Methodological issues in the regulation of mobile voice call termination

A response to Oftel's Review of Mobile Voice Call Termination Markets

July 2003

Summary

In May 2003 Oftel published a consultation paper as part of its review of mobile wholesale voice call termination markets which, amongst others, included a discussion of how a 'fair target charge' for mobile termination should be established. In July, Oftel published an explanatory note on its cost-benefit analysis of regulating mobile call termination charges at the level of the 'fair target charge'. We believe that the model used by Oftel as (a) one of a series of inputs into establishing the 'fair target charge' and (b) a tool for estimating the welfare effects of regulation is seriously flawed. This is particularly disappointing as many of the methodological problems with the Oftel model have been raised and discussed at length in the recent Competition Commission inquiry into the cost of calling mobile phones.

DotEcon provided support to O_2 during this inquiry, in the course of which we commented extensively on the methodological flaws of the model on which Oftel relies for its regulatory cost-benefit analysis, and the misguided definition of scenarios. We are concerned that Oftel continues to use a model which is unsuitable for the purpose at hand, and it is for this reason that we comment on the methodological problems with the model used by Oftel. The views expressed are those of DotEcon alone.

In summary, we find that:

▫ *the welfare model used by Oftel is based on an erroneous definition of social welfare;*

▫ *Oftel appears to misunderstand the relationship between the gross externality factor (capturing network externalities) and the observed cross-elasticities of demand, leading it to reject empirical observations in order to accommodate unsubstantiated assumptions; and that*

▫ *the definition of scenarios Oftel uses in establishing the welfare impact of regulation is highly questionable and strongly biased in favour of regulation.*

Introduction

1. On 15th May Oftel began its review of mobile wholesale voice call termination markets, in accordance with its obligations under the new European regulatory framework for electronic communications services, by publishing a consultation paper.

2. One of the issues raised by Oftel concerns the 'fair target charge', acknowledging that the need for mobile network operators (MNOs) to recover fixed and common costs, and the presence of network externalities would call for a mark-up over LRIC, which Oftel considers to be the 'most

appropriate and economically efficient basis for regulatory charge controls" (paragraph 7.13). The appropriate level of termination charges has been the subject of considerable debate over the past few years, and has been the focus of a year-long investigation by the Competition Commission.

3.   We have supported O2 throughout this investigation, and have in the course of our work commented extensively on the methodological problems with the model used by Oftel as well as its definition of scenarios for a regulatory cost-benefit analysis. We have developed a model that, to the best of our knowledge, has been acknowledged to be free of these flaws. Given this, we are concerned that Oftel continues to base its decisions on an analytical model that is flawed, and on a misguided definition of scenarios for its regulatory cost-benefit analysis. It is for this reason that we respond to Oftels' consultation paper, focusing on the methodological problems with Oftel's approach to regulating mobile voice termination charges.

Models for setting target charges

4.   In the context of this investigation, the Commission has been presented with a number of models for the estimation of Ramsey prices for mobile services in the presence of network externality. There is broad agreement that Ramsey-pricing is the appropriate theoretical benchmark for a socially optimal structure of mark-ups (and thus the appropriate target charge). However, Ramsey prices have been rejected by the CC for practical purposes for a number of reasons. Oftel also rejects Ramsey pricing approaches because:[1]

   ◻   it is difficult to establish Ramsey prices with any degree of precision;

   ◻   setting Ramsey prices for mobile termination charges would be inappropriate given that MNOs might not set other charges (which are not subject to regulation) at their Ramsey levels; and

   ◻   Ramsey pricing may be socially inequitable.

5.   In doing so, Oftel also criticises the work undertaken in the context of the CC inquiry. In particular, *"[t]he Director considers that the Frontier Economics, DotEcon and CRA models are flawed because of implausible elasticity assumptions and/or methodological deficiencies. In particular, the claimed values of the cross elasticities in these models imply wholly implausible values for the externality, suggesting that called parties benefit from a call being made to a much greater degree than callers."*[2] (Paragraph 7.5)

---

[1] Paragraph 7.3 f. of the Oftel document.

[2] Paragraph 7.5 of the Oftel document.

6.   Instead, Oftel relies on a model developed on its behalf by Dr Jeffrey Rohlfs of Strategic Policy Research. Oftel continues to use this model – which is a Ramsey pricing model - in order to assess the welfare impact of regulating termination charges as well as setting the 'fair target' charge (the outputs of various variants of the model are included in the range of estimates on which Oftel bases its estimation of the externality surcharge.[3])

7.   In the light of the discussion that took place during the CC investigation, the blanket criticism of models submitted by, amongst others, DotEcon and the continued reliance on the Rohlfs model are highly surprising. As we have demonstrated in the context of the CC investigation, and will discuss in more detail below:

   ❑   the approach used by Rohlfs is theoretically flawed (and with regard to the assumptions made with regard to the price setting of MNOs highly arbitrary);

   ❑   the alleged inconsistency between empirically observed (rather than 'claimed') cross-effects and the magnitude of the externality (which is based on plausibility considerations) only arises in the special case where one assumes (without any justification) a globally linear demand system. Oftel has chosen to reject empirically observed demand responses in order to accommodate unsubstantiated assumptions;

8.   In addition to the above points we believe that the two scenarios that appear in Oftel's cost benefit analysis as the basis for comparison are highly inappropriate for demonstrating welfare benefits from regulation, and that the case for regulatory intervention is far from clear cut once one uses appropriately defined scenarios.

Flaws in Oftel's welfare model

9.   Modelling welfare consistently in the presence of external effects is far from straightforward. In particular, it would be mistaken to simply 'scale up' consumer surplus as measured by the area under a demand curve, as observed demand already includes external effects (which are consequently reflected in observed own-and cross-price elasticities).

10.   For example, following a reduction in the price of mobile subscriptions, the number of subscribers and the number of mobile-to-mobile calls will increase. The cross-price effect from subscription on mobile-to-mobile call volumes is *partly* the result of the complementarity between having a phone and making calls and *partly* because existing mobile users now make calls to the new subscribers. The benefits associated with these calls have not been

---

[3] See Annex F of the Oftel document.

taken into account in the new subscribers' decision to join, and are therefore external network benefits. Therefore, *part* of the cross-elasticity between the subscription price and mobile-originated calls is due to network externalities. By contrast, the cross-price elasticity between the price of mobile subscriptions and aggregate fixed-to-mobile traffic *entirely* arises as a result of externalities.

11.   The fundamental problem with Rohlfs' approach is that he starts from a reduced demand system in which the external and the private effects of changes in subscriber numbers are not distinguished. This means that any attempt to compute a welfare change by taking a path integral (whether over prices or quantities) will be subject to the problem that the answer ultimately depends on the path of integration chosen. Rohlfs claims that this problem can be resolved by picking one particular, and intuitively plausible 'natural' path of integration. However, this is not the case, and consequently the definition of social welfare in the Rohlfs model is flawed. Careful analysis shows that Rohlfs' approach of first integrating over demand for subscriptions, followed by integrating over demand for mobile-originated calls, which may superficially appear natural because one has to have a mobile phone in order to make calls, treats the impact of network externalities on intramarginal mobile subscribers incorrectly. The correct definition of consumer welfare could have been obtained by separating external and private effects within the demand system.

12.   We demonstrate in a number of worked examples at the end of this document that Rohlfs' method does not capture social welfare correctly except under very special assumptions (e.g. that there are no network externalities of subscriptions on mobile originated calls). These assumptions are clearly not justified, as increases in mobile penetration have a strong external effects on call volumes (even though some of the increase in mobile-originated calls is due to private effects).

13.   Whether Rohlfs' method understates or overstates the true marginal social benefit of an additional subscriber is not determined a priori, but depends on parameter values. However, it is highly questionable that Oftel should use a model for comparing welfare under different scenarios where the definition of welfare is flawed.

The relationship between cross-effects and externalities

14.   Oftel has dismissed other models of welfare-maximising termination charges because their assumptions about own- and cross-price effects suggest implausibly high externality factors. However, this rejection is based on a misunderstanding of the relationship between own- and cross-price effects and the magnitude of the network externality.

15.   Using information about calibration prices and quantities and observed price elasticities, it is possible to calculate the gross externality factor for a given demand system by explicitly calculating social welfare functions from the

underlying demand functions. However, the resulting network externality factor is very dependent on the functional form of the welfare function and thus on the *global* shape of the demand system. The disadvantage of this approach is that it relies on assumptions about the global properties of demand functions, about which there is little evidence. In particular, elasticity estimates based on observed behaviour is unlikely to provide reliable guidance about the level and price responsiveness of demand far from current prices.

16. Thus, the conclusion that observed price elasticities imply an implausibly high network externality factor can only be drawn on the basis of assumptions about the global shape of the demand system. In Rohlf's case, the underlying assumption is one of a globally linear demand. There is little or no evidence to suggest that demand functions are globally linear (even though linear approximations in the neighbourhood of actual prices and quantities may accurately predict the impact of small price changes). This implies a number of possible interpretations of the supposed inconsistency between the network externality factor (whose magnitude is based on pure speculation) and own-and cross-price effects (which can be estimated on the basis of market data, even though these estimates are subject to uncertainty:

- □ elasticities are as observed, and the externality factor is as surmised, in which case demand functions cannot be globally linear;

- □ elasticities are as observed, and demand functions are globally linear, in which case the network externality factor cannot be as surmised; or

- □ demand functions are globally linear, and the network externality factor is as surmised, in which case elasticities cannot be as observed.

Of these three options, Oftel has chosen the third, using two highly speculative assumptions in order to reject elasticity assumptions which are based on empirical observations. This is highly questionable.

The definition of scenarios for the regulatory cost-benefit analysis

17. In order to establish welfare gains from regulation, Oftel compares total surplus in two scenarios:

- □ a 'regulated' scenario, where the fixed-to-mobile price is regulated at 6.76 pence per minute and other prices are set according to Ramsey rules; and

- □ an 'unregulated' scenario, in which prices are obtained by assuming that mobile operators maximise a distorted welfare function (where some components get less than full weight compared to the social welfare function).

18. Given that one of the reasons why Oftel has rejected the Ramsey approach to determining a fair target charge is its concern that mobile operators

would not set the remaining unregulated charges at the corresponding Ramsey levels[4], it is highly surprising that precisely this assumption has found its way into the 'regulated' scenario. This would tend to overstate the benefits from regulation compared to a situation in which unregulated charges were set in the same way as in Oftel's 'unregulated' scenario.

19.   As an aside, to the extent that the 'fair target charge' differs from the Ramsey charge, Oftel's proposed regulatory intervention will by definition not maximise social welfare, and even if it were to increase welfare relative to the unregulated outcome, further gains could be had from setting the termination charge at its Ramsey level.

20.   The 'unregulated' scenario is determined by using the Rohlfs model to obtain prices as a result of MNOs maximising their objective function (subject to a zero-profit constraint, capturing effective competition between MNOs). The result of this exercise is a fixed-to-mobile call charge of 26.5 pence per minute, compared to a current termination charge of 10.9 pence per minute. This implies that as a result of not regulating termination charges MNOs would more than double the current termination charge to a level far in excess of the charge that was set prior to the MMC price cap introduced in 1998. There is clearly a question how this could be achieved, given that even in the absence of a price cap on termination charges increases would need to be agreed with interconnecting operators, who might seek a determination from Oftel in the case of commercial negotiations not leading to a mutually acceptable outcome.

21.   Additionally, the assumptions used by Oftel in calibrating its model (including assumptions about the magnitude of fixed costs) imply industry-wide profits of more than £2 billion per annum for all MNOs. Given the level of competition (implicitly acknowledged in the zero-profit constraint used by Oftel for the unregulated scenario), this is highly questionable. Moreover, the welfare gains attributed to regulation are in their majority due to the elimination of these excessive profits, and if one were to assume that there no excessive profits exist at the calibration point, the move to Oftel's regulated scenario would imply a small welfare loss rather than the huge welfare gain implied by Oftel. Thus, even if the model results are subject to significant uncertainty, the case for regulatory intervention along the lines proposed by Oftel is far from clear-cut, and appears to be based entirely on a mistaken definition of scenarios in Oftel's welfare analysis.

---

[4] Rohlfs, 22 May 2002, *A model of prices and costs of mobile network operators*, page 10.

Conclusion

22.   In summary, it is regrettable that Oftel continues to use a model that has shown to be flawed, that requires one to make assumptions about own- and cross-price effects that are fundamentally at odds with what can be observed in the market place in order to be consistent with highly speculative and unproven assumptions about the global shape of demand curves, and that for these reasons will provide poor guidance to regulatory policy. Moreover, Oftel's case for regulatory intervention is far from proven as the considerable welfare gains claimed by Oftel are largely derived from a fundamentally flawed and highly biased definition of scenarios in the regulatory cost-benefit analysis.

Technical Annex

In order to show the problems in Rohlfs' approach, we use a simple example of a linear demand system where external effects are separated from private effects. Consider the following inter-related demand functions:

$$q_1 = a_1 \quad -b_1 p_1 \quad -c\,p_2 \qquad\qquad +g_1\,n$$
$$q_2 = a_2 \quad -c\,p_1 \quad -b_2 p_2 \qquad\qquad +g_2\,n$$
$$q_3 = a_3 \qquad\qquad\qquad\quad -b_3 p_3 \quad +g_3\,n$$

where q_1 refers to mobile subscriptions, q_2 to mobile originated calls and q_3 to fixed to mobile calls. Here g_i measures the external impact of additional mobile subscribers on demand for service i. In particular:

- □ g_1 represents the feed-back effect of more anticipated mobile subscribers on demand for subscriptions;

- □ g_2 represents the impact on the number of mobile-originated calls as a result of there being more mobile phones to call (as opposed to the additional calls made by new subscribers and anticipated in their subscription decision, which are represented by cross-price effects between goods 1 and 2);

- □ g_3 represents the impact on fixed-to-mobile calling of there being more mobile phones to call.

Separating externalities and representing these explicitly through the g's implies that the impact of prices on demand for each of these services arises entirely due to private effects. Therefore, cross-price effects have a symmetric Slutsky matrix of cross-partial derivatives.[5] Specifically,

$$\frac{\partial q_1}{\partial p_2} = \frac{\partial q_2}{\partial p_1} = -c \, .$$

These demands imply that consumers have an indirect utility function of the form

$$v\left(p_1, p_2, p_3, n\right) = -\left(a_1 + g_1 n\right) p_1 + \frac{1}{2} b_1 p_1^2 - \left(a_2 + g_2 n\right) p_2 + \frac{1}{2} b_2 p_2^2$$

$$+ c \, p_1 \, p_2 - \left(a_3 + g_3 n\right) p_3 + \frac{1}{2} b_3 p_3^2 + \phi\left(n\right)$$

where ϕ is a function of the network externality n only.

We can determine ϕ using the following argument. Once prices are sufficiently high to choke off demand for all three mobile services, consumers' utility should be independent of expected network size. Define choke prices $\overline{p}_i(n)$ as the solution to

$$q_1\left(\overline{p}_1(n), \overline{p}_2(n), \overline{p}_3(n), n\right) = 0$$

$$q_2\left(\overline{p}_1(n), \overline{p}_2(n), \overline{p}_3(n), n\right) = 0$$

$$q_3\left(\overline{p}_1(n), \overline{p}_2(n), \overline{p}_3(n), n\right) = 0$$

Then we require that $v\left(\overline{p}_1(n), \overline{p}_2(n), \overline{p}_3(n), n\right)$ is independent of *n.* Without loss of generality, we can take $v\left(\overline{p}_1(n), \overline{p}_2(n), \overline{p}_3(n), n\right) = 0$, which determines the function $\phi(n)$. This is equivalent to Rohlf's convention that welfare is zero when the quantity of each of the three goods consumed is zero.[6]

We can then express welfare as a function of quantities, as

$$w\left(q_1, q_2, q_3\right) = v\left(p_1\left(q_1, q_2, q_3\right), p_2\left(q_1, q_2, q_3\right), p_3\left(q_1, q_2, q_3\right), q_1\right),$$

---

[5] This is a standard result from consumer theory. For example, see Varian "Microeconomic Analysis", Chapter 3.

[6] Rohlfs' line integral defining welfare considers a path starting from zero quantities of each of the three goods. Therefore, zero consumption is conventionally given zero welfare.

where p_i are the inverse demands holding $n = q_1$. This definition of welfare is derived directly from the indirect utility of consumers and therefore reflects true social welfare. It is expressed in a form where it can be compared directly with Rohlfs' definition of social welfare.

In contrast, Rohlfs does not start from consumers' indirect utility functions, but rather computes welfare as a line integral

$$r\left(q_1,q_2,q_3\right) = \int_0^{q_1} p_1\left(x,0,0\right)dx + \int_0^{q_2} p_2\left(q_1,x,0\right)dx + \int_0^{q_3} p_3\left(q_1,q_2,x\right)dx - \sum_i p_i q_i \ .$$

Here we subtract consumers' payments, so that both w and r express net consumer surplus. It can be shown that

$$w\left(q_1,q_2,q_3\right) - r\left(q_1,q_2,q_3\right) = \frac{1}{2}\frac{b_2 g_1 - c\, g_2}{b_1 b_2 - c^2}q_1^2 \ .$$

This has a number of immediate implications:

- Rohlfs' calculation of social welfare does not in general correspond to true social welfare, else this difference would always be zero[7];

- Rohlfs measures the marginal benefit of additional usage (both mobile originated calls and fixed-to-mobile calls) correctly as

$$\frac{\partial w}{\partial q_2} = \frac{\partial r}{\partial q_2} \qquad \frac{\partial w}{\partial q_3} = \frac{\partial r}{\partial q_3} \ ;$$

- However, Rohlfs measures the marginal benefit of additional mobile subscribers incorrectly as, except in very special circumstances

$$\frac{\partial w}{\partial q_1} \neq \frac{\partial r}{\partial q_1} \ ;$$

- Rohlfs definition of welfare is correct if there are no network externalities on mobile subscriptions and mobile-originated calls (i.e. $g_1 = g_2 = 0$),

Whether Rohlfs' welfare definition overstates or understates the marginal social benefit of an additional subscriber depends on parameters considered. Consider the following examples.

Example 1 (no cross effects) Suppose that there were no private cross-price effects between subscriptions and calls, so that $c = 0$. In this case, the

---

[7] Note that both *w* and *r* are money-metric measures of welfare and normalised to be zero at zero quantities. Therefore, they should precisely agree if Rohlfs' line integral method were correct.

difference between Rohlfs' valuation of the marginal social benefit of an additional subscriber and the true marginal social benefit is given by

$$\frac{\partial w}{\partial q_1} - \frac{\partial r}{\partial q_1} = \frac{g_1}{b_1} q_1 > 0 .$$

Rohlfs systematically understates the benefit of an additional subscriber. This understatement is larger the greater is the feedback effect (g_1) or the smaller the own-price elasticity of subscriptions (b_1).

The reason for this is that when Rohlfs integrates over a change in subscriber numbers, he fails to include the external benefits that intramarginal mobile subscribers enjoy from increasing mobile network size. Specifically, the integral

$$\int_0^{q_1} p_1(x,0,0)\, dx$$

in Rohlfs' definition of welfare can be thought of as joining successive subscribers to the network, but it only adds together the benefits enjoyed by each of those successive subscribers. It does not include the benefits enjoyed by those *already* joined to the network when an additional subscriber is added.

Example 2 (no feedback effect) Suppose instead that there were no feedback effect on mobile subscriptions, so that $g_1 = 0$. In this case

$$\frac{\partial w}{\partial q_1} - \frac{\partial r}{\partial q_1} = -\frac{c\, g_2}{b_1 b_2 - c^2} q_1 < 0$$

provided that subscriptions and mobile originated calls are both private and external complements, so that $c, g_2 > 0$.[8] Thus in this case, Rohlfs' definition overstates the marginal social benefit of a new mobile subscriber.

The reason is again that Rohlfs has ignored external impacts on intramarginal mobile subscribers. If the number of mobile subscribers is increased, say by Δn, there is an external impact on the demand for mobile originated calls equal to $g_2 \Delta n$ were call prices not to change. However, Rohlfs' definition of welfare requires increasing subscriber numbers *holding mobile originated call volumes equal to zero*, which requires corresponding price changes to

---

[8] As is standard, we assume that $b_1 b_2 - c^2 > 0$ so that indirect utility is concave in prices.

neutralise the increase in call volumes due to externalities that would otherwise occur. In other words, along the first step of Rohlfs' line integral, the price of mobile originated calls increases as mobile subscriptions increase, holding mobile originated call volumes equal to zero. In particular, the implied subscription price must increase by

$$\frac{\partial p_1}{\partial q_2} g_2 \, \Delta n = \frac{c \, g_2}{b_1 b_2 - c^2} \Delta n$$

in order to compensate for the external boost in mobile originated calls that would otherwise occur due to the external effect of more subscribers. This price change has a welfare effect on *all* mobile subscribers equal to

$$- \frac{c \, g_2}{b_1 b_2 - c^2} q_1 \, \Delta n \; .$$

This term represents the external impact on mobile subscribers of adjusting prices to keep mobile originated calls choked off. It accounts precisely for the difference between Rohlfs' incorrect definition of the marginal social benefit of an additional subscriber and the true value.