Final Consolidation of Uplift Factor Calculations for Imperfect Competition

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FCR Revisions 20/7/2024

Page	Changes
2	Added New Background and Context section
3	Removed reference to business user benefits
5	Added cross-reference to pass-through formula
5	Removed second plot
7	Reformatted Qmax equation
12	Responses to comments on duopoly limit
13	Added additional rows to table to include monopoly cases

Note: the page numbers refer to the document containing DfTs comments. These revisions may have led to some minor changes in pagination.

Background and Context

The wider benefits in imperfect markets have been addressed by applying an uplift factor to the benefits usually calculated for a perfect market. The principle source of additional evidence to support these calculations has been a price-cost margin and a price elasticity of demand. There have been a number of long-standing questions relating to the details of the way this evidence is converted into an estimate of the uplift factor. These include the treatment of indirect taxation and the calculation of the number of competing firms. More recently, the need for the uplift to include the cost-price pass-through term has become apparent. A new question has also arisen: the distribution of benefits between consumers and producers. This report will describe recent progress on each of these questions.

On the basis of current evidence, both 2023 and 2005 margins were *exclusive* of indirect taxes, the uplift factor had reached 13.4% and consumers share had been reduced to close to three quarters of the change in welfare.

Introduction and summary

First, the implications of different units of account (the inclusion or exclusion of indirect taxation) on the formulation of the uplift will be presented. It confirms that, when factor price units were adopted for both margins (0.31) and pass-through, the resulting units agree with that presented by Oxera in 2024 [1]. The evidence provided by Oxera for earlier time periods supports the view that

factor price units for margins of 0.2 were also adopted by DfT in 2005 [2] where the Pass-through was not included. Implications for the uplift factors are detailed in section 7. Consistent pass-through values are facilitated by knowledge of the number of firms. This issue will be addressed in section 6.

Section 1 is an elaboration of a document provided by TASM division of DfT in [3], but this should not be required to follow the analysis presented here.

Section 2 provides formulae for converting margins (Lerner indices) between different units of account. This helps checking which units may have been adopted elsewhere and are used in the Cournot analysis of margins in section 4. See [4] appendix B for further guidance on units of account.

Section 3 sets out the Cournot model for imperfect competition. It derives the equilibrium price equations and pass-through rates, for both market and factor price units. Section 4 derives the Cournot/Nash equilibrium expressions for margins, based on both market and factor units. Section 5 derives the Cournot equilibrium formula for the price elasticity of demand.

In section 6 we obtain a solution of the Cournot equilibrium equation to obtain an endogenous value for the number of firms. This requires knowledge of the price elasticity of demand and the factor based margin. This solution does not appear to have been noted by previous investigators.

In section 7 we examine a range of alternative but *Cournot-equivalent* representations for the uplift factor. These include a representation entirely in terms of the number of firms and an expression entirely in terms of the factor-based pass-through. *Each of these gives a 2023 estimate of the uplift factor of 13.4%.* The alternative representations provide consistency checks for the uplift factors when simplifying assumptions have been made elsewhere.

In section 8 we examine the practice of using exogenously defined pass-through rates. The implications were applied to both the 2023 and 2005 uplifts. It was concluded that better methods for deriving exogenous pass-through rates were both desirable and feasible. Procedures such as the replacement of a monopoly limit by a duopoly limit would be an example.

In section 9 we return to the welfare basis and examine how benefits are split between consumers and producers, and how the level of market imperfection influences this split.

1 The Welfare Basis for the WB3 Uplift Factor

In an imperfect market the wider benefit uplift factor is determined from the welfare change ΔW under imperfect competition and the business user benefit BUB for a perfect market. The excess of ΔW over BUB is denoted by WB3 and is expressed as a fraction of perfect market business user benefits.

The welfare change is the sum of changes in consumer surplus ΔCS and producer surplus ΔPS, in consistent units. Consumers pay indirect taxes, so their benefits are expressed in market price units. Producer surplus excludes indirect taxes and is in factor units. An indirect tax correction factor of 1+t is applied to producer surplus convert it to a market price basis. Based on an economy wide average tax rate of 19%, this factor is often taken to be 1.19

The resulting sum of changes in consumer and producer surplus gives the change in welfare, the core of the uplift factor specification.

Let P_M be prices in market units and P_F prices in factor units. Let c be marginal cost (always in factor units), and let Q be total output. (Note: strictly c is an average cost, but a horizontal supply curve is assumed, so that marginal cost is equal to average cost).

The changes in welfare, CS, PS and BUB in the table are all in market units:

Description	Symbol	Equation
Welfare change	**ΔW**	**ΔCS+ΔPS**
Change in consumer surplus	**ΔCS**	**$-Q\Delta P_M = -Q(1+t)\Delta P_F$**
Change in producer surplus	**ΔPS**	**$\Delta PS = (1+t)\Delta (Q(P_F - c))$**
Business user benefits	**BUB**	**$BUB = -(1+t)Q\Delta c$**
Wider benefits in imperfect markets	**WB3**	**ΔW-BUB**
Uplift Factor	**U**	**WB3/BUB**

Benefit measures (market units) and the uplift factor.

The *pass-through* are $k_F = \Delta P_F/\Delta c$ for factor prices and $k_M = \Delta P_M/\Delta c = (1+t)k_F$, for market prices. The market price elasticity is: $\eta = P_M\Delta Q/Q\Delta P_M$, the margin in factor units is: $\mu_F = (P_F - c)/P_F$ and the margin in market units is $\mu_M = (P_M - c)/P_M$. The ratio of the change in consumer surplus to business user benefits is:

$$\frac{\Delta CS}{BUB} = \frac{Q(1+t)\Delta P_F}{(1+t)Q\Delta c} = \frac{\Delta P_F}{\Delta c} = k_F$$

The ratio of the change in producer surplus to business user benefits is:

$$\frac{\Delta PS}{BUB} = -\frac{\Delta\left(\mathrm{Q}(P_F - \mathrm{c})\right)}{\mathrm{Q}\Delta\mathrm{c}} = -\frac{\Delta\mathrm{Q}(P_F - \mathrm{c})}{\mathrm{Q}\Delta\mathrm{c}} - \frac{\Delta P_F - \Delta\mathrm{c}}{\Delta\mathrm{c}}$$
$$= -\frac{(P_F - \mathrm{c})\Delta\mathrm{Q}}{\mathrm{Q}\Delta\mathrm{c}} + 1 - k_F$$

Adding consumer and producer expressions, the k_F terms cancel giving:

$$\frac{\Delta W}{BUB} = 1 - \frac{(P_F - \mathrm{c})\Delta\mathrm{Q}}{\mathrm{Q}\Delta\mathrm{c}}$$

The uplift factor U now takes the form:

$$U = \frac{WB3}{BUB} = \frac{\Delta W}{BUB} - 1 = -\frac{(P_F - c)\Delta Q}{Q\Delta c}$$

The terms in Q are next replaced using the elasticity and market prices: $\frac{\Delta Q}{Q} = \frac{\eta\Delta P_M}{P_M}$ and then reverting to factor prices giving the uplift factor as:

$$U = -\frac{(P_F - c)\Delta P_M}{P_M\Delta c}\eta = -\frac{(P_F - c)}{P_M}\eta k_M = -\frac{(P_F - c)}{(1+t)P_F}\eta k_M$$

Replacing prices and marginal cost by the margin μ_F in factor units and substituting for the factor based pass-through gives the *1st reduced form*:

$$U = -\frac{\eta\mu_F k_M}{1+t} = -\eta\mu_F k_F$$

This formulation is consistent with that given by Oxera. Their pass-through of n/(n+1) means their prices exclude indirect taxes so their 2023 margin of 0.31 is on a factor price basis. Their 2005 margin of 0.2 would be in the same units. The

factor basis pass-through n/(n+1) is derived in section 3. The corresponding market basis formula includes a (1+t) term.

2 The Conversion of Margins between Units of Account

The margin in *market price units* is given by:

$$\mu_M = \frac{P_M - c}{P_M} = 1 - \frac{c}{P_M}$$

The margin in *factor price units* is:

$$\mu_F = \frac{P_F - c}{P_F} = 1 - \frac{c}{P_F}$$

It follows that:

$$\frac{1 - \mu_F}{1 - \mu_M} = \frac{P_M}{P_F} = 1 + t$$

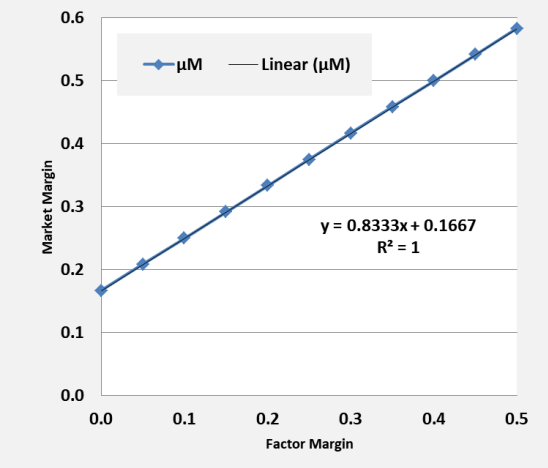
The conversion from market to factor price margin is:

$$\mu_F = (1 + t)\mu_M - t$$

The conversion from factor to market price margins is:

$$\mu_M = \frac{\mu_F + t}{1 + t}$$

The conversion from factor to market margins is shown below.



Conversion of margins from factor to market units of account, t = 0.2

3 Cournot Equilibrium, Units of Account and Pass-through Rates

A pass-through rate is the incremental effect of a unit increase in marginal cost on prices. For consumers the price is in the *market* units. For producers the price is in the *factor* units. The marginal cost is always in factor units.

The symmetric Cournot model for an oligopoly is adopted. Each firm k is sets their output level q_k to maximise their own profit π_k. Market prices are given by an inverse demand function $P_M = D(Q)$ where $Q = \Sigma_k q_k$ is total output of n firms.. The producers are assumed to be identical, so we can focus on any of them, so we pick firm 1. The Cournot/Nash equilibrium for firm 1 maximises:

$$Max\ \pi_1(q_1, \dots, q_n) = \left(\frac{D(Q)}{1+t} - c\right) q_1$$

The resulting first order condition is:

$$\frac{\partial \pi_1}{\partial q_1} = \frac{D(Q) + D_1(Q) q_1}{1+t} - c = 0$$

where $D_1(Q)$ is the partial derivative of D(Q) with respect to q_1. Assume a linear demand function D(Q) = a – bQ. The first order condition becomes:

$$\frac{\partial \pi_1}{\partial q_1} = \frac{a - bQ - bq_1}{1+t} - c = 0$$

Solving for the output of firm 1 gives:

$$q_1 = \frac{a - b\sum_{k=2}^{n} q_k - c(1+t)}{2b}$$

Now apply the symmetry condition and let q denote the common equilibrium output of all firms, so that:

$$q = \frac{a - b(n-1)q - c(1+t)}{2b}$$

Solving this for q and setting total output Q = nq yields:

$$Q = \frac{n(a - c(1+t))}{(n+1)b}$$

Using Q in the linear inverse demand yields the equilibrium prices:

$$P_M = a - \frac{n\big(a - c(1+t)\big)}{n+1} = \frac{a + nc(1+t)}{n+1}$$

$$P_F = \frac{a + nc(1+t)}{(n+1)(1+t)}$$

The b parameter has cancelled. The pass-through parameters are:

$$k_M \triangleq \frac{\partial P_M}{\partial c} = \frac{n(1+t)}{n+1}$$

$$k_F \triangleq \frac{\partial P_F}{\partial c} = \frac{n}{n+1}$$

and the 'a' parameter does not appear. The pass-through k_F is independent of indirect taxes. From the equilibrium equation for Q and the pass-through parameters, the total output can be expressed as:

$$Q = \frac{a - c(1+t)}{b} k_F$$

In the limit of a large number of firms the pass-through k_F approaches unity so total output approaches a maximum of:

$$Q_{max} = \frac{a - c(1+t)}{b}$$

Oxera used the pass-through formula $k_F = n/(n+1)$ but employed exogenous approximations for the number of firms. They noted that in a perfect market k_F would be unity and in a monopoly it would be ½. Their average gave a k_F value of ¾. This was an input to calculate the uplift factor, using the 1st reduced form. *Consistent endogenous determination of the number of firms is given in section 6 and a better exogenous pass-through will be presented in section 8.*

4 Margins in Cournot Equilibrium

It was shown earlier that the equilibrium market price is:

$$P_M = \frac{a + nc(1+t)}{n+1}$$

The resulting ratio of marginal cost to market price is given by:

$$\frac{c}{P_M} = \frac{c(n+1)}{a + nc(1+t)}$$

The margin in market price units is therefore:

$$\mu_M = 1 - \frac{c}{P_M} = \frac{a - c + nct}{a + nc(1+t)}$$

We convert this to factor units using an identity from section 2:

$$\mu_F = (1+t)\mu_M - t$$

Substituting for the Cournot market price margin and simplifying yields:

$$\mu_F = \frac{a - c(1+t)}{a + nc(1+t)}$$

In the limit of a large number of firms, the market based margin approaches the limit t/(1+t) and the factor based margin approaches zero.

5 The Demand Elasticity in Cournot Equilibrium

The price elasticity of demand is defined by:

$$\eta = \frac{P_M}{Q}\frac{dQ}{dP_M}$$

The inverse demand function $P_M = a - bQ$ implies $dQ/dP_M = -1/b$. The elasticity of demand becomes:

$$\eta = -\frac{P_M}{bQ}$$

From section 3, Cournot equilibrium prices and quantities are given by:

$$P_M = \frac{a + nc(1+t)}{n+1}$$

$$Q = \frac{n(a - c(1+t))}{(n+1)b}$$

Using these in the preceding elasticity, b and n+1 cancel giving:

$$\eta = -\frac{a + nc(1+t)}{n(a - c(1+t))}$$

6 Determination of the number of firms from margins and elasticities

In section 4, the Cournot equilibrium margin was shown to be:

$$\mu_F = \frac{a - c(1+t)}{a + nc(1+t)}$$

Multiply this by the elasticity obtained in section 5 to obtain, after cancellation:

$$\eta\mu_F = -\frac{1}{n}$$

Making the number of firms the subject of the equation yields:

$$n = -\frac{1}{\eta\mu_F}$$

This *endogenous* number of firms provides a Cournot consistent basis for the pass-through rate, as in the calculation $k_F = n/(n+1)$.

7 Equivalent Representations of the Uplift Factor

In section 1 the uplift factor was expressed in the 1st reduced form:

$$U = -\eta\mu_F k_F$$

Substitute $V_F = -\eta\mu_F$ to express the uplift as:

$$U = V_F k_F$$

Both V and k can be written in terms of the number of firms. First, in section 3 the pass-through was shown to be n/(1+n). Second, in section 6 V_F was shown to be 1/n. Together these give:

$$U = \frac{1}{n+1}$$

which we refer to as the *second reduced form*. An equivalent representation arises from replacing 1/n by the term V_F giving:

$$U = \frac{V_F}{1 + V_F}$$

which we refer to as *the 3rd reduced form.* V_F is easy to calculate from surveys.

Demand Elasticity η	Factor Margin μ_F	V_F	3rd Reduced Form	
-0.5	0.00	0.000	0.000	
-0.5	**0.20**	**0.100**	**0.091**	**2005 data**
-0.5	0.25	0.125	0.111	
-0.5	0.30	0.150	0.130	
-0.5	**0.31**	**0.155**	**0.134**	**2023 data**

Calculation of Uplifts using the 3rd reduced form.

The table is given in worksheet RForm3. The second row shows that, when V_F = 0.1, the uplift is less than 10% because V_F is divided by 1+V_F. *The last row uses the 0.31 margin given by Oxera and results in an uplift of 13.4%*

Finally, the uplift can be expressed entirely in terms of the pass-through rate. The 2nd reduced form gave the uplift as 1/(n+1) while the pass-through rate is n/(n+1). Eliminating n gives the 4th reduced form:

$$U = 1 - k_F$$

The pass-through needs to be consistent with margins, demand elasticities and the number of firms, highlighting an issue with externally derived pass-through rates. A range of different reduced forms assists in the identification of inconsistencies. The next table shows all of the reduced forms. They yield the same value for the uplift factor, confirming their consistency. The limiting case of a factor margin of unity will be discussed in the next section.

	η	μ_F	V_F	n	k_F	1st V_Fk_F	2nd 1/(1+n)	3rd $V_F/(1+V_F)$	4th 1-k_F
Perf Market	-0.5	0.01	0.005	200	0.995	0.005	0.005	0.005	0.005
	-0.5	0.20	0.100	10.0	0.909	0.091	0.091	0.091	0.091
	-0.5	0.25	0.125	8.00	0.889	0.111	0.111	0.111	0.111
	-0.5	0.30	0.150	6.67	0.870	0.130	0.130	0.130	0.130
	-0.5	0.35	0.175	5.71	0.852	0.149	0.149	0.149	0.149
Mean	-0.5	0.40	0.200	5.00	0.833	0.167	0.167	0.167	0.167
Worst	-0.5	1.00	0.500	2.00	0.667	0.333	0.333	0.333	0.333

Uplift factors for all reduced forms

The final table in this section includes the recommended uplifts from GHC as well as implied uplifts from Oxera 2023 and DfT 2005 for the 3rd and 4th reduced forms. The 3rd forms agree with the GHC values. The 1st and 4th forms are compromised due their use of an exogenous pass-through.

	η	μ_F	V_F	n	k_F	1st V_Fk_F	2nd 1/(1+n)	3rd $V_F/(1+V_F)$	4th 1-k_F
2023 GHC	-0.5	0.31	0.155	6.45	0.866	0.134	0.134	0.134	0.134
Oxera	-0.5	0.31	0.155	n.a.	0.750	0.116	n.a.	0.134	0.250
2005 GHC	-0.5	0.20	0.100	10.00	0.909	0.091	0.091	0.091	0.091
DfT	-0.5	0.20	0.100	n.a.	1.000	0.100	n.a.	0.091	0.000

Uplifts including values of 3rd and 4th forms for 2023 and 2005

These tables are given in the worksheet Allforms. Consistent estimation of the 2023 uplift remains at 13.4%, compared to 11.6% obtained by Oxera.

8 Exogenous Pass-through Rates

Previous analysis has encountered difficulty in determining the value for the pass-through rate. However, the Cournot equilibrium gave a endogenous resolution via the number of firms, obtained from the margin and the demand elasticity. It is of interest to further investigate exogenous estimation of the pass-through rate, particularly when the margin is unknown or problematic.

First, the DfT 2005 uplift formulation either omitted k_F entirely or implicitly used a first reduced form where it had been set to unity. Since unity is an upper bound for a factor-based pass-through this sets an upper bound on the resulting

uplift factor, approached in a perfect market. Its accuracy in imperfect markets applications is problematic.

Second, in the Oxera 2023 formulation a pass-through rate of ¾ was adopted. This was an average of the upper bound of unity and a lower bound of ½ for a monopoly. This lower bound will be improved, giving a better average value.

Consider the value of the factor-based margin $\mu_F = (P_F\text{-}c)/P_F$ and assume that marginal costs c are not negative. In a perfect market this margin approaches zero. But consider markets which are far from perfect. The margin μ_F must still lie in the range [0,1]. Using the Cournot equation for μ_F from section 4 the limiting margin of unity would be approached when the marginal cost *c* was small in comparison to the inverse demand intercept *a*.

In conjunction with the demand elasticity η, this leads to an improved lower bound for k_F. We assume that the market price based elasticity of demand is strictly negative. Multiplying both ends of this range by -η means that $V_F = -\eta\ \mu_F$ must lie in the range [0,-η]. As $n = 1/V_F$ this requires 1/n to lie in this interval, where n is the number of firms, giving a lower bound for the number of firms of -1/η. When η is equal to -0.5 this requires there to be at least two firms, i.e. a duopoly instead of a monopoly.

A monopoly would require the elasticity to be equal to -1, but this is out of line with the evidence supporting an elasticity value of -0.5. On this basis a monopoly bound is not supported by the evidence.

If the number of firms cannot be less than 2 then the pass-through rate cannot be less than 2/3,improving on the minimum pass-through of one half for a monopoly. The average of a lower bound of 2/3 and an upper bound of unity results in an average pass-through of 5/6 = 0.833. This exceeds the value of 0.75 adopted by Oxera. It would correspond to a value which would prevail in a Cournot oligopoly with five firms. In contrast, Oxera's chosen average would correspond to an oligopoly with just three firms.

The improved average pass-through value of 0.833 yields a revised uplift via the 1st reduced form. When $V_F = 0.5*0.31 = 0.155$ and $k_F = 0.833$, the uplift is 12.9%.

This exceeds Oxera's value of 11.6% based on monopoly bounds and is closer to our value of 13.4% for a Cournot consistent estimation procedure. The rationale for the duopoly bound follows.

The minimum number of firms is obtained by setting the margin equal to unity:

$$n_{min} = -1/\eta$$

The corresponding worst feasible case for the pass-through is:

$$k_{min} = \frac{n_{min}}{1 + n_{min}} = \frac{-1/\eta}{1 - 1/\eta} = \frac{1}{1 - \eta}$$

With an elasticity of -0.5 the minimum number of firms is two and the minimum pass-through is 2/3. The exogenous pass-through value is given by taking the average of k_{min} and the perfect market value of unity:

$$k_{exo} = \tfrac{1}{2}(1 + k_{min}) = \frac{2 - \eta}{2(1 - \eta)}$$

Finally, the resulting exogenous estimate of the uplift factor is given by using this in the 1st reduced form:

$$U_{exo} = V_F k_{exo} = -\eta \mu_F k_{exo}$$

With an elasticity of -0.5 the minimum number of firms is 2, giving a minimum pass-through of 2/3 and an exogenous pass-through of ½ (1 + ⅔) = 5/6 = 0.833. This is used in the 1st reduced form with η = -0.5 and prevailing margins, to give the uplifts shown below. The table includes duopoly and monopoly bounds for worst case scenarios for the DfT 2005 uplifts, where the Cournot uplift was 9.1%. The monopoly limit pass-through gave an uplift of 7.5% while the duopoly limit was 8.3%. Further details, including the values for V_F, are given in worksheet Exo_K.

	η	**μ_F**	**V_F**	n_{min}	k_{min}	k_{exo}	Uexo
2023	-0.5	0.31	0.155	2	0.667	0.833	12.9%
2023	-0.5	0.31	0.155	1	0.500	0.750	11.6%
2005	-0.5	0.2	0.100	2	0.667	0.833	8.3%
2005	-0.5	0.2	0.100	1	0.500	0.750	7.5%

Uplift calculations including Duopoly-Limit Exogenous Pass-throughs

It is concluded that the use of exogenous pass-through rates are feasible, but improvements to their estimation are needed, primarily in relation to 'worst case' scenarios. Moving away from monopoly bounds, would to contribute to such improvements. The refinement of exogenous pass-through estimates, would require improved values for the demand elasticity.

9 Distribution of Benefits in Imperfect Markets

We examine how benefits are distributed between consumers and producers and its dependency on the degree of market imperfection. The uplift factor under imperfect completion was specified as:

$$U = \frac{WB3}{BUB} = \frac{\Delta W}{BUB} - 1$$

where ΔW is the total change in welfare and BUB is the welfare change in a perfect market. We can write:

$$\frac{\Delta W}{BUB} = \frac{\Delta CS}{BUB} + \frac{\Delta PS}{BUB} = 1 + U = 1 + \frac{1}{1+n} = \frac{2+n}{1+n}$$

We are interested in the shares ΔCS/ΔW and ΔPS/ΔW, so that:

$$\frac{\Delta CS}{\Delta W} = \frac{\Delta CS}{BUB} \Big/ \frac{\Delta W}{BUB} = \frac{\Delta CS}{BUB} \Big/ (1+U)$$

From section 1 ΔCS/BUB = k_F, so the consumers share of welfare change is:

$$\frac{\Delta CS}{\Delta W} = \frac{k_F}{1+U} = \frac{n}{1+n} \Big/ \frac{2+n}{1+n} = \frac{n}{2+n}$$

Finally, since ΔCS + ΔPS = ΔW it is clear that the producers share must be:

$$\frac{\Delta PS}{\Delta W} = \frac{2}{2+n}$$

As the number of firms gets large, consumers capture all of the welfare changes. For a duopoly welfare change is equally shared with producers. For 2005 with 10 firms the consumer share reaches 83.3%. In 2023, when the number of firms reduced to 6.45 the consumer share dropped to 76.3%.

	Monopoly	Duopoly	2023	2005	Perfect
No. of firms	1	2	6.45	10	100
ΔCS/ΔW	33%	50%	76.3%	83.3%	98%

Consumer % share of benefits in imperfect markets (1)

The benefit shares can also be expressed in terms of the uplift factor. Since ΔCS/ΔW = n/(2+n) and U = 1/(1+n) eliminating n gives the consumer share as:

$$\frac{\Delta CS}{\Delta W} = \frac{1-U}{1+U}$$

The corresponding producers share is:

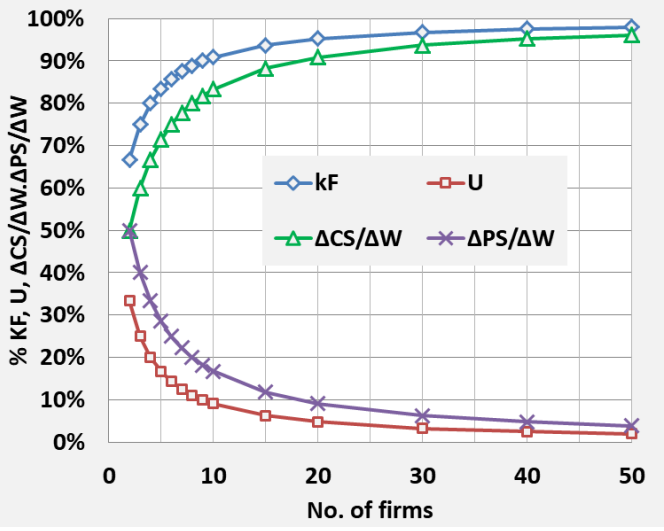
$$\frac{\Delta PS}{\Delta W} = \frac{2U}{1+U}$$

The consumers share approaches 1-2U as the uplift factor U becomes small.

U	**0**	**0.05**	**0.10**	**0.15**
ΔCS/ΔW (%)	100%	90.5%	81.8%	73.9%
1-2U (%)	100%	90%	80%	70%

Consumer % share of benefits in imperfect markets (2)

This table illustrates consumer shares of benefits for uplifts up to 15%. More details are given in worksheet Exo_K. Pass-through, ΔCS/ΔW, ΔPS/ΔW and uplift are plotted against the number of firms. The bottom two curves are mirror images of the top two curves



Pass-through, Uplift and Welfare shares v no. of firms

10 Conclusions

1) A revised estimate of the 2023 uplift factor of 13.4% of (perfect market) business user benefits has been obtained.

2) The revised uplift estimate ensures consistency with the Cournot model for oligopoly, particularly in its application to pass-through values.

3) While the treatment of indirect taxation in the evidence for margins had previously been problematic, Oxera's 2023 report has led to a resolution. This requires the prices used to calculate the surveyed margins to *exclude* indirect taxes, i.e. to be in the factor unit of account.

4) Notwithstanding, conversions between units of account still need to be conducted. This applies to both the welfare basis for the uplift factor and in the Cournot derivation of the pass-through rate.

5) Consistent (endogenous) determination of the pass-through rate requires knowledge of the number of firms. This is deduced from the Cournot equilibrium equations for the elasticity of demand and the factor priced based margin.

6) The methods for making exogenous estimates for pass-through rates, as used in Oxera 2023 could be improved by a tightening of the worst case imperfect market scenario. When the price elasticity of demand is equal to -0.5. This scenario would be a duopoly and the number of firms corresponding to the average pass-through would rise from 3 to 5. This improves the consistency between exogenous and endogenous pass-throughs and hence the resulting uplift factors. The duopoly bound would need to be reviewed if new elasticity values became available. On the other hand, the 2nd and 3rd reduced forms should yield Cournot consistency without using an exogenous pass-through.

7) The distributional analysis indicated that consumer share of benefits fell from 83% in 2005 to 76% in 2023, a period over which there is evidence of a decline in market competition.

References

[1] 2023 Oxera. Review of Output Change in Imperfectly Competitive Markets (OCICM) Parameters for Transport Appraisal Guidance.

[2] 2005 Department for Transport July 2005 Transport, Wider Economic Benefits, and Impacts on GDP Discussion Paper

[3] 2023 DfT, TASM Division, Iven Stead. OCICM derivation with IT correction V6.

[4] https://assets.publishing.service.gov.uk/media/659d13ddd7737c000df335ac/tag-unit-a1.1-cost-benefit-analysis.pdf