Annex K

Ramsey prices

K.1 Ramsey prices are a set of prices for a group of services that maximize social welfare when the presence of common and fixed costs across these services does not allow the adoption of marginal costs pricing (as the firm would not breakeven). Ramsey prices include a mark-up over marginal cost for each service that allows the recovery of common and fixed costs, where the mark-up is determined so as to limit the loss in economic efficiency introduced by the departure from marginal cost pricing. More specifically, the Ramsey pricing rule, in its simplest version, requires each mark-up over marginal cost to be inversely proportional to the market own-price elasticity of demand [93] of the service. This rule minimizes the impact on welfare as the reduction in the demand for each service generated by the increase in prices above the first-best level (i.e. above marginal cost) is smaller the more inelastic the demand for the service. If there are externality and cross-price effects[94] the rule requires that each mark-up is inversely proportional to super-elasticity[95] of that service.

K.2 The 'Ramsey principle', thus, requires that own-price and cross-price elasticities, as well as any other inter-relation between the demands for these services, such as externalities, are considered when setting the mark-ups.

The May consultation

K.3 In its May consultation the Director considered whether he should set Ramsey termination charges and reached the conclusion that the Ramsey was not the appropriate methodology to allow for the recovery of common costs in these markets. The main reasons behind his position were:

- the difficulties inherent in calculating reliable Ramsey prices and the lack of any robust and reliable estimate on which to base such an exercise;
- the fact that it is unlikely that all the other prices for mobile services would be set at Ramsey level; and
- the distributional inequities generated by a Ramsey pricing structure for mobile services.

K.4 The Director, therefore, considered other alternative methodologies and proposed to set the fair charge for termination services on the basis of LRIC plus equal proportionate mark-up ('EPMU') for common costs and an externality surcharge.

[93] The own-price elasticity of a service is a measure of the sensitivity of the demand for that service to changes to its own price.
[94] The cross-price elasticity of one service is a measure of the effect on demand for that service of a change in the price another service.
[95] The super-elasticity of one service measures the percentage change in the demand for that service in respect to a percentage change in the prices of the other services. Formally the super-elasticity is the sum of the service's own price and cross-prices elasticities weighted by relative revenue shares.

K.5 This Annex focuses on the use of equal proportionate mark-up or Ramsey prices to derive the mark-up for the recovery of common costs. The mark-up for the network externality is discussed separately in Annex G.

The MNOs' responses

K.6 In their responses to the May consultation the MNOs have made a number of comments in favour of the use of Ramsey prices. The main argument raised is that there is no public interest rationale for preferring EPMU just because it is simpler to implement and that the Director should adopt the Ramsey approach, as this is the one that maximizes consumer welfare.

K.7 The Director has carefully considered these submissions, but, for the reasons set out below, he remains of the view that the Ramsey pricing principle is not the appropriate methodology for recovering common costs in the markets for mobile services. He is, therefore, still proposing to set termination on charges on the basis of LRIC plus EPMU for common costs and an externality surcharge. More details on how the methodology adopted to arrive to the proposed fair target charge can be found in Chapter 6 and Annexes F and H. This Annex discusses in detail the rationale behind the Director's position on the use of Ramsey pricing principle.

Conceptual issues in the modelling of Ramsey prices

K.8 The Director considers that there are two main conceptual reasons against using the Ramsey pricing principle to set termination charges. These are discussed in detail below.

1 Prices in the retail market

K.9 The Ramsey approach to be correctly applied involves the whole set of mobile prices (i.e. prices for all mobile retail services as well as for termination) because the mark-ups are based on the relative demand conditions for all the services that share common costs. Hence, in this case prices for all mobile services should be set according to this pricing rule. If the termination charge is set on the basis of the Ramsey principle by the regulator, the overall set of mobile prices would be efficient only if the MNOs had the incentives to set Ramsey prices for the remaining services. If this condition was not satisfied the MNOs would not be constrained to select the structure or the level of Ramsey-based retail prices and the Director is of the view that the MNOs do not have this incentive for the reasons discussed below.

K.10 The Director believes that the retail mobile market does not satisfy the very demanding condition of perfect competition (see Chapter 4 for more details). Hence, the Director is of the view that, if he determined the termination charge using the Ramsey approach, the MNOs could not be relied on to set prices for the other mobile services on the same basis. Since he does not intend to regulate the mobile retail market, where he considers that no MNO holds SMP, he believes that there is a strong risk that setting Ramsey termination charges would not maximise social welfare and, thus, Ramsey would not be the efficient pricing approach for regulating termination charges.

K.11 Further, to the extent that MNOs are not likely to internalize all externalities (see Annex G), the Director considers that the prices that would prevail if the retail mobile market satisfied the zero profit constraint might in any case depart from Ramsey prices calculated to take account of externalities.

K.12 Hence, under the current market conditions, the Director considers that the efficient pricing structure would be more complicated than the standard Ramsey approach. The optimal termination charges would also have to take into account how the MNOs set retail prices given the termination charges determined by the regulator, i.e. it would have to account for imperfect competition in the retail market and for the MNOs' failure to internalize all externalities. This would imply solving a 'principal-agent' model in which the regulator (or 'principal') has to set the termination charge that maximizes social welfare taking account of the MNOs' (or 'agents') retail prices, which themselves depend on that termination charge. This introduces the substantial complication of having to model accurately the way in which retail prices are set.

K.13 Dr Rohlfs examined this issue on behalf of Oftel and reached the conclusion that the mark-up on termination charges should be reduced when this is taken into account.

K.14 (For further details on this see Dr Rohlfs' paper, *A Model of Prices and Costs of Mobile Network Operators,* 22 May 2002). However, any specific result on the size of the optimal mark-ups depends on the specific way in which retail competition is modelled. Hence, the Director considers that to assess optimal termination charges in this way would be extremely resource-intensive, difficult and, above all, prone to disputes on the nature of the model of retail competition.

K.15 The Director notes that the CC (paragraph 2.519 of the CC report) also raised doubts as to the complete effectiveness of the retail competition in the mobile market and whether it would be sufficient to generate Ramsey pricing patterns.

Current retail prices are not set according to the Ramsey rule

K.16 T-Mobile rejects the Director's claim that actual retail prices are not set in accordance with Ramsey pricing principle and, in particular, disputes the assertion he made in the May consultation that this is proved by the large disparities between prices for outgoing on-net and off-net calls. T-Mobile claims that the own-price elasticities for the two types of calls are very similar and so are relative mark-ups, as required by the Ramsey principle. The large disparity between the absolute level of the prices is due to differences in marginal costs. T-Mobile bases its assertion on a comparison of figures on average call revenues per minute and average contribution for common costs per minute derived from the CC report[96]. Using these figures, T-Mobile shows that the average revenues per minute for on-net and off-net calls are very different, which it claims is due to large difference in the marginal costs of provision, but that relative mark-ups are similar, as required by the Ramsey pricing principle.

[96] Table 5.21 of the CC report.

K.17 The Director considers that the evidence provided by T-Mobile is not sufficient to support its claim. T-Mobile's result on the relative size of the mark-ups implicit in the prices for these two services depends on how the average call revenues are calculated. T-Mobile has employed figures that include subscription revenues together with call revenues. However, the Director considers that if average revenues are employed as a proxy for the typical marginal prices of these calls, it would be more appropriate to exclude subscription revenues. Once subscription revenues are removed, the two relative mark-ups become considerably different. Hence, the Director remains of the view that there are both theoretical and empirical reasons for doubting that retail prices are set on a Ramsey basis.

2 Multi-part prices and price discrimination

K.18 All of the models that try to assess optimal mobile prices, apart from Rohlfs' one[97], do not even attempt to incorporate the complex pricing behaviour that is commonly observed in the retail market. All these models assume that all consumers pay not only the same price as every other, but also the same price for every call minute of a give type and, thus, estimate optimal linear prices. However, non-linear pricing is feasible and commonly practised in the mobile market. The MNOs do offer a wide variety of multi-part pricing schemes, which allow price discrimination by virtue of the subscribers self-selecting themselves on to alternative tariffs.

K.19 By allowing for multi-part tariffs and some price discrimination it would be possible to reduce the loss of social welfare caused by the need to raise prices above marginal costs to recover common costs (i.e. to obtain a more efficient set of prices). The more disaggregated the MNOs' approach to pricing, and the more non-linear the tariff systems, the lower the optimal mark-up on termination would need to be. The MNOs may even be able to price at marginal cost through price discrimination. In that case, all the common costs would be recovered from the infra-marginal subscribers. Therefore, the estimation of optimal mobile prices should not be limited to linear prices. (See also Annex G).

K.20 The Director, hence, believes that linear prices are not the most efficient set of prices that could be achieved in the mobile markets, even taking into account that full price discrimination is not possible. He is of the view that optimal prices would take account of the use of multi-part tariffing and price discrimination. The Ramsey price models submitted by or on behalf of the MNOs fail to do so.

Practical problems with the implementation of Ramsey prices in the mobile markets

K.21 In addition to the conceptual reasons given above, the Director considers that there also practical problems that render extremely unreliable any attempt to employ the Ramsey pricing principle in setting mobile termination charges (or any other approach that based mark-ups for the recovery of common costs on the relative super-elasticities of mobile services). These problems, discussed in detail below,

[97] For further details see Dr Rohlfs' papers from 19 June 2002 "*Response to the CC – Estimates of targeted subsidies*".

lead the Director to believe that any pricing methodology based on the elasticities of the services is unlikely to provide a reliable basis for setting regulated charges.

3 The estimation of the elasticities poses big technical hurdles

K.22 The Director considers that robust econometric estimates are usually extremely difficult to derive, because of a variety of factors including data deficiencies and the presence of unobserved explanatory variables, such a change in taste.

Identifying prices

K.23 The wide variety of pricing packages with different average and marginal prices and the practice of bundling of free minutes into the subscription prices renders very difficult the identification of the prices for the estimation of the elasticities of the demand for mobile-originated calls.

Estimating the functional form of demand functions

K.24 The values of elasticities can vary depending on the price level at which they are calculated (for instance the elasticity varies all the way along a linear demand curve). In estimating elasticities both DotEcon and Frontier Economics use log-linear demand systems. Where there have been large changes in price, as is the case in the mobile market, it may be that the elasticities at the different price levels are different (i.e. the relevant prices are on different portions on the demand curve) and so may, therefore, relate to different elasticities. Therefore, assuming the same elasticity has existed throughout the time period used in estimation might not be particularly realistic and may adversely affect the estimates.

K.25 The derivation of Ramsey prices is likely to require knowledge of elasticities at prices rather different from the observed prices (e.g. at prices equal to marginal cost). The estimation of Ramsey prices may therefore be sensitive to the validity of the functional form used in the econometric estimates, as well as the elasticities at observed prices.

Data deficiencies

K.26 Consistent empirical estimates rely on a long time-series of data. However, the MNOs' estimates are based on a relatively short time-series of data. In addition, for the estimated models to pick up the relationship between variables effectively, some variation in the data is required, however this condition is not satisfied by all data.

Non price effects

K.27 In addition, there are non-price effects that are likely to bias the estimation process. The large rise in mobile subscriptions and usage, which took place in the last few years in the UK, cannot solely be explained by the reduction in mobile prices and changes in aggregate variables, such as national income. This phenomenon is probably also due to a substantial increase in taste for mobile communications. If these effects are not adequately captured, the estimation is likely to mistake them for additional demand elasticity and generate estimated price elasticities which are biased upward in absolute value.

K.28 The Director is of the view that placing the number of subscriptions into the usage demand equations picks up some of this non-price effect. Consequently, the estimates of other usage elasticities in the equation may not be substantially biased. However, the estimates of the effect of subscription on demands for usage remain strongly biased by the unobserved and excluded taste effect.

K.29 Vodafone argues that it has taken into account these unobservable effects by estimating the regression in differences and including quadratic trend variables.

K.30 The Director considers that the use of a trend variable may reduce the bias introduced by the unobserved taste effect. Nevertheless, he believes that the number of subscriptions is a better proxy for the taste variable than any simple trend, consequently, as discussed above, a substantial bias is likely to remain.

4 The models for estimating the optimal mark-ups are over-simplified

K.31 The Director considers that all the models of the mobile sector presented by the MNOs that attempt to estimate elasticities and from these derive the optimal set of mobile Ramsey prices are over-simplified and, therefore, cannot generate robust results. Economic models are by definition a simplified representation of reality, but to generate robust output they must include all the key variables. The Director considers that these models do not satisfy this requirement and, therefore, cannot be relied upon for setting a regulatory intervention. Below some of the disadvantages of these models are discussed in more detail.

Exclusion of some mobile services

K.32 The models presented by the MNOs only include a sub-set of all mobile services (i.e. mobile subscription, fixed-to-mobile calls and mobile originated calls) and exclude the other mobile services (i.e. text messaging, roaming, international calls and mobile internet access). Hence the models only estimate a 3x3-elasticity matrix. The Director considers that, to correctly set Ramsey prices, it would be necessary to estimate elasticities for all mobile services (e.g. a 9x9 matrix[98]).

K.33 T-Mobile argues that removing some services from the model does not alter the relative relationships between the elasticities and, thus, does not affect the calculation of Ramsey prices. Moreover, it claims that the services excluded either represent a small part of total mobile traffic (e.g. roaming) or generate almost no revenues (e.g. mobile Internet) or already include a high mark-up (i.e. SMS).

K.34 The Director does not agree with T-Mobile's argument. Ramsey mark-ups allow for the recovery of common costs across all the services to which they are common. If some services are excluded, along with their marginal costs, they would be assumed not to contribute to the recovery of these costs and this would generate

[98] The relevant mobile services are 9: mobile subscription, fixed-to-mobile calls, mobile-to-mobile off-net calls, mobile-to-mobile on-net calls, mobile-to-fixed calls, text messaging, roaming, international calls and mobile internet access.

upwardly biased estimates of the mark-ups for the services included in the model. Such a set of prices would, thus, be sub-optimal because of this error of omission. Furthermore, if any mark-up was added on marginal cost of the excluded services, these mark-ups would be set arbitrarily, thus generating a lower level of social welfare than a set of Ramsey prices and there would be a problem of over-recovery of common costs. If the services excluded had a high mark-up for common costs, such as SMS mentioned by T-Mobile, then there would also be additional concern that costs could be recovered more than once.

K.35 In addition, Ramsey prices are set on the basis of super-elasticities, which capture own price elasticities and cross-price effects between all the services across which the costs are common, and take into account any externality effect. The exclusion of some services may alter the estimates of the super-elasticities.

K.36 Vodafone argues that the omission of some services from the models does not have a material impact on the estimates, because there are no significant cross-price effects between the service included and those excluded. Vodafone holds that a 3x3-elasticity matrix is a valid substitute for a 9x9-elasticity matrix because some of the cross-elasticities thus excluded are zero. The Director does not agree with Vodafone’s claim. First, the Director considers that Vodafone has not provided any support to its claim that the cross-elasticities between the service included and those excluded are zero (or close to zero). Further, the 9x9 matrix also includes the own-price elasticities of the excluded services, which are not zero. Hence the exclusion of these elasticities from the calculations of the mark-ups, as discussed in the paragraph above, may distort the results and generate non-efficient mark-ups.

Mobile-to-fixed, off-net mobile-to-mobile and on-net calls

K.37 The Director considers that even the mobile services that are included in the model are captured in too simplified a manner. In particular, mobile originated calls are modelled as a single “composite” service, when in reality these are three different services: mobile-to-fixed, off-net mobile-to-mobile and on-net calls.

K.38 Vodafone and T-Mobile argues that this simplification does not generate any distortion because services contained within the composite do not exhibit very different own-price or cross-price behaviour. However, they do not provide any robust evidence to support this assertion. The Director maintains his view that to assess a reliable set of Ramsey prices on which to base a regulatory intervention, it is necessary to have a clear understanding of how mobile subscribers react to changes in prices and price structures and, in his view, sufficiently reliable information on demand conditions cannot reasonably be obtained.

5 The economic relationships underlying some of the elasticity estimates are implausible

K.39 The Director considers that a further source of doubt on the reliability and robustness of the models’ results is that some of the elasticity estimates presented by the MNOs entail implausible assumptions on underlying economic relationships.

This concerns in particular the value of the gross-externality factor[99]. This issue is discussed in detail in Annex G.

6 Discrepancies between the elasticity estimates

K.40 The models presented by the MNOs generate estimates of the elasticities which are very different, not just in absolute, but also in relative terms (see also Chapter 8 of the CC report). This lack of agreement sheds further doubts on the reliability of these estimates as the base for a regulatory intervention.

The relevance of the issue of common costs recovery

K.41 The Director believes that the network and non-network costs that are common across termination services and retail services are very limited. He believes that common costs represent between 10% and 15% of the total network and non-network costs incurred by an MNO. Therefore, the Director considers that the issue of how the mark-ups are set is of less importance than argued by the MNOs. More details on the Director's view on common costs can be found in Annex F and H.

Use of EPMU

K.42 Vodafone and T-Mobile argue that the Director should set termination charges at a level that maximizes consumer welfare and that he should take into account all the available evidence in doing so. These two MNOs claim that existence of some uncertainty on the robustness of these data does not relieve the Director of his duty to make a reasonable judgement given the available evidence. The Director, however, believes that he cannot base a regulatory intervention on evidence which presents a large number of conceptual and practical problems and raises doubts about its usefulness. He considers that the reasons provided above are sufficient to justify his decision not to rely on the evidence provided by the MNOs on elasticities and not to adopt the Ramsey pricing rule.

K.43 In addition, the use of EPMU should be considered in context. The Director is proposing to add two mark-ups to the LRIC to set the termination charge: one to recover common costs and one to account for the uninternalised network externality. The EPMU methodology is used only for the first of these mark-ups, so the relevant conceptual question should be the reasonableness of EPMU to recover common costs in the absence of externality effects. Given the limited size of the common costs and the difficulties, discussed above, of setting mark-ups on the basis of demand conditions, the Director considers that EMPU achieves an appropriate balance between practicality and efficiency.

K.44 T-Mobile also argues that the loss, in terms of consumer welfare, of setting the price of an inelastic good, such as termination, below the Ramsey level is higher than setting the price above it by an equivalent amount[100]. Hence, it concludes that, if the Director is concerned about the impact on consumer welfare of its regulatory intervention, setting EPMU, which is equivalent to setting Ramsey mark-ups

[99] The gross-externality or Rohlfs-Griffin ('RG') factor measures the amount of external benefit that is generated by additional mobile subscribers.

[100] T-Mobile holds that the result is the same when cross-price elasticity effects are incorporated

assuming that the super-elasticities are the same, is likely to be more harmful than attempting to set evidence-based Ramsey mark-ups. The reason is that it would be very difficult to set a termination charge so high that the welfare cost of exceeding the optimal Ramsey level was greater than the one EPMU will impose by underestimating this level.

K.45 The Director considers T-Mobile's argument not to be correct when applied to this specific case. First, T-Mobile compares the welfare losses generated by a termination charge with an EPMU and a charge with a Ramsey mark-up, which is an incomplete comparison since the Ramsey mark-up takes account of the externality effect whereas EPMU does not[101]. In addition, T-Mobile's claim overlooks the fact that, since competition in the retail market is imperfect, not all the additional profits earned in termination are passed into lower retail prices. Hence, an overshooting in the termination charge is unlikely to be fully reflected in lower prices for other services, thus the welfare loss of an overshooting would be higher than in T-Mobile's example. Further, T-Mobile's result is based on the assumption that the overshoot and the undershoot are of the same order. However, from this result it does not follow that the undershoot generated by the use of EPMU and the overshoot caused by an attempt to set Ramsey mark-ups are of the same magnitude. Given the fact that the available elasticity estimates are non-robust, the overshooting generated by an attempt to assess Ramsey termination charges could be much larger than the undershooting caused by using EPMU.

K.46 The Director considers that evidence from the history of the mobile market does not support the claim that EPMU represents inappropriate regulation. Since 1998 termination charges (for Vodafone and O2) have been regulated on the basis of Fully Allocated Costs (plus an externality mark-up), which is very close to setting charges on LRIC plus EMPU, and the mobile market has thrived (i.e. penetration rate and level of usage have increased dramatically). Hence, the Director is still of the view that using EPMU (plus an externality surcharge) strikes an appropriate balance between the relevant principles of efficient pricing and practicality.

Conclusions on setting the fair target charge at Ramsey level

K.47 In conclusion, the Director considers that the derivation of Ramsey prices, or more generally welfare-optimal prices, raises complex conceptual and practical issues. For the reasons set out above the Director considers that these are too severe for sufficiently reliable estimates of optimal prices to be derived, on which regulated termination charges can rely.

K.48 Hence, the Director is confirming his proposal to use EPMU to address the question of recovery of common costs.

[101] The termination charges proposed by the Director in fact include both an EPMU and an externality surcharge.