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The macroeconomic principles and mechanics governing the impacts of broad carbon taxation on the UK economy

Policy Briefing 2: What are the macroeconomic and household welfare trade-offs of introducing broad carbon taxation?

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Summary

This is the second of two policy briefs produced by the Centre for Energy Policy aimed at building better policy understanding of what the macroeconomic impacts of introducing greater and broader carbon pricing/taxation may be. In the first brief we established that the **main driver of the macroeconomic outcomes of extending carbon pricing to all sectors of the economy**, via a carbon tax applied via the supply of (domestically produced and imported) refined oil/petroleum and gas, is the **impact on producer costs and competitiveness**. There, using an economy-wide scenario simulation framework, we demonstrated how the **central drivers of the extent of wider economy contraction are producers' ability to moderate taxed energy use and wage costs in determining output prices, and export demand responses to higher prices.**

Here, we present fuller findings of our scenario simulation analyses for the UK, with focus on distributional impacts across different household income groups. We extend to consider the impacts of any attempt to **moderate negative impacts on UK producers and consumers through some extent of revenue recycling, while maintaining priority on wider fiscal responsibility.** Five fundamental findings emerge:

1. Where the UK is a first mover in adopting broad carbon taxation, all our scenarios point to **negative effects on average household real incomes and the competitiveness of domestic producers.**
2. While the energy and CPI impacts of the carbon tax are regressive, **when effects on real activity levels are incorporated, the real income impacts may be mildly progressive,** provided government maintains the real value of all spending and transfers.
3. The size and characteristics of economy-wide contraction are highly dependent on wage bargaining responses as labour demand falls. **Where workers resist real wage reductions, the costs of the carbon tax are increasingly pushed onto less energy-intensive but more labour-intensive sectors** of the economy.
4. While **negative wider economy impacts can be cushioned by recycling carbon tax revenues**, the net total government revenue increase is always less than the revenue from the carbon tax. Thus, full **earmarking of carbon tax revenues to either offset costs to some or all economic actors, and/or to enable further emissions reductions, would lead to an increase in government borrowing.**
5. Reducing **income tax moderates macroeconomic losses by reducing household real income losses while limiting wage pressure and competitiveness loss.** However, with low-income households earning less, it is regressive.

Figure 1:

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1. Our scenario simulation approach

As in the first policy brief, our analysis focusses on identifying and understanding the key principles and mechanisms determining the macroeconomic impacts of introducing a new carbon tax using a multi-sector economy-wide computable general equilibrium (CGE) scenario simulation model.[1] We isolate the impacts of introducing a carbon tax by running staged simulations where nothing else changes.

The illustrative carbon tax rate is imposed at a rate of £50 per tonne of CO_2 (in average use) of (domestic and imported) supply of gas and refined oil/petroleum, varying assumptions about cost and competitiveness pressures.[2] This is in addition to existing carbon prices/charges. We focus reporting on long-run outcomes where the economy is fully adjusted (which we find can take up to 30 years but with 80%/90% of the adjustment taking place within the first 10/15 years).[3]

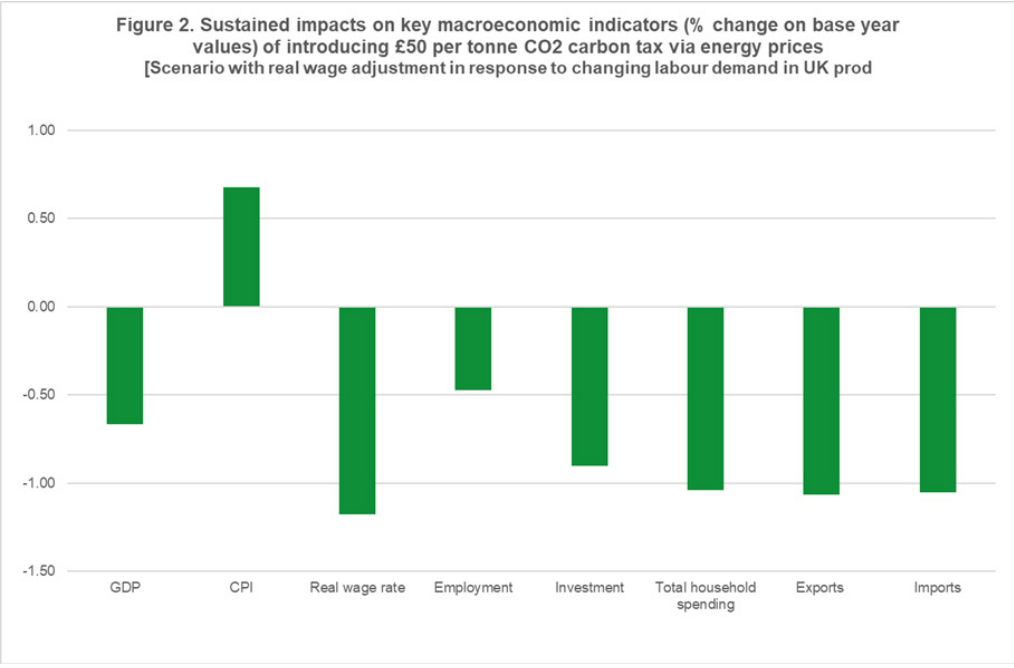
Here, we begin by focussing on a central case where the UK labour market is characterised by real wage bargaining, with workers' real take-home wage demands reducing with falling labour demand. This is important, where the relative competitiveness of UK producers falls with relatively price responsive export demand, assuming that (with no other policy intervention) firms have limited ability to substitute away from taxed fossil fuel use in their input mix.

In all cases, we assume government maintains the real value of its spending and transfers, involving increased nominal spending as consumer prices rise. We extend here to focus on how outcomes are affected if government priorities balancing the public budget, and the broad approach to doing so in recycling or recovering revenues.

2. The basic message – taking a leading role in bearing carbon costs, with no other policy action, will have negative impacts on household incomes and producer competitiveness

In all our simulations we assume that the UK acts alone in introducing the new carbon tax. This means that UK producers bear an additional cost that is reflected in output prices. In the central scenario reported in Figure 2 (where we assume that there is some downward real wage adjustment as labour demand falls, but with no recycling of revenues), we see that, from a domestic perspective, this adds to the consumer price index (CPI) pressure of the energy price increases themselves, with a net CPI increase of 0.68%. However, the main trigger for a wider economy contraction, accompanying a substantial (-11.05%) reduction in total fossil fuel use, is that domestic producers lose international competitiveness, with rising UK prices across all sectors (see first bar in Figure 4 below). This triggers a -1.07% contraction in export demand.

Figure 2:



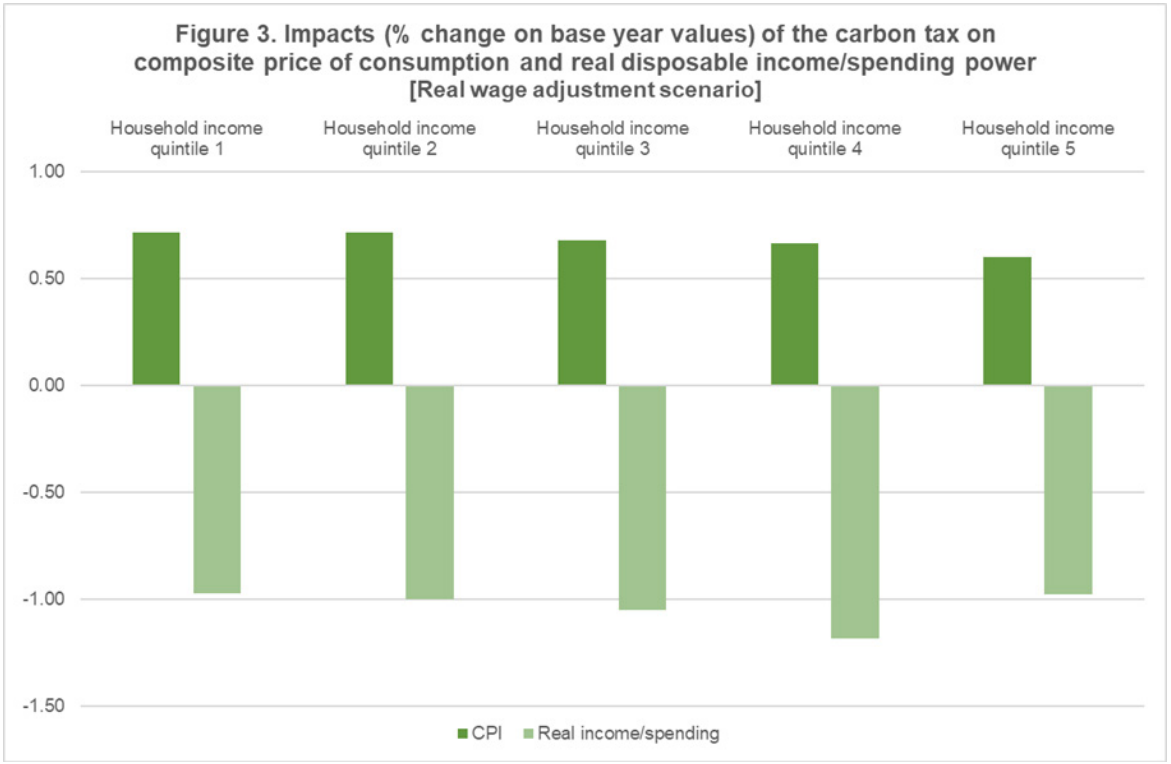
Crucially, the wider economy contraction triggered involves a reduction in UK employment of -0.47%, where this and other macroeconomic impacts (including the CPI increase) are cushioned by a -1.18% reduction in the average real wage demanded by workers as labour demand falls and unemployment rises. These wage and employment reductions add to CPI pressure in driving a -1.04% contraction in total real household spending, with the net reduction in activity across the UK economy involving a -0.91% reduction in total investment and a sustained -0.67% contraction in GDP.

3. The impact on UK households involves a mix of regressive price impacts and more progressive real income impacts

An important political economy question is likely to be whether the imposition of the carbon tax is regressive. This is not a straightforward question. As may be expected, the relatively large increases in energy prices (see Figure 4 below) drag up the composite price indices for the 40% of households on the lowest incomes (household income quintiles 1 and 2 in Figure 3), where a greater share of spending goes to energy. This makes the general price impacts of the carbon tax regressive. However, in all our scenario simulations, the macroeconomic impacts set out above dominate in determining the real income and spending impacts for all UK households, so that the overall real disposable income impact becomes broadly progressive, as shown in the second bar in Figure 3.

Crucially, though, while employment and wage income impacts dominate for most UK households, transfers from government are an important source of income for lower income households. Here, our assumption that government adjusts nominal spending to maintain pre-carbon tax real spending levels as consumer prices rise is important in determining outcomes, particularly in cushioning the real income and spending power impacts of the carbon tax for the lowest income households.

Figure 3



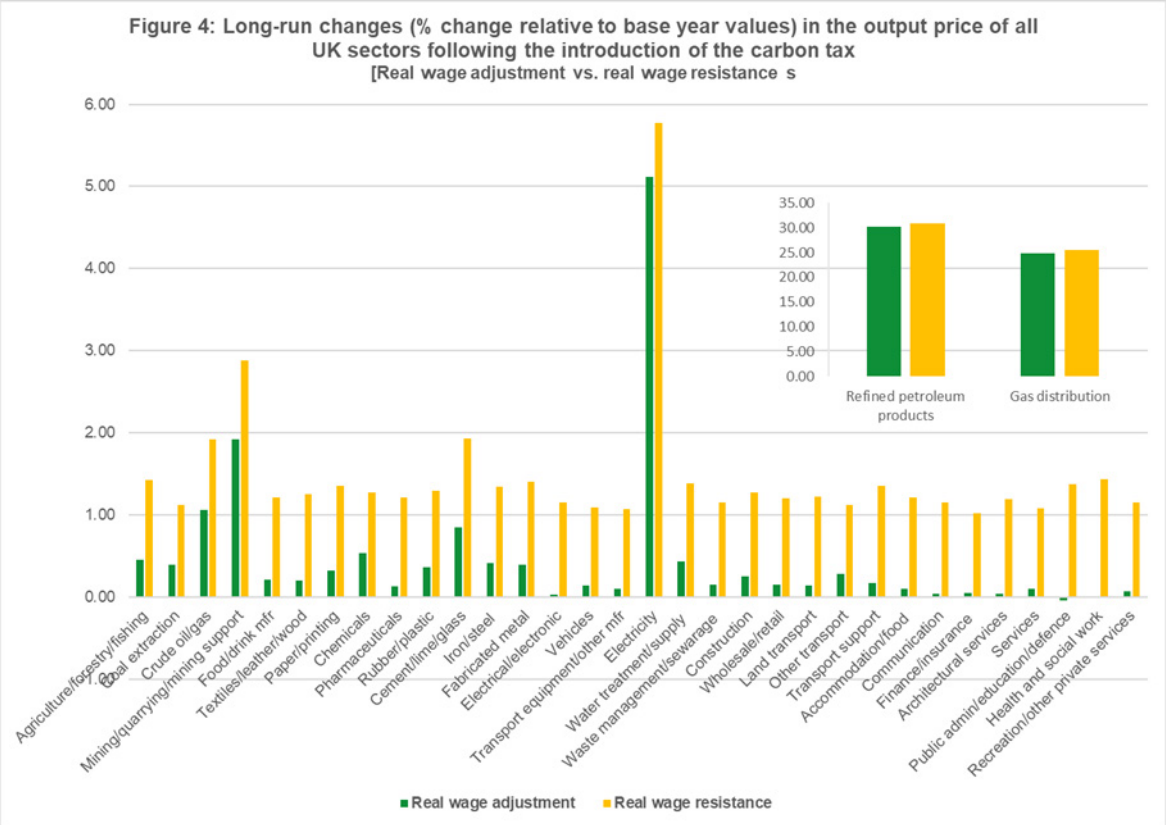
4. Wage bargaining responses in a supply constrained UK labour market are crucial in determining macroeconomic and household welfare outcomes

The change in competitiveness following the introduction of the carbon tax is a key determinant of the macroeconomic outcomes, where an important driver of the price changes associated with the tax is the real wage adjustment in the labour market. In the case reported in Figures 2 and 3, workers accept a reduction in average real wage rates (-1.18%), which allows the average gross nominal wage rate faced by producers to fall (-0.51%), limiting the CPI increase (0.68%).

However, if we consider an extreme case where there is full pushback in the labour market – i.e., workers attempt to fully maintain their real take-home wage rate and purchasing power as consumer prices rise – the outcome is one where both GDP and employment contractions are much greater (-1.86% and -1.75% respectively). The reason is straightforward: with no flexibility in wage rates as labour demand falls, the cost of the carbon tax is fully reflected in producer and, thus, consumer prices, with a greater, 1.73%, CPI increase reflecting an increase in the nominal wage rates faced by all producers.

This was identified as the most negative macroeconomic outlook in our first policy brief. One crucial outcome, reflected in Figure 4, is that rising wage costs mean that the costs of the carbon tax are increasingly pushed onto more labour-intensive sectors, even where direct exposure to the carbon tax (dependent on energy/fossil fuel-intensity) is limited. Another is that, despite maintenance of pre-carbon tax real wage rates, all households suffer greater real disposable income losses, due to a combination of greater employment losses and higher consumer prices.

Figure 4:



5. The wider economy contraction means that full earmarking of carbon tax revenues would involve some government borrowing

Of course, the actual outcomes of introducing broad carbon pricing/taxation across the UK economy will depend not only on the extent to which this involves the UK acting alone and/or ahead of other nations, but also on the wider 'net zero'/ decarbonisation policy agenda (including actions to incentive and enable producers and consumers to shift away from fossil fuel use). Here, one central issue may be the extent to which revenues generated from the carbon tax may be used both to enable efficient and effective decarbonisation and to moderate the types of negative impacts on producers and consumers set out above.

While our carbon pricing research is yet to develop to integrate such a fuller range of issues (see Section 7), one key insight emerging from the economy-wide scenario simulations reported here is the fact that the contractionary pressures triggered by the introduction of broad carbon taxation will have implications for the public budget outlook.

Table 1:

Table 1: Long-run per annum changes (£million) in government spending, revenues and net budget balance due to the introduction of the carbon tax (2018 prices)
[central cases holding export price responses and producer substitution possibilities constant]

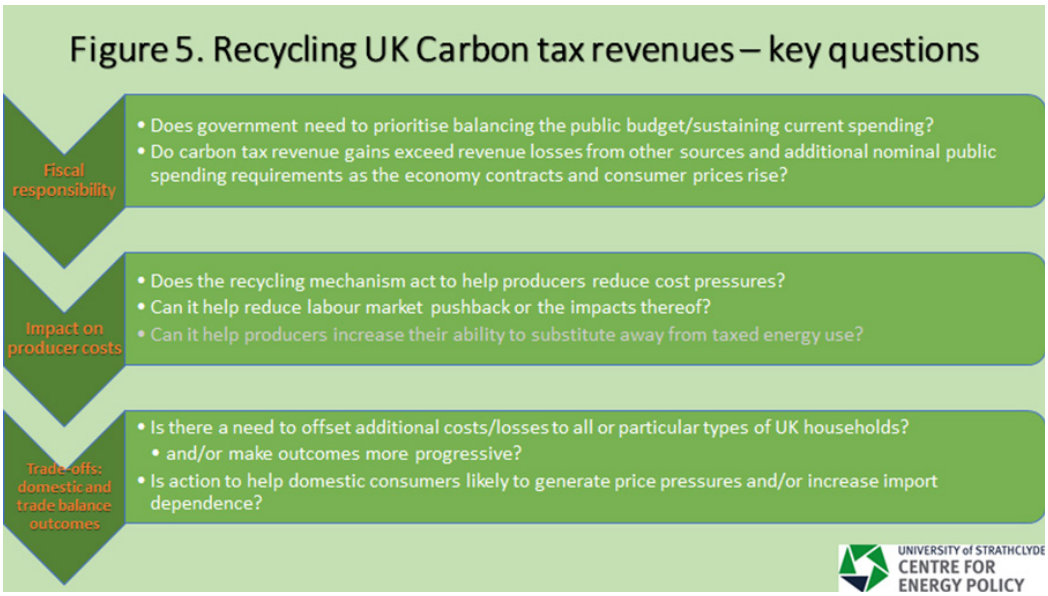
	Real wage adjustment (Real wage bargaining in UK labour market)	Real wage resistance (Real wage pushback in UK labour market)
Government budget balance	5,352	-408
Real government spending	0	0
Nominal government spending	2,369	11,959
Carbon tax revenues	12,603	12,519
Other UK tax revenues	-4,881	-968

Table 1 shows that the gross gain of carbon tax revenues will be eroded by a combination of two forces. First, where activity and employment decline, so will a range of other tax revenues. Second, where government prioritises maintaining pre-carbon tax real spending levels, nominal public spending (on goods and services, and transfers) must rise to offset the impacts of CPI increases. Our simulations suggest that the former is moderated where real wage rates do not fall (where taxes on income from employment are a key source of revenue) but at the cost of greater CPI pressure driving the latter. Crucially, our results suggest that the extensive contractionary pressure associated with real wage resistance in the labour market may lead to net public deficit outcomes, where the other revenue and spending costs more than offset revenue gains from introducing an economy-wide carbon tax.

6. Focussing recycling on reducing producer cost pressure may deliver the greatest macroeconomic benefits but with potentially regressive outcomes

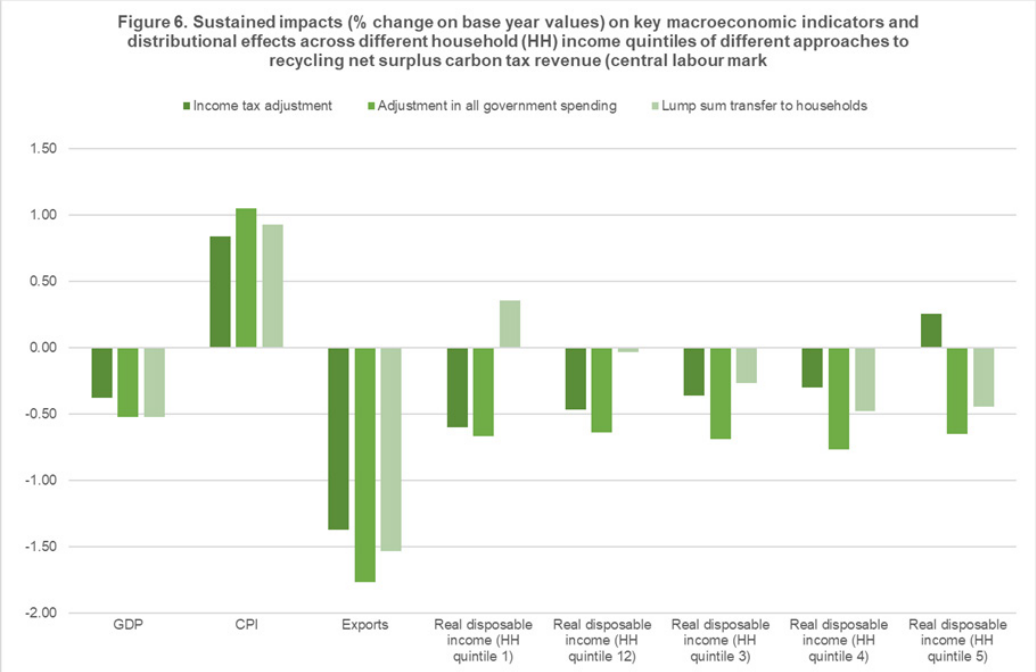
If fiscal responsibility concerns are a clear government priority, questions regarding recycling of carbon tax revenues may arise as set out in Figure 5 (with this brief considering all but one question). One key point emerging from the results reported in Figure 4 is that where the answer to the second question in Figure 5 involves a situation where introduction of broad carbon taxation generates public deficit outcomes, no positive recycling may be possible. Indeed, pre-carbon tax spending and other tax rates may need to adjust to balance the public budget. However, assuming this reflects a fairly extreme and conservative case, we focus attention in this brief on the outcomes of positive recycling of net surplus carbon tax revenues.[4]

Figure 5:



Here, we start by considering three very basic approaches. The first is to reduce the income tax paid by households, which may also help moderate producer cost pressure, by limiting the need for working households to attempt to restore real incomes and spending power through wage bargaining. Two factors drive the outcomes reflected in the first bar of Figure 6. The first of these is the initial incidence of the tax reduction. The second is the subsequent macroeconomic impact. The incidence of income tax reduction is typically shared between a reduction in the cost of labour to the firm, which is then passed on to the consumer, and an increase in the take-home income of the worker.

Figure 6:



Here, where we assume very labour supply constrained conditions, much of the income reduction goes to recovering household consumption, even where there is some real wage adjustment through labour market bargaining. The domestic macroeconomic picture does improve, with GDP, employment, and household spending reductions reduced (-0.67%, -0.47%, and -1.04% to -0.38%, -0.19%, and -0.17% respectively). However, the moderation of producer costs is limited where the outcome of recycling supports recovery of household consumer spending. This is reflected in a greater increase in domestic CPI pressure (0.84%, compared to 0.68% without recycling) and a greater reduction in UK exports (-1.38% compared to -1.07%). While not reported in Figure 6, this is set against greater import dependence (imports fall by -0.34%, more than halving a -1.05% contraction without recycling).

However, perhaps the greatest political economy concern with the income tax approach may be that the distributional impact across households becomes regressive. Crucially, the outcome for all five household income quintiles does improve relative to the no recycling case (i.e., comparing the outcomes in Figure 6 with those in Figure 3). However, it improves by less in lower income quintiles, which are less dependent on the wage and other incomes affected by the income tax reduction.

Moving to the second and third bars in Figure 6, we see that where government spending approaches are adopted, outcomes continue to be driven by the strength of the domestic consumer spending response, involving trade-offs with producer cost and competitiveness impacts. For example, recycling through more general government spending is an obvious (and likely broad welfare-enhancing) alternative to supporting a relatively import-intensive consumer spending recovery. However, in our scenario simulations, the resulting CPI pressure counters the benefits of stronger domestic multiplier effects so that, while outcomes are more progressive, greater losses are experienced in both domestic and export spending.

As a simple example of an alternative government spending approach, recycling net surplus carbon tax revenues via equal lump sum transfers to households will both favour lower income households (where the direct incidence of the carbon tax is greater in absolute terms) and slightly limit the CPI and producer cost pressures across the economy. However, the broader macroeconomic outcomes remain less positive overall than what may be achieved with income tax recycling, and the associated (albeit limited) relief on producer wage cost pressures. The trade-off is one of more regressive outcomes for UK households under an income tax approach.

7. Conclusion and future research direction

Between the two policy briefs produced on our initial carbon pricing research, we have established the importance of understanding how the impacts of introducing broad carbon taxation across the UK economy impact producer costs and competitiveness, and domestic consumer prices. Here, we have focussed attention on how wage bargaining responses in the supply constrained UK labour market are crucial in determining the macroeconomic and distributional picture. This is in terms of how costs are borne both across different production sectors and households. The general message emerging is that it would be challenging for the UK to act alone and/or lead in requiring all producers and consumers to bear additional carbon costs where this may damage the international competitiveness of the economy.

Of course, much more research effort is required. One issue is the dynamics of the adjustment process to the long-run outcomes we have initially focussed on. This is both in terms of what may be happening in the wider political economy and international landscape, and because the responsiveness of labour market and other demand/supply responses may take time to evolve. A second is that, given the fundamental macroeconomic principles and drivers identified here, further economy-wide scenario simulation work is required to consider how outcomes may be affected by both targeted and more general developments in the fiscal and decarbonisation policy landscape in the UK. In this regard, there is a pressing need to integrate our carbon pricing work with other CEP research focussed on the impacts of directing policy attention on enabling and incentivising producers and consumers to shift away from fossil fuel use through uptake of low carbon alternatives.

Contact

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Endnotes

1 A peer reviewed journal paper that underpins this work is available at https://doi.org/10.1016/j.eneco.2022.106393. This fully sets out the foundations, methodology, and results of the research reported here.

2 As set out in the first policy brief, the average emissions intensity in use of each of these broad fuel types is estimated using data from the 2018 release of the BEIS Digest of United Kingdom Energy Statistics (DUKES). The new (additional) £50 per tonne tax rate is introduced to the model at the rates of 27.5p and 14.5p per £1 respectively on the output prices of the UK 'Refined Petroleum Products' and 'Gas Distribution' sectors and on corresponding imports. It is passed on and paid by all users.

3 We note that there could be important dynamic impacts, particularly where a range of conditions, including both labour supply and demand responses, may be constrained in the short run. Going forward, we will develop our scenario simulation design to fully consider the adjustment process and key drivers of transitory outcomes.

4 Our full academic paper includes analysis of the impacts of different options to balance the public budget where introduction of broad carbon taxation leads to deficit outcomes. As noted in the first endnote, this paper (published in the journal Energy Economics) is available open access at https://doi.org/10.1016/j.eneco.2022.106393.