Present and Future Welfare Loss Due to Electricity Tariff Inefficiencies

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Marginal cost pricing guides economic efficiency. For electricity, a large proportion of costs are fixed and marginal cost pricing may lead to an under-recovery of total costs. Two-part 'Coasian' tariffs can facilitate marginal cost pricing, whereby volumetric tariffs are priced equal to marginal cost and a fixed 'standing charge' recovers fixed costs (Coase, 1946).

The current deviation from marginal cost pricing creates a welfare loss, but reform on Coasian principles may create distributional or environmental counter-effects. Alongside these concerns, the shifting structure of the electricity supply chain to accommodate Distributed Energy Resources (DERs) may also affect welfare distributions. As DERs substitute for grid-sourced electricity they bring a change in the revenue structures faced by utilities. If Coasian pricing is not in place, and therefore some fixed costs are recovered via volumetric tariffs, utilities must restructure their tariffs to ensure full cost recovery.

This Energy Forum article will summarise the findings of Farrell (2018) which provides two primary contributions. It first estimates the welfare loss due to the existing electricity tariffs in Great Britain, and compares this welfare loss to potential distributional and environmental counter-effects. The second contribution is to show the effects of DER deployment on welfare distributions. Under current British tariffs, DER deployment necessitates tariff rebalancing which redistributes welfare from non-adopters to adopters and leads to a net welfare loss in likely circumstances.

Simulating welfare change due a Coasian tariff reform

The UK's Living Cost and Food (LCF) survey provides the foundation for this analysis. Electricity expenditures are converted to units consumed by matching each household to a tariff. Utility 'Consolidated Segmental Statements' (Ofgem, 2017) allows for the marginal and fixed cost breakdown to be identified. Using this information, a revenue-neutral Coasian tariff reform is calculated for the LCF population.

The second stage of analysis concerns DER deployment. Adoption is simulated amongst a subset of households. Utility revenues are calculated relative to costs and tariffs are recalibrated to ensure full cost recovery, if required. This is carried out for both current British tariffs and the Coasian counterfactual.

Welfare change due to Coasian tariff reform

Coasian volumetric tariffs are over 50 percent less than 2015/16 British tariffs. A Coasian tariff is in the region of £0.06/kWh, compared with current tariffs in the region of £0.14/kWh. Standing charges must increase from 350 to 450 percent under a Coasian tariff structure.

The welfare effects are predicated on consumers' price elasticity of demand, with the empirical literature finding that the long-run price elasticity of demand is in the range of -0.3 to -0.8, with many studies converging on the upper end of this spectrum. A change in consumer surplus is calculated using a constant elasticity of demand function, D(p) = Ak pe. Welfare changes are calculated as the area to the left of the demand curve, bounded by the original and Coasian volumetric price, less the change in the standing charge.

Current British tariffs create average welfare losses of £28 to £86 per household, per annum. These household-level welfare losses aggregate to average population-level losses of between £729m to £2,235m, or between 6 and 18 percent of domestic consumption value (Ofgem, 2017).

Distributional and environmental counter-effects

Distributional impacts are predicated on the price elasticity of demand. If the true elasticity of demand corresponds to that estimated by the empirical literature, all income groups benefit from tariff reform, on average. This is because of the large discrepancy between current and Coasian volumetric prices. Coasian reform creates a large demand response that outweighs the increase in standing charge for most households. This trend persists for those in low income groups.

As there are still those who lose out due to reform, current inefficiencies may be justified if the welfare cost of redistribution via existing tariffs is less than the welfare cost of redistribution via the next best alternative, the tax-benefit system. For every £1 raised through energy taxes in the UK, £1.13 is lost through economic distortion. For labour taxes, every £1 raised costs £1.81 (Barrios, 2013). Every £1 distributed via current tariffs costs between £2.02 and £5.98, which is greater than either benchmark. Distributional concerns are not irrelevant, however. While current tariffs cannot be justified on distributional grounds, these distributional effects are likely to be of policy concern. The findings of this analysis indicate strongly that these are more efficiently addressed via the tax-benefit system.

Coasian reform also presents environmental concerns. During the period of study, the carbon price floor in the UK was £18/tCO2, lower than many estimates of the social cost of carbon. The UK Committee on Climate Change recommend that targetconsistent carbon prices are in the region of £50/tCO_2 (CCC, 2015). Accounting for the carbon price floor in calculations, this paper quantifies the welfare loss per ton of CO_2 avoided of £119/tCO_2. A correctly-specified carbon price is therefore likely a more efficient way to achieve carbon reductions than current tariff inefficiencies.

Distributed Energy Resources (DER) and Dodging the Deadweight Death Spiral

This paper also considers the welfare impacts of substituting a subset of household generation for DER-sourced electricity. No household is assumed to fully defect (and therefore substitution is infra-marginal). If a Coasian tariff is in place, utilities lose their marginal cost for each unit of electricity replaced by DER generation. If a Coasian tariff is not in place, utilities lose their marginal cost and a portion of fixed costs. A tariff surcharge is calculated to ensure full cost recovery. Both standing and volumetric tariff recalibrations are considered.

Under Coasian pricing, households will only adopt if the average cost of DER-sourced electricity is less than or equal to the marginal cost of grid-sourced electricity. These are circumstances that are welfare-improving. There are no negative distributional impacts; adopters benefit and non-adopters are unaffected as tariffs do not need to be changed. This removes worries of a `utility death spiral'.

When Coasian pricing is not in place, it is cost-effective to adopt once the DER price reaches parity with the retail price. Figure 1 shows that at retail price parity (c. 200 percent of marginal cost), deployment leads to welfare loss as grid tariffs are adjusted to ensure cost recovery.[1] The welfare loss of this adjustment is greater than the benefit to adopters. This can be up to £1,000 million per annum, or 10 percent of the value of residential electricity consumption, with 10 million adopters (33% adoption rate). Non-adopters, on average, lose up to £55 per annum under this scenario. Total welfare losses fall as DER costs fall. Total welfare remains unchanged at grid parity but welfare redistribution persists under current tariff structures; adopters benefit at the expense of non-adopters.

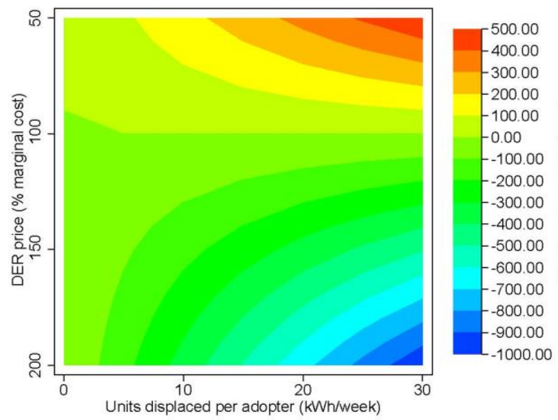

Figure 1: Total change in welfare due to 10 million DER adopters with no Coasian price and standing charge tariff adjustment

Conclusion

This paper has analysed the welfare losses arising from inefficient British electricity tariffs. A Coasian tariff reform may avoid welfare losses of up to 18 percent of domestic consumption value. This paper demonstrates clearly that environmental and social factors do not justify current departures from efficient tariff structures and distributional concerns should be addressed via the social welfare system. These findings will inform the ongoing tariff review processes being carried out by the UK regulator Ofgem.

This paper also shows that not only does Coasian reform lead to immediate benefit for consumers, it safeguards against potential future welfare losses. Without a Coasian price structure, DER deployment may necessitate tariff rebalancing to ensure full cost recovery. While the policy discourse is focussed on a `utility death spiral', the under-recovery of network fixed costs due to a major decrease in the volume of sales, this finding draws attention to a potential `deadweight death spiral', where growing welfare losses due to increasing distortions outweigh the benefits of technological change.

Footnote

[1] We present results due to standing charge adjustments. Please see Farrell (2018) for a discussion of the results due to volumetric tariff adjustments, which are of similar magnitude.

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