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Living Green but Poor? Investigating Inequality in Household Energy Costs among Income Groups

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Living Green but Poor?
Investigating Inequality in Household Energy Costs among Income Groups

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Abstract

What are the social consequences of climate mitigation policies? International agreements and activities of international organizations have led to an increase in national policies to mitigate climate change. The question of who has to pay the costs of intensive public programs for mitigating greenhouse gas emissions, however, is mainly addressed on a national level. So far, research has widely neglected whether the costs of climate change mitigation policies are unequally distributed among socio-economic groups. As a consequence, the impact of climate policies on individuals' life situations is largely unknown, even though the design of, for example, a general tax on energy suggests a highly regressive effect on national patterns of housing utility costs among low-income households. Taking into account that lower income groups of Western societies are also characterized by a significantly smaller carbon footprint than those of higher income groups, the implementation of such policy instruments in the residential housing sector creates a challenge for social justice. This conflict between effectiveness of climate mitigation policies and unintended social consequences, such as increasing fuel costs, is analyzed in this paper by applying a before-after design for three country cases: Austria, Denmark, and the United Kingdom. Depending on their design, climate mitigation policies can foster patterns of inequality in household energy costs by stimulating consumption behavior and the promotion of more efficient appliances, support for small-scale renewable energies, and/or increasing taxes and contributions included in the housing utility costs. The reason is, for example, that the poor cannot cope with increased costs as effectively as the rich can. Depending on the welfare or social housing regime, this effect can also be compensated for by high levels in housing allowances or social transfers. The analysis is based on longitudinal data of housing utility costs from the EU-SILC study using multivariate panel-regression models for the period of 2005 to 2008.

Introduction[*]

Following the climate conference in Rio de Janeiro in 1992, the European Union (EU) and its member states established various policy regulations for avoiding human-induced global warming. The debate on climate policies, however, has had a narrow focus on their effectiveness in the reduction of carbon emissions, and takes only an economic definition of sustainability into account (Levine et al. 2007). What has been largely missing is an assessment of the social consequences of these instruments, in terms of increasing income inequality or poverty. Such an omission requires further attention, since it potentially jeopardizes the goals and accomplishments of European welfare states. In particular, incentive-based climate policies to reduce greenhouse gas (GHG) emissions contain the risk of regressive effects and greater social conflict (Grant 2001). The reason is that high-income groups, with their large carbon footprint, are only mildly affected by changes in prices, while low income groups, whose energy consumption is already low, cannot cope with additional costs, due to financial restrictions (e.g. Sefton 2002).

This negative social impact of national regulation is suggested to be most prominent when climate policies directly target individual households, as is the case for regulation in the residential housing sector. Even without climate policies, we find patterns of inequality in household energy costs among income groups, taking the low elasticity of energy consumption into consideration. The question is whether these inequalities are increased by domestic regulations on GHG emissions or whether their effects are only marginal.

Residential housing is regulated by country-specific authorities under the EU Effort Sharing Decision (EU ESD). Hence, it is the responsibility of national governments to institute regulations on renewable energy, energy efficiency, and low carbon consumption in private households to reach the overall EU goal of a 20% reduction in GHG emissions, a 20% increase in renewable energy production, and a 20% improvement in energy efficiency by 2020. Since significant reductions in the energy consumption of individual households is necessary for realizing this ambitious agreement, it is crucial to gain fundamental knowledge about the effectiveness and social impacts of existing climate policies in this field by comparing differing strategies of the EU member states.

This paper evaluates the potential impact of domestic climate policy instruments on inequality patterns of energy costs in the residential housing sector. The analysis is based on a three country comparison of Austria, Denmark, and the UK for the time period from 2005 to

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2008. In the first section, I outline the potential conflict between the two policy fields of climate mitigation and social policy and suggest mechanisms that lead to increased inequality patterns. The following section further describes the three cases according to their domestic climate policy strategies and dominant social policy characteristics in the residential housing sector. Section 4 then tests the potential impact of climate policy instruments on inequality in energy costs with empirical data from the EU SILC study, complemented by descriptive data from Eurostat.

Conflicting fields: social policy and climate measures

This investigation combines the more general perspectives of social and environmental justice and describes the conflict between both concepts in the specific domains of climate change and residential housing (Fitzpatrick and Cahill 2004; Elkins 2005). The focus is on inequalities in the distribution of costs for climate mitigation measures.

Environmental justice is an issue that became more prominent during the process of late industrialization and global economies. It is defined as

> *'The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no population, due to policy or economic disempowerment, is forced to bear disproportionate share of the negative human health or environmental impacts of pollution or environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local and tribal programs and policies'* (US Inst Med 1999)

In consequence, this definition constitutes a human right for environmental goods, such as clean air or water (Franzen 2003; Franzen and Meyer 2010), equally for all citizens, independent of race, education, or income (Johnson et al. 2008). Climate policies in the residential housing sector aim to provide this long-term and global principle of environmental justice by mitigating greenhouse gas emissions and, thus, avoiding climate change, with all its negative consequences for the poor. Most climate policies do so by reducing household energy consumption, namely electricity and heating, which is the major source of carbon emissions in the residential housing sector. This approach, however, intervenes with another social principle, *social justice*, which states that all citizens should be able to benefit from housing, energy use, and heating facilities which provide protection, warmth, and general comfort. As a consequence, this would mean to increase energy consumption. Thus, it is social policies, such as housing allowances, providing sufficient means to lower income households, and stimulating higher energy consumption that increase GHG emissions in the residential housing sector. In contrast, we find that regulative authority, such as eco-taxes, standards, and emission allowances implemented for emission reduction, distributes financial burdens unequally across income groups (e.g. Serret and Johnstone 2006).

For example, climate policy instruments, like taxes on fuel and electricity, affect low-income households more than citizens with higher income levels (Büchs et al. 2011). Following economic literature on household income, we have to consider that the elasticity of income in energy is below one (which means that it is not elastic) (Häußermann and Siebel 1996; Engel 1857). Low-income households already operate on the bottom level of energy consumption and simply cannot afford further energy reductions without falling below socially accepted standards of living. In contrast, higher-income households have the financial means to invest in energy-efficient technologies and, thus, to maintain their consumption-intensive lifestyles.

As another example, one of the most successful climate policy instruments is the Feed-in Tariff for renewable energy, which ensures high benefits for owners of private renewable energy installations (for example, solar cells). Energy traders allocate the costs of these higher tariffs on the electricity bill of all consumers. More clearly, it is lower-income households who cannot afford investments in renewable energy installations but partly pay for these indirect subsidies through higher energy prices (Schiellerup et al. 2009). Based on these considerations, it is reasonable to assume that climate policies can create a trade-off between social equality and GHG emission reduction.

I suggest three mechanisms that influence inequality patterns in energy consumption among income groups in the residential housing sector:

(1) Climate policies stimulate individual behavior in energy-saving activities that give financial incentives/sanctions or information/education for energy-efficient behavior. Households might reduce their general consumption levels or use more efficient appliances while maintaining the same living standards. Reducing consumption behavior for lower-income households most often means a reduction in general comfort, as energy-efficient appliances, such as fridges or washing machines, are more costly in the short-term than products of lower quality. Consequently, lower-income households are highly vulnerable to climate policies that stimulate individual behavior, whereas information and education might bear more efficient behaviors that were not considered before.

(2) Climate policies provide incentives and loans for investments in small-scale renewable energy installations for a subgroup of the population: higher income households with sufficient financial means. Energy costs for these households drop nearly to zero (taking interests into account).

(3) Climate policies most often include hidden costs for staff (e.g. for education/information campaigns) or losses in benefits for energy providers caused by fixed feed in tariffs. These additional costs are allocated to the general price on electricity and heating through contributions and taxes. Thus, energy prices for household energy are less affected by changes in oil/gas prices, due to long contracting, than they are by climate policies that increase contributions or taxes. Due to the inherent inelasticity of energy consumption, lower-income households are more affected by increases in their share of energy costs on total disposable income than higher income households are.

(4) Regardless of climate policies, inequality in energy costs among income groups might also be influenced by changes in income situations through housing allowances and social transfers. Depending on the national welfare or housing regime, these transfers might even balance increasing inequality patterns induced by climate policies in the residential housing sector.

The following three chapters will provide a more detailed analysis by comparing domestic climate policies and the specific housing (policy) regime in Austria, Denmark, and the UK. This analysis will provide insights on the four mechanisms that are at work.

Data, Variables, Methods

I use recent survey data from the 2005-2008 *Community Statistics on Income and Living Conditions* (EU SILC) Household File. The data collection is based on probability samples of persons older than 14 years of age in Austria, Denmark, and the UK. In order to analyze the effects of national context, I use data from Eurostat and the International Energy Agency. Table 1 shows a detailed description of the variables included in the analysis. The dependent variable is total housing utility costs of a household, which is measured in purchasing power parity-adjusted Euros, equalized for household members and number of rooms in the dwelling.

I will apply a most-similar case study design by choosing countries with equal economic strength, national climate policy activity, or EU membership status, but different housing regimes and characteristics of domestic climate policies in the residential housing sector. Each case is analyzed separately in a before-after design by comparing household energy costs before (2005) and after (2008) certain climate-policy instruments have been introduced. Thus, the data reveal a longitudinal structure of households for the years 2005 to 2008. In order to address these data characteristics, random-effects multilevel panel regression models are applied with interactions between year-dummies and the respective indicators (e.g. income, consumption). Table 1 gives an overview of the relevant variables on housing utility costs, income, and living characteristics on the household level.

Table 1: Description of Variables and National Indicators

Variables/Indicators	**Description**
Share in housing utility costs of disposable household income	Purchasing power parities, weighted by equivalized household size before taxes after taxes including housing allowances after taxes including social transfers
Housing utility costs	Purchasing power parities, weighted by equivalized household size
Disposable household income	Power purchasing parities, weighted by equivalized household size and all income resources, including social transfers (quintiles coded)
Tenure status	Dummy: 1 = owner, 0 = tenant
Dwelling type	Dummy: 1 = (semi-)detached house, 0 = apartment or flat
Dwelling size	Number of rooms available
Housing conditions	Additive index: 0 (very bad) – 6 (very good), including appropriateness of lighting, heating and plumping facilities, whether the roof is leaking, and whether the dwelling is adequately cool in summer
Number of appliances	Additive index: 0 (no appliances) – 4 (household owns telephone, TV, computer, washing machine)

The analysis proceeds as followed: First, I will characterize the domestic climate policies adopted between 2005 and 2008 with regard to their likely influence on inequality patterns in energy costs among income groups, depending on consumption behavior, taxes and contributions, housing allowances, and other social transfers. Second, these effects will be statistically analyzed by applying random-effects panel regression models, including interactions between income-groups and the year-dummies. I will do separate analyses for before and after tax/contributions of household utility costs, and before and after housing allowances/social transfers. This analysis will be complemented by additional descriptive data from Eurostat.

Characterizing domestic climate policy, energy consumption, and energy prizing

Austria, Denmark, and the UK are similar countries in many aspects concerning economic wealth, their status in the European Union, and their level of industrialization. All three countries also rank equally high in their climate mitigation policy efforts, according to the index of climate protection from the German non-governmental organization Germanwatch

(Burck et al. 2008). Under the EU Burden Sharing Agreement, Austria agreed on a 13% reduction in domestic GHG emissions, and the UK agreed on a 12.5% reduction. Denmark also needs to reduce their emissions by 21% by 2020 (Schreurs and Tiberghien 2007). The UK, especially, is considered to be one of the leading states in climate change legislation and pushed for an ambitious EU climate reduction agreement during its EU presidency in 2005-2007 (Schreurs and Tiberghien 2007; Wurzel and Connelly 2011). Furthermore, Denmark is one of the leading states with respect to technological innovation and promotion of renewable energies (wind power) (Ryland 2010), while Austria historically "has adopted a wide range of relatively stringent environmental laws (leading to a significant reduction in classic mass pollutants such as sulphur dioxide and nitrogen oxides), opted for fairly ambitious climate change reduction targets and reached one of the highest levels of renewable energy use in Europe" (Wurzel et al. 2003: 51).

Despite these similarities, climate policies in the residential housing sector can have quite diverse impacts on housing utility costs across income groups within these countries. Austria is a strongly regulative country with high efficiency standards combined with moderate taxes on energy (Wurzel et al. 2003). This regime of environmental regulation led to strong insulation standards for new buildings and rather low energy consumption within the current housing stock. Despite strong existing regulations in the housing sector, Denmark adapted a number of additional economic instruments in the early 1990s, in pursuit of mixed incentive revenue (Andersen 2004). However, it is Denmark's open political input structure and strong policy integration across different policy domains that makes the social impact of climate policies on inequality in household energy costs less negative (Andersen 1997). Finally, the UK started rather late in introducing new policy instruments and is still quite skeptical about carbon or energy taxes (Jordan et al. 2003). Lower energy efficiency of the housing stock in the UK is due to lower ecological standards than, for example, in Austria (Weale 1997). With the change in government from the Conservative Party to Labour in 1997, the debate on how policies target different households (such as the Value-Added-Tax on energy products) and affect lower income groups became more prominent (Jordan et al. 2003). This concern led to more sensitive consideration of the negative impacts of climate policy instruments in the British residential housing sector.

Table 2.1 - 2.3 provide an overview of all domestic climate policies in the residential housing sector implemented from 2005 to 2007 in Austria, Denmark, and the UK, and gives information about their scope and underlying mechanisms. Austria's short-term policies directly address energy consumption behavior either by direct consulting households or by

using an online household efficiency calculator. These measures might be able to balance the lack of information of disadvantaged socioeconomic groups on how to conserve energy, even though their effect is expected to be weak. Furthermore, incentive-based policies that benefit higher income groups, such as the Federal Promotion of Extraordinary Efficiency in Buildings, have a long-term scope. Thus, their impact on energy inequalities should be visible after 2008. In general, there is no indication that the Austrian policies have an effect on changes in taxes or contributions, and housing allowances and social transfers should not be necessary to compensate for negative impacts on energy inequalities.

In Denmark, all relevant policies were adopted in 2006—most of them targeted energy consumption through means of efficiency, such as insulation codes or inspections of appliances. Their effects are short- to medium-term, and we can expect an impact until 2008. These energy-saving activities affect contributions, because their efforts are financed by energy prices. This measure harms lower-income households disproportionally, because their share in housing utility costs demand a higher part of their disposable income.

British climate policies only partly affected energy costs during the reference period until 2008. All of the British measures targeted energy consumption in households and avoided changes in taxes or contributions. The Energy Efficiency Commitment is a similar measure to the saving activities undertaken by energy companies in Denmark but with a more moderate impact. British energy companies are obliged to address a certain percentage of costumers with lower-income in order to reach their efficiency target. The effect of the building regulations of 2005 is expected to be rather weak, since it addresses efficiency measures in a very restricted manner.

Austria, Denmark, and the UK are countries with different characteristics in their respective housing policy regimes. Consequently, housing allowances or social transfers should compensate negative effects of domestic climate policies quite differently across these countries. In Austria and Denmark, social and private housing is integrated into one single housing market, including universal subsidies across all tenures. Consequently, social housing support is far more independent from the individual tenure status in Austria and Denmark than in the UK, where social housing is separated from the private market and organized by public authorities (Arbaci 2007; Kemeny 1995).

Table 2.1: Domestic climate policy instruments 2005-2007 in Austria

Name	Description	Mechanism	Scope	Impact	Year
Energy Consulting for Households: klima:aktiv leben to Employ Chimney-Sweepers as Climate Ambassadors	Part of the larger Austrian climate strategy, the klima:aktiv leben campaign partners with the nation's chimney sweepers to publicize energy efficiency measures in residences. The chimney sweepers visit households and bring with them easy-to-implement energy-saving advice while identifying possible needs for expert consulting in energy efficiency matters or useful investments in energy-saving and climate protection measures. Following the chimney sweepers' visits, the Austrian Federal Provinces' energy consultants assist households with qualified consultation.	behavior	short-term (1 year)	medium (voluntary)	2005
Quick-Check Online Household Energy Efficiency Calculator	Quick-Check is an online energy efficiency calculator for household products: http://www.e-control.at/de/home/redirect?pUrl=www.e-control.at/portal/page/portal/ECONTROL_HOME/PRESS/PRESSEKONFERENZEN/2006-15-03_Pressemappe_Jahresbericht2005.pdf	behavior	short-term (1 year)	weak (voluntary)	2006
Federal Promotion of Extraordinary Efficiency in Buildings	Under this program to reduce the climate impacts of housing, residential buildings must clearly exceed regulatory standards to qualify for state funding. The agreement includes an initial insulation standard of 65kWh per square meter, falling to 25-45 kWh/m^2 by 2010. It also introduces new incentives for use of renewable heating systems.	behavior/ efficiency	long-term (5 years)	medium (only change in rather stringent regulation)	2006

Note: only national policies.
Source: Climate, Renewable and Energy Efficiency Policies Database International Energy Agency (IEA) 2011; Climate change policies and measures in Europe Database, European Environmental Agency 2011.

Table 2.2: Domestic climate policy instruments 2005-2007 in Denmark

Name	Description	Mechanism	Scope	Impact	Year
Savings activities by energy companies	Energy companies carry out campaigns and energy saving activities aimed at energy consumers. They are obliged to realize savings in final consumption without geographical or sector limitations. The effort is financed by the consumers via the consumers' price.	behavior, contribution	short-term (1 year)	medium	2006
Thermal Building Code Revision	To reflect Danish implementation of the EU Energy Performance of Buildings Directive 2002/91 EC, the national building code for energy efficiency in new buildings changed. As of 2006, the maximum energy use in new buildings is based on an energy performance calculation. New buildings will be subject to thermal efficiency standards approximately 25-30% more stringent than those of existing buildings in all new buildings. Calculation of buildings' efficiency now involves consideration of the total energy consumption of heating, lighting, cooling, and ventilation within the building frame.	efficiency	medium-term (2-3 years)	low (only change in already rather stringent regulation for new buildings)	2006
Energy Labeling and Certification	Under this scheme, buildings need an energy label when they are newly constructed, when they are sold, and if they are rented out. For existing buildings, certificates cannot be more than 5 years old. New buildings must meet requirements corresponding to the second highest standard. A handbook has been developed for energy consultants who establish labels, in which two types of energy saving measures must be identified: immediately feasible ones and those feasible if carried out in addition to ongoing renovation.	efficiency	short-term (1 year)	high (relevant for new, sold, and rented buildings)	2006
Inspections of Boilers, Heaters, Ventilation, and Air Conditioning Systems	A scheme for the regular inspection of boilers and heating systems was also implemented as of 1 September 2006, supplanting an already existing inspection scheme for oil-fired boilers. A scheme for air conditioning and large ventilation system inspection took effect from 1 January 2007.	efficiency	medium-term (2-3 years)	high	2006, 2008

Note: only national policies.
Source: Climate, Renewable and Energy Efficiency Policies Database International Energy Agency (IEA) 2011; Climate change policies and measures in Europe Database, European Environmental Agency 2011.

Table 2.3: Domestic climate policy instruments 2005-2007 in the United Kingdom

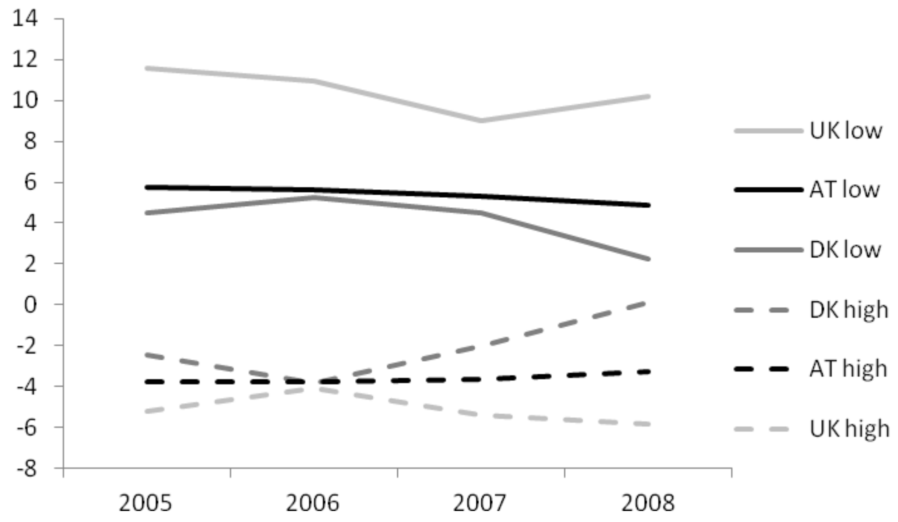
Name	Description	Mechanism	Scope	Impact	Year
Energy Efficiency Commitment (EEC)	Under the EEC, electricity and gas suppliers are required to achieve targets for the promotion of energy efficiency improvements in the domestic sector. Suppliers can fulfill their obligations by carrying out any combination of approved measures, including installing insulation or supplying high efficiency appliances or boilers. The only constraint on the suppliers' activities is that they must achieve at least half of their energy savings in households using income-related benefits and tax credits.	behavior/ efficiency	short-term (1 year)	medium (addressing behavior directly, given a specific target)	2005
2006 building regulations, including 2005 condensing boiler update	In September 2005, further changes to the Building Regulations were announced and came into force in April 2006 to make buildings more energy efficient. One provision of the revised Building Regulations came into force in April 2005, which required all new boilers to be at least B-rated condensing boilers, subject to some exemptions.	behavior/ efficiency	short-term (1 year)	weak (only **new** boilers)	2005
Low Carbon Buildings Programme (LCBP)	The main objective of the LCBP is to demonstrate the potential for encouraging both energy-efficiency and microgeneration technologies in a range of buildings. The program funds single installations in households and large-scale developments in the public and charitable sectors (social housing, libraries, hospitals, schools, etc.). The government has established carbon reduction targets that go beyond the building regulations. www.lowcarbonbuildings.org.uk/home/	behavior/ efficiency	long-term (up to 5 years)	medium	2006
Building Regulations Part L	Minimum energy efficiency standards for new housing in England and Wales are contained in Part L of the Building Regulations. Revisions to the Regulations in 2002, 2005 (covering new boilers and windows), and 2006 have significantly improved the energy performance standards of new houses, so that a house built in 2007 will be 40% more efficient than one built before 2002.	behavior/ efficiency	long-term (up to 5 years)	medium (only **new** buildings)	2006

Note: only national policies.
Source: Climate, Renewable and Energy Efficiency Policies Database International Energy Agency (IEA) 2011; Climate change policies and measures in Europe Database, European Environmental Agency 2011.

The social impact of climate policies

In order to investigate country differences in the social impact of domestic climate policies in the residential housing sector, we now focus on the changes in housing utility costs from 2005 to 2008. Figure 1 shows the difference in the relative share of housing utility costs on household disposable incomes for the highest and lowest income quintile, as a percentage of the mean share in the general population of Austria, Denmark, and the UK from 2005 to 2008. Energy inequality is indicated by the gap between the graph of the low income and the graph of the high income group in the respective year.

Figure 1: Percentage of deviation from country mean share of housing utility costs on disposable household income



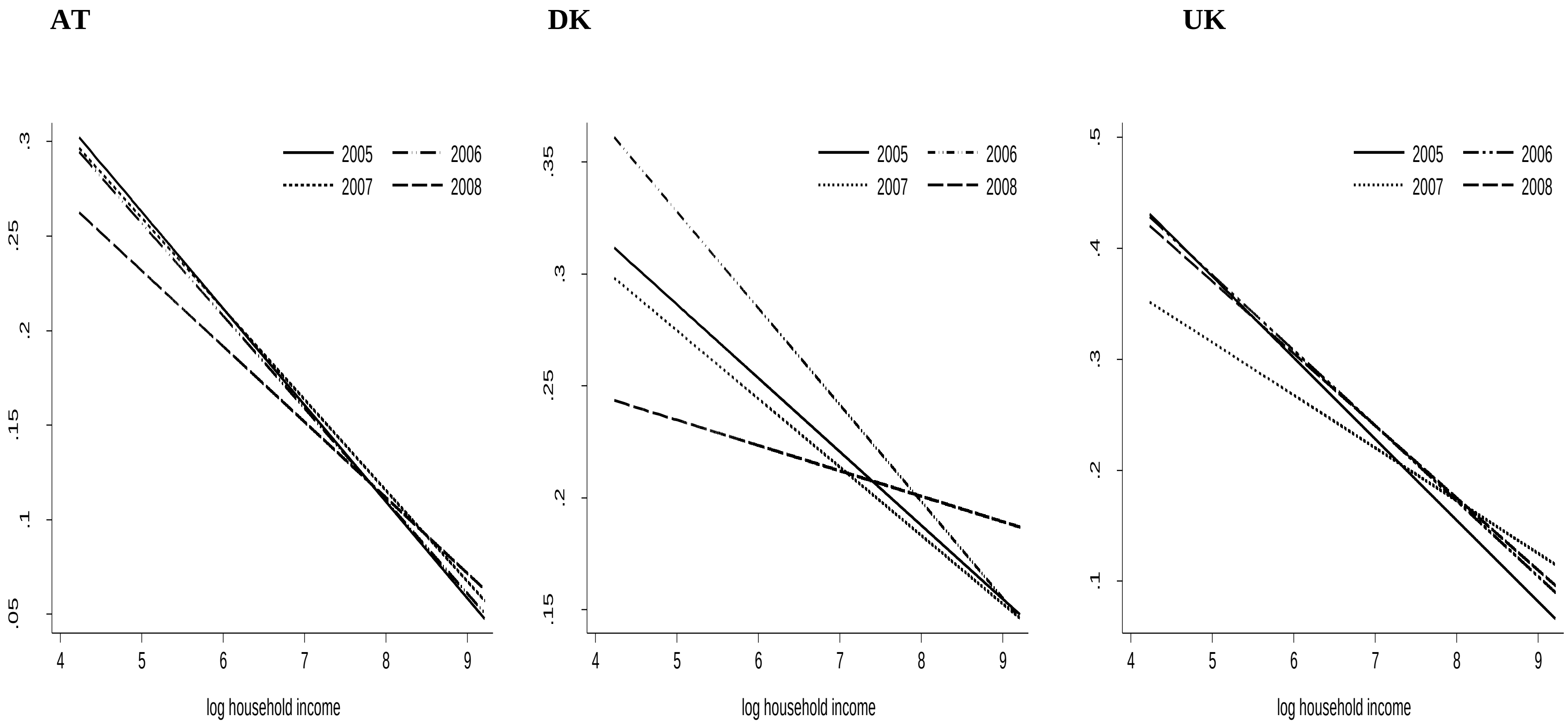
Note: low = 20% of all households with the lowest disposable household income of the population; high = 20% of households with the highest income; both net of taxes, equivalized to household size and measured in purchasing power parities; housing utility costs are calculated as total housing costs – rent and housing insurances, equivalized to household size and number of rooms in the dwelling, measured in purchasing power parities.
Source: EU SILC 2005-2008, own calculation.

The findings indicate changing inequalities in housing utility costs. Austria had a slight decrease in the share of housing utility costs on the disposable income of lower-income households, whereas the highest income group’s proportion of housing utility costs on their disposable income remains stable in relation to the population mean. In Denmark, we find a remarkable convergence process in the share of housing utility costs towards the population mean of both the lowest and the highest income groups. Starting with a diverging slope in the share of housing utility costs, we find a turn to a convergence in relative utility costs of both groups between 2006 and 2007 right after all Danish climate policies became active. In the UK, the development of housing utility costs is not as straightforward. Inequality in housing costs, measured as the share of household disposable income, decreased slightly from 2005 to 2006, the year when the relevant climate policies became active. After 2006, however, the share of housing utility spending in higher income households decreased again, and relative energy costs for the lowest income quintile even increases between 2007 and 2008. On one hand, higher income households increasingly benefit from energy-saving activities in the same way that low-income groups do after 2006. On the other hand, there might be other factors that affect lower-income groups proportionately more than higher-income groups, such as increasing energy prices after 2007 (see also Figures 6 and 7).

These findings are supported by the multivariate results shown in Figure 2 (see also Model 1 in Appendix 3,). In the UK, lower income groups in 2007 paid a smaller share for housing utility costs than in 2005. This effect, however, changes back to the 2005 value in 2008. In Denmark, housing costs are higher in 2006 than in 2005 for lower-income households, but decrease in 2007 and even more in 2008. In Austria, the only significant, but also minor, change in housing utility costs is from 2007 to 2008, when the share in housing utility costs decreased for lower-income households. Whether this change is due to Austrian climate policy, however, is still an open question.

In Sections 4.1 to 4.3, I will investigate the underlying mechanisms of these effects in more detail by focusing on energy consumption, taxes, and contributions, as well as housing allowances and social transfers.

Figure 2: Change in the share of housing utility costs on total disposable income 2005 - 2008

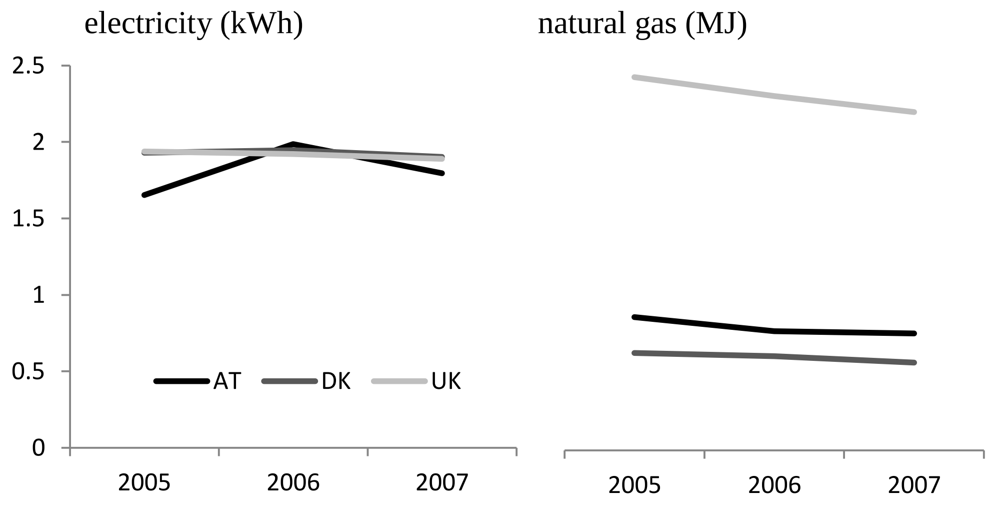


Note: Results of the conditional effect plots derived from Model 1 in Appendix 1-3.
Source: EU-SILC 2005-2008.

Mechanism 1: Behavior change in energy consumption

Most of the climate policies discussed in Section 3 influence energy consumption through energy-saving activities or by means of improving energy efficiency (insulation, efficient appliances, etc.). Political measures aimed at energy reduction within households are only effective in countries with high domestic consumption levels and, thus, have the potential for improving energy efficiency. Figure 3 shows national differences in per capita household energy consumption of electricity and natural gas. Interestingly, we find almost no differences in electricity use between the countries. Only Austria is characterized by a slightly u-shaped curve in electricity consumption behavior. This might be the result of similar energy efficiency standards, due to the global diffusion of technological standards for electrical appliances. In contrast, the UK has a rather high per capita level consumption of natural gas, in comparison to much lower use of natural gas in Austria and Denmark. One reason is likely the rather low standard for housing insulation in the British housing stock. Another reason is the availability of gas resources from the North Sea, which provides the country with gas 'made in Britain' for lower prices. Consequently, there is much stronger potential for carbon reduction and energy conservation through policies on insulation efficiency, heating appliances measures, and increasing gas pricing, compared with Austria and Denmark. Consumption of natural gas slightly decreases in all countries over the time period studied, but is strongest in the UK—this might be either a sign for lower overall consumption behavior of energy goods or the wider use of efficiency measures.

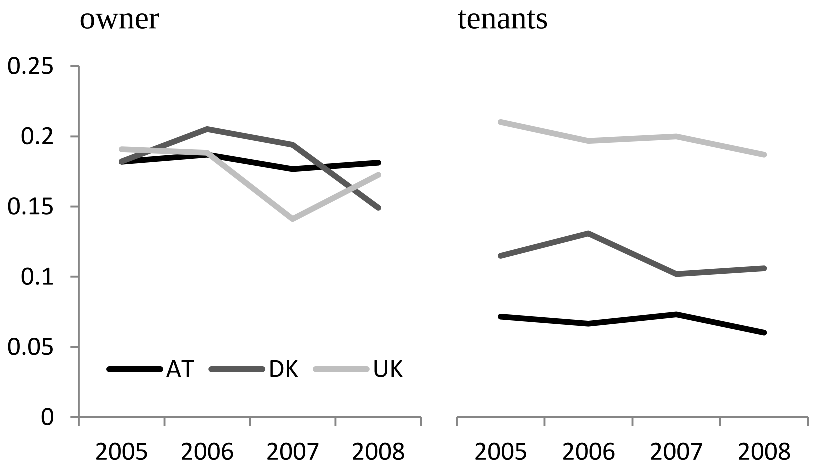
Figure 3: Per capita household energy consumption



Note: natural gas including LNG.
Source: UN Energy Statistics Database 2011.

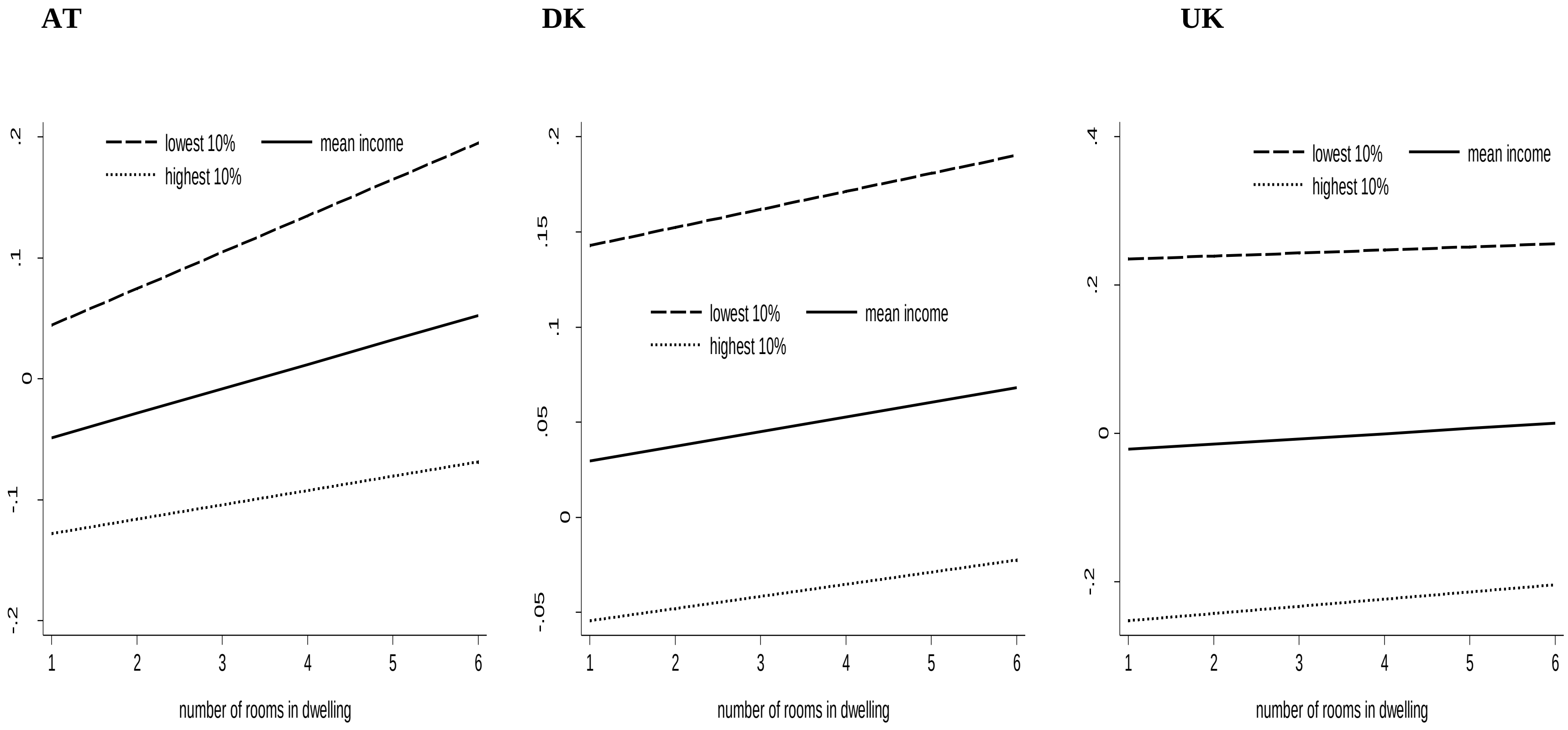
One indicator for consumption behavior is dwelling status. Figure 4 reveals that differences in the share of housing utility costs on disposable household income between income groups are on comparable levels for owners in all three countries. However, tenants with lower incomes pay a much higher share for housing utilities than higher income households in the UK, whereas in Denmark and Austria, this difference is much lower. Denmark and Austria are characterized by a unitary renting market with a high level of social inclusion of all income groups and moderate pricing levels, whereas the British housing market is highly segregated into publicly financed social housing programs and the private rental market. In contrast, rising inequality in energy costs in the UK after 2007 is mainly due to changes in the energy costs of owners and not tenants. It seems that those with higher incomes who own property more successfully make use of insulation and energy efficiency measures and, thus, benefit more from climate policies than lower-income owners do in the UK.

Figure 4: Difference in share of housing utility costs on disposable household income between lowest and highest income quintile



Note: Positive values indicate a higher share for the lower income quintile; disposable household income including social transfers.
Source: EU SILC 2005-2008, own calculation.

Figure 5: Interaction between income and the number of rooms in a dwelling



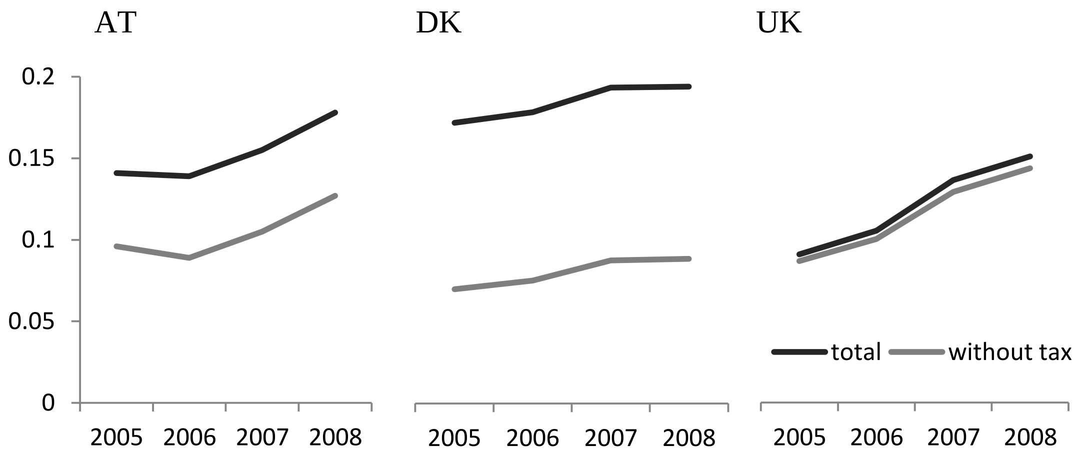
Note: Results of the conditional effect plots derived from Model 2 in Appendix 1-3.
Source: EU SILC 2005-2008

Figure 5 gives further insight into how changes in energy consumption affect income groups. The effect is statistically significant in all three countries. Although the effect is rather weak in the UK and Denmark, it is more precise for Austria. Here, we find that lower-income groups pay a higher share in housing utility costs for each increase in the number of rooms in the dwelling, in comparison to higher income groups. This finding supports the idea that higher-income households invest in energy-efficient appliances for heating or insulation and, thus, reduce their energy consumption without a deficit in general comfort. In contrast, lower-income households do not have these opportunities, due to rather high investment costs in energy-efficient technologies and, thus, are forced to face higher bills for electricity and natural gas, while holding their energy consumption level stable.

Mechanism 2: Changes in taxes and contributions

The second mechanism affecting energy costs is the change in taxes or contributions for household energy. As shown in Figure 6, we find a general trend of increasing prices for electricity, which is strongest in the UK. Figure 7 shows the development in prices for natural gas, which indicates an increasing trend in the UK, but a price reduction in Denmark and Austria after 2007. In Denmark and Austria, taxes on electricity remain constant but slightly increase in the UK. For natural gas, taxes decrease in Austria and Denmark after 2007, whereas they slightly increase in the UK during the same period.

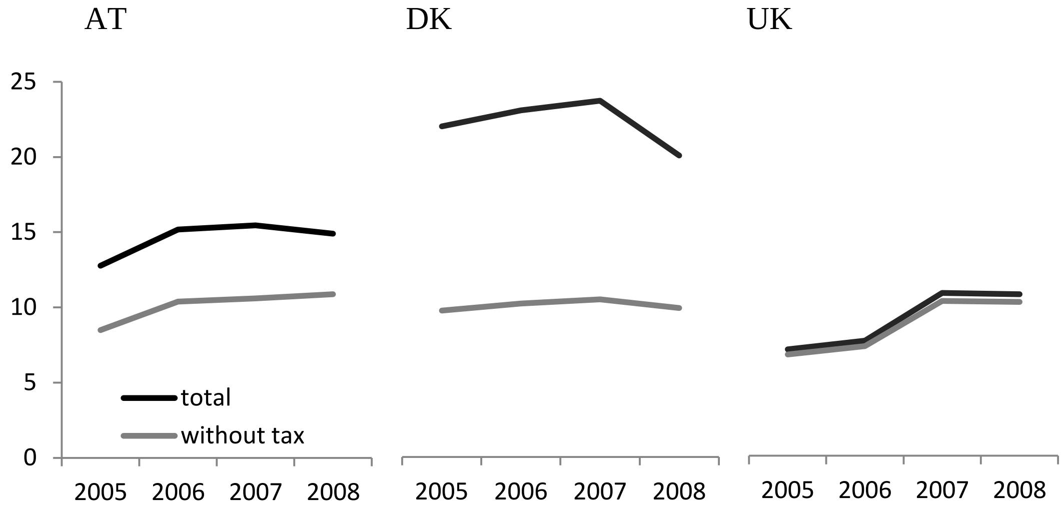
Figure 6: Household prices for electricity



Note: In purchasing power parities per kWh; consumption group DC: 2500kWh – 5000kWh.
Source: Eurostat 2011.

Since both natural gas for heating purposes and electricity constitute housing utility costs but show contrary developments in taxes, it is rather difficult to determine a clear effect of taxes on energy inequality among income groups. However, when controlling for consumption variables and dwelling characteristics in the multivariate regression models, it seems that both effects cancel each other out in Austria and Denmark.

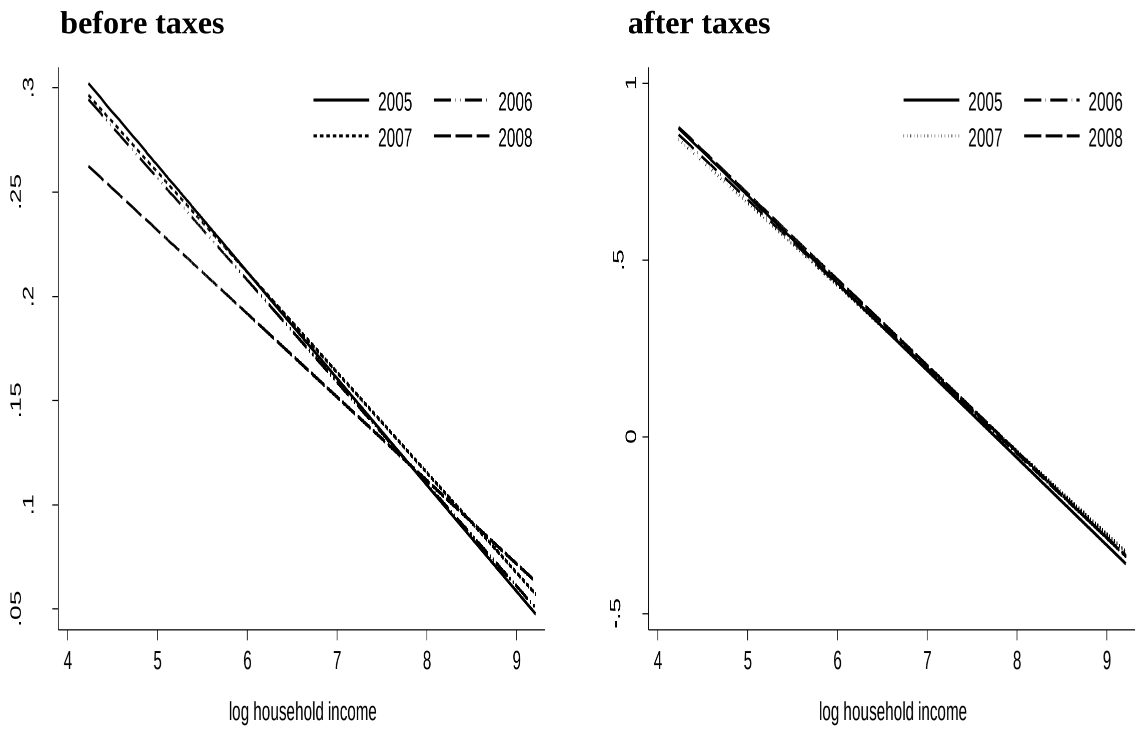
Figure 7: Household prices for natural gas



Note: In purchasing power parities per gigajoule; consumption group D2: 20GJ – 200GJ.
Source: Eurostat 2011.

Appendix 1 and 2 reveal no change when including taxes into the calculation of the share of housing utility costs on household income—the effect of income in 2008 or either of the preceding years, in comparison to the effect of income in 2005, remains stable in Austria and Denmark, but decreases in the UK. Figure 8 shows a comparison of the income effect for the respective years, separate for the calculation before and after taxes (see also Appendix 3). The results reveal significant but extremely small differences in the effect of household income on the share of housing utility costs between 2005 and 2006 or 2007, respectively. As discussed in Section 4, energy inequality in the UK slightly decreased after 2007 when not considering taxes. It seems that this trend is totally compensated for by changes in taxes on electricity and natural gas. In other words, it is not the consumption behavior but the British tax-system that supports higher-income households disproportionately more than lower-income households and, thus, prevents more positive trends in energy inequality patterns.

Figure 8: Change in the share of housing utility costs on total disposable income from 2005 - 2008 in the UK

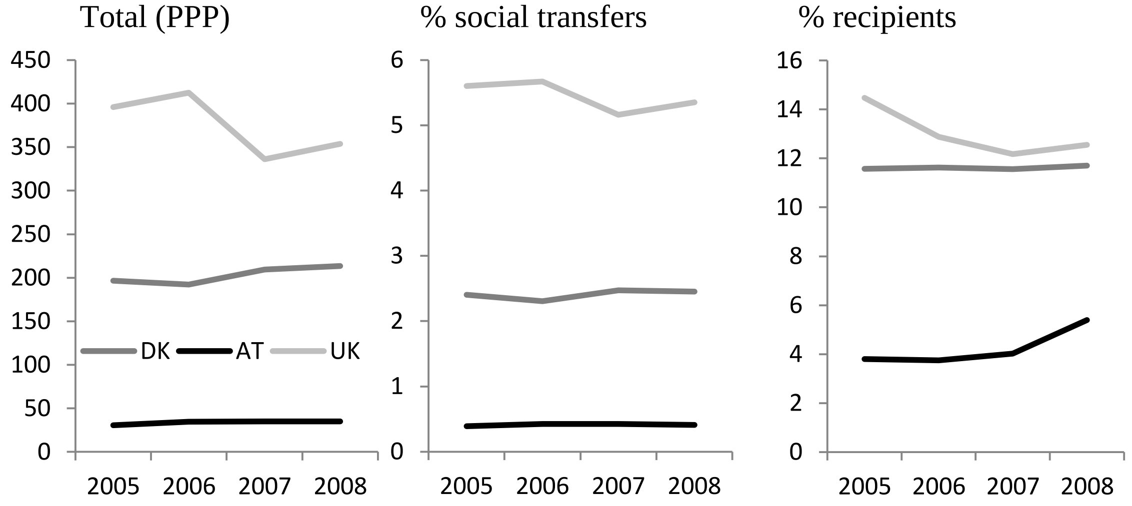


Note: Results of the conditional effect plots derived from Model 2 and Model 3 in Appendix 3.
Source: EU-SILC 2005-2008

Mechanism 3: Changes in household income

The last mechanism concerns the income situation of households. In addition to income from capital or employment, housing allowances or social transfers might balance negative developments in energy inequalities. Figure 9 gives an overview of three indicators that measure public generosity in the residential housing sector for Austria, Denmark, and the UK. We find substantial variation in the amount of housing allowances (in purchasing power parities), the percentage of social transfers, and the percentage of recipients of the population—these are highest for the UK, medium for Denmark, and lowest for Austria. The results suggest stable levels in public transfers for Denmark, a slight increase for Austria (see recipients' rate from 2007 to 2008), and a stronger reduction in housing utility spending, combined with a lower number in recipients, in the UK. Also noticeable is the high recipients' rate in Denmark of nearly 12 percent but a low level of total spending. Consequently, the strongest differences in the share of housing utility costs on household incomes between income groups should be in the UK and less in Austria and Denmark. Controlling for energy consumption patterns and housing characteristics, however, we find no substantial change in energy inequalities (see Model 3-5 in Appendix 1-3). In the UK, changes appear in the effects of the consumption variables. For example, tenants benefit more from housing allowances and social transfers and pay a lower share than owners do.

Figure 9: Housing allowances



Source: Eurostat (total, transfers); EU SILC 2005-2008 (recipients), own calculation.

Conclusion

The aim of this research paper is to systematically analyze the principal ways of harmonizing the issues of *social* and *environmental justice* by either implementing domestic climate instruments, which are designed in socially friendly ways, or by compensation for potential negative social impacts of climate policy measures, through existing social policy instruments, such as housing allowances or other social transfers. I focus on the residential housing sector, which is responsible for about one-third of total GHG emissions within European member states, since climate policies in this domain are likely to influence households' income situations more directly than in other sectors. Three Western European countries, each a typical example of the welfare regime type from the Esping-Andersen (1990) typology, have been compared by their styles of climate policy adoption. Four mechanisms have been discussed, with respect to the principal effects of climate policy instruments on household energy costs.

The results show interesting differences between the countries. Even though not explicitly designed to be socially friendly, Denmark and Austria's domestic climate policy instruments do not increase inequality in housing utility costs among income groups; rather, they even introduce a converging trend in housing costs between the highest and lowest income quintiles in Denmark. Changes in inequality patterns are mainly due to changes in consumption and efficiency behaviors; namely, more widespread use of insulation and more efficient appliances. However, national climate policy measures that are likely to increase inequality patterns were not active during the reference period or are of long-term character, and their impact falls in the years after 2008.

Efforts striving for policy integration of the social and climate policy domains and the implementation of policy instruments that consider both environmental and social justice issues are promising but could not be tested in the short time frame between 2005 and 2008. Thus, further research should concentrate on long-term effects of policy instruments, their social impacts, and their environmental effectiveness. Furthermore, research should point out major obstacles of political awareness for the basic conflicts between social justice and climate mitigation, policy integration, and policy implementation.

Despite this high amount of empirical analysis, the direct effect of specific climate policy instruments could not been tested in a three-country longitudinal design. One reason is the problem of unobserved heterogeneity on the country level. External factors, such as economic pressures, change in domestic politics and discourses, developments in the domestic energy market (energy mix), reforms in social policy (most likely in the UK because of strong retrenchment in public housing allowance spending), and other unobserved factors, might influence inequalities in housing utility costs, as well as public spending for housing allowances and social transfers. Future analyses will also benefit from a more detailed evaluation of the real and more direct effects of single policy instruments, with respect to emission reduction, energy consumption behavior, and impacts on energy inequality patterns.

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Appendix 1: Share of utility costs on disposable income in Austria

Share of utility costs on disposable income										
	Excluding consumption variables		Including consumption variables		After taxes		After taxes, including housing allowances		After taxes, including social transfers	
	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	SE	B	SE	B	SE	B	SE	B	SE
Log disposable income	-0.051***	0.002	-0.084***	0.005	-0.084***	0.005	-0.083***	0.005	-0.081***	0.005
2006	-0.017	0.019	-0.007	0.014	-0.007	0.014	-0.007	0.014	-0.007	0.014
2007	-0.018	0.019	-0.014	0.013	-0.014	0.013	-0.013	0.013	-0.015	0.013
2008	-0.086***	0.020	-0.083***	0.014	-0.083***	0.014	-0.083***	0.014	-0.085***	0.014
Log income*2006	0.002	0.002	0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.002
Log income*2007	0.003	0.002	0.003	0.002	0.003	0.002	0.002	0.002	0.003*	0.002
Log income*2008	0.011***	0.002	0.011***	0.002	0.011***	0.002	0.011***	0.002	0.011***	0.002
Owner			0.091***	0.001	0.091***	0.001	0.091***	0.001	0.091***	0.001
Number of appliances			-0.058***	0.008	-0.058***	0.008	-0.058***	0.008	-0.061***	0.008
Housing conditions			-0.005	0.009	-0.005	0.009	-0.005	0.009	-0.001	0.009
House (vs. flat)			0.100***	0.012	0.100***	0.012	0.102***	0.012	0.103***	0.012
Number of rooms			0.100***	0.004	0.100***	0.004	0.100***	0.004	0.103***	0.004
Log income*appliances			0.010***	0.001	0.010***	0.001	0.010***	0.001	0.010***	0.001
Log income*conditions			0.000	0.001	0.000	0.001	0.000	0.001	-0.000	0.001
Log income*house			-0.014***	0.002	-0.014***	0.002	-0.014***	0.002	-0.015***	0.002
Log income*rooms			-0.010***	0.001	-0.010***	0.001	-0.010***	0.001	-0.010***	0.001
Constant	0.518***	0.014	0.600***	0.037	0.600***	0.037	0.595***	0.037	0.578***	0.037
Observations	20349		20349		20349		20349		20349	

Notes: Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$
Source: EU-SILC

Appendix 2: Share of utility costs on disposable income in Denmark

Share of utility costs on disposable income	Excluding consumption variables		Including consumption variables		After taxes		After taxes, including housing allowances		After taxes, including social transfers	
	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	SE	B	SE	B	SE	B	SE	B	SE
Log disposable income	-0.033***	0.002	-0.108***	0.008	-0.109***	0.009	-0.107***	0.009	-0.107***	0.009
2006	0.093***	0.024	0.104***	0.020	0.101***	0.021	0.100***	0.021	0.100***	0.021
2007	-0.023	0.024	-0.026	0.020	-0.030	0.021	-0.030	0.021	-0.030	0.021
2008	-0.159***	0.024	-0.155***	0.020	-0.158***	0.021	-0.158***	0.021	-0.158***	0.021
Log income*2006	-0.010***	0.003	-0.012***	0.002	-0.011***	0.003	-0.011***	0.003	-0.011***	0.003
Log income*2007	0.002	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Log income*2008	0.022***	0.003	0.021***	0.002	0.021***	0.003	0.021***	0.003	0.021***	0.003
Owner			0.125***	0.002	0.144***	0.002	0.145***	0.002	0.145***	0.002
Number of appliances			-0.070***	0.015	-0.067***	0.016	-0.068***	0.016	-0.068***	0.016
Housing conditions			-0.024*	0.014	-0.028*	0.015	-0.025*	0.015	-0.025*	0.015
House (vs. flat)			0.088***	0.020	0.089***	0.021	0.094***	0.021	0.094***	0.021
Number of rooms			0.022***	0.007	0.030***	0.007	0.031***	0.007	0.031***	0.007
Log income*appliances			0.010***	0.002	0.010***	0.002	0.010***	0.002	0.010***	0.002
Log income*conditions			0.002	0.002	0.003	0.002	0.003	0.002	0.003	0.002
Log income*house			-0.010***	0.003	-0.010***	0.003	-0.011***	0.003	-0.011***	0.003
Log income*rooms			-0.002**	0.001	-0.003***	0.001	-0.003***	0.001	-0.003***	0.001
Constant	0.451***	0.017	0.895***	0.063	0.892***	0.066	0.874***	0.066	0.874***	0.066
Observations	21633		21633		21633		21633		21633	

Notes: Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$
Source: EU-SILC

Appendix 3: Share of utility costs on disposable income in the United Kingdom

Share of utility costs on disposable income										
	Excluding consumption variables		Including consumption variables		After taxes		After taxes, including housing allowances		After taxes, including social transfers	
	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	SE	B	SE	B	SE	B	SE	B	SE
Log disposable income	-0.073***	0.002	-0.246***	0.008	-0.247***	0.008	-0.236***	0.008	-0.224***	0.007
2006	-0.025	0.020	-0.022	0.019	-0.052***	0.019	-0.049***	0.019	-0.039**	0.018
2007	-0.188***	0.020	-0.185***	0.019	-0.087***	0.020	-0.083***	0.019	-0.068***	0.018
2008	-0.045**	0.020	-0.047**	0.019	-0.010	0.020	-0.005	0.019	0.009	0.019
Log income*2006	0.005**	0.003	0.005*	0.002	0.008***	0.002	0.008***	0.002	0.007***	0.002
Log income*2007	0.026***	0.003	0.025***	0.002	0.013***	0.002	0.013***	0.002	0.011***	0.002
Log income*2008	0.008***	0.003	0.008***	0.002	0.003	0.002	0.003	0.002	0.001	0.002
Owner			0.061***	0.002	0.072***	0.002	0.081***	0.002	0.095***	0.002
Number of appliances			-0.190***	0.014	-0.158***	0.014	-0.160***	0.014	-0.179***	0.013
Housing conditions			-0.116***	0.012	-0.094***	0.013	-0.076***	0.012	-0.042***	0.012
House (vs. flat)			0.037*	0.023	0.002	0.023	0.025	0.023	0.053**	0.022
Number of rooms			-0.015**	0.007	0.012*	0.007	0.014**	0.007	0.015**	0.007
Log income*appliances			0.029***	0.002	0.026***	0.002	0.026***	0.002	0.028***	0.002
Log income*conditions			0.013***	0.002	0.010***	0.002	0.008***	0.002	0.004**	0.001
Log income*house			-0.004	0.003	-0.000	0.003	-0.003	0.003	-0.007**	0.003
Log income*rooms			0.003***	0.001	0.000	0.001	-0.000	0.001	-0.000	0.001
Constant	0.741***	0.014	1.920***	0.057	1.920***	0.059	1.821***	0.057	1.712***	0.055
Observations	33856		33856		33856		33856		33856	

Notes: Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$
Source: EU-SILC

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