

Appendix: The equity and efficiency effects of energy subsidy cost-recovery

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Appendix A Tariff and electricity consumption calculation

Each household must be matched with a electricity tariff representative of that which they faced in 2015/16. This allows us to elicit household-level PSO payments and quantity of electricity consumed. This is required as the HBS does not contain consumption volume or tariff data. The representative tariff is constructed in the following way. Ireland’s retail electricity market was dominated by four suppliers in 2015/2016: Electric Ireland, Bord Gais, SSE Airtricity and Energia. Electricity tariffs change through time and, unfortunately, an archive of tariffs is unavailable. Two methods were taken to specify a set of representative tariffs. First, each supplier publishes their current tariffs online. While a supplier archive does not exist, an internet archive provides a snapshot of published tariffs at a given moment. This archive was consulted to identify a representative tariff from each supplier. The internet archive contains intermittent snapshots and the available snapshot that is closest to the HBS sample period is chosen.

The tariffs available on the internet archive are as follows. For Electric Ireland, September 2014 [Standard] and September 2015 [NightSaver] tariffs are available, For SSE Airtricity, tariffs for April 2015 are available. For Bord Gais, tariffs for March 2015 are available. For Energia, tariffs for November 2017 are available. For the standard tariffs, Tables 1- 4 lists each tariff (including VAT) and weighs the tariff according to market share (excluding minor participants such as PrePayPower, Pinergy and ‘others’ who collectively serve c.5% of the market). These data are obtained from CER (2017). Tables 5- 10 carry out this process for the nightrate tariff.

Under a standard tariff, all units consumed have the same volumetric price. Under a

‘NightSaver’ tariff, day and night consumption are subject to different prices. The HBS does not provide information on tariff type. Following Farrell (2021) and Centre for Sustainable Energy (2016), we use electric heating as a proxy for being on the NightSaver tariff, as the day/night meter is generally recommended for those with electric storage heaters. When calculating consumption, We assume 60% peak and 40% off-peak usage, following the assumptions of Farrell (2021) and Centre for Sustainable Energy (2016). The resulting a weighted average volumetric tariff for urban and rural customers is outlined in Tables 11 and 12.

Table 1: Representative Standard Volumetric Tariff (€/ kWh): Urban Households

Firm	Market share	€/kWh Urban	Weighted Average Price
<i>Electric Ireland</i>	0.629	€0.1931	€0.1215
<i>SSE Airtricity</i>	0.163	€0.1908	€0.0311
<i>Bord Gáis</i>	0.163	€0.1831	€0.0298
<i>Energia</i>	0.044	€0.1890	€0.0083
TOTAL:			€0.1907

Table 2: Representative Standard Tariff Standing charge: Urban Households

Firm	Market share	Standing Charge	Weighted Average Price
<i>Electric Ireland</i>	0.629	€139.61	€87.81
<i>SSE Airtricity</i>	0.163	€162.53	€26.49
<i>Bord Gáis</i>	0.163	€149.41	€24.35
<i>Energia</i>	0.044	€158.05	€6.95
TOTAL/annum:			€145.62
TOTAL/week:			€2.80

Table 3: Representative Standard Volumetric Tariff (€/ kWh): Rural Households

Firm	Market share	€/kWh Rural	Weighted Average Price
<i>Electric Ireland</i>	0.629	€0.1931	€0.1215
<i>SSE Airtricity</i>	0.163	€0.1947	€0.0317
<i>Bord Gáis</i>	0.163	€0.1835	€0.0299
<i>Energia</i>	0.044	€0.1890	€0.0083
TOTAL:			€0.1914

Table 4: Representative Standard Tariff Standing charge: Rural Households

Firm	Market share	Standing Charge	Weighted Average Price
<i>Electric Ireland</i>	0.629	€186.13	€117.08
<i>SSE Airtricity</i>	0.163	€204.03	€33.26
<i>Bord Gáis</i>	0.163	€187.56	€30.57
<i>Energia</i>	0.044	€201.00	€8.84
TOTAL/annum:			€189.75
TOTAL/week:			€3.65

Table 5: Urban Nightsaver: €/kWh (day)

Firm	Market share	€/kWh	Weighted Average Price
<i>Electric Ireland</i>	0.629	€0.2011	€0.13
<i>SSE Airtricity</i>	0.163	€0.2079	€0.03
<i>Bord Gáis</i>	0.163	€0.1969	€0.03
<i>Energia</i>	0.044	€0.2073	€0.01
TOTAL:			€0.2016

Table 6: Urban Nightsaver: €/kWh (night)

Firm	Market share	€/kWh	Weighted Average Price
<i>Electric Ireland</i>	0.629	€0.0994	€0.06
<i>SSE Airtricity</i>	0.163	€0.1029	€0.02
<i>Bord Gáis</i>	0.163	€0.0975	€0.02
<i>Energia</i>	0.044	€0.0993	€0.00
TOTAL:			€0.0996

Table 7: Urban Nightsaver: standing charge

Firm	Market share	Standing Charge	Weighted Average Price
<i>Electric Ireland</i>	0.629	€191.64	€120.54
<i>SSE Airtricity</i>	0.163	€208.92	€34.05
<i>Bord Gáis</i>	0.163	€196.47	€32.02
<i>Energia</i>	0.044	€197.99	€8.71
TOTAL/annum:			€195.33
TOTAL/week:			€3.76

Table 8: Rural Nightsaver: €/kWh (day)

Firm	Market share	€/kWh	Weighted Average Price
<i>Electric Ireland</i>	0.629	€0.2011	€0.1265
<i>SSE Airtricity</i>	0.163	€0.2079	€0.0339
<i>Bord Gáis</i>	0.163	€0.2006	€0.0327
<i>Energia</i>	0.044	€0.2073	€0.0091
TOTAL:			€0.2022

Table 9: Rural Nightsaver: €/kWh (night)

Firm	Market share	€/kWh	Weighted Average Price
<i>Electric Ireland</i>	0.629	€0.0994	€0.06
<i>SSE Airtricity</i>	0.163	€0.1029	€0.02
<i>Bord Gáis</i>	0.163	€0.0992	€0.02
<i>Energia</i>	0.044	€0.0993	€0.00
TOTAL:			€0.0998

Table 10: Representative Rural Nightsaver Tariff: Standing Charge

Firm	Market share	Standing Charge	Weighted Average Price
<i>Electric Ireland</i>	0.629	€242.64	€152.62
<i>SSE Airtricity</i>	0.163	€254.40	€41.47
<i>Bord Gáis</i>	0.163	€243.40	€39.67
<i>Energia</i>	0.044	€251.88	€11.08
TOTAL/annum:			€244.84
TOTAL/week:			€4.71

Table 11: Representative Urban Nightsaver €/kWh Tariff

Period	Tariff	Proportion of use	Weighted tariff
Day	€0.2016	0.6	€0.1210
Night	€0.0996	0.4	€0.0398
Weighted average			€0.1608

Table 12: Representative Rural Nightsaver €/kWh Tariff

Period	Tariff	Proportion of use	Weighted tariff
Day	€0.2022	0.6	€0.1213
Night	€0.0998	0.4	€0.0399
Weighted average			€0.1613

To validate our choice of tariffs, a second source is consulted. The Commission for Regulation of Utilities (CRU) has published the average electricity tariff for the 2015/16 time period. This tariff is shown in Table 17, yielding a very a similar tariff calculation.

The process of calculating the average tariff of Table 17 is outlined in Tables 13 - 16, weighted according to the market share data of CER (2017). Table 13 calculates the average expenditure per supplier. Table 14 subtracts the PSO levy. Table 15 calculates the average standing charge. This is subtracted from the expenditure, along with the PSO, in Table 16. Finally, a weighted price is calculated in Table 17

Table 13: Annual average household expenditure incl. SC, PSO & VAT

Supplier	Jan-15 Exp.	Jan-16 Exp.	Average Exp.	Price (€/kWh)
Electric Ireland	1211	1182	1196.5	0.226
Energia	1253	1228	1240.5	0.234
Bord Gáis	1218	1169	1193.5	0.225
SSE Airtricity	1271	1218	1244.5	0.235

Note: Data pertain to average household expenditure for 5300kWh annual consumption. Calculation includes standing charge, PSO & VAT. ‘Jan-15 Exp.’ pertains to the average expenditure for January 2015, ‘Jan-16 Exp.’ pertains to the average expenditure for January 2016. ‘Average Exp.’ refers to the average of these two numbers.

Table 14: Annual average household expenditure incl. SC & VAT

Supplier	Average Exp.	Exp. less PSO	Price (€/kWh)
Electric Ireland	1196.5	1128.26	0.213
Energia	1240.5	1172.26	0.221
Bord Gáis	1193.5	1125.26	0.212
SSE Airtricity	1244.5	1176.26	0.222

Note: Data pertain to average household expenditure for 5300kWh annual consumption. Average Exp. pertains to average expenditure including standing charge, PSO & VAT (See table 13. ‘Exp. less PSO’ refers to average expenditure less a PSO of €68.24. This is the average PSO for 2015/16 as calculated by CER (2017). Price (€/kWh), refers to the average price inclusive of the standing charge and VAT alone.

Table 15: Annual Average Standing Charge

Supplier	Jan-15 S.C.	Jan-16 S.C.	Average S.C
Electric Ireland	122	127	124.5
Energia	140	139	139.5
Bord Gáis	131	130	130.5
SSE Airtricity	144	138	141

Note: Data pertain to average household expenditure for 5300kWh annual consumption. Calculation includes VAT. ‘Jan-15 S.C.’ pertains to the average standing charge for January 2015, ‘Jan-16 S.C.’ pertains to the average standing charge for January 2016. ‘Average S.C’ refers to the average of these two numbers.

Table 16: Annual average household expenditure incl. VAT

Supplier	Average Exp.	Less PSO	Less S.C.	Price (€/kWh) incl. VAT
Electric Ireland	1196.5	1128.26	1003.76	0.189
Energia	1240.5	1172.26	1032.76	0.195
Bord Gáis	1193.5	1125.26	994.76	0.188
SSE Airtricity	1244.5	1176.26	1035.26	0.195

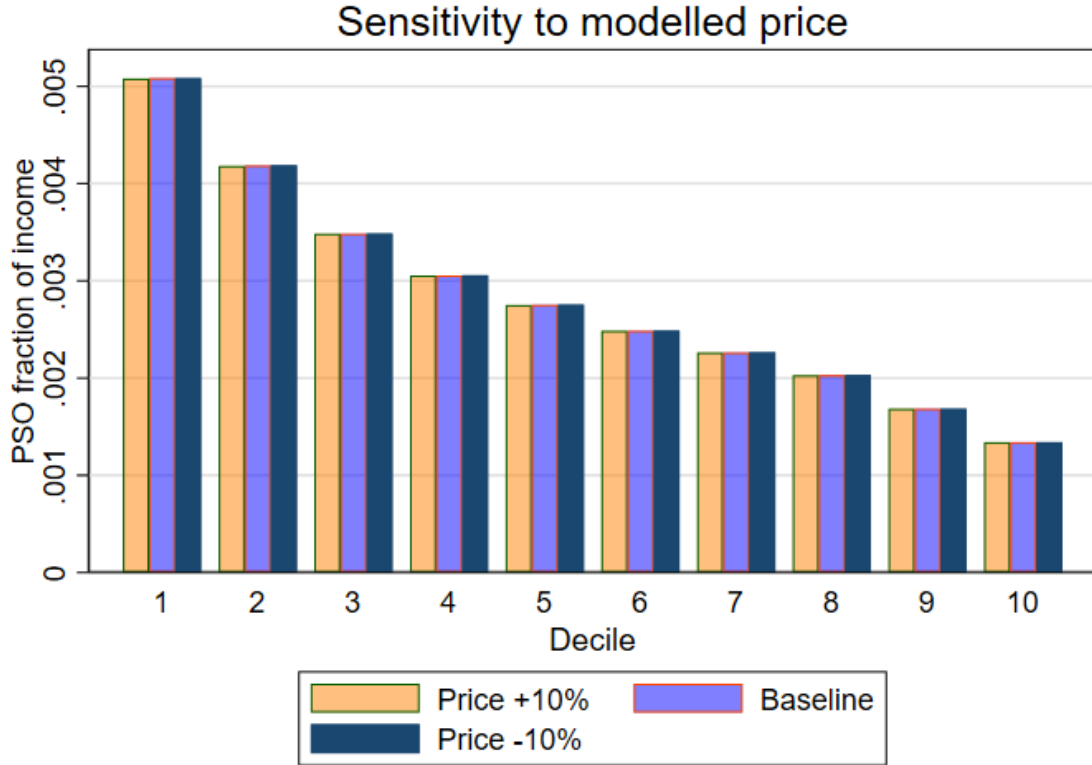
Table 17: Weighted Average Tariff (Alternative Calculation)

Supplier	Price (€/kWh)	Market Share	Weighted Price (€/kWh)
Electric Ireland	0.1894	0.6290	0.1191
Energia	0.1949	0.1630	0.0318
Bord Gáis	0.1877	0.1630	0.0306
SSE Airtricity	0.1953	0.0440	0.0086
Average:			0.1901

Note: Data pertain to average volumetric tariff as calculated by Tables 13 - 16, weighted according to the market share data of CER (2017).

To further ensure the robustness of the tariff specification, a sensitivity analysis is carried out. Lower and upper bound prices are assumed to show that the results of this paper are insensitive to the chosen tariff calculation methodology presented above. We specify tariffs that are upper and lower bounds of the calculated tariffs, $\pm 10\%$. Figure 1 shows that resulting distributional analysis is insensitive to this choice of tariff.

Figure 1: PSO burden as a proportion of income for alternative tariff calculations

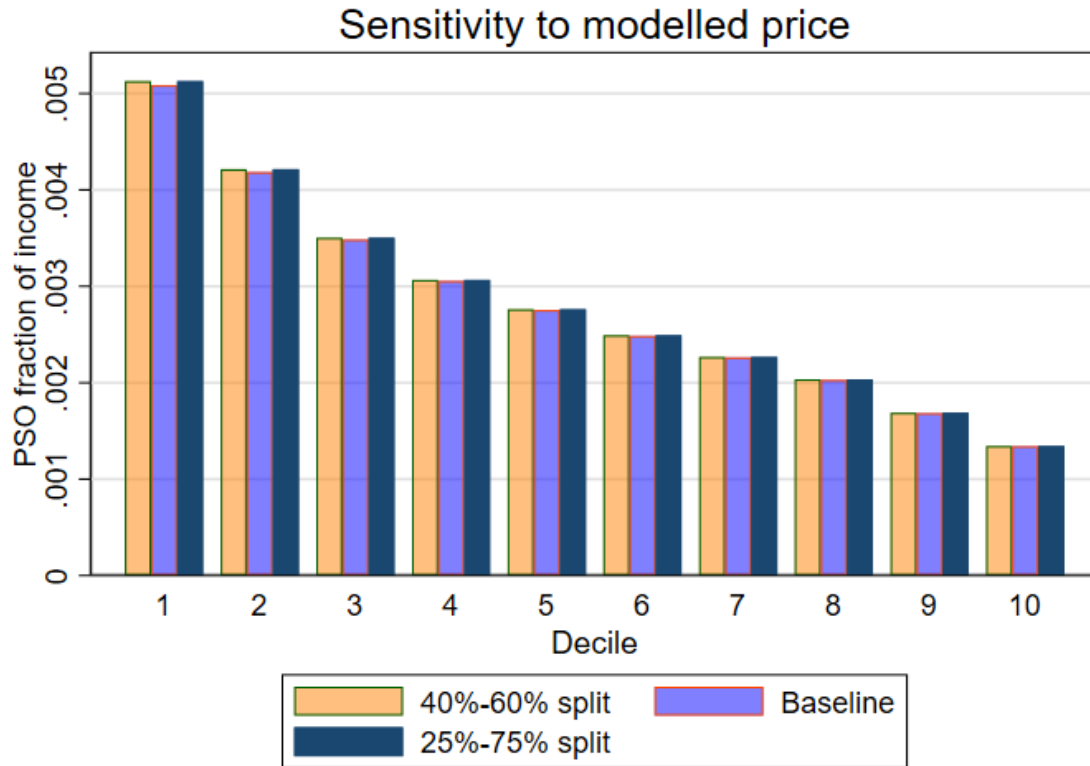


Note: Bars calculate PSO costs as a proportion of household equivalised disposable income. Price + 10% represents a scenario where the assumed baseline volumetric prices and standing charges are increased by 10%. Price - 10% represents a scenario where the assumed baseline volumetric prices and standing charges are reduced by 10%

To ensure that our results are not sensitive to the assumed rate of disaggregation between day and nighttime usage for households on the ‘Nightsaver’ tariff, a sensitivity analysis is carried out in Figure 2. We vary the assumed 60% day/40% night split to 75% day/25%

night and 40% day and 60% night. 25% is a lower bound for off-peak consumption as below this figure it is more costly to be on a NightSaver meter than a standard 24hr meter.

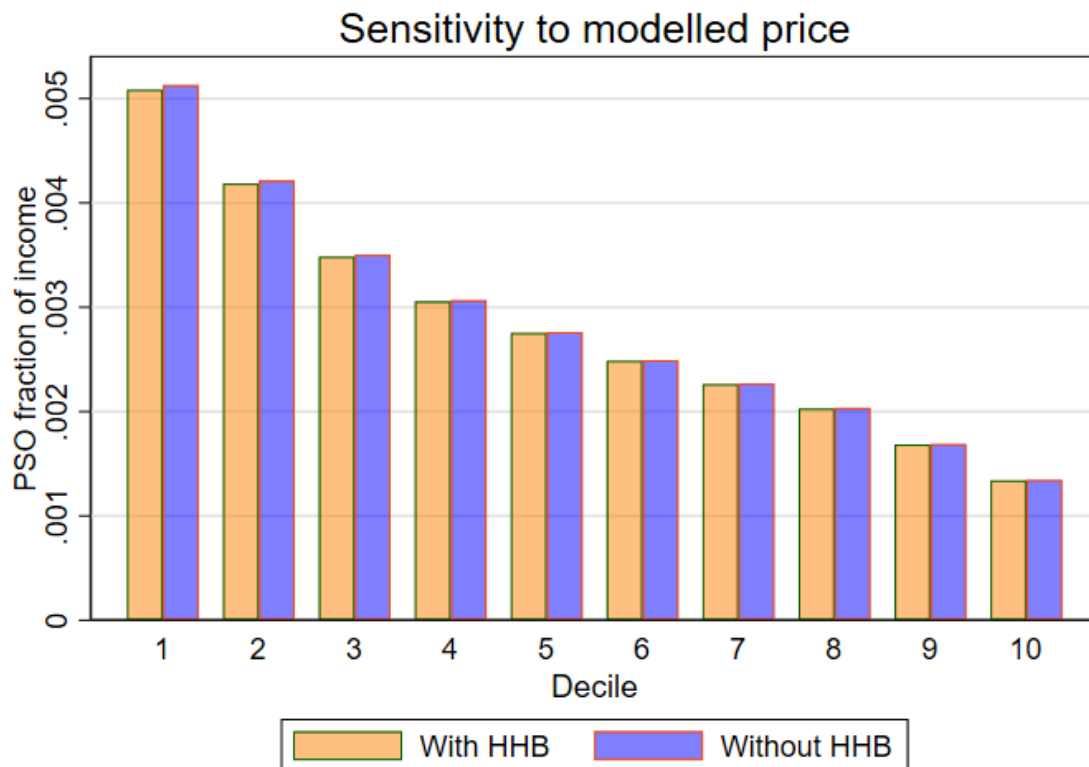
Figure 2: PSO burden as a proportion of income for alternative day/night consumption disaggregations



Note: We vary the assumed 60% day/40% night split to 75% day/25% night and 40% day and 60% night. 25% is a lower bound for off-peak consumption as below this figure it is more costly to be on a NightSaver meter than a standard 24hr meter.

Finally, Figure 3 shows that the inclusion of the household benefits package reduces the magnitude of the regressive burden by a small amount but the pattern remains the same.

Figure 3: PSO burden as a proportion of equivalised disposable income: before and after accounting for the household benefits package

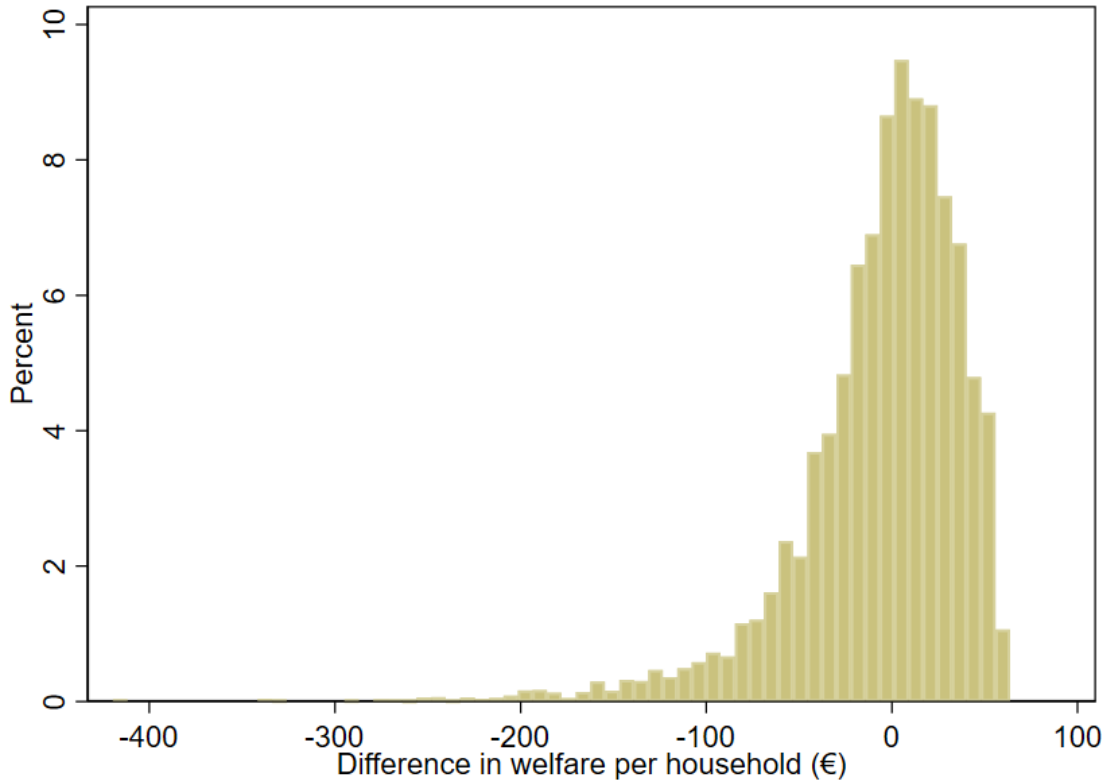


Appendix B Testing the sensitivity of results to assumed Nightsaver consumers

While much literature points to the overlap between electric storage heater and nightsaver tariff eligibility, there is unfortunately no external source against which we can validate this modelling step. To account for this potential source of noise in our estimate, we carry out a sensitivity analysis, finding that the distribution of welfare loss is insensitive to variations in this assumption. As part of this sensitivity analysis, we test the existence of both additional and fewer Nightsaver consumers. We do this by (i) assuming that a random 50% of households with electric heating have Nightsaver tariffs and (ii) assuming that an additional number of other households equivalent to 10% of the population have

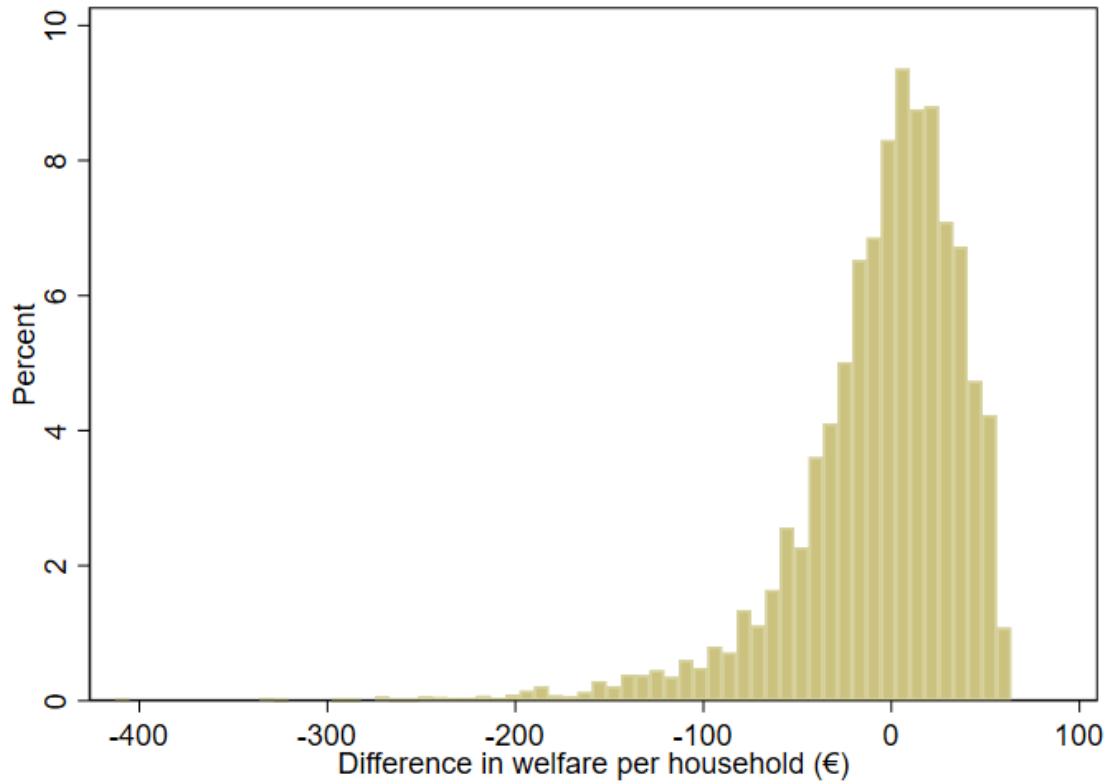
Nightsaver tariffs. As the Figures 4 to Figure 5 show, the distribution of welfare loss is largely insensitive to this variation and therefore we can be confident that any potential attenuation arising from this modelling assumption is not driving considerable bias in our results.

Figure 4: Distribution of welfare loss: random 50% of electric heater consumers use night-saver tariff ($\eta = -0.6$)



Note: Distribution calculated based on weighted HBS 2015/2016 sample

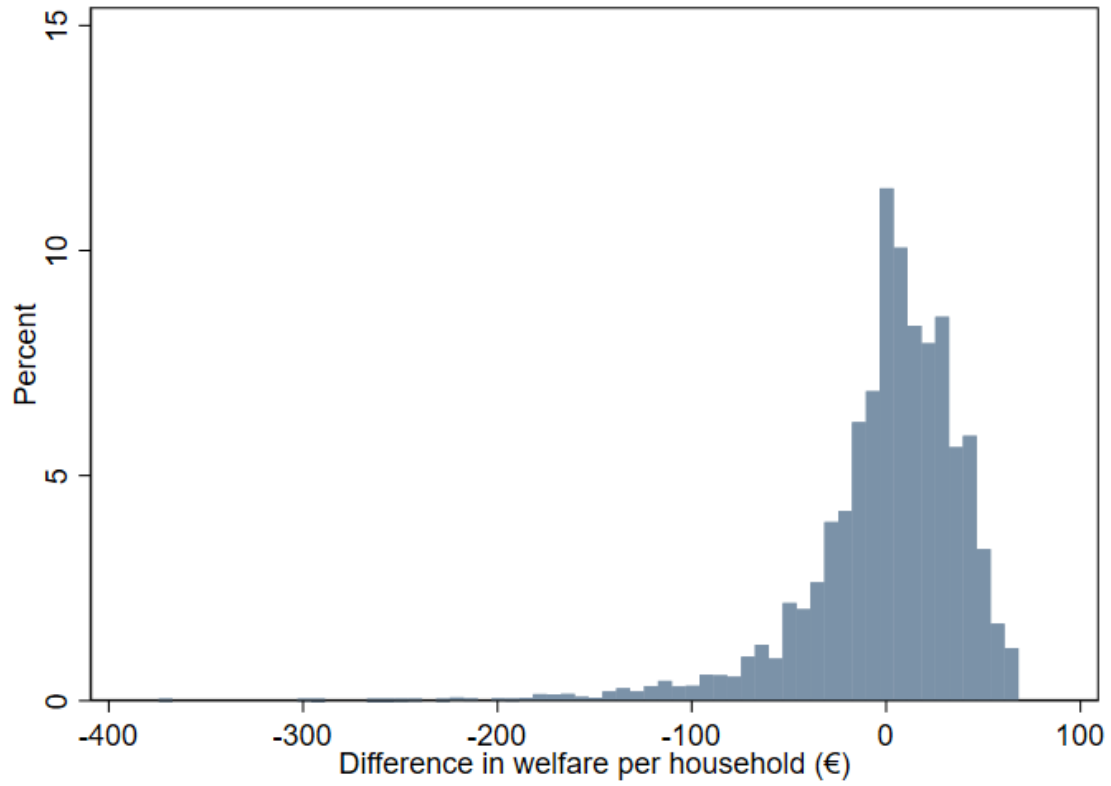
Figure 5: Distribution of welfare loss: additional electric heater consumers use nightsaver tariff ($\eta = -0.6$)



Note: Distribution calculated based on weighted HBS 2015/2016 sample. Number of nightsaver tariff users equivalent to all electric heating consumers and an additional number of other households equivalent to 10% of the population have Nightsaver tariffs.

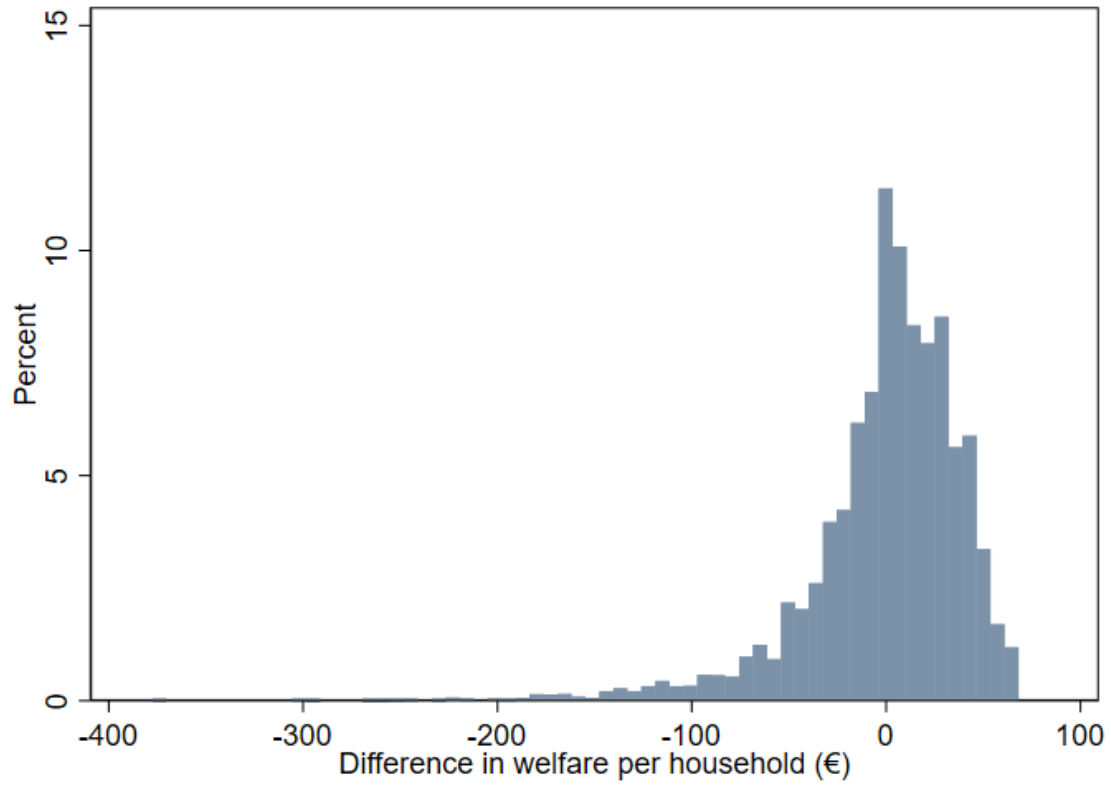
Appendix C Distribution of energy subsidy cost per unit

Figure 6: Annual household-level welfare losses due to switch from flat-rate levy to consumption surcharge ($\eta = 0$)



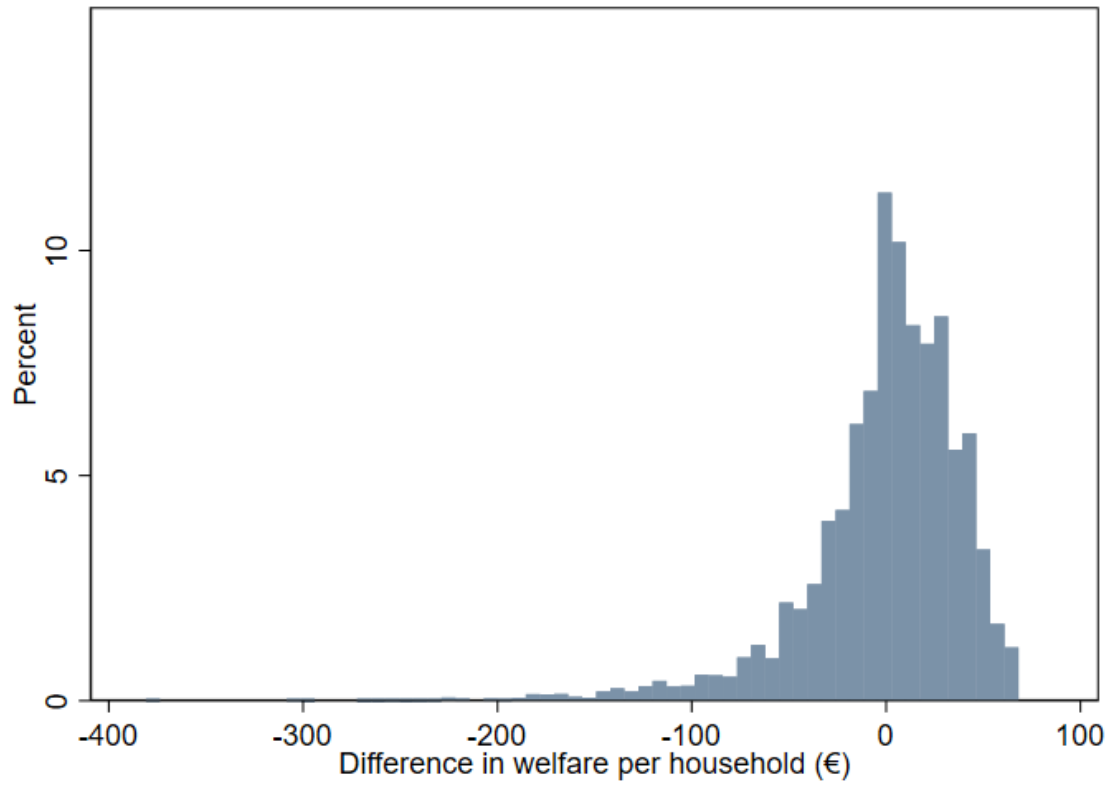
Note: Figures estimated using 2015/2016 Household Budget Survey (HBS) data.

Figure 7: Annual household-level welfare losses due to switch from flat-rate levy to consumption surcharge ($\eta = -0.2$)



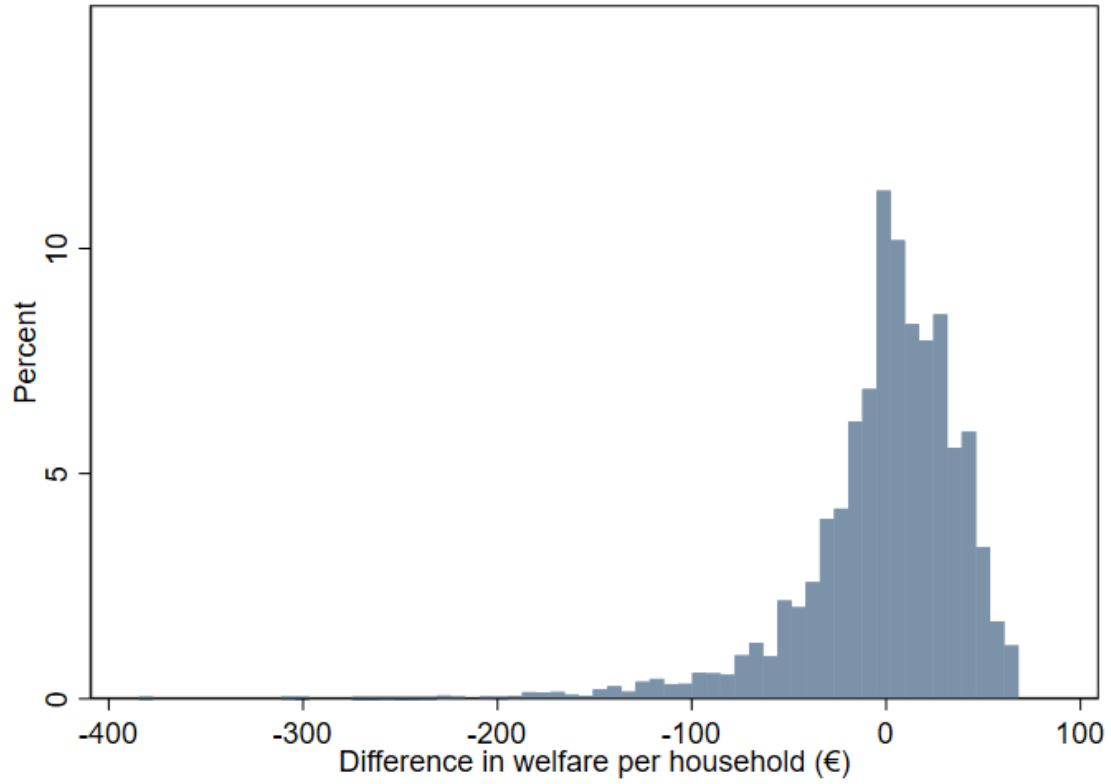
Note: Figures estimated using 2015/2016 Household Budget Survey (HBS) data.

Figure 8: Annual household-level welfare losses due to switch from flat-rate levy to consumption surcharge ($\eta = -0.4$)



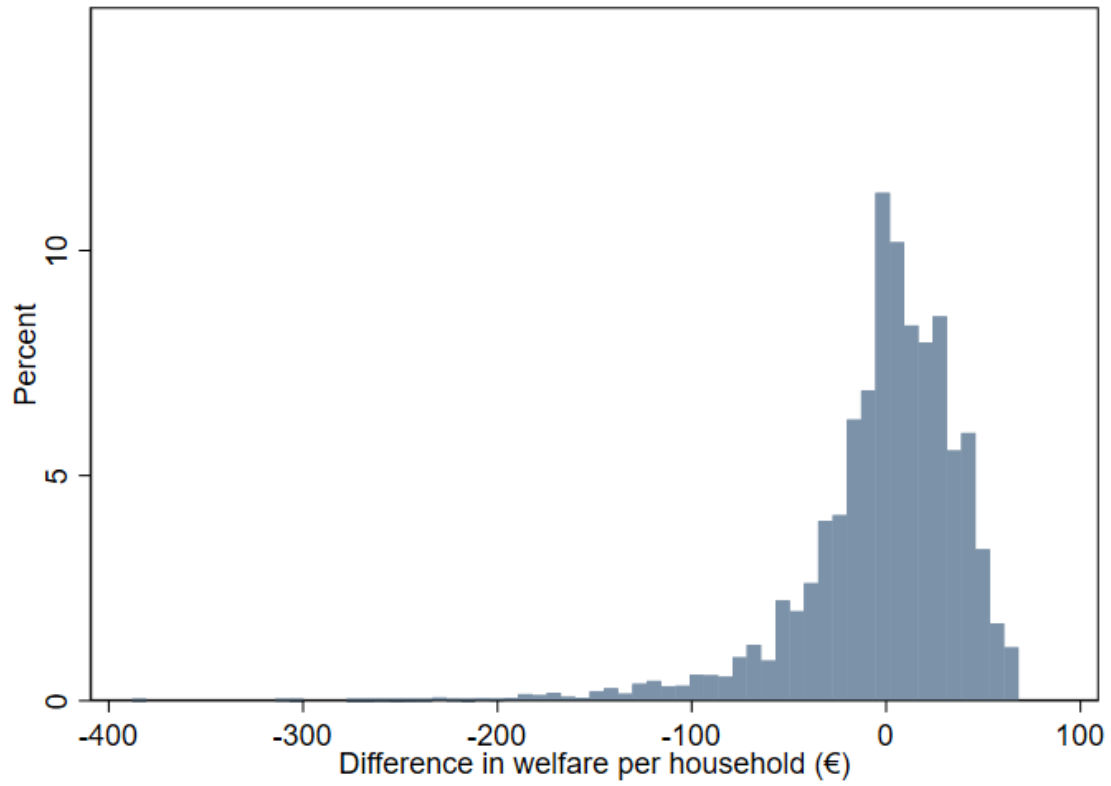
Note: Figures estimated using 2015/2016 Household Budget Survey (HBS) data.

Figure 9: Annual household-level welfare losses due to switch from flat-rate levy to consumption surcharge ($\eta = -0.6$)



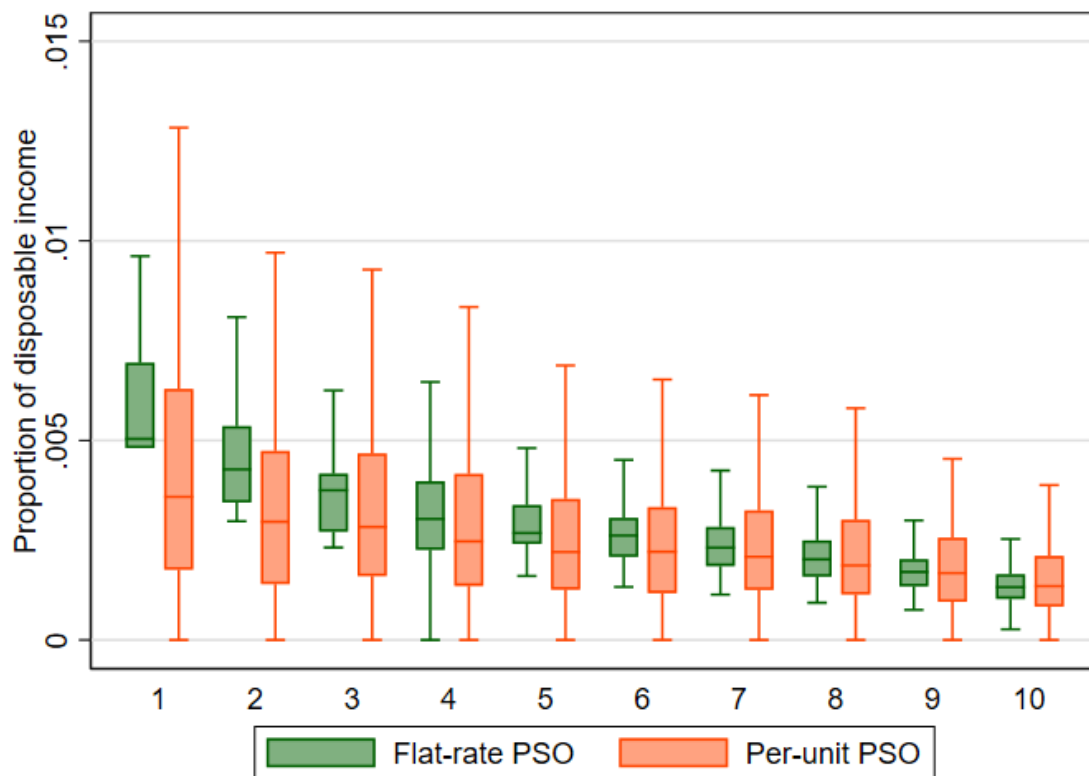
Note: Figures estimated using 2015/2016 Household Budget Survey (HBS) data.

Figure 10: Annual household-level welfare losses due to switch from flat-rate levy to consumption surcharge ($\eta = -0.8$)



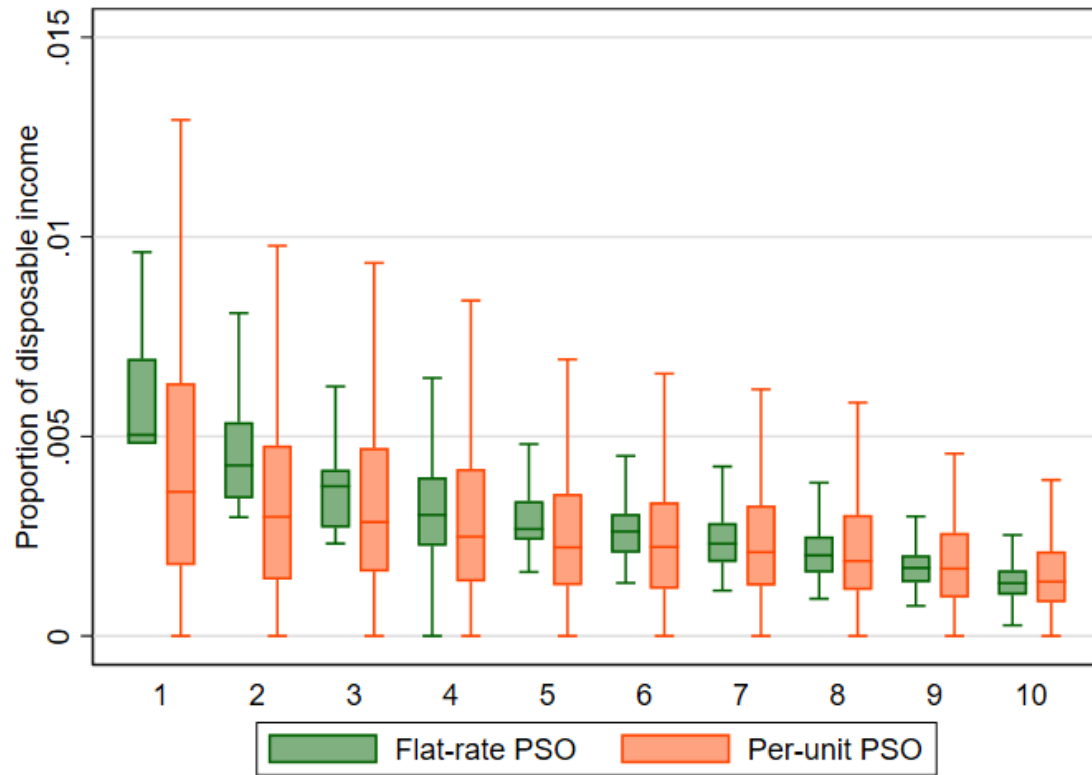
Note: Figures estimated using 2015/2016 Household Budget Survey (HBS) data.

Figure 11: Energy subsidy cost as a proportion of equivalised disposable income ($\eta = 0$)



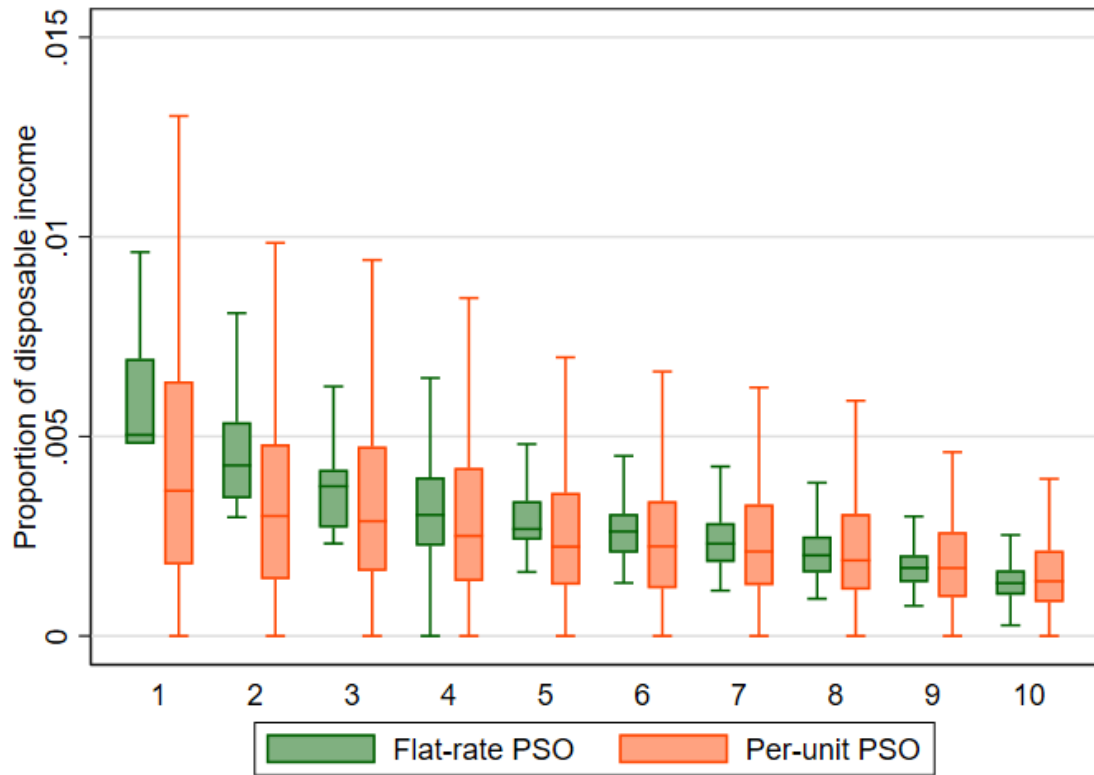
Note: Distribution calculated based on weighted HBS 2015/2016 sample. Figure excludes outliers

Figure 12: Energy subsidy cost as a proportion of equivalised disposable income ($\eta = -0.2$)



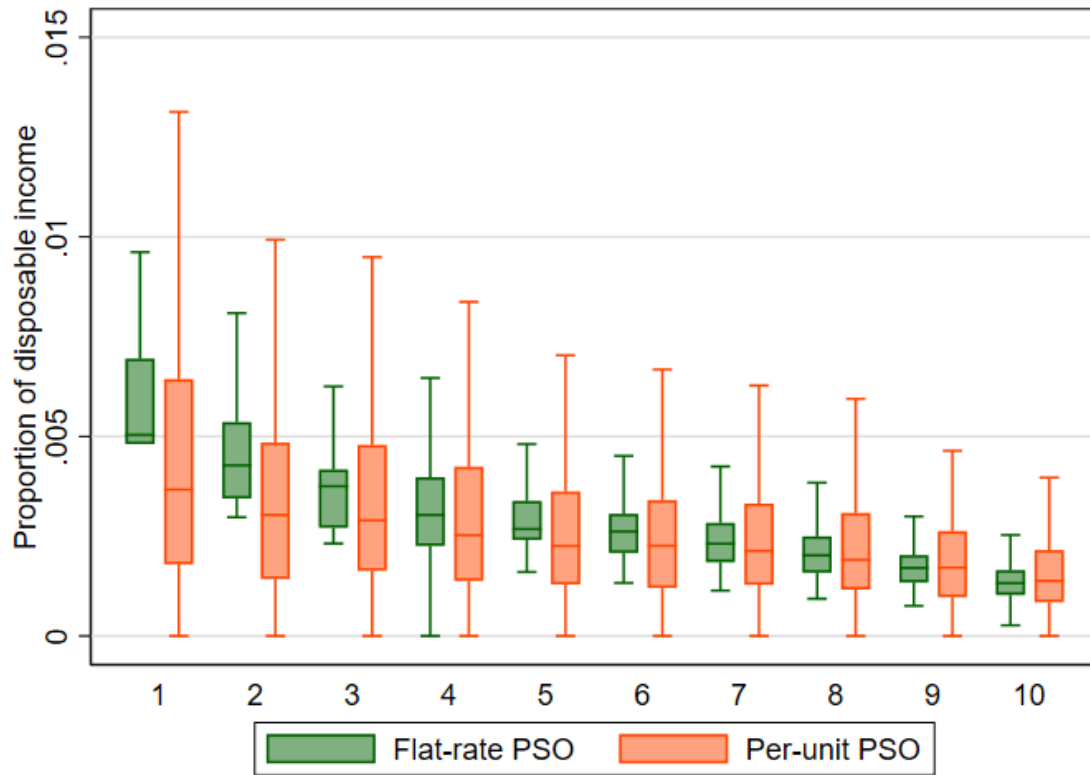
Note: Distribution calculated based on weighted HBS 2015/2016 sample. Figure excludes outliers

Figure 13: Energy subsidy cost as a proportion of equivalised disposable income ($\eta = -0.4$)



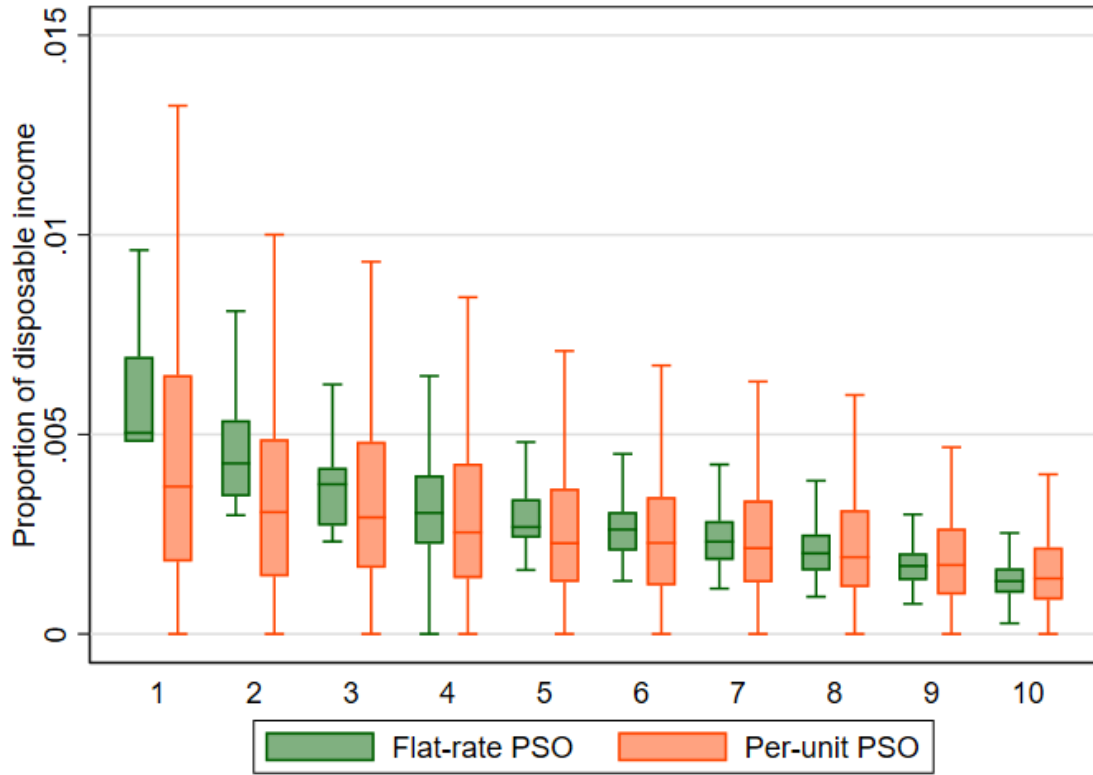
Note: Distribution calculated based on weighted HBS 2015/2016 sample. Figure excludes outliers

Figure 14: Energy subsidy cost as a proportion of equivalised disposable income ($\eta = -0.6$)



Note: Distribution calculated based on weighted HBS 2015/2016 sample. Figure excludes outliers

Figure 15: Energy subsidy cost as a proportion of equivalised disposable income ($\eta = -0.8$)



Note: Distribution calculated based on weighted HBS 2015/2016 sample. Figure excludes outliers

References

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