensity reflecting the

[10] The carbon intensity of textiles for Norway is 0.0043 $kgCO_2$/Norwegian kroner, whereas the carbon intensity of the textile produced elsewhere but consumed in Norway is 0.012 $kgCO_2$/Norwegian kroner, or nearly a factor three higher.

European energy mix[11]. The effect of this change is that the relationship is shifted upward and the estimated expenditure elasticity of carbon decreases to 0.79[12]. This tends to indicates that the high estimated expenditure elasticity of carbon is partly due to the particular characteristics of the Norwegian electricity sector. Such a pronounced impact is rendered possible by the extensive use of electricity in Norwegian households for heating purposes as well as for their power needs.

We perform a second robustness check in order to illustrate the importance of using different emission intensities for domestically-produced and for imported goods and services. Assuming Norwegian emission intensities for imported goods and services leaves the expenditure elasticity of carbon virtually unchanged to 1.03[13]. However, the consumption-based carbon footprint would be underestimated by 15% (mean first quintile in thousand Norwegian kroner) to 17% (mean fifth quintile in thousand Norwegian kroner).

8. Summary and implications

Global problems such as climate change require global solutions. However, in the absence of a global solution, individual acts can pave the way to a more sustainable future. Yet, in a world driven by consumption, and as long as a global solution is not found; a narrow focus on domestic-based emissions is problematic due to the large and growing importance of trade.

In this study we analyze the relationship between consumption-based carbon footprint and household expenditure for Norway in 2007, where the emission intensities reflect the global emissions related to the production of a good or a service consumed by Norwegian households. Results show that the consumption-based carbon footprint per capita is proportional with respect to expenditure per capita and the expenditure elasticity to carbon is approx-

[11] In our study, we assume near-zero carbon intensity of 0.009 to 0.0117 kgCO_2/Norwegian kroner depending on the location of the household, whereas the average calculated emission coefficient for Europe is 0.595 kgCO_2/Norwegian kroner.

[12] 95% confidence interval ranging from 0.76 to 0.81.

[13] 95% confidence interval ranging from 1.00 to 1.05.

imately 1. This result is striking as it is particular to the case of Norway and its unique characteristics. For instance, Norway is relying on a nearly zero emission power sector, which implies low carbon emission intensities from the use of power to produce goods and services and from the use of electricity to heat Norwegian houses. A robustness check was used to demonstrate that this low emission intensity contribute to increasing the expenditure elasticity of carbon.

In addition, the amount of carbon embedded in imported goods and services constitute a large share of the total carbon footprint, thus omitting trade would underestimate the environmental impact of Norwegian households domestically and abroad.

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Disclaimer

Some of the data applied in the analysis in this publication are based on 'Consumer Expenditure Survey, 2007'. The data is provided by Statistics Norway, and prepared and made available by the Norwegian Social Science Data Services (NSD). Neither Statistics Norway nor NSD are responsible for the analysis/interpretation of the data presented here.

Appendix I

Composition of each subcategories used in this analysis. The description of each GTAP category is reproduced from GTAP (2013a). [1] nec means not elsewhere classified. [2] direct emissions due to the consumption of electricity, natural gas, parafin and fuel oil are imputed to the energy category. [3] direct emissions due to the consumption of gasoline and diesel are imputed to the transport category.

Category	GTAP	description	GTAP	description
Food	G01	Paddy rice	G19	Bovine meat products
	G02	Wheat	G20	Meat products nec[1]
	G03	Cereal grains nec[1]	G21	Vegetable oils and fats
	G04	Vegetables, fruits, nuts	G22	Dairy products
	G05	Oil seeds	G23	Processed rice
	G06	Sugar cane, sugar beet	G24	Sugar
	G09	Bovine cattle, sheep and goats, horses	G25	Food products nec[1]
	G10	Animal products nec[1]	G26	Beverages and tobacco
	G11	Raw milk	G45	Water
	G14	Fishing		
Energy	G15	Coal	G43	Electricity
	G16	Oil	G44	Gas manuf., distr.
	G17	Gas	N/A	Direct emissions[2]
Transport	G38	Motor vehicles and parts	G49	Water transport
	G39	Transp. equip. nec[1]	G50	Air transport
	G48	Transport nec[1]	N/A	Direct emissions[3]
Clothing	G07	Plant based fibers	G28	Wearing apparel
	G12	Wool, silk-worm cocoons	G29	Leather products
	G27	Textiles		
Other	all other GTAP categories			

Appendix II

Expenditure of Norwegian households on domestically produced and imported food, energy, transport, clothing and other per quantile and in '000 NOK, and their related contribution to the households' carbon footprint in tonnes CO_2.

		Expenditure			Emissions		
		Q1	Q3	Q5	Q1	Q3	Q5
Food	Domestic	21.9	32.5	41.3	1.1	1.6	2.0
	Imported	4.0	5.9	7.5	0.2	0.4	0.5
	Total	25.9	38.5	48.8	1.3	2.0	2.5
Energy	Domestic	8.1	8.7	10.0	0.3	0.3	0.4
	Imported	0.3	0.3	0.4	0.0	0.0	0.0
	Total	8.4	9.0	10.4	0.3	0.3	0.4
Transport	Domestic	8.2	20.9	60.9	1.5	2.9	6.0
	Imported	3.0	10.3	61.0	0.4	1.3	4.6
	Total	11.2	31.3	121.9	2.0	4.2	10.6
Clothing	Domestic	1.4	3.5	7.6	0.1	0.1	0.3
	Imported	4.2	11.4	24.1	0.5	1.2	2.7
	Total	5.7	14.9	31.7	0.5	1.4	3.0
Other	Domestic	25.8	64.4	134.1	0.9	2.3	5.5
	Imported	15.5	33.8	69.1	0.9	2.0	5.0
	Total	41.4	98.3	203.2	1.7	4.3	10.6
Total expenditure		92.5	191.9	416.1			
Total emissions					5.9	12.2	27.1
From imports		27.1	61.8	162.2	2.0	4.9	12.8

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