The distributional impact of the Irish public service obligation levy on electricity consumption

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The distributional impact of the Irish public service obligation levy on electricity consumption

Niall Farrell[*a] and Seán Lyons[a]

Abstract

We analyse the distributional impact of financing energy and environmental policies through additional charges on electricity consumption, focussing on the impact Ireland's flat-rate Public Service Obligation (PSO) levy has on domestic consumers. Switching Ireland's flate-rate charge to a unit-based charge results in reduced regressivity across the entire income distribution. A unit-based scheme reduces aggregate burden for most households on low incomes. Regressive impacts are greater for a subset of heavy electricity users. Incremental block pricing (IBP) exaggerates these effects. A hybrid fixed/variable structure mitigates regressivity for high users but lessens overall regressivity reduction. Redistribution via Ireland's Household Benefits Package is sub-optimal relative to a hypothetical equivalised income-based scheme. Net of 'merit order' savings, flat charges redistribute burden incidence from rich to poor whilst fixed per-unit charges have a neutral effect. IBP shifts cost to heavy users, predominantly large households. IBP results in a negative net burden for the majority of households across all income groups.

Keywords: Renewable Energy Support Schemes; Distributional Impact; Policy Cost

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1. Introduction

Achieving energy and environmental policy goals through renewables deployment changes the composition of the electricity price. First, public subsidy is often required (Doherty and O'Malley, 2011; Krozer, 2013). Ireland, like many other countries, finances these subsidies through a Public Service Obligation (PSO) levy on electricity consumption. Subsidising renewables with zero marginal cost, such as wind, may also affect electricity prices. As wind generation has zero marginal cost, and as wholesale electricity prices are determined by marginal cost, the resultant displacement of conventional generation may cause wholesale prices to fall (Sensfuß *et al.*, 2008). Clifford and Clancy (2011) have found that in Ireland to date, these counteracting effects cancel each other out and give a net impact close to zero.

While rising wind power penetration may or may not affect the total cost of electricity, a compositional change is undoubtedly taking place. As more wind power enters the generation mix, a greater share of each consumer's electricity bill is made up of the PSO charge as opposed to the energy cost. To the extent that suppliers pass on savings in the wholesale market to consumers, the per-unit cost of electricity for each consumer will decrease. However, the subsidy required may increase and the means by which this cost is recovered from each consumer then becomes more important. If, as is the case in Ireland, the PSO is recovered using a flat-rate charge, over time a greater proportion of each consumer's electricity bill is composed of a fixed charge as opposed to a variable unit-based charge. Such a fixed charge will tend to comprise a larger share of a poorer consumer's budget than a wealthier consumer's budget. The extent of regressivity may be varied using alternative payment schemes and redistributive measures.

The distributional impact of energy and environmental policy is of particular relevance following recent Irish policy changes. Budget 2013 (Department of Social Protection, 2013) changed the free electricity allowance available under the 'Household Benefits Package' (HBP). Beneficiaries now receive a fixed monetary allowance instead of a fixed unitary allowance, whereas previously fixed charges such as the PSO were covered by the benefit regardless of their cost. This change has been

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Abbreviations: DCENR: Department of Communications, Energy and Natural Resources; DSP: Department of Social Protection; FiT: Feed-in Tariff; HBP: Household Benefits Package; HBS: Household Budget Survey; IBP: Incremental Block Pricing; kWh: Kilowatt Hour; MW: Megawatt; REFIT: Renewable Energy Feed-in Tariff; PSO: Public Service Obligation (levy); SEM: Single Electricity Market.

motivated on the grounds of encouraging competition (Department of Social Protection, 2013), as beneficiaries now have an incentive to source electricity at least cost. However, it also means that HBP beneficiaries are now exposed to changes in the PSO levy.

The magnitude of the Irish PSO and similar charges elsewhere may be relatively small at the moment, but they are subject to potential increase in the future. To meet Ireland's 40% renewables target in 2020, Devitt and Malaguzzi Valeri (2011) find that Renewable Energy Feed-in Tariff (REFIT) subsidies alone will grow and may comprise up to 6.8-17.2% of the gross wholesale price, should high renewable energy penetration prevail. This does not include further subsidies covered by the Irish PSO, which include peat, the Alternative Energy Requirement (AER) scheme and security of supply measures. This trend indicates that the PSO levy will comprise an increasing and non-trivial portion of future electricity expenditure and thus the way that PSO costs are recovered will become increasingly important as renewables deployment progresses. Indeed, this is also a relevant topic in other jurisdictions; for example, the equivalent German mechanism, the EEG surcharge, made up approximately 18% of household electricity cost in 2013 (Bryant, 2013; DW, 2013; Eurostat, 2014; Loreck *et al*., 2012). This grew by around 20% for 2014 (BEE, 2013; Patel, 2013).

This paper analyses the incidence of current and potential alternative PSO levy structures, both in terms of the cost alone and the cost net of electricity price reductions. Analysing cost incidence alone informs policymakers as to the distributional impact of renewables subsidies and alternate policies covered by the Irish PSO (see CER, 2013), such as subsidies for peat generation. Indeed, it is due to peat subsidies that the Irish PSO has already risen in recent years (see, for example, CER, 2009, 2013). Examining both price and PSO cost effects addresses a gap in the literature as analyses have either focussed on aggregate net impacts (e.g. Clifford and Clancy, 2011; Devitt and Malaguzzi Valeri, 2011) or concentrated on the equity of cost distribution alone (Chawla and Pollitt, 2013; Neuhoff *et al.*, 2013). Identifying the distributional impact of these changes is especially important from an Irish policy context as the incidence of cost differs from the incidence of potential price reductions under the current levy structure. Chawla and Pollitt (2013) advocate greater debate on distributional impacts of different levy payment structures discussing both costs alone and impacts net of benefits received in return. This paper follows that suggestion by considering the equitable implications of various flat-rate and unit-based alternatives. This paper extends that field further to assess the impact net of wholesale price reductions, alongside the effect of social transfers and their design in reducing some of the negative factors associated with energy and environmental policy.

In carrying out these goals, this paper is structured as follows. Section 2 reviews the literature to date. The methodology is presented in Sections 3 whilst data and key descriptive statistics are presented in Section 4. Section 5 presents an analysis of cost incidence, Section 6 analyses redistributive measures, whilst Section 7 analyses changes in cost net of reductions in price. Section 8 offers some concluding comments.

2. Motivation and Literature

Much of the literature analysing the social implications of energy and environmental policy has focussed on aggregate impacts. Devitt and Malaguzzi Valeri (2011) quantify the aggregate Irish subsidy required to meet a number of renewables deployment and energy price scenarios. Clifford and Clancy (2011) carry out a similar analysis but focus on the cost of deployment for 2011. They find that the addition of wind caused the gross cost of electricity in the Irish republic to fall by approximately €74 million with aggregate subsidies approximating €50 million. Increased constraint costs approximate the difference between reduced wholesale and increased subsidy costs. Overall, Clifford and Clancy (2011) find that the reduced market costs of electricity in Ireland in 2011, net of incurred constraint costs, were roughly equal to the aggregate cost of wind subsidy. Whether this balance will prevail in the future is uncertain. Devitt and Malaguzzi Valeri (2011) illustrate that the net impact on electricity cost is dependent on the fuel scenario assumed.

These aggregate impacts have not been explicitly disaggregated to the household level in the literature to date, although elements of these and similar payments have been assessed in isolation. Chawla and Pollitt (2013) analyse the distribution of cost to support energy efficiency and environmental policies in the UK. They find that the proportional cost has risen in recent years, with a disproportional burden on low-income households. Neuhoff *et al.* (2013) analyse the distributional impact of the German energy transition at the household level and consider the effect that a number of policy options may have on mitigating the regressivity of resultant impacts. Grösche and Schröder (2011) consider the distributional impact of Germany's equivalent levy, the EEG surcharge, on income inequality net of solar PV ownership, finding that inequality rises marginally and the scheme is mildly regressive. Verde and Pazienza (2013) analyse the distribution of the Italian equivalent of the Irish PSO, the A3 surcharge, and suggest that financing this policy through a carbon tax would be less regressive. Although focussing on charging schemes for general energy consumption as opposed to particular levies, Borenstein (2012) and Borenstein and Davis (2012) analyse the distributional impact and deadweight loss of different electricity and gas pricing structures.

This review shows that existing literature has either focussed on aggregate impacts (e.g. Devitt and Malaguzzi Valeri, 2011; Clifford and Clancy, 2011) or has concentrated on the equity of cost distribution alone. Grösche and Schröder (2011) provide the closest contribution to this paper by analysing the net redistributive effect of solar PV subsidy. They take into account changes to household income as a result of private ownership but do not consider any 'merit order' effect on wholesale prices. Studies such as that of Neuhoff *et al.* (2013), Chawla and Pollitt (2013) and Verde and Pazienza (2013) have contributed towards the distributional understanding of German and UK energy policies. This paper adds to these contributions by analysing the distributional effect of existing Irish policy, whilst also giving insight into alternative levy structures. Thus, this paper builds on the suggestion for further debate on the design of energy and environmental policy as advocated by Chawla and Pollitt (2013). The distributional impact of social transfers is also analysed in this paper. This analysis draws on Neuhoff *et al.* (2013) in that past and prospective alternative options are considered. This paper further contributes a discussion of options previously employed in an Irish context and explicit attention is paid to equity of impact across the entire income distribution.

It should be noted that enacting an environmental levy such as Ireland's PSO requires an appropriate legal framework. We understand that one reason for Ireland choosing a flat-rate PSO levy structure was to comply with EU stipulations stating that levies tied to consumption, where the benefit is granted to national production only, should not be imposed on imported producers. However, we do not consider that these requirements necessarily rule out a shift to a structure that includes a consumption-based component. Such a measure might be deemed acceptable if justified appropriately, as in the case of Norway (EU, 2008), or alternate measures may be put in place to ensure imports are not discriminated against.

3. Methodology

To carry out the analysis of this paper, we calculate the aggregate PSO cost and disaggregate this cost to the household level in the presence of different PSO levy designs and social transfer mechanisms. This is carried out by first calculating the household-level cost for the current policy, and redistributing this total revenue for our sample population according to each alternate levy design. Second, we must calculate the total wholesale price reduction and disaggregate this according to each unit consumed. These costs and savings are then simulated across a representative dataset to analyse the incidence relative to income. Each step will now be outlined in greater detail.

3.1. PSO Cost: Existing Flat-Rate Levy

The single cost scenario of Clifford and Clancy (2011) is chosen and deemed sufficient for this analysis, given the emphasis on the distributional impact. This represents a wind installation and energy price scenario similar to that which existed in Ireland in 2011.

Table 1 shows how aggregate costs calculated by Clifford and Clancy (2011) are disaggregated to weekly household cost. In Ireland, electricity users are classified as either domestic, small commercial, or medium/large consumers. Total wind subsidies are calculated by the Commission for Energy Regulation (CER) and delineated amongst each consumer category according to the percentage of individual peak (CER, 2009). For the 2009/2010 operating period, domestic customers comprised 43% of total individual peaks (CER, 2009)[1]. Thus, household-level charges are calculated by apportioning 43% of the total wind subsidy requirement quoted in table 1 amongst the 2,029,956 domestic customers quoted by (CER, 2009). in their calculations. This calculates annual flat-rate PSO incidence per household, and is multiplied by $7/_{365}$ to get a weekly rate.

[1] This proportion appears to be fairly stable, as domestic consumption comprised 41% of the 2013/2014 calculation (CER, 2013), 43% of the 2012/2013 calculation (CER, 2012b); 44% of the 2011/2012 calculation (CER, 2011a), 43% of the 2010/2011 calculation (CER, 2010a), and 41% of the 2008/2009 calculation (CER, 2008).

Table 1: Wind subsidy portion of PSO cost per household: flat-rate levy

Parameter	Value (€)
Aggregate REFIT requirement	50,000,000
Domestic proportion	21,500,000
Annual REFIT PSO cost per household	10.591
Weekly REFIT PSO cost per household (flat rate)	0.2031

3.2. Alternate Pricing Structures

The total revenue raised from the HBS sample using a flat-rate charge is calculated and alternate levy structures are designed such that the same amount of total revenue is raised. The two alternatives considered are a fixed per-unit payment and an Incremental Block Pricing (IBP) scheme. For a fixed per-unit scheme, household-level PSO cost is determined by the number of units of electricity consumed multiplied by a per-unit price. This price is calculated by dividing the total HBS PSO requirement by all units consumed in the HBS sample. This cost per unit is 0.0019788/kWh.

IBP presents consumers with a per-unit schedule of prices grouped into 3 'blocks'. The first price is applicable to units consumed until threshold 1; the second price for units consumed between thresholds 1 and 2; and the third price for all units in excess of threshold 2. This analysis chooses thresholds of usage at the 25th quantile (51.358kWh) and 75th quantile (128.8kWh). The IBP system is structured such that the third price block is 3 times that of the initial block, with the second price chosen such that the sum of PSO revenue is equal to that for the fixed and per-unit levy designs. Thus, price 1 is 0.001289426/kWh, price 2 is 0.0018062/kWh and price 3 is 0.003868278/kWh.

The final pricing structure is a hybrid design, where a flat rate is charged alongside a per-unit rate. Such a structure may be preferred in order to retain the certainty of remuneration associated with a flat rate whilst also retaining elements of progressivity associated with a per-unit rate. The portion of total cost which is recovered via a per-unit and flat-rate levy may be one of many combinations. For simplicity, we analyse a single scenario where 50% of total cost is recovered via the flat-rate portion and 50% via the per-unit portion. This gives enough insight to gauge the impact of alternate proportions in a hybrid levy design.

3.3. Social Transfer

The effectiveness of social transfers in reducing regressivity are assessed in this paper. First, we assess the Irish Household Benefits Package (HBP). The HBP is a package of three allowances that help those on low incomes with household costs. One element of this package is the free electricity allowance. Budget 2013 restructured this allowance from a unitary allowance, alongside all fixed charges and PSO levies, to a monetary-based charge (Department of Social Protection, 2013). The electricity allowance during 2013 and 2014 was a cash allowance of €35 per month towards electricity usage from which the PSO levy and other fixed charges must be paid. As a result of this new HBP structure, changes in the PSO levy will now affect the budget constraint of low-income households. As the purpose of the HBP is to aid vulnerable households, we analyse the distributional impact and aggregate cost of social transfer via the HBP mechanism and, in doing so, provide insight into the distributional impact of the Budget 2013 change and potential impact should PSO coverage be reintroduced. An alternative social transfer based on equivalised disposable income is also analysed as a hypothetical benchmark.

3.4. Wholesale Price reductions

Renewables such as wind generate electricity at zero marginal cost. This has a depressing effect on wholesale electricity prices (Sensfuß *et al.*, 2008). We analyse the distribution of this effect, assuming that reductions in wholesale prices are passed on entirely to consumers through per-unit retail price reductions. A well-functioning market may result in such cost pass-through (Von der Fehr and Hansen, 2010). However, there is little empirical evidence analysing such cost pass-through in an Irish context. International empirical evidence suggests that suppliers may pass price reductions to consumers but are more inclined to pass price increases (Mirza and Bergland, 2012). As such, effects reported net of price reductions should be interpreted as an upper bound on the potential effect.

Disaggregating the reduction in wholesale price calculated by Clifford and Clancy (2011) according to actual population electricity usage will differ from a calculation using the HBS sample population of electricity usage. This is due to differences between the sampled and actual population. In order for internal consistency within the sample, the sum total of household-level PSO cost for the HBS population, calculated using the methodology above, is taken as equal to the sum total of per-unit electricity cost savings for the HBS population. This is then apportioned equally amongst all electricity units consumed by the HBS population. The total per-unit cost reduction is shown in Table 2.

Table 2: Electricity price reduction due to Wind

Parameter	Value
Total REFIT Cost (€)	296,807.1
Total Electricity consumed (kWh)	149,991,312
Electricity price reduction per kWh (€)	0.0019788

Note: Figures based on HBS population

4. Data and Descriptive Statistics

The anonymised 2009/2010 Household Budget Survey (HBS) (Central Statistics Office, 2012) provides the platform for this analysis. The HBS details household-level socio-economic characteristics, income and itemised weekly expenditures which specify the cost of total electricity consumed. From these data, quantities of electricity per household may be derived using standing charges and prices paid during the survey period of 2009/2010[2] (CER, 2010b, 2011b).

Table 3 shows the distribution of household variables associated with electricity usage by equivalised income[3] quintile (corresponding deciles are given in brackets). Electricity use peaks for quintiles 3-4 (deciles 5-8). If we split quintile 1 usage by decile, decile 1 has a median level of electricity use greater than other low income deciles 2-4. Table 3 shows that the first quintile has a relatively high proportion of unemployed, students and retired individuals. In terms of household size, quintiles 1 and 5 have a higher proportion of small households, whilst quintiles 2-4 have a higher proportion of larger households.

[2] It should be noted that during this period, ESB Customer Supply, Bord Gais and Airtricity operated in the retail electricity market for domestic consumers. The vast majority of customers (80% in Q4 2009, falling to 68% at end Q3 2010) were served by ESB Customer Supply (CER, 2010b, CER, 2011b). The HBS does not contain data on supplier or billing structure faced by each household. Given the dominance of ESB Customer Supply during this period, it is assumed that each consumer is an ESB customer. Further, customers may choose either a standard tariff or a dual 'nightsaver' tariff. As customers on the nightsaver tariff comprise only c.11.4% of all residential ESB customers, it is assumed that all households are on the standard tariff (CER, 2012a). Given the low number of users on alternate tariff structures and the modest difference in pricing (see ESB, 2009), the calculated difference in units consumed is assumed to be negligible. Thus, the standing charge for this tariff (ESB, 2009) is deducted from the gross expenditure on electricity, and the remainder is divided by the unitary cost to calculate the units of electricity consumed.

[3] Household incomes are adjusted by household size to reflect economies of scale inherent in larger households. The "OECD-modified scale" is used, which is the favoured scale of the OECD and Eurostat. When weighting household income, this scale assigns a value of 1 to the household head, 0.5 to each additional adult member and 0.3 to each child.

Table 3: Socioeconomic characteristics as proportion of income group total

Quintile	1	2	3	4	5
Decile	(1 & 2)	(3 & 4)	(5 & 6)	(7 & 8)	(9 & 10)
Socioeconomic group					
Professional	9.4%	12.2%	23.3%	40.5%	66.3%
Non-manual	12.3%	14.8%	24.7%	19.7%	15.5%
Manual skilled and semi-skilled	12.7%	22.0%	21.9%	18.2%	8.1%
Unskilled and agri workers	6.6%	9.8%	8.7%	8.6%	4.1%
Own account workers and farmers	11.3%	16.8%	11.4%	10.2%	4.5%
Other employed and unknown	47.7%	24.3%	10.0%	2.6%	1.6%
Total	**100%**	**100%**	**100%**	**100%**	**100%**
Employment status					
Full time	10.2%	17.9%	44.1%	66.3%	81.8%
Part time	5.8%	9.7%	17.1%	11.3%	6.8%
Unemployed	22.9%	19.6%	9.7%	3.9%	0.6%
Retired	16.2%	21.5%	14.7%	11.5%	8.5%
Student	10.7%	4.9%	2.0%	1.1%	0.4%
Other	34.1%	26.3%	12.4%	5.9%	1.9%
Total	**100%**	**100%**	**100%**	**100%**	**100%**
No. Inhabitants					
1 to 2	63.7%	50.2%	43.4%	43.8%	55.9%
3 to 4	24.4%	33.0%	39.9%	42.3%	35.4%
5 to 6	10.2%	13.7%	14.1%	13.3%	8.7%
7+	1.7%	3.2%	2.6%	0.6%	0.1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**
Median disposable income (€)	*207.78*	*293.97*	*405.2*	*585.45*	*905.87*
Median electricity use (kWh)	*78.29*	*81.70*	*92.13*	*96.98*	*88.84*

Note: Median electricity use for decile 1 is 90.53kWh and 61.98kWh for decile 2.

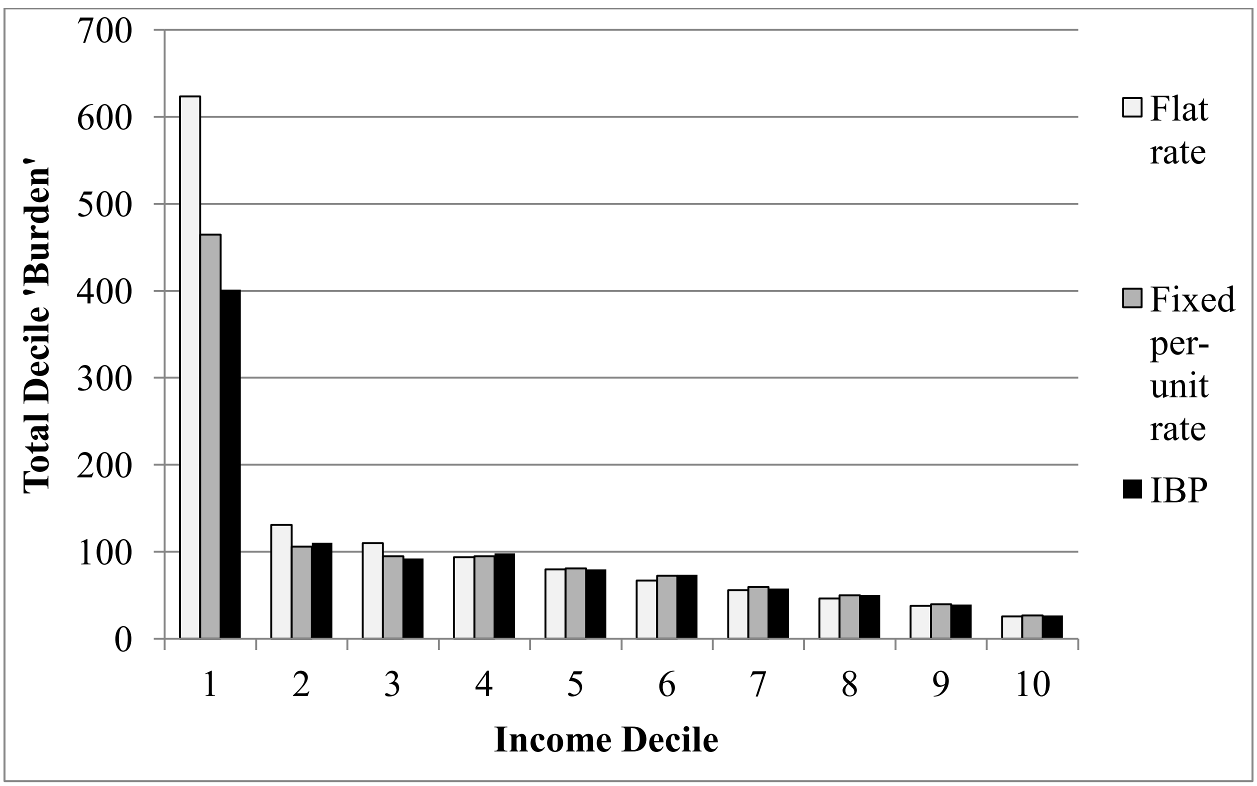
5. Results

5.1. Distributional Incidence of Cost

Cost incidence by income group is measured relative to income. Household 'burden' is assessed by analysing PSO cost as a proportion of household income. To display this incidence, two metrics are used. First, decile burden is analysed in terms of the decile sum of each household's proportional cost ($\sum_{hh} \frac{cost_{hh}}{income_{hh}}$). Second, the range of this burden is analysed using boxpot diagrams to give further insight into household-level proportional cost at key intervals within each income group.

Figure 1 shows that the 'burden', or impact relative to income. Switching to a fixed per-unit levy increases burden by 1-2% for deciles 4-5, 4-5% for deciles 9-10, whilst deciles 6-8 have an increase of around 6.5-8%. The proportional burden falls by 25% and 18% for deciles 1 and 2 respectively. Despite these changes, absolute decile burden for decile 1 is 9.34 times the average rate for deciles 5-10. Deciles 2 and 3 benefit from a per-unit levy to the extent that the burden for these deciles is brought to a similar magnitude to that of decile 4. Relative to a fixed per-unit levy, first decile proportional incidence falls by 13.5% for an IBP levy. Proportional incidence rises modestly for decile 2. This is due to the presence of a number of outliers who drive the aggregate total for this decile. This is discussed in more detail in Section 5.2. In absolute terms, proportional incidence is of similar magnitude for all policy choices for deciles 6-10. This is due to the rising income levels resulting in proportional incidence being less sensitive to change.

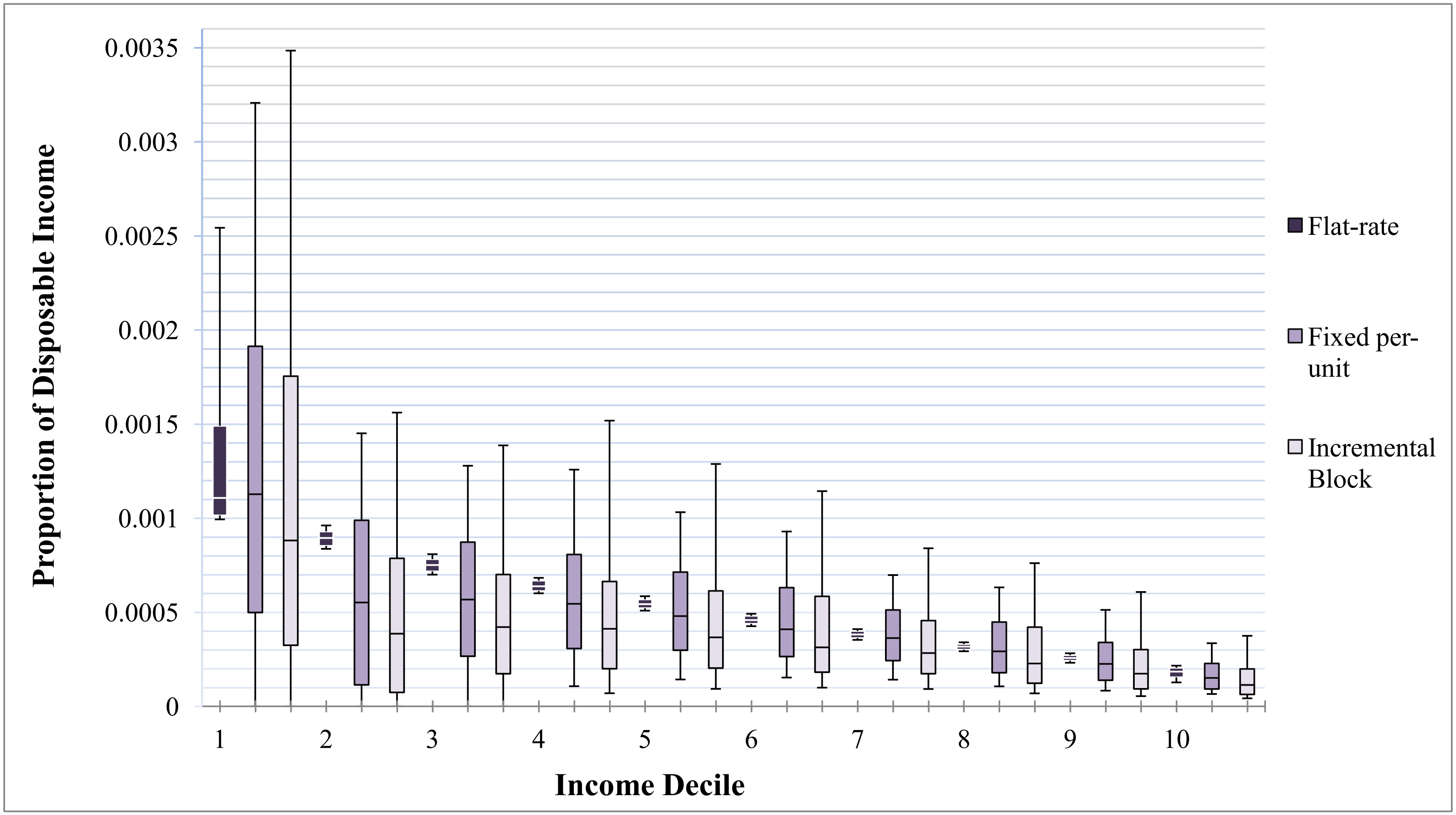
Figure 1: 'Burden' by income decile



For a more complete understanding, Figure 2 shows that there is a wide range of incidence amongst households within each decile. For the flat rate levy, this range is driven by the distribution of household income alone. Variations in income and electricity use drive incidence for unit-based charges. This results in a wider range of incidence for the fixed per-unit charge. The range of incidence for an IBP regime is of a similar magnitude to that outlined for the fixed per-unit levy, however there is a lower interquartile range and higher upper tails for an IBP levy. The increase in burden observed in Figure 1 for decile 2 is less apparent here, as those households are in the 95th-99th percentile of incidence. Overall, fixed per unit and IBP levies reduce the incidence for the majority of consumers, with 59% and 72.6% of all households benefitting respectively. This is achieved by shifting the burden of cost to heavy users, with heavy users more negatively affected under an IBP regime. The usage threshold at which a change to a unit-based policy turns into a cost is 102.6kWh and 126kWh for fixed and IBP policies respectively.

The first decile shows a wide range of incidence under unit-based regimes. This is due to the low absolute level of income resulting in a relatively higher range of within-decile incidence. Median values for flat and fixed per unit rates are approximately the same. The interquartile range of incidence is much wider under a per-unit scheme, with a greater proportion of individuals incurring both a greater and lower level of incidence. The tails of the distribution are wider also, especially in relation to households who incur a high level of incidence. IBP regimes reduce the impact on the interquartile range but exaggerate the tails, following the pattern from other deciles. Interpreted in the context of figure 1, it may be deduced that the numbers who benefit within decile 1 outweigh those who lose out. However, there is a considerable number of households within the first decile who incur a large proportional burden. Conversely, decile 2 does not show such a range of incidence, suggesting that outliers are influencing the increase in burden observed in Figure 1. To further inform policy, these factors will be explored in greater detail in the following section.

Figure 2: Distribution of Incidence by Income Decile



Note: Boxplots show range of proportional incidence per decile. Results are displayed in terms of 10th, 25th, 50th, 75th and 90th percentiles. The IBP range of incidence for decile 2 appears to fall, indicating that the increase observed in Figure 1 is due to a number of outliers.

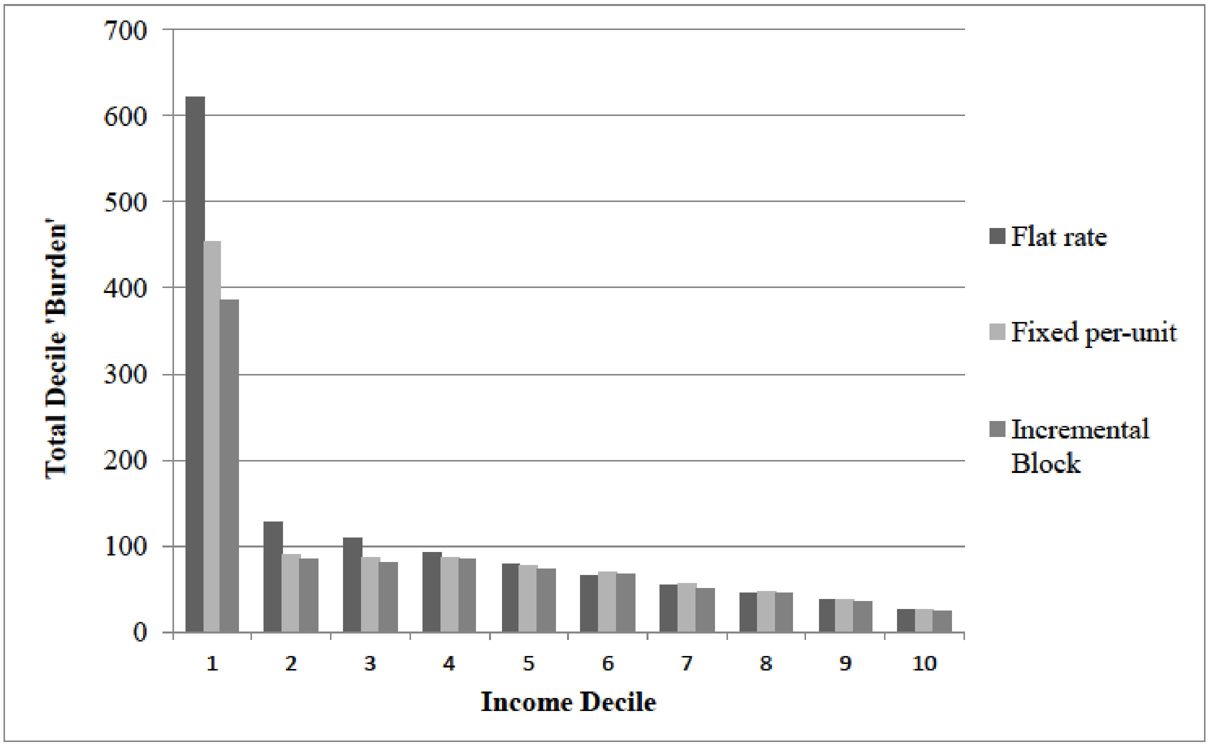
5.2. Discussion of cost incidence

So far, we have identified that unit-based policies are effective in reducing aggregate inequality, except for incidence amongst a considerable subset of high users, particularly in deciles 1 and 2. This section offers a complete insight into the influence of these factors, both in terms of examining the distribution of burden without including such heavy users, whilst also identifying the characteristics of those heavy users. As household size has been identified as a potential key determinant of incidence, this is also examined in this section.

5.2.1. Distribution of burden: omitting heavy users

The findings of Section 5.1 suggest that a number of outliers are heavily influencing the aggregate incidence of unit-based policies. In order to gain insight into the majority of users within each decile, gross proportional burden is assessed by limiting those analysed to being less than or equal to three standard deviations of each decile's mean. This results in between 0.7% and 2.3% of decile observations being dropped. Figure 3 shows that both unit-based schemes result in a lower proportional burden across deciles 1-5, particularly across the lowest deciles of 1-3. This finding emphasises the fact that IBP schemes shift incidence to heavy users who comprise a small proportion of each decile's population. However, the negative impact on these households is not of a negligible magnitude as Section 5.1 demonstrated. Identifying those negatively affected in the lowest income group may aid policy design.

Figure 3: Decile Burden: Sample limited to less than three standard deviations from decile mean



Note: Incidence is calculated relative to equivalised disposable income.

5.2.2. 'Winners' and 'losers' in decile 1

Figure 4 shows socio-economic characteristics of winners and losers for decile 1 as a result of switching from a flat-rate levy to a fixed per-unit policy. Analysing the full decile 1 population, Figure 4(a) shows that those who 'lose out' due to a unit-based policy have higher electricity usage than those who benefit, as we would expect. Figure 4(a) shows that little over half of decile 1 households (54.3%) are below the threshold of benefitting for fixed per-unit regime, with 73.5% of users benefitting from an IBP scheme. Figure 4(b) shows that the population of 'losers' in this sample has a less positively skewed distribution of equivalised income than winners.

Figure 4: Breakdown of decile 1 'winners' and 'losers' by characteristic

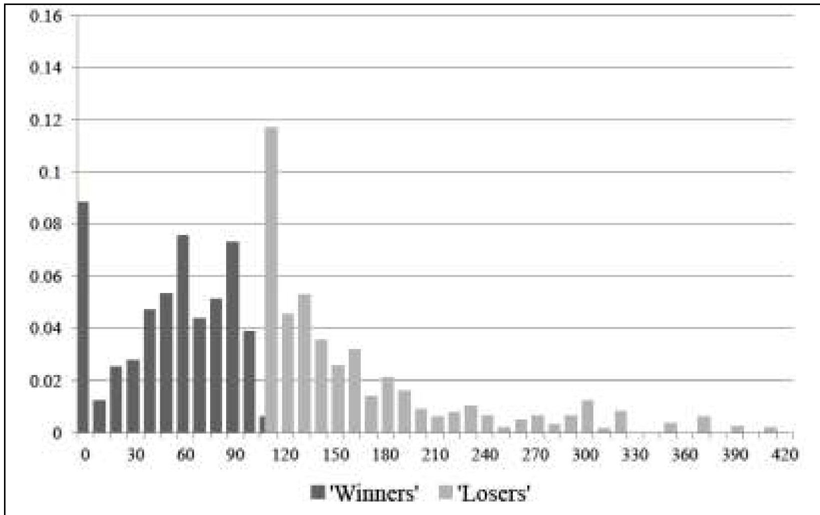


Figure 4(a): Electricity Use

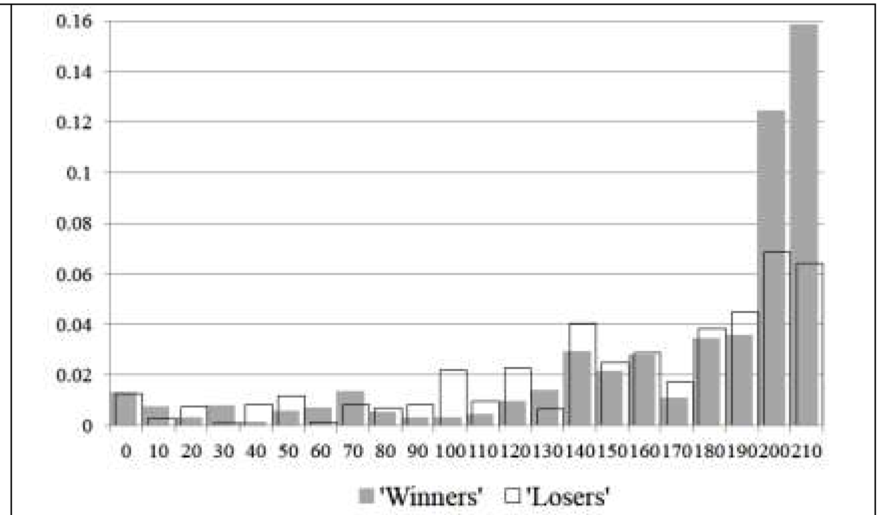


Figure 4(b): Income

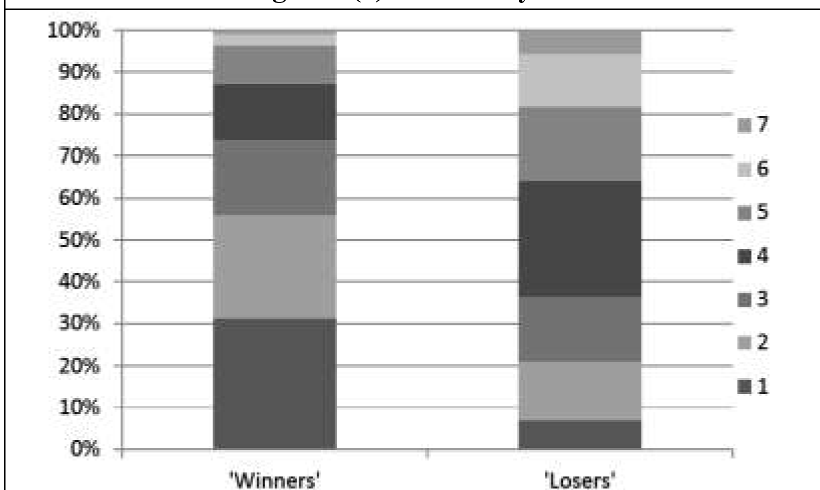


Figure 4(c): Household Size

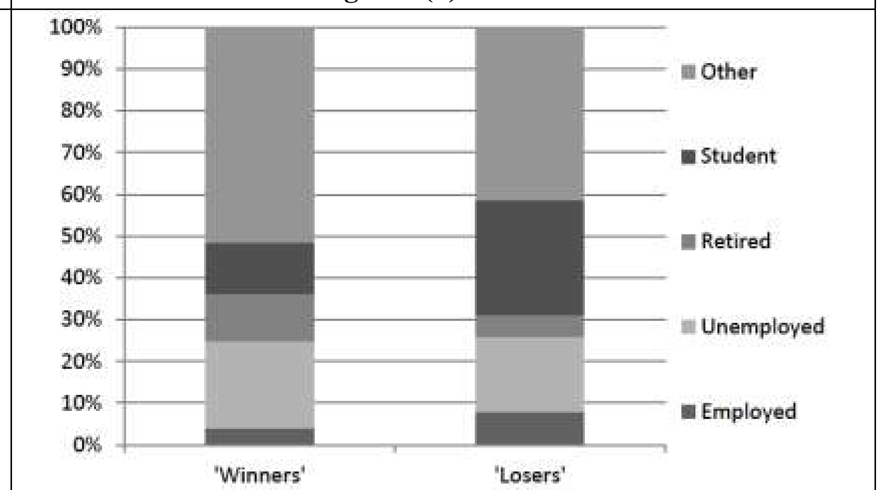


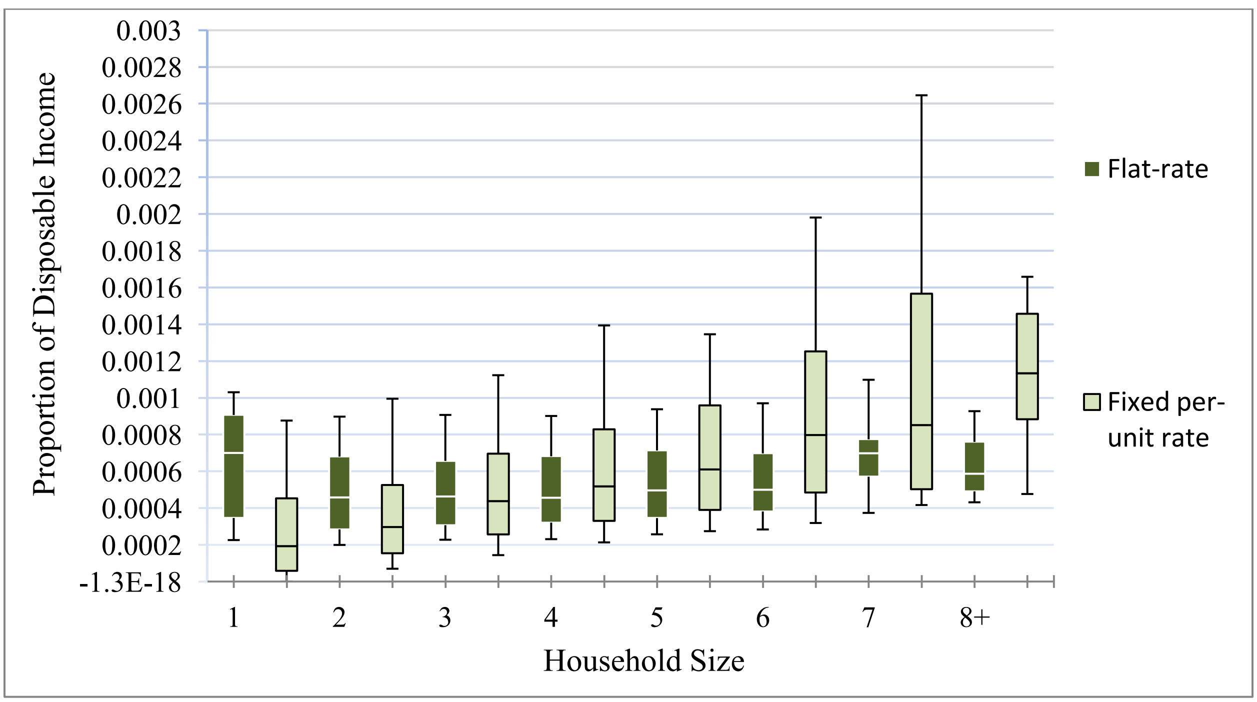
Figure 4(d): Socio-economic Characteristic

Figure 4(c) shows that smaller households are more heavily represented in the group of individuals benefitting, with 73.9% of beneficiaries being of 3 inhabitants or less. Conversely, just 36% of households in the losers category have 3 inhabitants or less. Figure 4(d) gives a breakdown of winners and losers by socio-economic group to aid understanding of this finding. This illustrates that there are twice as many households headed by employed persons and students in the losers category. Furthermore, there are considerably fewer households headed by retired persons in the losers category.

5.2.3. Incidence of Cost by household size

As household size may be a key determinant of incidence, and of interest to policymakers in it's own right, Figure 5 graphs PSO incidence by household size using a flat rate and fixed per-unit PSO charge. When one incorporates incidence as a function of electricity use under a per-unit charge, a strong positive correlation is evident. As such, it is reasonable to infer that larger households incur a greater proportional burden under unit-based levies.

Figure 5: Distribution of Incidence by Household Size



Note: Incidence is calculated relative to equivalised disposable income. Boxplots display incidence at 10th, 25th, 50th, 75th and 90th percentiles.

6. Measures to reduce the regressive impacts of unit-based policies

6.1. Hybrid flat-rate and unit-based combinations

This section will analyse levy structures that may alleviate the identified high proportional incidence amongst low income groups. A hybrid combination of a unit-based and fixed levy structure is first considered. Figure 6 shows that hybrid designs have a similar level of incidence for deciles 4-10 than both fixed and flat-rate levies. Hybrid structures are less regressive than a flat rate structure and more regressive than a fixed per-unit structure for deciles 1-3. For the first decile, total incidence is 12.7% and 17.8% less than the flat rate levy for fixed and IBP-based hybrid levies respectively. However, these levies are respectively 17% and 10% more burdensome on this first income decile than the fixed per-unit levy.

Figure 6: Hybrid Unit and per-unit levy 'burden' by income decile

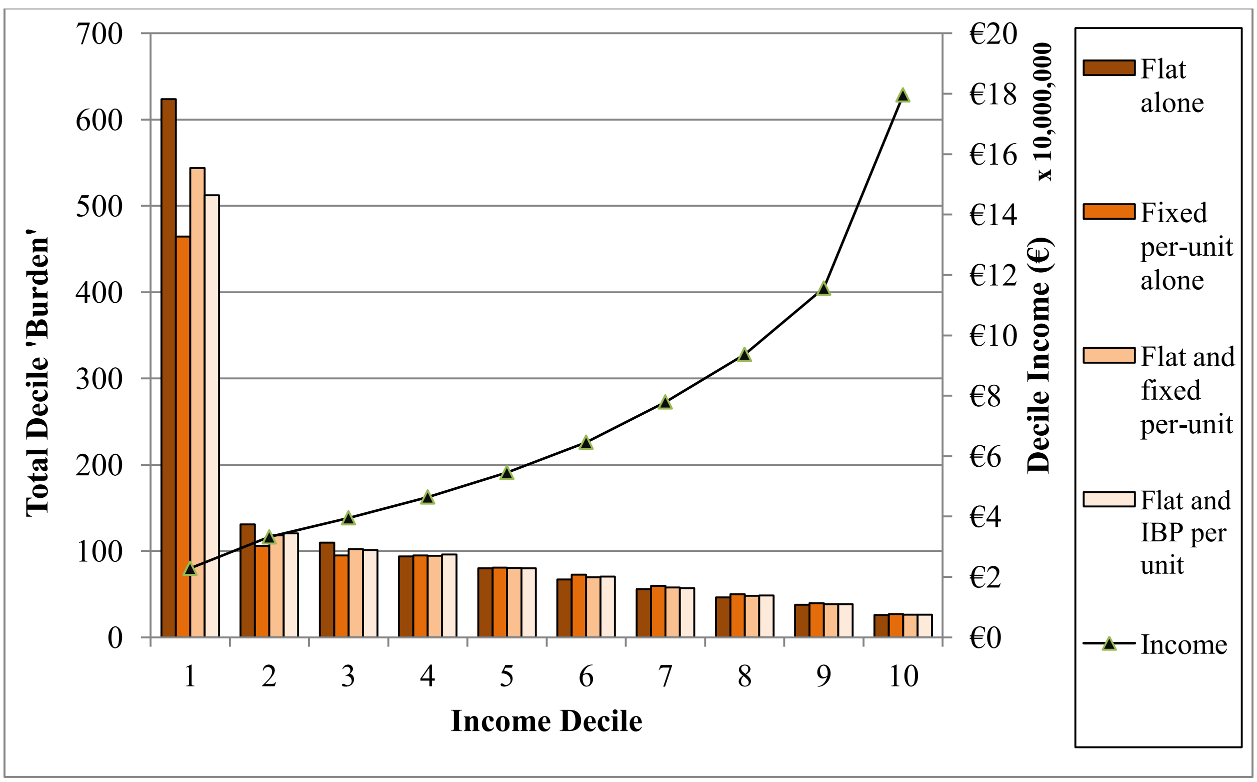
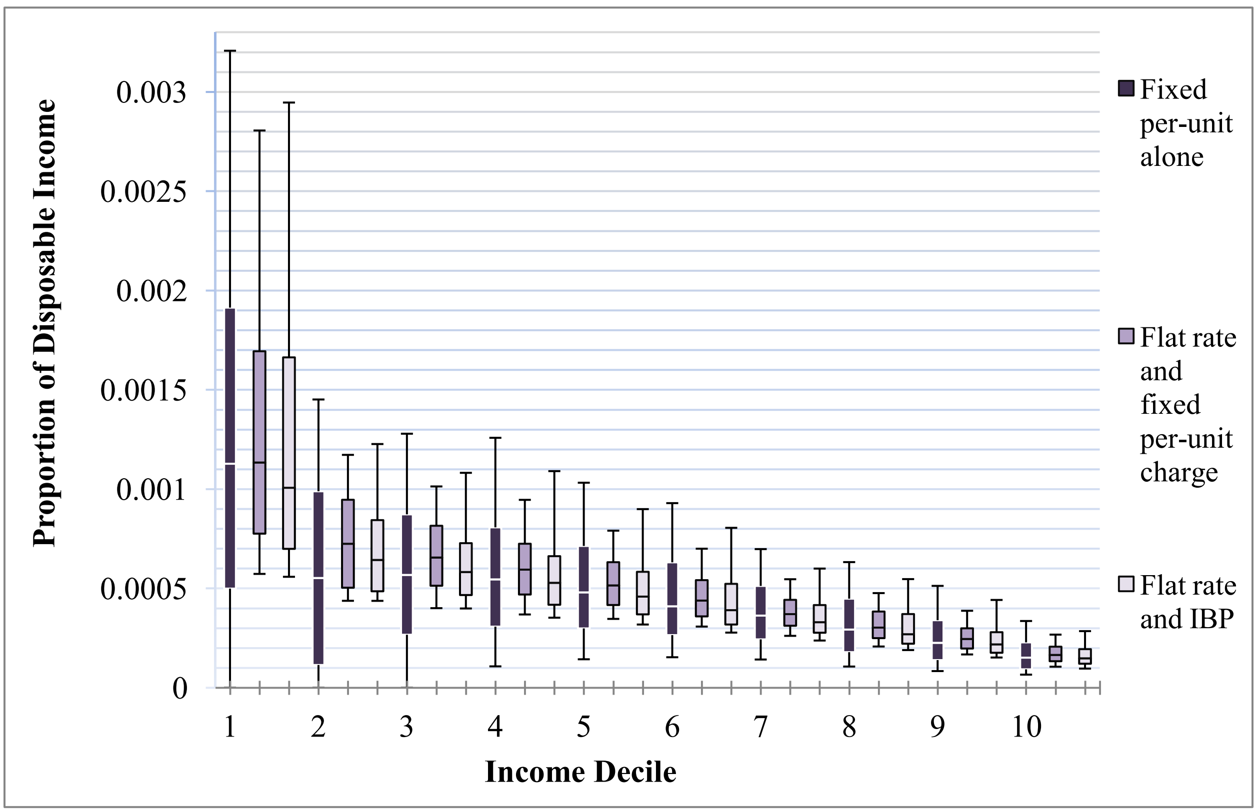


Figure 7 shows the range of incidence for these hybrid structures. Results indicate that for most income groups, median incidence for both hybrid designs is as regressive or more regressive than a fixed per-unit levy. A hybrid design works to reduce the variability of incidence, however, with a narrower interquartile range observed across all deciles. This reduced interquartile range is greater for an IBP levy structure, but occurs at the expense of a higher upper tail due to the high cost such a levy design imposes on heavy electricity users. Concentrating on the first decile, it is found that a hybrid regime (flat and fixed-per unit combination) is effective in reducing the negative impact of a fixed unit-based policy on high electricity users, totalling 45% of decile 1 households. As Figure 6 shows, there are more losers than winners so the increase in burden outweighs the reduction in burden and results in a net increase in burden for decile 1. These effects are exaggerated for an IBP scheme, where 56% of decile 1 inhabitants benefit.

Figure 7 Range of Hybrid Unit and per-unit levy incidence



Note: Incidence is calculated relative to equivalised disposable income. Boxplots display incidence at 10th, 25th, 50th, 75th and 90th percentiles.

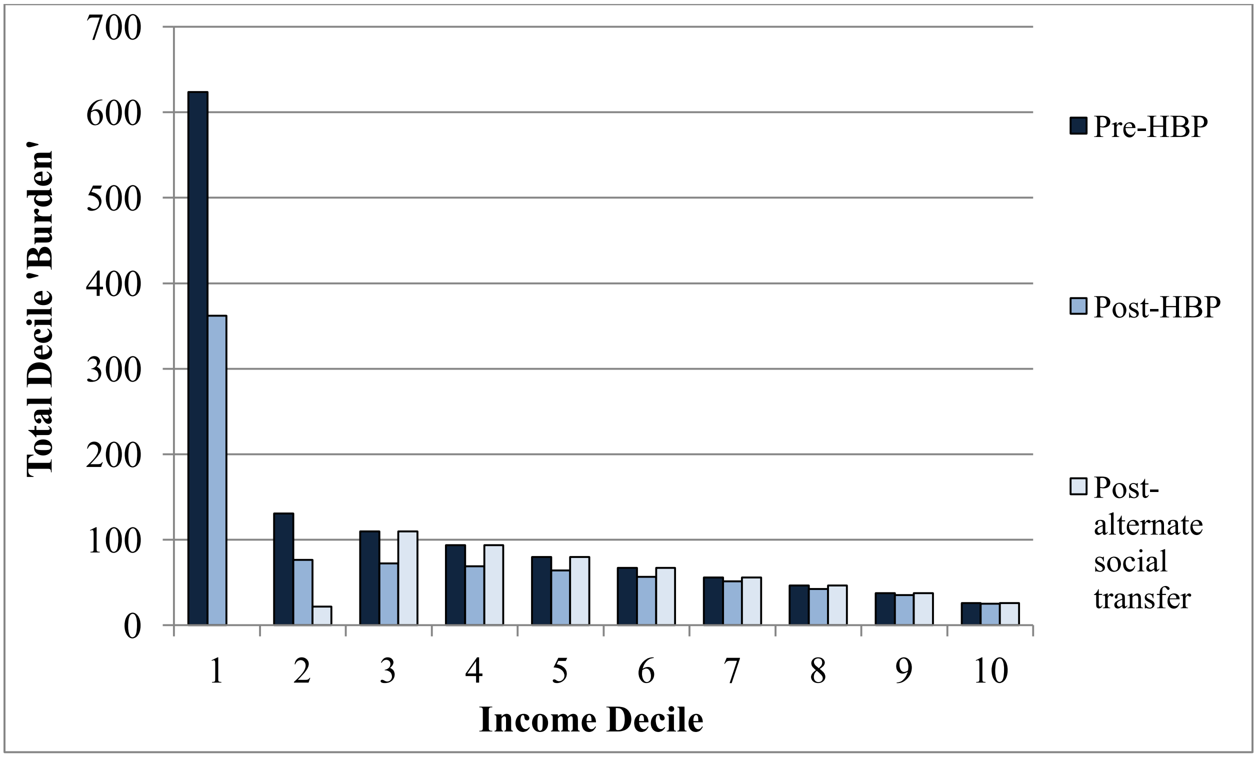
6.2. Impact of financing PSO by social transfer

Two different mechanisms of social transfer are considered. First, we analyse the pre-Budget 2013 mechanism whereby those eligible for the Household Benefits Package (HBP) do not incur the PSO levy. This provides an ex-post distributional analysis of Budget 2013 changes in the HBP. Second, we consider an alternative where beneficiaries' equivalised income is less than or equal to €238. The cost of subsidy to this point approximates the cost of HBP subsidy according to simulations using HBS data.

The HBP is financed through the tax-benefit system and the distributional incidence of financing this policy is thus difficult to identify. Instead of inaccurately approximating the distribution of this cost, the total cost to the taxpayer is quoted as a benchmark of the macroeconomic cost of redistribution against which the potential benefits may be gauged.

Overall, 15.3% of all households avail of the free electricity allowance as part of the HBP. Illustrated in Figure 8, subsidisation via the HBP is effective in reducing the burden amongst the first decile by 41%, but this is still 4 times greater than the pre-HBP average for deciles 2-10, and 5.6 times greater than the post-HBP average for this cohort. This is because only 19% and 42% of households in the first and second deciles are HBP recipients. Figure 9 illustrates how this shifts the range of incidence downwards however the majority of individuals in decile 1 still must bear a proportional burden greatly in excess of individuals in all other deciles. Furthermore, not only is redistribution through the existing HBP ineffective in targetting those most affected in the first decile, 66% of HBP recipients are in deciles 3-10, beneficiaries who have a PSO and electricity cost which is of a much lower proportional burden. Indeed, the distribution of beneficiaries is non-trivial for deciles 5 and 6, where a zero cost is observed at the 10th percentile.

Figure 8: Total Burden: Post-HBP

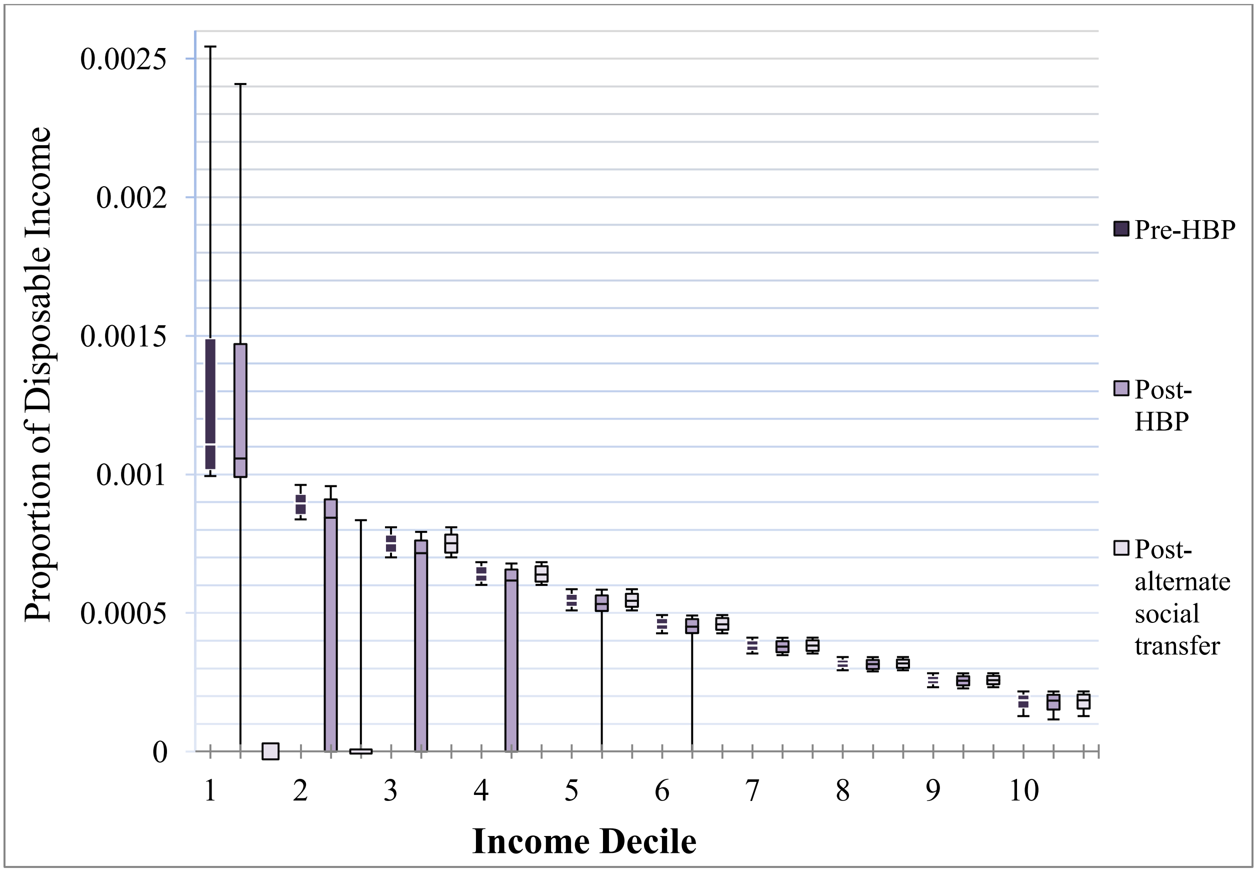


Note: Alternate social transfer mechanism has zero proportional cost for decile 1.

A hypothetical equivalised income-based measure corrects these problems, with a zero burden for decile 1 and a reduction of 71.5% for decile 2 burden relative to pre-HBP incidence. To facilitate this, there are no beneficiaries amongst deciles 3-10, with total burden for these deciles 24% greater than under the HBP scheme.

In order to achieve these distributional benefits, this subsidy must be financed by the taxpayer. Using the weighted population of the HBS, it is estimated that relative to the flat-rate PSO levy, the HBP-based subsidy costs in the region of €2,807,000 per annum. The equivalised income-based measure has an almost identical cost.

Figure 9: Distribution of Incidence: Post-HBP



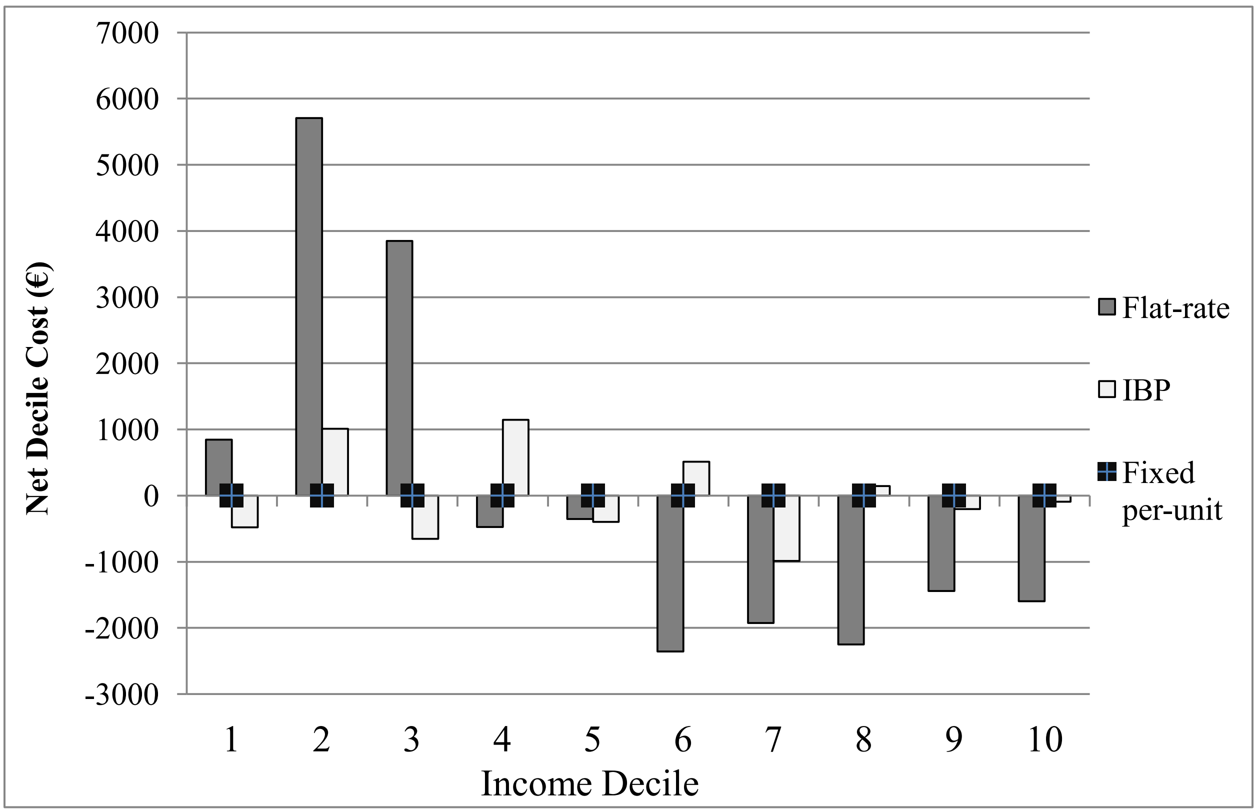
Note: Incidence is calculated relative to equivalised disposable income. Boxplots display incidence at 10th, 25th, 50th, 75th and 90th percentiles.

7 Net incidence of PSO cost increase and electricity price reduction

The final contribution of this paper is thus to assess the impact of PSO cost net of any changes in electricity price at the household level. This analysis is an upper bound on the potential net impact, as suppliers may not pass the entire amount of cost reduction to consumers. This will result in net costs increasing in aboslute terms, with proportional impacts remaining constant. Interpretation of Figure 11 in the context of Figure 1 gives insight into the sensitivity of overall burden for each decile to the magnitude of change in proportional incidence due to incomplete pass-through of wholesale price reductions. Net impact is assessed in terms of total absolute net cost alongside the measures of burden used thus far. The total net cost by decile is displayed in figure 10. The flat levy is somewhat regressive, with deciles 4-10 incurring a net benefit whilst deciles 1-3 incur a net cost. A fixed per-unit levy results in a net cost of zero for all income groups as cost is directly cancelled out by a per-unit levy. Should suppliers not pass all reductions to consumers, a trend similar to the flat-rate levy may be observed, although somewhat dampened due to lesser cost reductions.

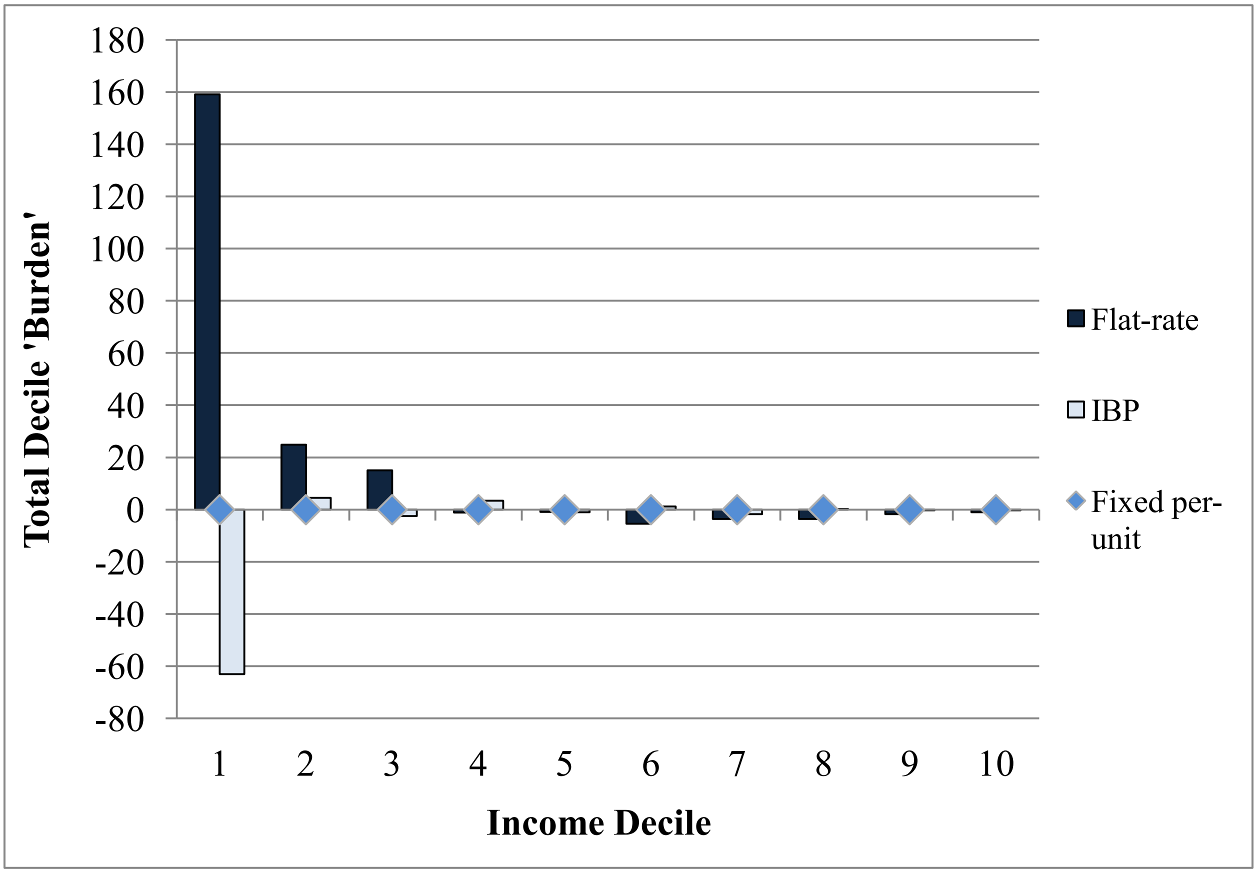
An IBP levy structure transfers the incidence to heavy users. Whether a decile has a negative or positive net cost is dependent on the distribution amongst households; deciles with many medium to high usage incur a net benefit, whilst those with a subset of extremely high users incur a net cost.

Figure 10: Total Net Cost by Income Decile



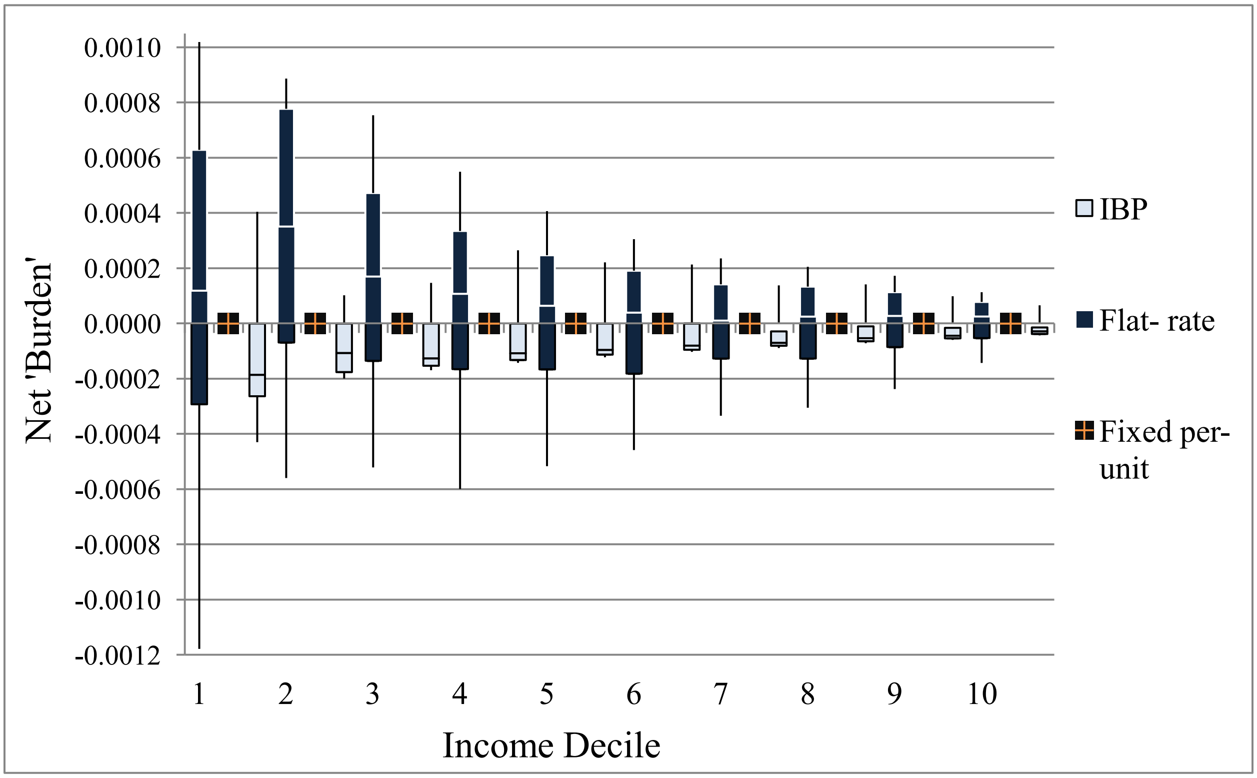
The proportional burden is analysed in Figure 11. The flat rate charge is progressive whilst the IBP tariff is regressive. The flat rate charge incurs a great proportional burden on income deciles 1-3. For deciles 4-10, the changes in levy structure have a negligible impact on burden, although an IBP scheme is less burdensome by a modest degree. Once again, we observe the neutral impact of the fixed per-unit charge.

Figure 11: Incidence by Income Decile



The range of incidence by decile is shown in Figure 12. Interestingly, the median for the flat rate levy is above zero for almost all deciles, whilst it is below zero for the IBP levy. This shows that the range of incidence is centred around a burden of net cost for the flat-rate levy, whilst an IBP levy is centred around a burden of net benefit. The balance of cost for the IBP scenario is borne by heavy users. The flat rate levy shows that greater net cost is placed on households in deciles 1-4, whilst deciles 5-7 have a lower distribution of incidence due to their higher incomes. Although we do not take the (presumably negligible) behavioural response into account, this finding would suggest that such non-linear levy structures benefit the majority of the population whilst also disincentivising heavy use.

Figure 12: Distribution of Net Absolute Incidence



8 Conclusion

The financing of energy and environmental policy through additional charges on electricity consumption forms a component of the price paid by electricity consumers. In many jurisdictions, such levies have shown a trend of growth in recent years and thus the means by which this burden is placed on consumers is of increasing policy importance. Using the Irish Public Service Obligation (PSO) levy as a case study, this paper considers how current and potential future policy structures may affect household welfare.

This paper has shown that a flat-rate PSO levy is regressive whilst per-unit levies reduce regressivity over the entire income spectrum. Non-linear Incremental Block Pricing (IBP) structures may lead to a greater overall reduction in regressivity. However, the imperfect correlation of electricity usage with income results in a higher incidence amongst a subset of high users located in low income groups. However, such heavy users are in a minority. Hybrid unit/flat-rate based policy structures are considered to alleviate the negative impact on heavy users but result in lower overall reductions in regressivity.

Another alternative is to address distributional concerns using social transfer mechanisms. The impact of subsidising household PSO costs through Ireland's Household Benefits Package (HBP) has been analysed. This provides an ex-post analysis of recent restructuring of these payments whilst also analysing their suitability for future application. Given a high proportion of beneficiaries in deciles 1 and 2, these deciles are the greatest potential beneficiaries of such a social transfer. However, beneficiaries exist throughout all deciles. It is demonstrated that the HBP-based transfer mechanism is sub-optimal, with a hypothetical measure based on equivalised disposable income found to be considerably more effective in aiding those in lower income grouups. These findings may inform specific policy measures, but may also feed in to the design of broader poverty reduction programs and allow for more efficient transfer design.

Costs analysed in this paper have also been considered net of wholesale price reductions, which exaggerate the regressivity of the flat rate scheme and progressivity of IBP non-linear schemes. Future work will be needed to analyse the efficiency costs of PSO levies, along with the causal relationships between the socioeconomic factors outlined and the unequal incidence of similar environmental policies. Furthermore, this paper does not take into account any behavioural response to changing levy structure.

This paper has identified the relative distribution of incidence across different population groups, findings that will be of increasing importance as renewables deployment progresses and the magnitude of the PSO changes to represent a larger share of household income. Indeed, such issues have already become of great concern in other jurisdictions where the cost of renewables policy has emerged as a topical policy issue. In a global energy market characterised by increasing importance of low-cost unconventional gas, the potential cost of renewables deployment is becoming an ever-increasing concern in policy and academic debate. This paper contributes to this discussion by providing an in-depth understanding of the potential implications that current and alternate means of financing renewables subsidy may have on household welfare.

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