# Mobile Terminating Access Service: Network Externality and Ramsey Pricing Issues

A Consultancy Report to the
Australian Competition & Consumer Commission
in relation to Optus's and Vodafone's Undertakings in relation
to the Domestic Digital Mobile Terminating Access Service

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# 1 Introduction

## 1.1 Scope of the consultancy report

On 30 June 2004 the Australian Competition and Consumer Commission (ACCC) replaced the existing GSM and CDMA terminating access service declaration with a new declaration under section 152AL of Australia's Trade Practices Act, 1974. At the same time, the ACCC also made a pricing principle determination which included price related terms and conditions for the Mobile Terminating Access Service (MTAS). According to these pricing principles the price of the MTAS should follow an adjustment path up to 30 June 2007 such that at the end of this adjustment period there is a closer association of the price and underlying cost of the service. The ACCC regarded the total service long-run incremental cost (TSLRIC) adjusted for a mark-up to include contributions to common organisational-level costs (TSLRIC+) as the appropriate measure of costs towards which the price of the MTAS should trend.

On 26 November 2004 and on 23 December 2004 Vodafone[1] and SingTel Optus respectively notified to the ACCC ordinary access Undertakings in relation to the MTAS. These Undertakings specify terms and conditions that these two mobile network operators (MNOs) would be willing to offer access seekers for the MTAS. If the ACCC accepts either of these Undertakings, it would be unable to determine terms and conditions of access inconsistent with any accepted Undertaking when arbitrating an access dispute in relation to the MTAS involving the carrier whose Undertaking was accepted.

Both Vodafone and SingTel Optus have outlined in their Undertakings higher prices for the MTAS than those that were indicated by the ACCC in its Determination. In support of these proposed prices, both MNOs provided detailed supporting documentation and consultants' reports. Some of the supporting documentation presents efficiency or welfare analysis, modelling and calculations associated with marking-up the incremental costs of supplying the MTAS to account for Boiteux-Ramsey pricing principles and network externalities. Vodafone's supporting material includes a model developed by Frontier Economics (Frontier) to estimate the efficient mark-ups to account for Boiteux-Ramsey pricing principles and network externalities. Notwithstanding the fact that Vodafone has not included the outputs of the Frontier model in the target price of its Undertaking the Frontier report was provided as part of Vodafone's submission..

SingTel Optus's supporting material includes a model developed by Charles River Associates (CRA) to estimate economically efficient prices which take account of mark-ups on incremental costs to account for Boiteux-Ramsey pricing principles and network

1 On 23 March 2005 Vodafone withdrew this Undertaking and replaced it by a new one. The basic difference between these two Undertakings relates to revised cost estimates.

externalities. SingTel Optus has also submitted two reports of NERA. The first of these reports (NERA, 2004a) contains an analysis on the welfare consequences of the exercise of market power in mobile termination. The second NERA report (NERA, 2004b) considers externality issues and the implications of cross-subsidies to mobile subscribtion. Optus's supporting material also includes a statement from Professor Jerry Hausman which includes analysis of the relevant market definition for the MTAS, the competitive benchmarks that should be used when assessing competition in the MTAS market and an analysis of the Ramsey pricing principles and network externalities that should be taken into account in estimating the efficient prices of supplying the MTAS.

The ACCC published in February 2005 a discussion paper on the SingTel Optus Undertaking and in April 2005 on the revised Vodafone Undertaking. These discussion papers aim to inform parties of the matters the ACCC will be likely to take into consideration when assessing the Undertakings. The ACCC also addressed a set of questions related to the Undertakings inviting interesting parties to provide comments on these issues.

In addition to receiving comments from interested parties the ACCC seeks advice on those aspects of the Frontier, CRA, NERA and Professor Hausman reports that relate to the efficiency or welfare analysis associated with marking-up the incremental costs of supplying the MTAS to account for Boiteux-Ramsey pricing principles and network externalities by way of a consultancy report. This consultancy shall also consider other possible relevant externalities, issues of second-best and the appropriate approach to efficiency evaluation across related markets. On 5 July 2005 the ACCC commissioned WIK-Consult to undertake and provide this consultancy report to the ACCC. The ACCC requested to prepare a consultancy report that includes in detail advice on the following issues:

(1) The conceptual validity of arguments advanced in the Frontier, CRA, NERA and Professor Hausman reports that when determining the efficient price of supplying the MTAS, incremental costs need to be marked up on the basis of Ramsey-Boiteux pricing principles to ensure the recovery of common costs.

(2) Which categories of costs (if any) should be covered by Ramsey-Boiteux mark-ups when applying a TSLRIC+ model to access pricing?

(3) Where - in your immediate knowledge - regulators in other jurisdictions have applied Ramsey-Boiteux principles in access pricing, and the similarities/differences with the approach taken by Frontier and CRA?

(4) The appropriateness of the methodology employed by Frontier and CRA to mark-up incremental costs to account for Ramsey-Boiteux pricing principles.

(5) The conceptual validity of arguments advanced by Frontier, CRA, NERA and Professor Hausman that, when estimating the efficient prices of supplying the

MTAS, incremental costs need to be marked up to reflect the existence of network/subscription externalities (and where applicable, other types of externalities).

(6) The appropriateness of the methodology employed by Frontier and CRA to mark-up incremental costs to account for network/subscription externalities.

(7) Whether there are any other kinds of externalities (relating to fixed-line, mobile and other networks and calls) that may be relevant to the decision about the imposition of a network externality surcharge.

(8) Whether there are reciprocities in any relevant externalities and how these may influence the analysis.

(9) The appropriateness of the Rohlfs-Griffin (RG) factor used in the Frontier and CRA analysis. In particular, the ACCC is interested in views and/or evidence on the relationship between external value placed on new subscribers and the level of population penetration of mobile telecommunications.

(10) The trade-off between possible efficiency costs from a surcharge on mobile termination and the possible efficiency gains from subsidising mobile subscription, including direction on the rule for determining the efficient trade-off between these.

(11) The appropriateness of the various own and cross-price elasticities used in the Frontier and CRA analysis, and whether the consultant is aware of alternative estimates.

(12) Whether the methodology used to calculate cost, price and demand inputs used in the Frontier and CRA reports is appropriate.

(13) The conceptual validity and relevance of NERA's analysis regarding the joint product nature of mobile termination and mobile subscription services (summarised on page 1-2 and detailed in section 2 of the NERA report: *Mobile Services as Jointly Produced Products: Concepts and Empirics*).

(14) The conceptual validity and relevance of the analysis undertaken by Professor Hausman to conclude that reducing mobile terminating prices "is creating a transfer from a competitive industry, mobile operators, to a non-competitive industry, fixed line telephone and in particular Telstra" (paragraph 47).

(15) Whether "it is incorrect that Ramsey (Boiteux) pricing must require market power in the sense of setting price above competitive levels" (Professor Hausman, paragraph 54).

(16) The analysis undertaken by Professor Hausman to estimate the benefits received by calling parties from additional mobile subscribers (paragraphs 67 to 69); the calculation of the net social gain (paragraphs 70 to 76) and possible ACCC responses (paragraphs 77 to 81).

On 26 July 2005 we received the confidential versions of the MNOs' Undertakings as well as the commercial-in-confidence supporting submissions and the commercial-in-confidence versions of the submissions which interested parties provided in relation to the SingTel Optus Undertaking. On 23 August we received the submissions related to the Vodafone Undertaking. We used and analysed these submissions for our report insofar as they referred to issues and questions which the ACCC has addressed to us.

We have structured our approach and analysis into two dimensions. We firstly separated our analysis into its conceptual, methodological and empirical dimension. We then secondly deal with the subject matters of cost concepts, market power and Boiteux-Ramsey pricing issues and externalities. We kept in mind in all parts of our theoretical and empirical analysis the close interrelation of these subject matters. The final chapter on summary and recommendations presents all of our results in an integrated manner.

## 1.2 Pricing proposals of MNOs for MTAS

SingTel Optus (2004) proposes two options for MTAS prices. The first option consists of linear tariffs per minute for the years 2005, 2006 and 2007, as follows:

| | |
|---|---|
| 2005: | 19.25 cents per minute |
| 2006: | 18.00 cents per minute |
| 2007: | 17.00 cents per minute |

The second option consists of two-part tariffs that are based on and are consistent with the above linear tariffs. In proposing these tariffs Optus explicitly refers to the results of model calculations carried out by its consulting firm Charles River Associates that were derived using the Boiteux-Ramsey (B-R) principle and including a surcharge for externalities. Actually, the prices that CRA arrived at with its model calculations are as follows:

| | |
|---|---|
| 2004-05: | 17.03 cents per minute |
| 2005-06: | 16.97 cents per minute |
| 2006-07: | 16.93 cents per minute |

Thus only for the year 2007 Optus bases its proposal on the prices that were calculated by CRA which are effectively the same for the three years.

Vodafone (2004) proposes prices for the MTAS as follows:

| | |
|---|---|
| 2004: | 21.00 cents per minute |
| 2005: | 19.38 cents per minute |
| 2006: | 17.77 cents per minute |
| 2007: | 16.15 cents per minute |
| Subsequent validity periods: | 16.15 cents per minute |

It points out that it has decided not to explicitly include the analysis of B-R pricing and externalities within its Undertaking prices. This analysis had been carried out for Vodafone by the consulting firm Frontier Economics which had come up with estimates for the price of the MTAS service between 22.32 and 32.73 cents per minute. Vodafone points out at the same time that if the ACCC's decision to accept or reject the Undertaking is the subject of an appeal, it reserves the right to review its current position not to include the results of the B-R pricing and externality analysis.

## 1.3 ACCC's position on Ramsey pricing and externalities in its June 2004 decision

### 1.3.1 Access pricing principles

In dealing with the arguments of interested parties regarding whether prices for the MTAS should contribute to fixed and common costs of MNOs, the ACCC referred to its general rulings on access pricing. The ACCC had in the past generally accepted that TSLRIC-based access prices should include a contribution to organisational level costs in setting prices for originating or terminating access services.[2] A failure to account for those costs in the form of a mark-up over directly attributable costs may not allow access providers to earn sufficient revenue to recover their costs over all the services they provide. Furthermore, incentives to maintain and invest in infrastructure may be reduced and the choice of technology may be distorted if prices do not include a contribution towards the recovery of organisational level costs.

On the way or method of determining an appropriate mark-up the ACCC also referred to previous PSTN access service decisions. There it has chosen to base the mark-up on an "equi-proportionate mark-up" (EPMU) over directly attributable costs.[3] The ACCC also regarded that approach as appropriate for the TSLRIC-based price for the MTAS in its pricing principle Determination.

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2 ACCC (2004), p. 209.
3 ACCC (2004), p. 209.

### 1.3.2 Ramsey prices

The ACCC also dealt with arguments forwarded from interested parties regarding whether mark-ups to account for common costs should be based on Ramsey pricing principles. In particular some MNOs argued that the application of Ramsey pricing principles for the MTAS would encourage economic efficiency. Those MNOs that subscribe to this view claimed that FTM demand is very inelastic with respect to price, thereby justifying relatively higher mark-ups on relevant costs for meeting economic efficiency. Optus, Vodafone and Telstra submitted statements that their prices at that time reflect Ramsey pricing principles. Some other parties, including fixed-line competitors and their advisors, on the other hand were sceptical about claims that current pricing reflects Ramsey pricing principles and generally questioned whether mobile network competition for subscribers will lead to socially optimal Ramsey prices.

First of all the ACCC concluded that none of the parties specified a set of relevant Ramsey prices sharing common costs among all relevant services. The ACCC further addressed the problem that Ramsey pricing structures do not explicitly specify the relevant level of prices. Ramsey pricing exactly describes the pricing structure of a profit-maximising monopolist. In particular the ACCC believed that Telstra and Optus are likely to be exceeding cost recovery or a zero economic profit constraint. The ACCC also agreed with the view that there is no reason to suspect mobile network competition for subscribers to lead to socially-optimal Ramsey prices.[4]

At the empirical level the ACCC believed that mark-ups based on Ramsey principles are difficult to estimate. Exact knowledge of own-price and cross-price demand elasticities across a broad range of services is required. In this regard, the ACCC believed there was broad disagreement on the relevant range of these elasticities if relevant estimates were available at all.

In its overall judgement, the ACCC rejected the application of Ramsey pricing principles because Ramsey pricing required market power and therefore the ability to set prices above costs which would not be consistent with the outcome of a competitive market.

### 1.3.3 Externalities

In its report the ACCC discusses the relevance of so-called fixed-line externalities and the (more traditional concept of ) mobile network externalities.[5] The ACCC mainly discusses and assesses the arguments and evidence brought to it by the interested parties.

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4 ACCC (2004), p. 170.
5 See ACCC (2004), pp. 157-169.

Under the concept of the fixed-line externality the ACCC discusses the demand relationship between FTM calls and mobile subscriptions. MNOs argue in this context that (given their zero economic profit constraint) they are forced to increase the price of mobile subscriptions to recover decreases in revenue as a result of decreases in the price of the MTAS due to regulation. Higher prices for mobile subscriptions reduce demand for mobile access and therefore the ability of FTM users to place calls to such (potential) mobile subscribers. Therefore, the benefits from FTM calls will be reduced and a relevant welfare loss may occur. NERA (2004b) on behalf of Optus estimates the magnitude of these efficiency losses to be $984 million per year.

The ACCC criticises this externality argument at the conceptual as well as at the empirical level. Conceptually, the ACCC believes that the fixed-line externality as defined above is only one externality that affects the interaction between the FTM, retail mobile and mobile termination services. Mobile subscribers also derive some benefit from having a greater number of fixed-line callers which are affected by the level of mobile termination rates. Furthermore, there are welfare losses to mobile subscribers by the reduced willingness of FTM customers to make FTM calls if the MTAS is priced above costs. All these externalities have to be evaluated against each other to consider the relevant magnitudes of all possible external benefits. Furthermore, the ACCC questions strongly that MNOs will choose a price for the MTAS that efficiently internalises externalities enjoyed by fixed-line consumers.

Empirically, the ACCC expected a much smaller increase in the retail price of mobile subscription services than some of the MNOs and their consultants claim. The ACCC does not accept the notion of effective competition for retail mobile services and does therefore not expect that all of the net revenue lost from a decrease in the MTAS price will be compensated by higher subscription prices. The ACCC expects a smaller price elasticity for subscription than Optus. Taken all arguments together the ACCC expects a much smaller loss (if any) in FTM consumer surplus as a result of the fixed-line network externality effect.

With respect to the mobile network externality issue, the ACCC discusses the argument that mobile subscription prices should be subsidised by higher prices for mobile termination services to internalise the benefit mobile subscribers receive from having additional other subscribers to call and receive calls from. In this context, the ACCC also considered the argument regarding whether mobile subscriptions should be subsidised to receive efficient levels of mobile subscription. The ACCC generally accepts the notion and the relevance of mobile network externalities and the potential benefit of promoting subscription by some degree of subsidies. If there is a network externality at the margin efficiency analysis suggests that subsidies up to the amount of the marginal externality increases efficiency. This effect has to be traded off against the deadweight loss of funding this subsidy through a surcharge on the FTM termination charge.

The ACCC, however, believes that positive marginal externality benefits may depend on the degree of penetration in the sense that the marginal benefits of subsidisation are higher at lower levels of penetration. The ACCC presents as empirical evidence for a declining marginal externality benefit that the majority of more recent subscribers are pre-paid with relative lower ARPUs and generally declining ARPUs over time.

In its final assessment the ACCC is not convinced that mobile network externalities justify a surcharge on the MTAS price over and above relevant costs. The parties have not provided to the ACCC evidence to quantify the size of such externalities. Furthermore, the ACCC questions whether surcharges on the price of the MTAS would be the most efficient way to finance subsidisation of mobile subscription. Because of the maturity of the Australian market, the ACCC expects marginal externalities to be negligible.

The ACCC points out two further more indirect arguments against externality surcharges on the price of the MTAS. Firstly, mobile subscribers perceive benefits from being called by fixed-line subscribers. This benefit is dependent on the price of FTM calling. Pricing of MTAS above costs reduces this call externality and therefore the amount of the optimum subsidy. Secondly, the ACCC refers to the inefficiencies caused by handset subsidies which are a typical means in the market to subsidise subscription.[6] Subsidised handset prices have encouraged greater than efficient turn-over of mobile handsets by consumers. This is an additional deadweight loss of subscription subsidies besides financing them.

# 2 Conceptual Analysis

## 2.1 Relevant cost concepts for pricing of the MTAS

### 2.1.1 Mobile services as jointly produced product

NERA (2004a) characterises the outputs of mobile network operators (outgoing call, termination and subscriptions) as jointly produced goods. NERA partially takes it back by stating that there are no strict fixed proportions as would be required by joint products. This analogy is overdrawn and in any case does not contribute to an understanding of the relevant relationships beyond what could be achieved without it. As pointed out below (in Sections 2.3 and 3.2.5) NERA's analysis actually does not depend on this hypothesis. This later part will be reviewed without reference to it.

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6 ACCC (2004), p. XVI.

Mobile services are not produced in fixed proportions, meaning that there are no joint costs in the customary use of "jointness" (Marsden Jacob Associates, 2005a, p. 48). If one interprets jointness as the presence of common variable costs then the allocation of such common costs should follow peak-load pricing principles.[7] Provided there are no economies of scale, the prices of the jointly produced goods have to add up to the joint marginal costs, and the individual prices are determined simply by the marginal willingness-to-pay at peak capacity. If one of the goods is sold at less than full capacity, its price equals its attributable marginal costs, while the other good(s) share the common marginal costs. If all goods are produced at capacity their rationing prices have to add up to the joint marginal costs (plus the attributable marginal costs). This means that Ramsey pricing principles do not apply.

Some submissions (Marsden Jacob Associates, 2005a, p. 14; AAPT, 2005, Appendix A, p.17) comment on the sloppy use of the "fixed cost" concept in the CRA paper and others. They point out that, in the long run, all costs are variable (and, by the same reasoning, sunk costs would be bygones). However, the ACCC needs to be guided by substantive issues rather than words. Important for the cost allocation and pricing issues at hand are economies of scale and scope. Economies of scale are generally defined by the property that the cost function exhibits decreasing (ray) average costs. This means that total costs will not be covered if all outputs are priced at marginal costs. Economies of scope are defined by the property that the costs of producing several outputs in one firm are lower than producing them separately in several firms. In this case, the incremental costs of an output are smaller than the stand-alone costs. Typically, in the literature, economies of scale are illustrated by a cost function with fixed costs and constant variable costs. The assumption here is that, while these costs may be variable in the long run, they are nevertheless incurred if one wants to produce any output. Long-run fixed costs in the sense of Baumol and Willig (1981) represent a discontinuity in the long-run total cost function at zero output. Another way of expressing this is that they are common costs for all units of any particular positive output. In that sense, economies of scale can be reinterpreted as economies of scope between all units of output. Typically, over a large range, average variable costs are non-increasing. Thus, we interpret the presence of "fixed" costs to mean economies of scale.[8] "Fixed common" costs refer to fixed costs incurred in the production of multiple outputs. The presence of "fixed common" costs therefore generally implies the presence of economies of scale *and* scope. Economies of scope can exist without economies of scale so that there can be common costs without fixed costs. Nevertheless, AAPT (2005, Appendix A, pp. 17/18) is right that many concrete cost items identified as "common and fixed" are not "long-run fixed" costs in the sense of Baumol and Willig (1981). Also, fixed

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7 Peak-load pricing is treated in all standard textbooks on public utility regulation, such as Viscusi, Vernon and Harrington (2005).

8 This is not strictly true because marginal costs could be upward-sloping so that average costs become U-shaped and exhibit diseconomies of scale beyond some output. However, increasing marginal costs are uncommon in the long run.

costs per se are not the main indicator of the cost allocation problem in the Boiteux-Ramsey tradition. Rather, it is the role of fixed costs as a proxy for the extent of scale economies. This role is treated more deeply in Section 2.2.2.2 below.

The absence of economies of scale in the presence of common costs could be exemplified by a network facility that can be installed in small capacity increments so that there are no economies of scale, but the facility is shared by two outputs. Further assume the outputs require some directly attributable (constant) variable costs in addition. Now, we can have two different cases. In the first case, the two outputs are full rivals in the use of the common facility. This would be the case of local and long-distance calls sharing the local network. In that case the "common" costs can be directly attributed to the outputs by their relative use so that all costs become variable and can be directly attributed. In the second case, the two outputs can both share the facility without interference (like day calls and night calls or DSL and PSTN use of a copper access line). Then the service requiring the full amount of capacity (the "peak" service") has to carry all the common costs while the other service only carries its directly attributable costs. In neither of these very different cases is there a reference to inverse elasticity rules.

### 2.1.2 The concept of TSLRIC

Ramsey prices relate mark-ups to marginal costs, because marginal costs are the classic benchmark for welfare-maximising prices. In contrast, the concept of incremental costs was introduced into this literature in the context of competition and market entry. Incremental costs are therefore relevant for competitive aspects of regulation. In addition, incremental costs are often easier to measure than marginal costs.

Frontier (2004) notes that regulated prices are typically based on long-run average incremental costs (LRAIC) or on the equivalent total service long-run incremental costs (TSLRIC) rather than on marginal costs because of the difficulty to estimate elasticities and because of the necessity to avoid cross subsidies. They then continue to recommend application of B-R pricing principles to LRAIC as the basis. Both for practical reasons and because LRAIC form the basis for regulatory pricing in Australia we in principle agree with this.

### 2.1.3 Economies of scale and TSLRIC

The relevant cost concept for access pricing in Australia is TSLRIC. LRAIC are TSLRIC per unit of output. The main argument in favor of basing access prices on this concept is that access prices at TSLRIC would provide the right entry or bypass (make-or-buy)

decision for the user of a bottleneck facility.[9] The "TSIC" part is justified over marginal costs, since an entry decision concerns a service rather than a unit of service, while the "LR" part is justified by the long-run aspects of entry or bypass. The use of TSLRIC represents a mark-up on marginal costs in the presence of product-specific economies of scale. TSLRIC proper contain any service-specific fixed costs, but no common costs. In contrast, the "TSLRIC" concept applied by ACCC and other regulators include equi-proportional mark-ups on pure TSLRIC for certain organisational and/or network common costs. This concept is sometimes referred to as TSLRIC+.

### 2.1.4 Common costs

#### 2.1.4.1 Network common costs

Network common costs refer to costs of the network that are common to the services produced with this network. If the services are call traffic and subscriptions the main candidate for network common costs would be parts of coverage costs. This would hold to the extent that at a site the traffic does not exceed the minimum requirements for coverage for network items that vary with traffic. Thus, in cities and suburban areas there would be hardly any coverage costs that could be counted as common (Marsden Jacob Associates, 2005b, p. 64). However, in more remote areas that would not generally hold.

#### 2.1.4.2 Organisational level common costs

Non-network costs are typically not determined in cost models but rather derived more directly from accounting data that do not reveal their nature as direct or common costs. For organisational level cost components, such as accounting or management, one can, however, in principle determine the nature of costs as common or direct by varying the outputs individually and together and measuring the associated cost variations. As long as this has not been done, it is somewhat naïve to accept certain costs, for example for accounting and management, as common.

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9 In the context of network unbundling the American FCC has developed the concept of total element long-run incremental cost (TELRIC). Since TELRIC refers to the unbundled parts of the network used to produce telecommunications services, TSLRIC is a weighted sum of the TELRIC levels of the network elements used plus the non-network costs.

#### 2.1.4.3 Other non-network common costs

Other non-network costs include among others customer acquisition costs and customer care costs, which can be quite substantial. These are direct costs of customer subscription and therefore not common costs at all. They are, however, indirectly influenced by prices and quantities of on-net and off-net calls and MTAS. For example, the customer acquisition cost function is likely to shift downward if mobile call prices or MTAS charges are reduced. Quite a different issue is the level of costs incurred by a mobile carrier for customer acquisition costs. This will increase in the mobile call prices and in MTAS charges not so much because of the shift in the cost function but rather because of the greater attractiveness of subscribers caused by such price increases. But this neither means that the customer acquisition costs are common to subscription, mobile calls and MTAS, nor that they vary with any one of them except subscriptions.

### 2.1.5 Conclusions on cost concepts

The basic cost concept, to which MTAS charges are related, is TSLRIC. Fixed service-specific costs are included in TSLRIC. In addition, fixed common cost reflect economies of scope and those scale economies that are not included in service-specific fixed costs. The fixed common costs have to be recovered in the prices of all mobile services including MTAS.

There could also exist variable common costs that reflect economies of scope but no economies of scale. A specific example of this would be joint costs requiring fixed output proportions. Joint costs in this sense are not relevant for mobile termination services. Variable common costs should be recovered under peak-load pricing principles.

Relevant fixed common costs include network common costs and organisational common costs. Other non-network costs often specified as common include customer acquisition costs, which we consider as direct costs of subscribers or subscription. However, because high prices make it hard and low prices make it easy to attract new customers the customer acquisition cost curve may shift up or down with prices charged by a mobile operator for subscription, calling and termination.

## 2.2 The conceptual applicability of Boiteux-Ramsey (B-R) pricing principles to the recovery of common costs in the mobile sector

Boiteux-Ramsey pricing principles originate in the derivation of optimal commodity taxation by Ramsey (1927). The contributions by Boiteux (1951 and 1956) have applied this work to public utility pricing and have extended and refined the analysis. The history of the pricing principles has been captured by Baumol and Bradford (1970), who have popularised the ideas and have shown that there are several other famous predeces-

sors after Ramsey's and before Boiteux's contribution, including Lerner, Pigou and Samuelson.

B-R pricing principles refer to welfare-maximising prices subject to a viability constraint on the regulated firm or sector. Unless legal rules interfere with them, economists should therefore favour B-R principles as the correct basis for regulating MTAS. However, the worldwide lack of applications of B-R pricing principles for regulating MTAS cautions against such advice without further analysis.

### 2.2.1 Introduction to B-R pricing principles

#### 2.2.1.1 Definition and characterisation

Boiteux-Ramsey prices (or simply: Ramsey prices) are defined as prices by a regulated firm that maximise welfare subject to a budget constraint for this firm. They were originally developed as a means for dealing with the issue of natural monopolies in multi-product settings. The problem here is that first-best welfare-optimal marginal cost prices may not raise enough revenues to cover total costs. In this case, regulation assuring the firm's viability requires deviation from marginal cost prices. The main property required for the budget constraint to be binding is the presence of economies of scale at the optimal level of output so that first best marginal cost pricing is not cost covering. The Ramsey pricing principles then relate to mark-ups above marginal costs that are inversely proportional to the market (super-) elasticities of demand. Thus in the case of independent demands, the B-R formula is

$$\frac{p_i - MC_i}{p_i} = \frac{\mu}{\varepsilon_i} \text{ for all } i \qquad (1)$$

Here $p_i$ is the price of service $i$, $MC_i$ is marginal cost of service $i$, $\varepsilon_i$ is the absolute value of the demand elasticity of service $i$ and $\mu$ is the so-called Ramsey number. In the original B-R formulation $\mu$ is determined by the degree of scale economies and therefore signifies the amount by which the service prices on average have to deviate from marginal cost prices in order to fulfill the balanced budget constraint. Since, under unregulated monopoly, one would always get equation (1) with $\mu = 1$ , and under perfect competition one would get equation (1) with $\mu = 0$, the similarity between B-R pricing and unregulated pricing structures has been noted in the literature and is used in the consulting reports to this proceeding. Note, however, that in the B-R formulation different values of $\mu$ result from the strength of the budget constraint that have little to do with competition. $\mu = 0$ simply means that pricing occurs, where there are locally constant returns to scale. In contrast, $\mu = 1$ means that the firm can only fulfill the constraint at the monopolistic profit maximum. From (1) follows the inverse elasticity property

$$\frac{\frac{p_i - MC_i}{p_i}}{\frac{p_j - MC_j}{p_j}} = \frac{\varepsilon_j}{\varepsilon_i} \text{ for all } i \text{ and } j \text{ and for } \mu > 0 \qquad (2)$$

In case of interdependent demands equation (2) is replaced by

$$\frac{\frac{p_i - MC_i}{p_i}}{\frac{p_j - MC_j}{p_j}} = \frac{\gamma_j}{\gamma_i} \text{ for all } i \text{ and } j \text{ and for } \mu > 0 \qquad (2')$$

In (2') the simple elasticities $\varepsilon_i$ are replaced by super-elasticities $\gamma_i$.[10] According to Rohlfs (1979), superelasticities are defined by

$$\gamma_i = \frac{1}{\sum_j \frac{R_j}{R_i} e_{ji}} \text{ for all } i \text{ and } j \qquad (3)$$

Here $R_i$ and $R_j$ are the revenues of services $i$ and $j$, respectively, and $e_{ji}$ is the demand flexibility[11] of service $j$'s price with respect to of service $i$'s quantity.

When we speak of Ramsey pricing principles for MTAS in contrast to other pricing principles such as, for example, the Baumol-Willig rule or constrained market pricing (between incremental and stand-alone costs), we mean pricing that maximises welfare (social surplus)[12] under a binding minimum profit constraint and that entails mark-ups on marginal costs that are inversely proportional to market (super-) elasticities.[13] It is

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10 Note that super-elasticities can be positive. It therefore can be misleading to use the absolute value of elasticities. Since equation (2) also holds if the true value of the elasticities is used while equation (1) does not, we use the super-elasticity approach only for equation (2).

11 "Flexibility" is the multivariate reciprocal of elasticity, $e_{ji} = \frac{q_i}{p_j} \frac{\partial p_j(q_1,\ldots q_n)}{\partial q_i}$. Frontier (2004, Annex 2.2) call the flexibility the "elasticity of the inverse demand function". See Rohlfs (1979, p. 9) for this and for equation (3) above. Equation 4.14 in Mitchell and Vogelsang (1991), on which CRA seems to build its formula for super-elasticities, contains a typographical error, which CRA has copied. AAPT (2005, Appendix B, pp. 21 and 39) provide different formulas for super-elasticities, noting that the precise formula depends on the formulation of the problem.

12 Social surplus is the sum of consumer surplus and profits generated in the markets under consideration. In the original formulations by Boiteux (1956) B-R pricing is derived as a Pareto-optimal solution. Social surplus is the dominantly used welfare criterion in markets because of its more convenient applicability as compared to the Pareto criterion. If the budget constraint is binding the maximisation of social surplus yields the same result as the maximisation of consumer surplus.

13 Long-run marginal costs equal LRAIC only if the increment is sufficiently small or if there are no product-specific economies or diseconomies of scale.

the inverse elasticity rule that is most important for the current case, because the demand for MTAS is deemed less elastic than that for other mobile services.

The Ramsey pricing rule has a wide application as it extends to peak-load pricing and nonlinear pricing principles under economies of scale. Economists and practitioners have also noted the formal similarity with the price structure under profit-maximising monopoly pricing and under Cournot oligopoly.[14] It is therefore important to look into the intuition behind the rule. Under Ramsey pricing an increase in price above marginal cost (within some range) increases the profit contributions necessary for fulfilling the budget constraint but hurts the objective function by reducing social surplus (as the sum of consumer surplus and profit). For initial deviations from marginal cost prices the relaxation of the budget constraint is greatest and the reduction in total surplus per unit of price increase is smallest in the least elastic markets. However, the larger the deviation from marginal cost prices becomes the larger becomes the additional total surplus loss from further price increases and the smaller the additional net revenues in the least elastic markets. In addition, demand tends to be more elastic with price increases. As a result, it does not pay simply to fund all the fixed or common costs from a mark-up in the least elastic market but it is best to balance mark-ups in inverse proportion to their market elasticities.

B-R pricing principles are compatible with the ACCC's pricing standards, as long as the profit contraint is binding. In that case consumer welfare is maximised, which would be in the long-term interest of end-users. At the same time, prices are sufficient for the financial health of mobile network operators.

#### 2.2.1.2 Potential importance for MTAS

Frontier (2004), in its report on "Modelling welfare maximising mobile termination rates", recommends adopting Ramsey pricing principles for MTAS pricing. Frontier claims that deviations between marginal cost prices and efficient prices are justified for MTAS because of high fixed common costs in the provision of mobile origination and termination services and because of the presence of network externalities. They state that "[i]n the last twenty or thirty years, it has been accepted among economists that the standard for economically efficient prices in a multi-product firm is given by the Ramsey rules and not by the rule….that price should be equal to marginal cost" (p. 6). Frontier here leaves out the condition of economies of scale that it alluded to earlier (on p. 5).

Frontier correctly observes that mark-ups on LRAIC would have to be much smaller and that the mistake made by using "wrong" elasticity estimates would be smaller as well than if mark-ups were calculated on marginal cost. Nevertheless, according to Frontier,

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**14** See, however, Höffler (2005), who questions this analogy.

fixed common costs have to be recovered on top of LRAIC and that would need to be done according to Ramsey pricing principles. Frontier does not specifically address the validity of the Ramsey approach for the context of MTAS beyond quoting the literature.

NERA (2004a) does not directly address the issue of Ramsey pricing. Rather, in its report to Optus on "Mobile Services as Jointly Produced Products", NERA only addresses net benefits to a price reduction of MTAS. In doing so, NERA considers consumer and producer surpluses (in both the mobile and the fixed network sector) without observing a balanced budget constraint. While this paper is quite comprehensive in looking at individual effects of a MTAS price reduction, it lacks the interactions relative to the budget constraint as required by Ramsey analysis.

According to CRA (2004, p. 14) "the welfare-maximising property of Ramsey-Boiteux pricing is well established in economic theory". While this is correct, it says little about the practical applicability of B-R pricing principles. One can agree with CRA and Newbery (2004) that B-R pricing principles are a correct conceptual starting point for the price regulation of monopolistic markets such as those for mobile termination and still reject the inverse elasticity mark-ups result that would justify high MTAS. Such rejection could, for example, be justified with a lack of significant economies of scale, with a large variation in elasticity estimates or with deviations of some unregulated prices from their B-R levels.

It has been known for some time (at least since the publication of Laffont and Tirole, 1993) that B-R pricing principles apply to access pricing and therefore to MTAS if economies of scale prevail at the relevant levels of output. Compared to conventional B-R pricing principles in a regulated monopoly setting, the MTAS setting may require modifications to take care of varying levels of competition in some markets, of the fact that MTAS is an intermediate input and of externality effects (that we treat separately).

#### 2.2.1.3 Use of B-R pricing principles for MTAS in other countries

As far as we know, B-R pricing principles have not been applied to the regulation of MTAS in any other country.[15] As Vodafone (2004, p. 16) points out in its submission to the ACCC, "While regulators around the world have typically accepted the positive efficiency properties of Ramsey pricing and recognising [sic] externalities when considering the appropriate price for the MTAS, they have generally decided not to explicitly incorporate them (and more so Ramsey pricing) into calculating a regulated price for the MTAS predominately on the basis of complexity and the lack of robust data." The most extensive consideration of B-R pricing principles has been given by Oftel (now Ofcom) in the U.K., that commissioned a consultant (Rohlfs, 2002) to develop a model for calcu-

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15 See also Marsden Jacob Associates (2005a, p. 39) and Hutchison (2005, p. 11 and p. 23).

lating Ramsey prices. Oftel in the end rejected the application of B-R pricing principles but accepted a limited externality mark-up for MTAS prices. This mark-up (as well as a similar mark-up granted in Israel) was not, however, based on a Ramsey pricing framework. Oftel's main arguments for the rejection included the perceived uncertainty about the relevant demand elasticities, the capture of fixed costs and part of the externality effects through non-linear pricing and other forms of price discrimination and the deviation of prices for other mobile services (and FTM prices) from their respective B-R levels. Oftel also alluded to distributional inequities generated by a Ramsey pricing structure for mobile services.[16]

Optus (2005, pp.7-8) claims that B-R pricing principles have been applied in other industries in Australia and the U.S.. To the best of our knowledge, these industries differ substantially from mobile telephony and the applications have been rather crude. For example, the U.S. railroad pricing is based on the observation that railroads can barely survive and therefore require high prices in those areas (essentially coal transport), where they face little or no inter-modal competition. The regulators have nevertheless established rate ceilings that the railroads may not exceed.

### 2.2.2 The applicability of B-R pricing principles outside regulated monopoly sectors

While multiproduct natural monopolies are usually associated with both economies of scale *and* scope, only the economies-of-scale property triggers the inverse-elasticity mark-ups.[17] It is therefore natural to associate Ramsey pricing with monopoly regulation, because that is where economies of scale may persist at the market output. However, Ramsey pricing principles could also apply to other markets. For example, Baumol, Bailey and Willig (1977), Baumol, Panzar and Willig (1982) and Braeutigam (1979 and 1984) have applied B-R pricing principles to various industry configurations involving dominant firms in competitive settings. It could, for example, be legitimate to apply such principles to a multiproduct industry with several firms, each of which holds a monopoly for a single regulated output, such as termination (MTAS).

In contrast to welfare-maximising regulators, profit-maximising firms are not interested in the consumer surplus aspects of price increases but only in the profit contribution.

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**16** In Oftel (2003a, pp. 52/53) the concern is that high termination charges translate into high FTM charges that affect (elderly and poor) people who depend on their fixed phones to reach mobile customers.

**17** Natural monopolies can also, in principle, exist in regions with diseconomies of scale. Such so-called unsustainable natural monopolies, however, do not fit well with our understanding of empirical cost functions. As explained below, profit maximisation always triggers elasticity-related mark-ups, even under constant returns to scale. These mark-ups relate to firm-specific elasticities that coincide with market elasticities only for monopolists. The difference between firm-specific demand elasticities and market demand elasticities is one of the main factors responsible for the difference between market prices and Ramsey prices alluded to, for example, in Section 2.2.2.3 below.

Under pure profit maximisation an inverse elasticity rule results only for a reason similar to that of providing a profit contribution to cover fixed costs under Ramsey pricing. Here it is clear that the firm will want to make money from all products. Mark-ups under inelastic demand can profitably be increased more than under elastic demand because, under inelastic demand, the profit increase from higher mark-ups is higher relative to the profit reduction from lower sales. For profit-maximising firms this inverse elasticity rule refers to each firm's residual demand elasticities, which only coincide with the market elasticities in case of monopolies. The price structure in imperfectly competitive markets is therefore likely to differ from that of B-R prices. It only coincides for sure if the level of competition for all goods is the same and if the demands are independent and of the constant elasticity type.[18] Otherwise, the analogy between B-R pricing and profit-maximising prices breaks down. To see this, one only needs to look at the case of constant returns to scale. In this case, Ramsey prices equal marginal costs, while profit-maximising prices still follow the inverse elasticity rule. Another example would be the case of two firms, both producing two products. One of the products has inelastic demand, is produced at constant returns to scale and under homogeneous Bertrand competition, while the other product has elastic demand, is produced under increasing returns to scale and Cournot competition. The competitive equilibrium will have $p_1 = MC_1$ and $p_2 > MC_2$. In contrast, the Ramsey price for good 1 has a higher (relative) mark-up of price over marginal cost than for good 2. Thus, CRA's quotation (p. 48) of Laffont and Tirole (2000, p. 63) about the price structure being "the same in the presence or absence of regulation" refers to a misleading or inaccurate part of Laffont and Tirole's otherwise admirable text. The sameness breaks down if competition differs between services and if scale economies and/or demand elasticities change with changes in output.

#### 2.2.2.1 Relevant B-R concepts adapted to competitive situations and their properties

Baumol, Panzar and Willig (1982) and Braeutigam (1979 and 1984) develop alternative Ramsey pricing concepts adapted to different industry configurations, and Rohlfs (2002) and Houpis and Valletti (2004) develop these concepts further.

Viable-industry Ramsey optimum

The viable-industry Ramsey optimum (VIRO) results from maximising the sum of aggregate consumer surplus and industry profits subject to market-clearing prices and non-negativity of industry profits (Baumol, Panzar and Willig, 1982, p. 334). It is fully equivalent to the original B-R pricing principles. Under this approach side payments between firms would need to be allowed in order to fulfill the budget constraint. The optimum under this approach presupposes an optimal industry structure. The consumer benefits are measured by market demands so that firm-specific demands and the extent

18 See Ten Raa (2005) for examples, where price structures are reversed between Ramsey pricing and monopoly pricing if either the independence or the constant elasticity assumption is violated.

of competition play no role for the derivation. The VIRO is compatible with economies of scale if firms specialise on specific outputs (differentiated products) or if ray-average cost curves are U-shaped. However, under L-shaped ray-average cost curves the VIRO implies that outputs produced by more than one firm are produced at constant returns to scale and prices at marginal cost. While the principal Ramsey model that Rohlfs (2002) developed for Oftel looks very much like a VIRO it actually deviates by assuming the given industry structure, which could be inefficient in the presence of economies of scale. With this proviso the VIRO is also the basis for the CRA model (CRA, 2005). It is, however, also compatible with the VFRO, which we discuss next.

Viable firm Ramsey optimum

The viable firm Ramsey optimum (VFRO) results from maximising the sum of aggregate consumer surplus and industry profits subject to market-clearing prices and non-negativity of each firm's profits (Baumol, Panzar and Willig, 1982, p. 337). Thus, a VFRO generally involves no side payments between firms. However, it need not be a market equilibrium. As Braeutigam (1984) notes, some firms may not be allowed to produce all products and thus be eliminated from those markets.

Autarkic Ramsey optimum

The autarkic Ramsey optimum (ARO) results from maximising the sum of consumer surplus and profits for each firm in an industry subject to market-clearing prices and non-negativity of each firm's profits (Baumol, Panzar and Willig, 1982, p. 344). In an ARO a product produced by at least two firms must be supplied at a price equal to marginal costs (and the two marginal costs have to be equal as well).

Principal-agent approach to B-R pricing

CRA (2004, p. 44) correctly observe that B-R pricing involves the choice of *a set* of prices that maximise welfare subject to a break-even constraint. However, the regulator of MTAS does not have the full set of prices at his/her disposal. This lack of tools is the motivation for the principal-agent approach to B-R pricing. The principal-agent approach to optimal MTAS pricing assumes that the regulator maximises welfare with respect to the MTAS price subject to a break-even constraint for all firms (assumed to be symmetric) and subject to a market equilibrium in the unregulated mobile markets.[19] That is, rather than setting B-R prices for their unregulated services the mobile operators are assumed to maximise their profits. In this case the regulator is assumed to be able to influence only the MTAS price and leave all other prices to the market. This approach was pioneered by Rohlfs (2002) and modelled more extensively by Houpis and Valletti

19 This also corresponds to the concept of "partially regulated second best" first developed by Braeutigam (1979).

(2004).[20] Rohlfs assumes that the regulator can differentiate MTAS by use. For example, he suggests reducing termination charges below marginal costs for off-net mobile calls, in order to offset the tendency of operators to charge such calls above costs. Rohlfs also assumes that the mobile sector is overall imperfectly competitive and that termination charge reductions will not be fully handed on to mobile customers. In particular, he assumes that call charges will be reduced by more than subscription charges, something that CRA (2004, p. 25) views as unrealistic. Overall, Rohlfs's principal-agent optimum involves positive profits for the MNO's. In contrast, Houpis and Valletti assume that the competitiveness of the mobile sector can vary between perfect competition and monopoly (or perfect cartel). The main other difference between Rohlfs and Houpis and Valletti is that Rohlfs does not explicitly model imperfect competition between MNO's but rather assumes a reduced form maximisation for the sector, where the objective is a weighted average of profits and total surplus. In contrast, Houpis and Valletti model imperfectly competitive market outcomes. Their emphasis is on externalities that may require subsidised pricing. So, they assume away economies of scale. Therefore, the only reason for potential Ramsey mark-ups in their model results from the necessity to finance external benefits from other services. Also the (monopoly) fixed network operator's services are assumed to be regulated at cost. Their main result is that MTAS charges should be higher the less competition there is for the other services (and therefore the less pass-through of higher termination charges to "subsidise" usage and subscription). Houpis and Valletti also find that, under perfect competition for the other services, MTAS should be priced at the B-R level, in which case the firms would only earn a competitive rate of return. The reason for finding a higher MTAS mark-up the less competitive the mobile sector is stems from the effect of the MTAS charge on mobile subscription charges. According to Houpis and Valletti, optimal regulation always reduces MTAS charges compared to the market outcome, and this induces firms to increase the mobile subscription charges. In the unregulated case, these subscription charges are higher (and therefore more inefficient) the less competitive the mobile sector is. Thus, the more termination charges are lowered the more inefficient subscription prices become, and this effect increases the less competitive the mobile sector is. Thus, it is optimal to reduce the termination charges by less if the mobile sector is less competitive than if it is more competitive. It is important to note, however, that this result is based entirely on the existence of a sufficiently large mobile subscription externality and on the absence of any fixed telephone subscription externality.

CRA (2004, p. 25) does not consider the Rohlfs principal-agent model to be relevant for Optus's current Undertaking. While we believe that Rohlfs's principal-agent model is not fully developed, it and the further developed Houpis/Valletti model appear to be on the correct theoretical track compared to the "simple" Ramsey model that optimises over all prices.

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**20** Houpis and Valletti call this approach 3rd best.

The various B-R approaches differ by the constraints imposed on the welfare maximisation problem. What all concepts of B-R pricing principles have in common is that they consider all relevant output prices simultaneously. However, the regulator directly addresses only MTAS. This means that the other prices could deviate from the B-R pricing principles. That, in turn, would invalidate the optimality of the MTAS based on such principles. Only the principal-agent approach deals with this issue. In that sense, it is the only *conceptually* correct approach to the MTAS problem discussed so far.[21] However, it also faces the biggest empirical problems with its implementability. These go beyond problems faced by all the other models, for example, with respect to the measurement of elasticities and additionally includes assessments of the firms' price responses and their feedback to finding the optimal MTAS charges.

#### 2.2.2.2 The conceptual issue of scale economies and common costs in competitive situations

A prerequisite for the fruitful application of B-R pricing principles would be the presence of economies of scale at the optimal output level, because otherwise marginal cost pricing would be optimal in the absence of externalities (which we deal with separately and which can also yield B-R type elasticity-related price mark-ups[22]).[23] In order to gain insights, we begin with a static welfare view, to which a dynamic perspective will be added later.

In a multi-firm industry, in the absence of diseconomies of scale for outputs beyond the MOS level, the optimal market structure requires constant returns to scale at all those optimal outputs produced by more than one firm.[24] In other words, if the (ray) average cost function is flat-bottomed or L-shaped rather than U-shaped the total industry costs can be minimised only if all firms produce at constant (ray) average costs. Otherwise, the industry structure could be improved by reducing the number of firms in the industry. In this case, B-R pricing principles would be third best because they would be applied to an inefficient market structure. The case of U-shaped (ray) average costs curves is different because then the sum of outputs at the bottom of the U only by coincidence add up to total industry output. So, in this case economies or diseconomies of scale can prevail. Diseconomies of scale, which are necessary for the U-shape, seem to be rare,

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**21** Oftel (2003b, p. 298) arrives at a similar conclusion and notes that the optimal mark-ups would then heavily depend on the way competition is modelled and therefore be "prone to disputes on the nature of retail competition".

**22** See Houpis and Valletti (2004, p. 9).

**23** Under some kinds of (Bayesian) incentive regulation mechanisms, positive economic profits may be required as incentives. In this case, prices above marginal costs may be optimal even under constant returns to scale. This should not be a major issue for regulation of MTAS, because the other services are also "regulated" by competition. Since there are several mobile operators, MTAS could be regulated with yardstick regulation, requiring small or no incentive mark-ups on prices.

**24** MOS or minimum optimal scale refers to the smallest level of output for which economies of scale are exhausted. Baumol, Panzar and Willig (1982) refer to this case as one of flat-bottomed ray average costs.

though. It is therefore highly unlikely that network-related (ray) average costs in the mobile sector are U-shaped rather than flat-bottomed or L-shaped. There are unlikely to exist any diseconomies of scale beyond a certain size, although congestion is a potential problem at the industry level of output but has not as of yet led to increasing average costs.

Also, if economies of scale resulted from product-specific fixed costs only, then there should not be any additional Ramsey mark-ups on (average) incremental costs (LRAIC) because in contrast to marginal costs they already cover all sources of scale economies. Or, rather, there would have to be mark-ups and markdowns correcting for the difference between LRAIC and marginal costs.

Relevant for the MTAS problem is that termination by each mobile operator is a monopolistic output, while all other outputs of mobile carriers are produced in competition with other mobile carriers. This suggests that in an efficient industry configuration only termination could be produced in an output range, where economies of scale prevail. However, termination uses almost exactly the same productive inputs as origination. This suggests that in the efficient industry configuration termination would also be produced at constant returns to scale. This in turn suggests that (with the exception of externality issues) there may exist no meaningful Ramsey problem of allocating common fixed costs in the mobile network industry, provided the industry structure is efficient. Rather, the problem would be one of estimating cost functions. In particular, it should be the question of estimating the cost function of the activities that give rise to common cost, and the identification of customer acquisition activities (including the extent to which they increase total mobile subscriptions as opposed to luring away customers from other mobile suppliers). There is usually much thought and effort spent on obtaining the LRAIC of efficient service provision but hardly any on the efficiency of non-network-related activities such as customer acquisition. Common costs are often estimated by empirical rule-of-thumb percentages, while for customer acquisition costs actual expenses are used without any recourse to efficiency.

Before one therefore applies B-R principles to MTAS pricing, it is necessary to carefully evaluate if mobile network operators produce in a range of economies of scale and if the economies of scale are caused by fixed common costs between the services produced. In this context, common costs for management, accounting, sales and the like are particularly suspect because they are likely to be variable and prevail in all industries including those definitely not operating under economies of scale. Rather, these common costs are perceived as common fixed costs in the short run only; but in the long run, they tend to be proportional to output. To the extent that they nevertheless appear to be common they should be candidates for equi-proportionate mark-ups. In our view, this also holds for these and other organisational level common costs that have received equi-proportionate mark-ups by the ACCC.

These fundamental issues for the validity of Ramsey pricing principles are not addressed in any of the reports done for this proceeding. Rather, these reports simply presume that certain costs are fixed and common and therefore need to be distributed according to a Ramsey formula.[25] Frontier speaks of "high fixed and common costs in the provision of mobile origination and termination services". CRA (2004, p.10) at least relates fixed and common costs to economies of scale, noting that recent studies confirm "the existence of significant economies of scale in mobile services". While they do not check the fixed and common costs against economies-of-scale estimates, their percentages (about 15 per cent) are at the top of the range implied by them.[26] The economies of scale estimates favorably referred to by CRA are Foreman and Beauvais (1999) and Noguchi (2004). Foreman and Beauvais found a scale factor for the US of 1.16, while Noguchi finds 1.11 for NTT DoCoMo for 2002.[27] Thus, fixed and common costs related to B-R pricing based on marginal costs should not exceed 10-15 per cent, and the percentage should be no higher than 5 per cent if TSLRIC rather than marginal costs are the basis for the mark-up.[28] This contrasts with econometric estimates of fixed common costs by Macpherson (2004), who comes up with a range between 14 per cent and 45 per cent of total costs in mobile networks of Greece, the Netherlands and Spain. In our view, these estimates reveal a problem in longitudinal estimations if there are build-out (coverage) requirements. In the cases with high estimated fixed common costs the author's time series started after the build-out requirement was met. Since fulfillment of such a requirement may force the firm to dimension its network ahead of demand, the starting point of the estimation may involve excess capacities so that subsequent expansion will be less than proportional to demand.[29] One can think of the costs for coverage as fixed (or, rather, lumpy) costs. However, they have the property that they allow an expansion from zero to some maximum level of output at zero marginal costs. After that maximum output further expansion requires marginal costs (or LRAIC), which roughly equal average incremental costs. As long as the firm stays below the level of output achievable with coverage costs alone, fixed costs would be 100 per cent of total

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25 Burton, Kaserman and Mayo (2004) point out that firms in regulated industries may have incentives to mis-specify some costs as fixed costs, for example, in order to be able to cross-subsidise certain services. The potential use of B-R pricing principles could also increase such incentives for mis-specification. Cave and Chambers (2005) point out that most coverage costs for mobile networks are variable.

26 The UK Competition Commission (2003, p. 403) reports that Rohlfs had said that Frontier Economics (in the UK mobile termination case) overstated fixed costs and hence mark-ups because scale economies of the magnitude implied by Frontier Economics' estimates were excessive compared to those likely to obtain for mature mobile markets, such as in the UK. We interpret the Frontier/Vodafone spreadsheets in the current proceedings such that their fixed and common costs are in the 14-30 per cent range.

27 According to the author this result holds without the effect of technical change, which would reduce scale economies. Thus, due to technical change the scale factor is likely to be smaller.

28 See also Marsden Jacob Associates (2005b, p. 64/65), who discuss fixed common costs at length and suggest 5-15 per cent.

29 In contrast, cost measurements during the period until the build-out requirement is met could show diseconomies of scale (negative fixed costs) if the build-out starts at a low rate and then occurs faster than the increase in output. Alternatively, it could also show high fixed costs if the build-out preceeds output growth.

costs. In reality (as noted by Cave and Chambers, 2005) the problem of coverage costs is complicated by the geographic dimension of networks. In dense areas the maximum level will be reached quickly, while in remote areas the level may never be reached. Thus, the relevance of coverage costs depends on the maturity of the mobile operators and on their geographic mix. Another potential drawback of the Macpherson study is that the author did not adjust the data for technical change, claiming that it would not play a role for sites, transceivers and cells, which make up 60 per cent of total costs.

We now turn to dynamic aspects of efficiency and economies of scale.

Even in an industry with several firms, fixed common costs could play a significant role without causing an inefficient market structure. It is the presence of lumpiness that requires large discrete investments, while output grows smoothly. In this case, the average cost curve will fall over some output range, because larger firms (which more easily smooth lumpiness during the growth phase) on average have a higher capacity utilisation than smaller firms. While this means that a smaller number of firms would be more efficient in the static sense, a larger number may be welfare-enhancing over time as the industry becomes large enough to support them at efficient scales. Thus, the productive inefficiency is only a temporary phenomenon and only acceptable in high-growth industries. In low-growth industries it would justify a smaller number of firms, in order to reduce excess capacity of the industry. The presence of lumpiness justifies the existence of several firms only if the economies of scale become sufficiently small at some point so that cost savings from consolidation are less than welfare gains from competition. These welfare gains from competition can relate to price-cost margins but also to costs directly. Under competition costs could be lowered through downward shifts in the cost curves from cost-cutting efforts or process innovations that compensate for the inability to fully exhaust economies of scale. In this sense the cost reductions for MTAS over time that are documented, for example, by Oftel (2003b) are due both to movements down cost curves, as economies of scale are exhausted, and to downward shifts in cost curves. As the industry matures, both effects decrease. The Australian mobile industry is highly mature so that economies of scale should matter fairly little.[30]

#### 2.2.2.3 The relevance of market power for the applicability of B-R pricing principles

Hausman (2004, paragraph 54) states that a "multi-product firm subject to effective competition will not have market power but will set its price to recover its fixed and common costs using Ramsey principles". Since Hausman, in this context, emphasises the recovery of fixed and common costs, he does not seem to refer to externalities here but rather to economies of scale and scope.

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**30** See also Marsden Jacob Associates (2005a, p. 40) and Hutchison (2005a, p. 28).

One problem in this context is that the persistence of scale economies is consistent with the presence of effective competition only temporarily, because it is inconsistent with industry cost minimisation. Under economies of scale, effective competition would normally lead to the elimination of a sufficient number of firms so that either monopoly or constant returns to scale result. "Fixed and common" costs as an indicator of economies of scale could therefore only occur for some time until an equilibrium with firms operating at constant returns to scale is reached. As described in the previous section, temporary disequilibrium situations could include excess capacity from lumpy investments and market growth, where scale economies are exhausted, when the market matures. The latter is likely to hold for the mobile sector, but at current Australian penetration of about 89 per cent (IDC, 2005) such maturity should have been reached by now. Effective competition could, however, be compatible with persistent economies of scale if the industry is characterised by product differentiation (so that monopolistic competition results) or by a heavy rate of innovation so that new products evolve in quick succession (the successive monopoly case). Both these conditions are very unlikely to hold for the Australian mobile sector.

Another problem with the application of Hausman's statement to the Australian mobile sector is that he assumes effective competition (with the possible exception of MTAS). The ACCC's regulatory power, however, is premised on the persistence of market power for MTAS of each mobile network operator. In addition, the level of competition seems to differ for different mobile services such as subscription, on-net and off-net calls. Hausman argues that the ACCC has not demonstrated a lack of effective competition. In contrast, ACCC (2005, p. 30, and 2004, p. 99) maintains that mobile "markets are unlikely to be effectively competitive as yet". Hausman seems to hold the view that only one level of effective competition exists. This comes out quite clearly in his example (paragraph 55) of Hewlett-Packard (HP) deciding on differentiated percentage mark-ups for its various products, which would "lead to ('second-best') economic efficient prices". This, however, can only hold if the level of competition for all of HP's products is the same. Otherwise, if HP holds mark-ups low that may either be the result of fierce competition in a particular market or of a highly elastic market demand.

Most textbooks on Industrial Organisation define market power by the ability of a firm to increase prices above marginal costs. In that sense, B-R pricing with prices above marginal costs always reflects market power. This strict view on market power (emphasised, for example, by AAPT, June 2005, pp. 7/8) is, however, not helpful for analysing the problem at hand. It would deny the absence of market power for all industries, for which fixed costs play any role, because in those industries firms could survive only by pricing above marginal costs. What is important is the significance of market power, as expressed by the ability of the firm to exclude and chasten rivals and to maintain long-run economic profits. We agree with CRA (p. 49) that B-R pricing in principle (i.e., abstracting from the specific context of mobile termination) does not have to imply significant market power, just because it requires prices to be above marginal costs. As Voda-

fone (2005, p. 18) notes, B-R pricing is fully compatible with and often implied by contestable market equilibria. The concept of contestability was introduced in the economics literature precisely for providing a *competitive* benchmark for industries with economies of scale. This benchmark requires the absence of any market entry barriers and the presence of Bertrand pricing behaviour by the first-moving incumbent and by second-moving potential entrants. The properties of such contestable equilibria include efficiency (to the extent feasible given potential economies of scale) and the absence of economic profits, meaning that consumer benefits are maximised. What all this says is that B-R pricing is not a priori incompatible with unregulated pricing. The applicability of B-R pricing thus depends on the specific empirical properties of the mobile sector.

Although competition in mobile markets other than MTAS may be vigorous, it is not perfect competition nor is it homogeneous Bertrand competition.[31] Rather, this is a differentiated oligopoly with some capacity constraints that would suggest Cournot-type outcomes.[32] Also, there may exist different levels of competitive intensity for different types of outputs, such as subscription services, on-net calls, off-net calls and fixed-to-mobile calls, and the competitive fierceness may vary between residential and business customers or between urban and rural customers. It is well-known that, while the resulting Ramsey formula should be indifferent to the level of competition in each market, the difference between the market outcome and Ramsey prices depends heavily on it. This is particularly important because the ACCC can only influence the MTAS price and cannot assure that setting an MTAS price at the Ramsey level will trigger the mobile operators to set the corresponding Ramsey prices for the other mobile products. If the other mobile prices are not at their Ramsey level it becomes suboptimal to set MTAS at its Ramsey level. Thus, contrary to the view expressed by CRA (p. 47), it does matter if B-R pricing principles are applied in practice by firms in a market. As Rohlfs (2002, p. 10) states, even if the regulator "does its part by setting mobile-termination rates at [the Ramsey] level MNO's may not do their part by setting the prices for subscription and MO usage at the Ramsey levels. Indeed,…, one would expect that they would *not* set those prices at the Ramsey levels."

To the best of our knowledge only Rohlfs (2002) and Houpis and Valletti (2004) have attempted to solve the Ramsey pricing problem for MTAS under inclusion of imperfectly competitive effects on the other prices. None of the reports in this proceeding addresses this issue at all. While this speaks to the imperfection of the submitted approaches, it does not justify equi-proportional mark-ups either. While Rohlfs finds that MTAS prices under imperfect competition in the other mobile markets should be lower

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**31** Note that the Ramsey optimality of global price caps as suggested by Laffont and Tirole (e.g., in Laffont and Tirole, 2000) requires that downstream markets are fully competitive so that the consumer surplus under the demand for access can be interpreted as the derived surplus of final consumers.

**32** Both product differentiation and capacity constraints would limit the above arguments on flat bottoms of ray average costs. However, the capacity constraints can be moved in the long term and the product differentiation is mild.

than their VIRO level, Houpis and Valletti find that the MTAS prices should be higher in that case.

#### 2.2.2.4 The scope of industry relevant for B-R pricing principles: potential inclusion of the fixed network sector

Ramsey pricing is welfare maximisation in the small by concentrating on a single firm or a single industry. However, it was known from the beginning of the Ramsey pricing literature that this is legitimate only if the other industries are competitive, independent in demand and not under the control of the same regulator. Otherwise, adjustments have to be made. In the current case, interactions with the fixed network industry are potentially large, among others, because of increasing fixed-to-mobile substitution.[33] Also, the ACCC has been asked to advise the Minister on the structure of retail price controls in the fixed network telephone industry. Thus, in light of this role the ACCC would either have to view both industries under one umbrella or turn around and revisit fixed network pricing, once MTAS pricing is done.[34] A careful analysis of the interactions between the fixed and the mobile sector with regards to termination charges is therefore required.

### 2.2.3 Conclusions on the conceptual applicability of B-R pricing principles to MTAS

Boiteux-Ramsey pricing principles refer to welfare-maximising prices subject to a viability constraint on the regulated firm or sector. They are in principle the correct starting point for the regulation of MTAS charges. However, they have not been explicitly applied anywhere yet. The main arguments for the rejection include the perceived uncertainty about the relevant demand elasticities, the capture of fixed costs and part of the externality effects through non-linear pricing and other forms of price discrimination and the deviation of prices for other mobile services (and FTM prices) from their respective B-R levels.

On top of that comes a lack of good models in the B-R tradition to capture the competitive interactions in the mobile and fixed network markets involved. A number of B-R concepts have been developed outside strict monopoly markets. Models assuming that all relevant prices follow B-R principles achieve good efficiency results but their prices are not implementable because the regulator only controls the MTAS charge. In con-

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33 Including other markets in a Ramsey pricing problem would be efficiency enhancing even in the absence of cost and demand interactions between the industries. This is known as the principle of increasing the common tax base.

34 A seeming paradox of Ramsey pricing is that the inclusion of another unregulated output in the Ramsey formula increases total welfare. Thus, under Ramsey principles, more regulation is better than less. This is one of the justifications for global price caps.

trast, principal-agent models, in which only the MTAS charge needs to be regulated, are not really mature yet for application.

A prerequisite for the fruitful application of B-R pricing principles would be the presence of economies of scale at the optimal output level, because otherwise marginal cost pricing would be optimal in the absence of externalities. Given that TSLRIC would form the base for a practical application of B-R pricing, only fixed common costs would be reflected in inverse-elasticity mark-ups. The fixed common costs should not on average exceed 10-15 per cent of TSLRIC. This holds in particular, since the Australian mobile industry is highly mature so that economies of scale should matter fairly little.

While the textbook definition of market power relates to the ability of a firm to set prices above marginal costs, the relevant factor for regulation is the ability of the firm to exclude rivals and to make long-run economic profits. In that sense, Ramsey pricing does not necessarily reflect market power. Rather, the relevant competitive benchmark in the presence of scale economies is contestability. It is well known that Ramsey prices are compatible with or even implied by contestable markets. This, however, neither means that prices in the mobile sector are Ramsey prices nor that they are necessarily competitive.

If B-R prices are calculated and only the resulting MTAS charge is regulated all other prices are most likely going to deviate from their B-R levels. The exception would be if all the other markets are contestable. This is unlikely to be the case. Below, in Section 2.5, we discuss how the result relates to other imperfect pricing principles.

Since the ACCC is concerned with both the mobile and fixed networks and since the fixed and mobile markets interact, an appropriate Ramsey pricing analysis would have to include both sectors.

## 2.3 The trade-off between possible efficiency costs of termination surcharges and possible efficiency gains from subsidising mobile subscribers

This section treats the conceptual underpinnings of both the NERA analysis of “Measuring the net benefits of regulation” and of Hausman’s social valuation. The main difference between the two is that NERA looks at social surplus changes, while Hausman considers consumer surplus changes only.

### 2.3.1 Possible efficiency costs of termination surcharges

The efficiency costs from a surcharge on mobile termination result from the increase in price for calls to the terminating network. Given the lack of substitutes for mobile termi-

nation the size of these efficiency costs depends on the retail demand elasticity. The less elastic the demand for calling mobile subscribers the smaller will the efficiency costs be. There may be additional efficiency costs to the originating networks in the form of reduced profits if they cannot fully pass on the termination surcharges, while in this case the distortion from the price increase is less. If one neglects these latter costs the efficiency costs include consumer surplus losses by callers to the terminating network (from calling less or from no longer subscribing to telephone services) and by receivers of a reduced amount of calls. This is correctly characterised by NERA (pp. 13ff), who deliberately decide to neglect the value to receivers of incoming calls (p. 21). This decision can be important because of the size of this variable and because it could reduce the number of mobile subscribers by shifting inward the demand curve for mobile subscriptions. NERA (2004a, p. 21) argues that the value of incoming calls is just a scale factor under the "seemingly reasonable" assumption that the value of a call experienced by the calling party is proportional to that of the receiving party. We would agree. However, it calls into question Hausman's and NERA's important empirical assumption that the value of calls to marginal mobile subscribers experienced by FTM callers is equal to the average value of calls to all mobile subscribers. Because marginal subscribers value calls to themselves less than average, so would callers.

If one only considers consumer surplus changes the relevant cost basis does not matter. Under social surplus calculation, however, the results could differ between basing the surplus measurement on TSLRIC and marginal costs. In principle, as pointed out by NERA (2004a, p. 15), marginal costs are the correct yardstick. For the termination part in mature mobile networks the difference to TSLRIC should be small. In mature fixed networks, sunk costs may matter. However, TSLRIC in fixed networks are small as well. Overall, the difference between (long-run) marginal costs and TSLRIC should have little influence on the final results.

The efficiency costs of surcharges tend to increase at an increasing rate, meaning that surcharges create particularly high efficiency costs if prices are already above marginal costs. This effect is enhanced by double marginalisation through additional mark-ups downstream, although part of this effect is ameliorated because of the resulting smaller change in quantity.[35] For Hausman and NERA this property is irrelevant because, rather than determining optimal MTAS charges, they compare the welfare effects of current MTAS charges with those based on TSLRIC (12 cents/min.). Thus, they make an aggregate comparison of the efficiency costs and benefits from such a price change and not a comparison of the marginal costs and benefits.

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**35** For a graphical representation of the double-marginalisation effect see Carlton and Perloff (2000, p. 395).

### 2.3.2 Possible efficiency gains (and costs) from subsidising mobile subscribers

A surcharge on mobile termination leads to a reduction in some other mobile charges (and an increase in handset subsidies). We will discuss the mechanics and the extent of these price changes below in Section 3.2.4 under the heading of "waterbed effect". What is important here is that these price changes have welfare effects. On the mobile network operator side, termination charge reductions lead to reduced subscriber subsidies that tend to increase profits from subscriptions. This profit increase is not an issue for Hausman, who only looks at consumer surplus changes. It would, however, be an issue for NERA, who calculate social surplus changes but seem to totally neglect this amount. This is surprising, because they account for other profit changes. Alternatively, NERA could have eliminated mobile profit changes altogether under the assumption of a full waterbed effect that would have cancelled all profit effects on mobile operators.

The likely source of this confusion is that in their Figure 3.3, which shows the welfare effects of an MTAS charge reduction on the FTM market, NERA (2004a, p. 17) draws TSLRIC and allows for a calculation of profit reductions. Because the TSLRIC refer to both the mobile terminating operator and the fixed originating operator, the profit reductions arising from the price change from $P^0$ to $P^1$ accrue to both the fixed and the mobile operator. For the mobile operator there is a corresponding profit increase from the reduced subscription subsidy (due to the assumed waterbed effect) that NERA neglects to show. This is associated with a welfare gain (not shown by NERA) due to the fact that subscriptions are sold below their marginal costs and that the subsidy rate is reduced).

On the consumer side, subscription subsidies and lower calling prices lead to an increase in the number of mobile subscribers. FTM callers gain consumer surplus from calling these subscribers. As NERA and Hausman correctly observe, this gain can be approximated by the value of calling the marginal subscriber multiplied by the number of subscribers gained.[36] In addition, Hausman notes that the marginal subscribers themselves gain consumer surplus as do all the other mobile subscribers. Under a social surplus analysis, again profits matter so that we have to deduct the mobile operator's profit loss from the reduced subscription fees (etc.). If the fixed operator prices FTM calls above marginal costs there will also be a profit increase for the fixed operator. Furthermore, NERA (2004a, p. 20) argues that the demand for fixed subscriptions may increase due to the ability to call more mobile subscribers (while the demand for fixed subscriptions would decrease due to the higher FTM call charges). NERA and Hausman, however, neglect that the new mobile subscribers may have given up their fixed network subscription or make fewer calls from their fixed network phones. Rather,

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**36** NERA (2004a, pp. 18/19) discusses the option value of mobile subscriptions but decides not to include this item in empirical estimates.

NERA suggests that the elasticity of fixed line subscriptions to FTM prices and mobile subscriptions is "immaterially different from zero".

As NERA (2004a, p. 17) correctly points out, there will also be consumer surplus gains (and profit gains) from additional MTM calls made by the new mobile subscribers. This would also extend to MTF calls. Not included in Hausman's and NERA's analysis are potential consumer surplus effects from changed outgoing mobile call charges. Lower outgoing call charges can be expected to materialise because higher termination fees make gaining customers more attractive and lowering mobile call charges are one way of attracting new customers. On the other hand, termination surcharges on MTM call prices could move MTM prices in the opposite direction. As a result, on-net prices could decline, while off-net prices could increase.

The main factor for assessing possible efficiency gains and costs from subsidising mobile subscribers is the social value of additional mobile subscriptions. Hausman (2004, paragraph 66) opposes the ACCC's argument that the social value of additional subscriptions vanishes as mobile penetration increases. He objects to an aggregate analysis in favor of individual valuation. Hausman's correct statement here is based on the lack of substitutability of calls from one person or to one person by any other person. Thus, *on a per call basis* there is no a priori reason that new subscribers provide less social benefits (externalities) than do old subscribers. It is very likely, however, that new subscribers make and receive fewer calls than average old subscribers. What remains of the ACCC argument (and needs to be determined empirically) is that, as penetration increases, a given subsidy will generate fewer new subscribers and those new subscribers will make and receive fewer calls than the old subscribers. In contrast, in his empirical estimation, Hausman (FN 79) assumes that new subscribers receive the average number of FTM minutes per year.

Not included in Hausman's and NERA's analysis are efficiency costs from handset subsidies.

They treat handset subsidies as costs of subscription services or as customer acquisition costs. This neglects potential distortions in the handset market, which arise, when handset subsidies are paid in the competitive process as a means of keeping customers or attracting them from other mobile providers rather than attracting new customers to mobile services. In this case handsets may be replaced earlier than economically efficient, and there may be no net addition of mobile subscribers at all. Thus, if profits from termination surcharges are competed away this can well be rent seeking rather than productive competition.[37] As AAPT (June 2005, p. 9) points out, "the handset subsidy induces inefficient handset investment rather than the internalisation of any network externality". In contrast, Hutchison (2005a, pp. 9/10) points out that subscription

37 This issue is, for example, raised in the submission by Hutchison (2005a, pp.8/9).

subsidies may signal good quality and therefore attract first-time buyers. However, according to Hutchison, they are no longer necessary for that purpose after consumers have gained experience. At a penetration rate of 89 per cent such new buyers would be scarce and familiarity with mobile phones would be high.

The potential efficiency gains from subsidising mobile subscription themselves are a result of a trade-off. There is a first-best optimal amount of mobile subscription, which is defined (a) by the property that the social benefits of the marginal mobile subscriber equals the marginal costs of including this subscriber to the network and (b) by the property that the marginal rate of technical substitution (MRTS) between mobile and fixed network subscriptions (or more simply their marginal cost ratios) are equal to their marginal social benefit ratios, where benefits and prices refer to the respective service bundles. This is an optimality condition known from general equilibrium analysis and expresses the marginal optimality conditions that have to hold between sectors.

In a second-best analysis the costs of financing mobile subscription subsidies in the form of termination surcharges have to be set against the gains from subsidies. As a result, the (second-best) optimal subsidies are such that under criterion (a) the social benefits of the marginal mobile subscriber have to exceed the marginal costs of including this subscriber to the network by the marginal efficiency costs of termination surcharges necessary to subsidise this subscriber. Under a second-best approach criterion (b) requires that the marginal social cost ratios (including the costs of mobile termination surcharges and possibly fixed network universal service costs) of fixed and mobile subscriptions would have to be equal to their marginal social benefit ratios. Because they only concentrate on the comparison of two states neither Hausman nor NERA is concerned with such an optimum.

CRA (2004, p. 43) maintains that, given the uncertainty about the optimal MTAS level, it is preferable for the ACCC to err in favour of 'too' high rather than 'too' low prices. The argument is that too high prices are compensated by the welfare gain from additional mobile subscription and usage. In this vain, it argues that systems like the US with low termination charges (due to the use of the RPP principle) have performed poorly in the mobile sector. This, however, assumes that more mobile subscription is always better than less even if it is paid for by fixed network subscribers (and a reduction in the number of those subscribers).

A problem noted in the above discussion of the Hausman and NERA analyses is that there are a lot of effects that have to be taken into consideration and that interact with each other. Both the Hausman and NERA analyses are incomplete in this respect. In addition, it appears that they consider the effects one at a time. However, the effects occur simultaneously and interact with each other. This requires an analysis that is much more in the spirit of the B-R approach. Furthermore, the consideration of several services (subscriptions, FTM calls and mobile outgoing calls) with interdependent de-

mands requires considering consumer surpluses as line integrals, for which the integrability conditions have to hold. The latter is unlikely because of the externality effects.

The welfare effects of subsidising mobile services can therefore lie in four ranges:

1. Too little mobile subscription according to both criteria (a) and (b). In this case more subsidisation increases benefits (probably at a decreasing rate).

2. Too little mobile subscription according to criterion (a) and too much according to criterion (b). In this case, the improvement under criterion (a) has to be traded off against the deterioration under criterion (b). The higher the subsidy, the more likely this will become negative.

3. Too much mobile subscription according to criterion (a) and too little according to criterion (b). In this case, the deterioration under criterion (a) has to be traded off against the improvement under criterion (b). The higher the subsidy, the more likely this will become negative.

4. Too much mobile subscription according to both criteria (a) and (b). In this case more subsidisation increases costs (probably at an increasing rate).

Case 1 would favour termination surcharges. Case 2 would favour termination surcharges and policies favoring fixed network subscription, such as fixed network universal service policies. Case 3 would advise against fixed network universal service policies and against termination surcharges. Case 4 would advise against termination surcharges. It may or may not favor fixed network universal service policies at the same time.

Since mobile termination charges were high in the past and subsidies from mobile termination high, it is not unlikely that Australia is currently in range 2, 3 or even 4 so that the benefits from continuing subsidisation are themselves questionable.

### 2.3.3 Conclusions

Under an optimisation approach the net marginal benefits from subsidising subscription have to equal the marginal welfare costs of termination surcharges. In contrast, Hausman and NERA do not determine an optimum but rather only compare two states described by different termination charges and assumptions about a full waterbed effect and pass-through of termination charge changes in FTM prices. They therefore compare an aggregate welfare (or, in the case of Hausman: consumer surplus) loss from a termination surcharge with an aggregate welfare (consumer surplus) gain from subscriber subsidies. This is methodologically correct if the choice is only between two states.

The efficiency costs from a surcharge on mobile termination result from the increase in price for calls to the terminating network. There may be additional efficiency costs to the originating networks in the form of reduced profits if they cannot fully pass on the termination surcharges, while in this case the distortion from the price increase is less. If one neglects these latter costs the efficiency costs include consumer surplus losses by callers to the terminating network and by receivers of a reduced amount of calls.

The efficiency costs of surcharges tend to increase at an increasing rate, meaning that surcharges create particularly high efficiency costs if prices are already above marginal costs. This effect is enhanced by double marginalisation through additional mark-ups downstream.

On the consumer side, possible efficiency gains from subscription subsidies and lower calling prices derive from an increase in the number of mobile subscribers. FTM callers gain consumer surplus from calling these subscribers. As NERA and Hausman correctly observe, this gain can be approximated by the value of calling the marginal subscriber multiplied by the number of subscribers gained. The main factor for assessing possible efficiency gains and costs from subsidising mobile subscribers is the social value of additional mobile subscriptions, which Hausman argues to be as high as for average subscribers.

There will also be consumer surplus gains (and profit gains) from additional MTM calls made by the new mobile subscribers. This would also extend to MTF calls. Not included in Hausman's and NERA's analysis are consumer surplus gains from possibly reduced outgoing mobile call charges. However, while MTF charges are likely to decrease, the effect of increased termination charges on outgoing MTM charges is theoretically open because a potential waterbed effect (as discussed in section 3.2.4) would reduce such charges, whereas the increased termination charges on outgoing MTM calls would increase such charges.

Not included in Hausman's and NERA's analysis are efficiency costs from handset subsidies. They treat handset subsidies as costs of subscription services or as customer acquisition costs. This neglects potential distortions in the handset market, which arise, when handset subsidies are paid in the competitive process as a means of keeping customers or attracting them from other mobile providers rather than attracting new customers to mobile services.

In a second-best analysis the costs of financing mobile subscription subsidies in the form of termination surcharges have to be set against the gains from subsidies. As a result, the optimal subsidies are such that the social benefits of the marginal mobile subscriber have to exceed the marginal costs of including this subscriber to the network by the marginal efficiency costs of termination surcharges necessary to subsidise this subscriber. Furthermore, under a second-best approach the marginal social cost ratios (including the costs of mobile termination surcharges and possibly fixed network univer-

sal service costs) of fixed and mobile subscriptions would have to equal to their marginal social benefit ratios. Because they only concentrate on the comparison of two states Hausman and NERA fail to meet such an optimum.

## 2.4 Hausman's issue of transfers arising from price reductions in a competitive sector that benefit a non-competitive sector

Hausman (2004, paragraph 47) claims that a reduction in MTAS charges will create a transfer from the competitive mobile sector to the non-competitive fixed network sector. This would, in Hausman's view, hurt the consumer interests, because fixed network subscribers would not benefit to the same extent that mobile subscribers would be burdened. Furthermore, Hausman seems to see it as a competitive distortion between the fixed and mobile sectors.

### 2.4.1 No price regulation in the non-competitive sector

Although he argued at an earlier point of his analysis that MTM calls and FTM calls share the same market, Hausman (2004, paragraph 46) maintains that Telstra is able to exercise market power in the FTM market (while the MTM market is competitive!). He continues arguing that, by reducing MTAS for FTM calls, the ACCC will create a transfer from the competitive mobile sector to the non-competitive fixed network sector (paragraph 47). The main argument here is that, due to persistent market power in the fixed network sector only part of the MTAS price reduction is handed on to FTM callers, while part of it is retained by fixed network operators (Telstra in particular) in the form of higher profits. At the same time, the mobile operators' profits will decrease.

If one takes market share as the criterion of market power, Telstra has market power in the market for domestic long-distance calls, but the market share has been decreasing from 70 per cent in 2002 to 65 per cent in 2004 (ACCC, 2005, p. 22). This should extend to FTM calls (p. 27). There appear to exist high margins for long-distance calls (p. 23). There exists price discrimination for FTM calls, "although" FTM MTAS charges are quite uniform (p. 26). For example, FTM residential calls are on average 27 per cent higher than (large) business calls (p. 27). The spread seems to have grown in recent years (p. 27). The ACCC considers the FTM market as being far from effectively competitive (p. 27) and prices seem to be quite profitable (p. 28).

### 2.4.2 Price regulation in the non-competitive sector

#### 2.4.2.1 Cost-based regulation

Under cost-based regulation cost reductions for FTM calls from an MTAS charge reduction would be passed on fully to FTM callers, although with a regulatory lag. Since cost-based regulation is not applied in Australia, this case is only of theoretical importance.

#### 2.4.2.2 Price cap regulation

In the Australian fixed network sector Telstra is regulated with respect to its end-user services under a CPI-X approach, where line rentals are in one basket, while calls – including fixed-to-mobile calls – are in the other basket. Provided call termination is not treated as a Y-factor that leads to an automatic pass-through by formula, this has the following consequences for the pass-through of changes in the MTAS:[38]

(a) Under a binding price cap in the call basket there would be no pass-through of MTAS charge reductions in the current price control period. Rather, a pass-through in the next price control period can be expected.

(b) Under no binding price cap in the call basket there would be some pass-through of MTAS charge reductions, the amount of which would mostly depend on the degree of competition. A complete pass-through could be reached if there were effective competition.

Hausman (2004, FN 54) argues that, given Telstra's price cap regulation, not even part of the cost decrease from a reduction in MTAS charges will be passed on to FTM callers. This argument only holds if price caps in the call basket are the constraining factor rather than competition. However, it appears that in the past prices in the call basket were substantially below price caps. For example, Telstra carried-in 7.4 percentage points as a credit from the previous price control period into the current one (ACCC, 2004, p. 74). This indicates that either the caps were above monopoly prices or that competition was sufficiently fierce. In the former case, one could expect roughly 50 per cent of the cost reduction to be handed on as price reductions, while in the latter case the pass-on could reach 100 per cent.[39] For the past, the pass-through could be calculated from the difference between cost reductions experienced then (in the form of productivity increases and reductions in MTAS charges relative to the CPI) and the result-

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**38** If MTAS charges were treated as a Y-factor that automatically leads to an adjustment of the price cap a full pass-through could be expected under fairly broad circumstances. This does, however, not hold for Australia.

**39** A 50 per cent pass-through results under monopoly with linear demand and constant marginal costs, something that always holds true approximately for small price changes.

ing price reductions. For the future, carry-in credits will no longer be available so that price caps will more likely be binding, once the regulated carrier has been forced by competition to lower its prices for a regulatory period below the level allowed by price caps.

### 2.4.3 Conclusions

Both in the absence of price regulation and under price cap regulation, it is likely that MTAS charge reductions will not translate into FTM price reductions of equal magnitude. Under binding price caps there may be a long lag for any FTM price reductions to occur. However, price caps currently do not seem to constrain Telstra's FTM pricing behaviour. It seems to be more constrained by competition, so that at least a partial price adjustment can be expected.

## 2.5 Alternatives to B-R pricing

### 2.5.1 Non-linear and optional pricing

A criticism by Oftel of the B-R pricing approach has been that it does not sufficiently capture the ability of mobile operators to price discriminate. This is not a criticism of B-R pricing principles per se, because these can also be extended to more sophisticated pricing methods. In that case, inverse elasticity mark-ups may vanish if no potential subscribers are excluded. The rationale is that mobile operators can use fixed fees to raise the required revenues and price usage at marginal costs if this excludes nobody. Since pricing at marginal costs leaves no surplus to be generated, the operators can this way maximise their net revenues for given consumer benefits. Conversely, if profits are competed away such pricing maximises consumer surplus. Continued growth in mobile subscription (and the claimed externality factors), however, suggests that some potential subscribers are definitely excluded. The inverse elasticity rule then reappears in a more complicated form. However, the mark-ups are on average smaller than without the more sophisticated pricing. Since optional pricing is a common practice in mobile markets in Australia, Ramsey mark-ups would have to be smaller accordingly.

### 2.5.2 Equi-proportional mark-ups (EPMU)

In the past, the practical inadequacies of B-R pricing have led many regulators to the adoption of equi-proportional mark-ups (EPMU). Before one can follow this suggestion, it has to be established that EPMU are likely to be superior to imperfectly implemented B-R pricing principles. In order to establish this, one needs to analyse EPMU in relation

to the problems identified for implementing B-R pricing principles. They are (a) deviations for the unregulated prices from their B-R levels, once MTAS are regulated at their B-R levels, (b) uncertainty about sizes of elasticities (e.g., WIK/EAC, 1994) and (c) misspecification of common fixed costs.

Ad (a): While the Rohlfs principal-agent model suggests that the firms will set unregulated prices well away from their B-R levels and Houpis and Valletti suggest that, in the presence of a sufficiently large mobile subscription externality, B-R prices for MTAS should actually be increased relative to their B-R level to take care of this, Sandbach (2004) seems to be the only one to compare pricing behaviour under B-R pricing for MTAS with pricing behaviour under EPMU. He concludes that B-R pricing is likely to improve on EPMU if one takes the price reactions in other markets into consideration.[40] Sandbach's crucial assumptions are that mobile industry profits tend to zero over time and that all mobile outputs (besides MTAS) are produced under similar competitive conditions. These questionable assumptions, which do not seem to characterise the Australian mobile sector, clearly cast some doubt on Sandbach's results. In our view, the assessment of EPMU under the principal-agent approach depends highly on whether the B-R price for MTAS under the VIRO is likely to be closer to the principal-agent price for MTAS than is the EPMU. If the Houpis-Valletti results are empirically realistic for the mobile sector this will hold as long as the VIRO MTAS price is higher than the EPMU MTAS price, because then the principal-agent MTAS price always has to exceed the VIRO MTAS price. This, however, would depend on the presence of a significant mobile subscription externality.[41]

Ad (b): As Optus (2005, p. 10) correctly observes, EPMU can only be strictly welfare maximising if there were equal super-elasticities across services. Also, the CRA and Frontier reports argue that the use of equal-proportional mark-ups as a best guess of super-elasticities is likely to be worse than elasticities based on even highly imperfect econometric estimates. However, it could be that the range of elasticity estimates is so large that B-R prices based on biased estimates are worse in terms of the welfare implications than EPMU. Provided that the elasticity range is wide and provided elasticities that are implied by EPMU do not fall significantly outside this range, EPMU can substantially facilitate the decision-making process, reduce regulatory gaming and save legal troubles without being too far off B-R pricing.

Ad (c): We have repeatedly raised doubts about the claimed size of fixed and common costs in the mobile sector. To the extent that these doubts are justified, mark-ups reflecting these costs would not be for scale economies but rather for cost mis-

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40 Newbery (2004, p. 11) conjectures without any formal analysis that setting MTAS charges at the Ramsey level will move the other mobile prices closer to their Ramsey levels as well.

41 We are here not concerned with the implementation of the principal-agent model, which is currently out of question. Rather, we are here only using the theoretical result of Houpis and Valletti that the MTAS charge under principal-agent pricing would be above the price according to "simple" B-R principles.

measurement. To that extent, the costs would actually be proportional to output and therefore justify proportionate mark-ups. Thus, if all fixed and common costs were mis-specified EPMU would be the correct approach. In particular, if the assumed common and fixed costs are in fact variable so that the technology exhibits approximately constant returns to scale then a proportional mark-up would be fully appropriate.[42] Thus, if the claimed common fixed costs are neither common nor fixed but rather proportional to output, then equi-proportional mark-ups would be justified. However, if true common (fixed) costs are sizeable there remains a case to be made for B-R pricing principles for this remainder. Thus, CRA (2004, p. 47) is wrong that EPMU is "an entirely arbitrary approach". As long as "fixed and common costs" are not correctly measured, there is a place for EPMU. If, as we suspect, true fixed and common costs exist in the mobile sector but are smaller than claimed a compromise approach could be to first apply EPMU to the extent of suspected variable costs and then B-R pricing principles to the remainder, which would have to be established empirically. As noted above, a large fraction of what are usually termed "fixed and common" costs are likely to vary proportionally with individual outputs so that the cost allocation problem that requires the use of B-R pricing principles would be quite small. Under these circumstances EPMU and correct B-R pricing are likely to lead to very similar results.

### 2.5.3 Conclusions

Nonlinear and optional prices reduce the requirement for raising fixed common costs from mark-ups on marginal costs or TSLRIC. They are economically efficient and a common practice in Australian and other mobile markets.

EPMU are in practice superior to the explicit application of B-R pricing principles

- if the unregulated prices would in practice deviate substantially from their B-R levels, once MTAS are regulated at their B-R levels,
- if uncertainty about sizes of elasticities is high and
- if a large fraction of other costs is mis-specified as fixed common costs.

We believe that all these conditions are fulfilled in the Australian mobile sector. Furthermore, the application of B-R pricing principles is likely to generate substantial procedural delays and costly legal disputes.

As long as "fixed and common costs" are not correctly measured, there is a place for EPMU. If, as we suspect, true fixed and common costs exist in the mobile sector but are

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42 Empirically, this could be tested by attempting to relate the claimed fixed and common cost items to the variations in output.

smaller than claimed a compromise approach could be to first apply EPMU to the extent of suspected variable costs and then B-R pricing principles to the remainder.

## 2.6 The relevance of externalities for MTAS pricing

### 2.6.1 The concept of externalities

In case of consumption externalities the utility functions of customers are interrelated in the sense that the consumption decision taken by one consumer imposes a cost or a benefit on one or more other consumers and this benefit is not paid for by the beneficiaries. Since such costs or benefits do not affect the consumer who makes the decision, the latter in general does not take this cost or benefit into account when making his or her consumption decision. Therefore, the presence of externalities can lead to sub-optimal decisions if all the effects related to a consumption decision would be taken care of. To achieve economic efficiency economists seek for pricing structures which are adjusted to internalise such externalities if they are not internalised otherwise. In the case of a positive consumption externality the level of consumption will be below its efficient level. This result follows from the fact that consumers will consume up to the point where their marginal private benefit is equal to the price. At the efficient level of consumption, however, the marginal cost should equal the marginal social benefit which is higher than the marginal private benefit due to the externality.

#### 2.6.1.1 Network externalities

In a general definition or description the so-called network externality describes the benefit existing (fixed and mobile) subscribers derive from calling and being called by new mobile subscribers and which is not taken into account in deciding on mobile subscription. A person deciding to become a mobile subscriber will only take into account the benefit that she obtains from calling and not the benefit her decision generates for others. This generates an external benefit. In this case a person may not derive enough private benefits to cover the price of subscription even though economic welfare or social benefits would be enhanced if that person would join the network. In that case the number of subscribers or penetration would be below its (socially) efficient level.

The network externality as defined above has several aspects or dimensions:

(1) Major parts of the network externality are directly related to usage. The change in the volume of FTM calls from a change in the number of mobile subscribers can be identified as a usage related network externality and be measured by the corresponding elasticity. The ACCC names this type of externality as the fixed-line externality.[43]

(2) There is also a usage related network externality in the change in the volume of mobile outbound calls from a change in the number of mobile subscribers. Different from the effect referred to under (1) this is not a pure externality effect. Only the change in the number of calls generated by parties other than the new subscribers can be attributed to the network externality.

(3) The willingness to become a subscriber to a certain degree depends on the subscription of other users to the same network. One reason to become a subscriber relates to the ability to communicate to certain other users. The more subscribers join the network, the more valuable subscription becomes to other customers. More people can be reached and contacted than before. New subscribers decide to join the network because there is a larger number of people to whom they can make a call or from whom they can receive a call.

(4) There may also be an option value involved in mobile subscription. The option value describes the externality that both mobile and fixed subscribers benefit from having the option to call new mobile subscribers even if they rarely (or even never) exercise that option. Rohlfs[44] regards the option externality as probably significant, but also probably small relative to the network externality associated with usage. The significant share of prepaid customers shows that even marginal users subscribe largely in order to use mobile services rather than to create an option for themselves.

#### 2.6.1.2 Call externalities

Besides externalities related to subscription there are externalities related to calls. Both the calling and the called party derive utility from communicating to each other and not only the calling party. If only the calling party pays, which is the general pricing principle in Australia, it is only the welfare of the calling party which determines the willingness to pay for a particular call. The benefit of the called party is ignored. In that sense, call externalities do exist. Albon and York (2005a) name this externality in the mobile context as the FTM call-receipt externality. While network externalities refer to the benefits

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**43** See section 1.3.3 and ACCC (2004), p. 170.
**44** Rohlfs (2002), Annex A, p.7.

fixed and mobile users receive from calling new mobile subscribers, the call externality refers to the benefits a mobile subscriber receives from being called. In that sense both types of externalities are usage related. Call externalities imply that the number of calls is less than would be appropriate according to normal welfare standards. Call externalities are often neglected by assuming that call externalities are (totally) internalised.

Indeed usual communication patterns and behaviour internalise a significant percentage of call externalities. Communication normally is not a one-way road. The more people communicate with each other, the more probable is the outcome that the number of calls from both sides is close to equal, which roughly internalises the externalities associated to their calls. On the other hand, for calls from persons outside the called party's usual community of interest uninternalised calling externalities may still be significant.[45] In so far as that is not the case, the pricing system may improve welfare. Related to mobile termination rates, Armstrong (2002) has derived the following result: if mobile subscribers derive a benefit from incoming calls, their termination charges should be set below costs in order to encourage calls from the fixed network. Or to put it into other terms: A too high price for the MTAS would lead to a sub-optimal number of calls to mobile subscribers. Although Rohlfs[46] assumes that major parts of call externalities will be internalised, his model takes care of such externalities. For that purpose Rohlfs varies the cross elasticities of subscription demand with respect to usage prices. He introduces a usage or call externality factor to allow for call externalities over and above those embodied in the cross elasticities of demand. He finds that even small externality factors of this kind have a significant impact on optimal usage prices and termination charges. In our view, the whole termination problem and the difference between termination charges under CPP and RPP could result because call externalities are not efficiently internalised.

### 2.6.2 Internalisation of externalities

If externalities are internalised totally or partially by market participants there is no need for corrective pricing to generate the welfare effects associated with externalities. Internalisation reduces the remaining magnitude of the externality. Competitive pressure can spur MNOs to internalise external benefits that accrue to mobile subscribers. Also consumers can develop a behaviour and activities that result in internalisation.

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**45** See Coase (1960).
**46** See Rohlfs (2002) p.4 f.

#### 2.6.2.1 Internalisation by consumers

Consumers internalise network externalities themselves when they share certain costs of subscription. Some consumers may contribute to the costs of acquiring mobile handsets and / or pay the relevant subscription for others in part or in total. Such behaviour can be expected when consumers have substantial community of interest, e.g. parents for their children, children for their parents, firms for their employees; a business may get mobile phones as an accommodation to its customers. Subscribers may also take account of the utility by others when two customers subscribe to a mobile network primarily to communicate with each other. In cases where the external benefits to any single subscriber are not very large, but the benefits to all existing subscribers are quite large, the network externality is often not easy to internalise. In such cases the transaction costs may be too high to internalise externalities by practical ways.

#### 2.6.2.2 Internalisation by MNOs

The most important instrument of MNOs to internalise network externalities is to offer a broad set of non-linear, multi-part or optional retail tariffs. Such pricing structures enable MNOs to offer low subscription tariffs. Given the consumption patterns of marginal subscribers, such pricing structures of low subscription rates and higher usage charges are also relatively targeted to address marginal subscribers. The mobile industry has been quite successful in developing complex pricing options to differentiate its pricing structures. Oftel[47] mentions the case that MNOs will even encourage some internalisation for off-net calls because there is a positive benefit for subscribers of an MNO when another MNO adds a marginal subscriber which generates reciprocal benefits. In practice, there are cases and situations where MNOs subsidise new subscribers, e.g. those which do not reach a positive cash flow over their customer life time. Such behaviour can be interpreted with the exploitation or internalisation of network externalities. MNOs have a long tradition in segmenting customers. Even the successful introduction of prepaid services indicates that demand segmentation is possible and successful. It is not only this line of segmentation which is relevant. There are a number of different pre-pay and post-pay tariffs in place indicating that MNOs have a fine level of granularity in segmenting customers.

### 2.6.3 Externalities and efficient pricing

We have developed the argument and reasoning that (in particular) network externalities may require some form of subsidising subscription to internalise externalities and to reach welfare maximising pricing structures. Corrective pricing therefore firstly means to

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**47** See Oftel (2003b), p. 270.

set the price of subscription below the relevant cost of subscription. The price of subscription in the real world of mobile service pricing can have several elements. The major ones are: one-off charges for subscription, the price of handsets and the price of monthly rentals. Each of these service or pricing elements individually or collectively can be used and is being used in practice as a means of subsidising subscription. The most prominent instrument of subsidisation in the discussion of externalities, however, is the subsidisation of handsets although the other two instruments are theoretically and practically of similar importance. The forms of subsidising subscriptions in practice and the welfare effects of financing subsidies can outweigh the positive welfare effects of subsidising the subscription of marginal subscribers.

It is important to note in this context that major (or perhaps even most) parts of subsidising subscription and handsets in particular can not be attributed to exploiting externalities in a welfare economic sense. Handset subsidisation as applied by MNOs is not only a means of getting marginal (non-)subscribers to the network, it is also used to keep customers tied to a particular mobile network or to motivate customers to switch from one network to another. In this capacity, handset subsidisation is a competitive instrument in the competition for subscribers which has nothing to do with getting welfare optimal levels of penetration. There is no welfare gain involved when a handset subsidy motivates a subscriber of mobile network A to become a subscriber of mobile network B. Externalities are only relevant if a handset subsidy motivates a customer which currently does not subscribe to any mobile network to become a subscriber. The same holds for subscribers which can be motivated by a handset subsidy not to step away from mobile subscription. From a welfare point of view it doesn't matter to which mobile network the new customer subscribes. One very rough indicator for the magnitude of handset subsidies not addressed to new subscribers is the share of handset replacement. For the Australian market Albon and York (2005b, p 13) report numbers of the Australian Mobile Communications Association, which suggest that at least 70 per cent of new handsets involved replacement rather than equipping a new mobile subscriber with a handset. This number implies that major parts of handset subsidies are used in Australia as a competitive tool for customer retention and customer transfer and not as means to drive overall industry penetration. The high degree of handset subsidisation in the mobile industry[48] and the high degree of churn (partially induced by the high degree of handset subsidies) is more an indicator of imperfect competition in the mobile retail markets. It is therefore not appropriate to associate the level of handset subsidisation observed in the market to the externality effects. Excessive handset subsidies are more an indication of an economic waste of resources because of the cost of churn and the uneconomic use of handsets by subscribers.

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48 Based on Telstra data for the year 2003/04 Albon and York (2005b) calculate the industry-wide handset subsidies of over $600 million in 2003/04. Telstra reported handset subsidies of 81 per cent of the handset sales.

In general one may look at taxation approaches to finance such welfare enhancing subsidies. In theory, lump-sum taxes may even generate revenues without generating efficiency losses. As far as other taxes are concerned revenue generation by taxation has the advantage that the larger the number of goods and services from which revenue is raised to fund subsidies, the smaller will be the deadweight loss. There is, however, at least one major argument against external financing of subsidies to internalise consumption externalities: Because the ACCC cannot impose taxes on the rest of the economy it has to apply the next best alternative within its powers. Corrective pricing to recover the cost of relevant subsidies therefore means and requires setting usage prices above costs. Because fixed network users also benefit from increased mobile subscription it is appropriate and efficient that fixed network users may contribute to the relevant subsidies by paying termination charges above costs ignoring countervailing effects at this stage. On the other hand termination charges below cost help to internalise call externalities.

A welfare model which determines efficient Ramsey prices including externality effects balances in a simultaneous way the trade-off between the benefits (or welfare gains) from price corrections to take care for externalities (by subsidising subscription) and raising the price of other services to fund the subsidy. Compared to a scenario in which the subsidy is to be funded outside of the model, second best Ramsey prices for subscription will be higher. A properly defined Ramsey model also "allocates" the costs of the subsidies for the subscription not only to the mobile termination rate but also to all other services (including mobile originated calls, data services and subscription) supplied by MNOs at amounts which depend on the relative and relevant elasticities of each service. It would not be an efficient outcome if the entire subsidy were financed by the MTAS charges.

Another aspect of proper modelling needs to be mentioned here. The cost of handset subsidies and retention measures to internalise network externalities which are financed by externality surcharges cannot at the same time be included in the LRIC of certain services and the common costs. This would lead to a double counting and allocation of certain costs.

### 2.6.4 Targeting of marginal subscribers

Positive welfare effects of network externalities are only related to marginal subscribers. Subscription should only be subsidised (if at all) to those (marginal) customers to become or remain mobile subscribers. Those marginal subscribers are defined as those subscribers who would not join or remain on the network in the absence of a subsidy. There are no positive welfare effects associated with subsidies provided to infra-marginal subscribers, those who are already subscribers and their subscription does not

depend on the existence of a subsidy. Subsidies provided to infra-marginal customers do not generate external benefits to existing subscribers.

Subsidies to infra-marginal subscribers are, however, not welfare-neutral as often assumed. Instead, they have a negative impact on welfare due to the need to finance the subsidy and the welfare distortions associated to financing, e.g. by overpricing termination charges.

Targeting subscription subsidies therefore becomes a key issue in determining the optimal size of a required subsidy. The theoretical approach presented in section 2.6.3 and Figure 3-1 already show that targeting subsidies to marginal subscribers can result in fractions of subsidies compared to the case that targeting is not possible and subsidies have to be provided to all infra-marginal and marginal subscribers. These theoretical results are supported by the empirical results of Rohlfs (2002) for the UK. As shown in Table 2-1 depending on the assumptions on targeting the optimal externality surcharge can vary by a factor of more than ten.

Table 2-1: Externality surcharge calculations in the UK

| Source | Description | Optimal surcharge |
|---|---|---|
| Rohlfs targeting model | Incorporates ability of MNOs to distinguish marginal and infra-marginal subscribers through price discrimination | 0.06 ppm |
| Rohlfs principal-agent model | Incorporates MNOs sub-optimal use of higher mark-ups on termination | 0.02 ppm |
| Rohlfs no targeting model | A linear pricing model (no price discrimination) with some internalisation of externalities by MNOs assumed | 0.66 ppm |
| Rohlfs model – reduced internalisation | Reduces assumptions about amount of externality internalised by MNOs (increasing the usage cross-elasticities) | 0.90 ppm |
| Externality surcharge in the UK | Ofcom's conclusion on externality surcharge | 0.5 ppm |

Source: Ofcom (2004), p. 165 and p. 171.

Price discrimination enables MNOs to target subsidies to marginal subscribers. Perfect discrimination if feasible would result in the most economically efficient subsidy. This would be achieved via targeting of individual marginal subscribers. This may be an unrealistic scenario. The opposite extreme scenario may be that MNOs are only able to charge the same price to all subscribers. Both scenarios should be unrealistic assumptions describing the effective possibility of MNOs to target subscribers. It may be assumed that MNOs are able to separate the group of marginal from the group of infra-marginal subscribers, but may be unable to differentiate among the group of marginal subscribers. MNOs may also be unable to completely separate both customer groups.

If targeting of subsidies to marginal subscribers occurs the appropriate subsidy is significantly lower compared to a scenario where targeting is not possible or exercised. The lack of the ability to target does not generally imply that no subsidies are appropriate. Once again the welfare costs of raising the surcharge must be balanced against the potential benefits that a surcharge will generate. When MNOs are unable to target marginal subscribers that increases the probability that the welfare losses of the subsidies exceed the benefits generated by them.

MNOs are able to separate out marginal from infra-marginal subscribers by offering a variety of tariff packages and by offering certain types of subsidies or handsets only to (current) non-subscribers. Marginal subscribers are generally thought to have lower usage. They might then be targeted by offering relatively low usage charges for an initial set of calls and relatively high prices at higher call volumes which makes it unattractive for high-volume customers to subscribe to such a tariff package. Rohlfs (2002) concludes that MNOs have substantial ability to internalise externalities through price discrimination but fall considerable short of perfect price discrimination. The arguments presented by Optus (2005, para 4.25) against its ability to target are not convincing. MNOs are able to offer special or promotion tariffs for (current) non-subscribers. It is true as Optus claims that not all low-volume users are marginal subscribers. It is, however, also true that the call volumes of new subscribers are on average lower than those of existing subscribers. Optional tariffs for low-volume users therefore remain an instrument for targeting marginal subscribers.

### 2.6.5 Externalities and reciprocity between mobile and fixed networks

We have discussed so far the externality effects with regard to mobile subscription. Similar to mobile network externalities there are also externality effects associated with fixed network subscription. They can be theoretically analysed and empirically identified in the same way as mobile network externalities. For decades these externalities have been the reason for subsidising access from call charges. Due to liberalisation many telephone companies have to a great extent (with or without regulatory pressure) rebalanced their rate structures such that access is charged at or close to a cost-based level.

There is also a long tradition in Australia to subsidise fixed-line access and to finance the subsidy by access deficit contributions ('ADC') imposed on interconnection charges. The ACCC has, however, increasingly seen the ADC as a significant distortion to competitive and efficient outcomes which should be removed from access prices as soon as practicable. In 2003 the ACCC[49] decided to remove the ADC over a three-year glide path approach. This will mean that by 2006-07 PSTN O/T access prices should be based solely on TSLRIC+ and no longer entail an ADC component.

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**49** ACCC (2003).

In our context financing mobile subscription subsidies by means of FTM prices above costs would have a negative impact on fixed-line subscription. Overpricing FTM calls to increase mobile subscription would at the same time due to the fixed-line externality decrease fixed-line penetration.[50] Such externality effects do not simply balance out. That is more an empirical question and of the relative amount of mobile and fixed-line elasticities and the marginal costs of subscription. It remains a fact that any meaningful welfare analysis has to estimate the effects of both externalities and it remains a matter of empirical fact whether the reciprocity of network externalities balances out the welfare effects and therefore the reasoning of subsidising mobile penetration.

Empirical analysis normally identifies low price elasticities of fixed-line subscription and relatively high mobile subscription price elasticities. At the same time we can observe a gradually increasing trend to substitute fixed access lines by mobile subscriptions. The number of telephone users which give up their fixed-line subscription and become mobile-only users is increasing. Although there seem to be indications that fixed-mobile substitution has reached a lower level than in Europe and in Asia, it is also an increasing reality in Australia.[51] While mobile-only homes are as high as 33 per cent in Finland and Portugal with a 15 per cent average across Europe, the corresponding number for Australia is estimated to 6 per cent. The currently relative lower level of fixed-mobile-substitution gives reason to assume that this process will accelerate in the next few years in Australia. Fixed-line penetration is slightly decreasing in Australia[52] while mobile penetration is still expected to grow.[53] The average decline in access lines subscriber numbers amounts to 3 per cent in West-Europe, while Telstra's access line subscriber numbers declined only 1.6 per cent.[54] Mobile penetration in Australia has reached around 89 per cent[55] of population, whilst fixed line penetration is approximately 57 per cent of population.[56] Because of the different communication situations of using a mobile or a fixed-line connection, these penetration rates cannot be compared directly. The figures indicate, however, a higher penetration rate for mobile than for fixed line networks on the basis of personal communications. We believe that the increasing trend for substitution in favour of mobile networks, network externalities should be more of a policy concern for the fixed network than for mobile networks. In any case, taking account of network externalities for one type of network whilst ignoring it in another distorts competition between these two types of networks. The current trend of substitution gives less rationale for regulators to tax fixed network users (via higher ter-

50 By stating a fixed-line penetration of 100 per cent Hausman (2004, at 62) is simply ignoring the fixed-line externality effect and ignoring the ongoing process of fixed-mobile substitution.
51 See Communications Day, August 23, 2005.
52 Telstra's number of SIOs has fallen slightly, having peaked at 10.40 million at 30 June 2002.
53 See the forecast of IDC (2005).
54 See Communications Day, August 23, 2005.
55 As of 31.12.2004 and as reported by IDC (2005), p. 2.
56 ACCC estimate, based on Telstra's reported 10.12 million fixed SIOs as at 30 June 2005, its estimate of market share of 89 per cent and a population of 20 million.

mination rates) in favour of increasing mobile penetration at levels which are already at saturation.[57]

57 See Bomsel et al. (2003), p. 24.

# 3 Methodological Analysis

## 3.1 B-R pricing approach

### 3.1.1 Methodological approaches

Both Charles River Associates (CRA 2004) and Frontier (2004) model prices based on the simple Boiteux-Ramsey (B-R) principle. This means that they determine prices under the premise that social surplus derived from the provision of services is maximised subject to a zero-profit constraint for the companies concerned. Both CRA and Frontier model only mobile sector services and exclude any fixed sector services except for fixed-to-mobile calls. The prices modelled are retail prices that are supposed to apply to the services provided by all MNOs in Australia, not only to those provided by a particular MNO. The price for the MTAS is then to be obtained by deducting from the retail price for fixed-to-mobile calls the retention by the fixed operator. Furthermore both use linear forms for the demand functions underlying the modelling. As regards these basic aspects, both consultants thus make the same choices. This means that their general methodological approaches can be discussed and critically assessed together. Differences between them appear at the level of the concrete empirical implementation and are addressed later under Section 4.2.

### 3.1.2 Critical discussion

(1) Application of the simple B-R principle:

The focus of the modelling is on the prices for MTAS and the result regarding this service is used to support the requests of the two MNOs to add particular mark-ups on the LRIC of this service where these mark-ups are higher than would result for example from applying an equal proportionate mark-up. Nothing in either of the consulting firms' justification for using the approach refers to how the other services are actually to be priced. For the modelled price for the MTAS to be justified in terms of the B-R principle, the prices for all the other services would also have to be set at the calculated levels. This point is not addressed. Actually one should expect that prices will be set according to the MNOs' competitive strategies. As has been demonstrated earlier in the report, there is no reason to expect that these strategies would lead to prices that correspond to the optimal levels as calculated on the basis of the B-R model.

(2) Linear structure of the demand functions - Calibration of the model on currently existing prices and quantities:

In order to calculate B-R prices one needs to specify the underlying demand functions. Such a specification requires an assumption regarding the general form of the functions and regarding the values of specific parameters. As presented by both CRA and Frontier, the important parameter specifications are those regarding the various elasticities. As it turns out, however, at least as important is the choice of the general form of the demand functions. One usually chooses between functions that are linear or functions having elasticities that remain constant at various price-quantity combinations and are therefore concave toward the origin. Both CRA and Frontier choose the linear form. This choice implies that elasticity values along any of the demand curves vary depending on the particular point at which the demand is realised. This has serious implications for the relevance of the calculated prices from the model for reasons that are developed below.

Having specified the elasticity values does not give one fully specified demand functions. One needs to calibrate the functions starting from those elasticity values and the quantities and prices existing in the current situation of which it is assumed that they represent particular points on these demand functions. Making this assumption then allows one to derive the "level" parameter and, in the case of the linear form, the linear coefficients, which then makes the specification of a demand function complete. To be more concrete, assume as an example that the quantity demanded of service Q depends on two prices $P_1$ and $P_2$. Then in the case of a linear demand function we would have

$$Q = A_{linear} + b_1*P_1 + b_2*P_2 ,$$

and in the case of a constant elasticity demand function

$$Q = A_{constant\ elasticity}*(P_1^{\varepsilon 1})*(P_2^{\varepsilon 2})$$

where both $A_{linear}$ and $A_{constant\ elasticity}$ are the (positive) level parameters and $b_1$, $b_2$, $\varepsilon_1$ and $\varepsilon_2$ have negative values. In above equations, the values of Q, $P_1$, $P_2$, $\varepsilon_1$ and $\varepsilon_2$ are known as given inputs. The value of $A_{constant\ elasticity}$ is then determined by solving for it given that all the other parameter values in the relevant equation are known. For determining the value of $A_{linear}$ one proceeds analogously after, however, first having the values of $b_1$ and $b_2$ derived from the known values of the elasticities $\varepsilon_1$ and $\varepsilon_2$. For this $\varepsilon_1$ and $\varepsilon_2$ are multiplied by the initial value of Q and divided by the initial values of $P_1$, respectively, $P_2$. What follows from this is that at any other than the initial point on the demand curve, showing different price-quantity combinations where $b_1$ and $b_2$ remain constant, the values of the elasticities change. They change the more that the new point is away from the initial point on the basis of which the demand function was calibrated. Correspondingly, prices are determined for which the relevant elasticities are different than the inputted ones and for which the mark-ups do not correspond to those

initial elasticities. This is not the case with constant elasticity demand functions where by construction the values of the elasticities remain constant from one point to the other and the mark-ups also.

This point is so important for the proper assessment of the calculations submitted by both CRA and Frontier that it is useful to provide a simple numerical example with actual data taken from the Frontier analysis. Just for the demonstration of the point made here, we assume that the three services modelled by Frontier, subscriptions (S), mobile outbound (MO) and fixed-to-mobile (FTM) depend only on their own prices, i.e. there are no cross price elasticities and there is no externality effect. We use as inputs own price elasticity values of -0.3, -0.6 and -0.6, and the initial values for prices and quantities as well as the values for per unit cost (LRIC) are as in the Frontier report. Shown below are the ratios of the prices to the corresponding cost values that result from the model calculations using the two forms of the demand functions and that are supposed to reflect the relevant mark-ups:

| | | | |
|---|---|---|---|
| Constant elasticity case: | $P_S/LRIC_S$ | = | 1.21 |
| | $P_{MO}/LRIC_{MO}$ | = | 1.09 |
| | $P_{FTM}/LRIC_{FTM}$ | = | 1.09 |
| Linear case: | $P_S/LRIC_S$ | = | 1.09 |
| | $P_{MO}/LRIC_{MO}$ | = | 1.16 |
| | $P_{FTM}/LRIC_{FTM}$ | = | 1.14 |

Note that in the constant elasticity solution the relations of the prices to their unit costs are as expected. Given the lower price elasticity of subscriptions, their price relative to the cost is higher than for mobile outbound and for fixed-to-mobile calls. Although nothing has changed except the form of the underlying demand functions, in the linear case the relationships are reversed. The reason for this strongly biased result is that initial prices, especially the price for subscriptions, are quite different than at the solution point. This, as pointed out above, causes in the linear implementation of the model large deviations from the results that a correctly specified model would produce. As will be proved in the empirical analysis, this bias affects all the results submitted both by CRA and Frontier. In particular higher prices for FTM calls are to a large extent due to this bias.

We consider the constant elasticity form of the demand functions as the version that should be used in the given context. The use of this form guarantees that the postulated effects that work through the price elasticities apply also at the models' solution points.

(3) Size of fixed common cost:

The postulated effects on the price for MTAS depend on the size of the amount of fixed common cost relative to the total of the incremental costs caused by the provision of the various services. Both CRA and Frontier take the total of common costs as the amount that is to be allocated according to the B-R principle to the various services. It is implicitly assumed that that total is also fixed. This, however, cannot be assumed, as discussed earlier in this report.

It is true that variable common cost, like fixed common cost, cannot directly be assigned to the various services due to the lack of a known direct causal relationship between particular services and these costs. This fact alone does not, however, justify that variable common cost should be allocated according to the B-R principle. The underlying productive capacities represent in principle no bottlenecks which would be a precondition for applying the B-R principle. These capacities can be expanded whenever the volume of the company's activities increases. These capacity increases may often be lumpy but this is no reason for applying the B-R principle either as also the fact of lumpiness of certain network elements does not prevent the application of the LRIC standard in case of network cost. Given, however, that no direct causal relationship can be determined, one must assume that each of the company's activities causes variable cost in proportion to the level of that activity which means that variable common costs should be allocated to the various services on an equal proportionate mark-up (EPMU) basis. The per-unit of service cost figures determined after this allocation as well as the remaining not yet allocated common cost, i.e. the truly fixed common cost, are then to be used in the price determination based on B-R modelling.

(4) Incomplete modelling of the sector:

The demand for mobile services comes from at least two segments, a business and a mass market segment. Lumping together the demands from these two segments risks to substantially distort the results. This is to be expected because business demand especially for subscriptions should be highly price inelastic and therefore be a service able to carry a high share of fixed common cost. Thus the model should be adjusted in a way that the demands coming from business are separated from the demands from the mass market.

Also a model that is restricted to the mobile sector is seriously incomplete. As pointed out under (1), the application of the model implies the setting of all relevant prices by the regulator. This same regulator, however, also oversees the fixed telecommunications sector with which the mobile sector interacts not only via FTM calls. If the B-R philosophy were to be applied in the form as proposed by the consultants, then the regulator would be amiss in applying it to the mobile sector in isolation without also including fixed sector services, respectively, at least also considering the interactions between the mobile and the fixed second

in addition to those via FTM calls. One example of such interaction is the cross-price elasticity between mobile subscriptions and fixed subscriptions.

In respect of both issues addressed above, the original Rohlfs model must also be considered as incomplete.

## 3.2 Hausman's analysis of the trade-off between possible efficiency costs of termination surcharges and possible efficiency gains from subsidising mobile subscribers

Hausman (2004, paragraphs 65-81) analyses and calculates the consumer surplus gains and losses from *lowering* MTAS charges to the TSLRIC level. This is not a B-R pricing analysis as Hausman concentrates on consumer welfare only and does not consider effects on profits and as he does not calculate optimal prices but rather only makes a comparison for two MTAS charges and their consequences on other prices.

### 3.2.1 Possible efficiency gains from subsidising mobile subscribers

#### 3.2.1.1 The effect of gaining a mobile subscriber on FTM users

Hausman (2004, paragraphs 67/68) uses a refined consumer surplus analysis to determine the social gain to FTM callers from adding a mobile customer. If one knows the (compensated) demand curve for FTM calls one can measure this surplus gain by calculating the area gained through the outward shift in the FTM call demand curve from adding a mobile customer. This is a potentially simple and standard approach, the value of which depends on the specific assumptions made about variables for which empirical data are not available.

Hausman makes two calculations, one (as a lower bound calculation) based on a linear demand curve and one (as an upper bound calculation) based on a constant elasticity demand curve. For the lower bound the calculation is simple, because the consumer surplus for FTM calls is a triangle given by $CS = ½TRxQ/\varepsilon$, where TR is total revenue, Q is the number of calls and $\varepsilon$ is the demand elasticity. The shift in the demand curve from adding a customer is assumed to be the demand for calling an average customer. Thus, $\Delta CS = CS/\#$, where # is the total number of mobile subscribers. Assuming 4.24 billion call minutes, a price of 0.4 $/min., a demand elasticity for FTM calls of -0.6 and 13.9 million mobile subscribers, Hausman then calculates $\Delta CS = ½4.24x10^9x0.4/0.6x13.9x10^6 = \$102$ per year. The upper bound calculation is more

complicated, since it involves estimating the demand curve.[58] According to Hausman it yields $378 per year for each new subscriber.[59] If, as claimed by the ACCC (2004, p. 100), the true number of call minutes is 6.037 billion instead of 4.24 billion, these numbers would have to be increased proportionately. A proportionate change would also result from a change in the assumed size of the FTM demand elasticity.

Even if one accepts the parameter values used by Hausman to be within the reasonable range, there are at least two questionable assumptions. The first is that the demand for calls to new subscribers equals that of average subscribers and the second is that the demand for FTM calls (in general and) to new subscribers has no substitutes. We discuss these assumptions in turn.

The first assumption is implausible for us, because it presupposes a consistent lack of correlation between the demand of the mobile subscribers for subscription and the demand for others to call such subscribers. Thus mobile subscribers with low willingness-to-pay for subscriptions are nevertheless assumed to generate an average demand for calls to them. This is in spite of the fact that their own value of these calls to them is included in their willingness-to-pay for the subscription. The willingness-to-pay for subscription is essentially the sum of (a) expected consumer surplus from mobile calling, (b) the expected consumer surplus from being called and (c) the option value of calling and being called. This sum is substantially lower for marginal subscribers than for average subscribers. It is in our view unlikely that the value of these components (and their sum) is not positively correlated with the demand for calling such subscribers. It is important to note that CRA assumes in their calculations that marginal subscribers only make and receive one third of the calls made and received by an average subscriber. As NERA (2004a, p. 21) notes, it is plausible that valuations of callers and called parties are on average proportional to each other. This is clearly an empirical question that deserves analysis. But we are not aware of any.

Hausman (paragraph 73), based on (confidential) data from Optus, makes an empirical counter-claim. The ACCC (2004) had pointed out that most of the customer growth in the mobile sector is coming from prepaid subscribers, who are associated with lower calling volumes than postpaid subscribers. Hausman now argues that, while prepaid customers generated less total calls (outgoing and incoming) their incoming calls on

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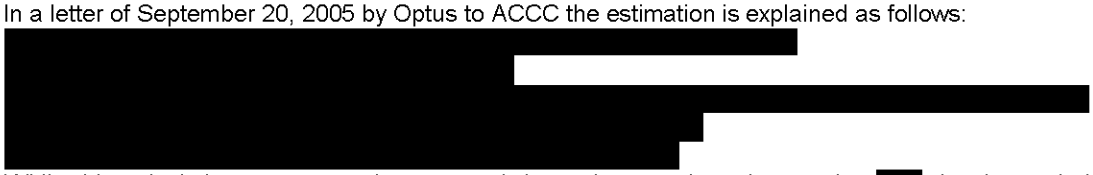
58 In a letter of September 20, 2005 by Optus to ACCC the estimation is explained as follows:



While this calculation appears to be correct, it begs the question why at price [redacted] the demanded quantity (per subscriber) would be [redacted], while it drops to zero at price [redacted]+ε.

59 If FTM calls are priced above marginal costs there would be an additional surplus generated for the fixed network operator. This is not considered by Hausman, because he only focuses on consumer welfare.

average exceed those of postpaid customers.[60] If the incoming call minutes for prepaid customers are on average more than for postpaid customers then the average consumer surplus generated for callers to the prepaid subscribers is likely to exceed that generated for callers to the postpaid subscribers. To counter this conjecture one would have to argue that the demand for calls to prepaid subscribers is substantially more elastic than that to postpaid subscribers.[61] One argument in favor of a higher elasticity is that most of this demand is created by the lack of calling by the prepaid customers. Usually, the party with the higher willingness to pay (or the lower price) calls. If prepaid customers substitute incoming for outgoing calls then those would be calls for which the other party would have a fairly low willingness to pay, thus indicating elastic demand. Another issue with Hausman's argument is that Optus's data seem to refer to the average prepaid subscribers. For Hausman's argument to be valid, however, the *marginal* prepaid subscribers would also have to receive an amount of calls that would be above *average* for postpaid subscribers. If the demand for calls to such marginal customers were in fact less than the demand for average customers (which includes both prepaid and postpaid customers) then the effect on the benefits of new subscriptions to FTM callers would be about proportional to the reduction in demand.

We now come to the second questionable assumption, which is that the demand for FTM calls (in general and) to a new subscriber has no substitutes. In particular, it is assumed to be independent of the FTF demand. Hausman has argued a lot about FTM and MTM calls being substitutes (and therefore sharing a market). But this also holds for the FTM and FTF markets. Many of the calls to marginal mobile subscribers would otherwise have gone to a fixed telephone where the subscriber would have been reachable before acquiring a mobile phone. By postulating that no reasonable substitute exists to reach a person except FTM (paragraph 66) [and quoting the ACCC on this] Hausman has assumed away this issue. This assumption bends the results heavily in his desired direction. However, the net results change substantially if only 10-20 per cent of the calls to new mobile subscribers would have been answered by these people on a fixed network phone had they not subscribed to mobile services. As a result the outward shift of the demand for FTM calls caused by an additional mobile subscriber is

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60 This is not a priori implausible, given that the price for outgoing calls of prepaid customers substantially exceeds that for postpaid customers. At the same time, the fixed monthly charges for prepaid customers are lower than for postpaid customers. We therefore have a selection effect, by which prepaid customers have lower demand for mobile services (which includes their demand for incoming calls) and lower demand for outgoing mobile calls than postpaid customers. Furthermore, the prepaid customers will substitute fixed outgoing and mobile incoming calls for mobile outgoing calls. It would nevertheless be important to verify the data. IDC (2005) gives the ARPU for prepaid with $15 and for postpaid with $60. If prepaid customers received more calls on average than postpaid it would mean that postpaid would indeed have very few incoming calls. Optus (in its letter of 20 September 2005) provides data that show that in its sample the sum of incoming and outgoing calls is [redacted] than implied by SingTel's 2003-04 reporting for Optus (ACCC notes to WIK). This implies, in our view, that the Optus data cited by Hausman do not reflect a representative sample of prepaid and postpaid customers.

61 One does not have to go so far as to argue (as in Optus, 2005, p. 14) that the value of being able to call a subscriber who places marginal value on their mobile subscription is zero (or near zero).

on average associated with a corresponding inward shift of the demand for FTF calls to that subscriber and that results in a consumer surplus loss for FTF callers. This (and, in our view the previous point as well) suggests that Hausman systematically overestimates the social gain to fixed network callers from an additional mobile subscriber. It also suggests that a fully legitimate approach would have to optimise simultaneously over fixed and mobile network activities.

A second potential substitute for FTM calls to a "new" mobile subscriber is an FTM call to an "old" mobile subscriber, who only has signed up with a further mobile operator. This is made possible through the fact that 5 per cent of mobile subscriptions are now multi-SIM users (IDC, 2005). These people could have been reached on a mobile phone before subscribing to a further mobile phone company. So, there is little benefit to FTM callers from such new subscriptions. Since this is a phenomenon of saturated penetration, it means that the percentage of multi-SIM users among new subscriptions is likely to be substantially higher than 5 per cent. Multi-SIM users can be reached on several mobile numbers, which are substitutes for the FTM caller.

#### 3.2.1.2 The gain in mobile subscription and its efficiency effect

Hausman (paragraph 69) calculates a consumer surplus gain to FTM calling parties of between $153 and $568 million per year arising from subscriber subsidisation in response to termination surcharges. This gain derives from a per subscriber gain of between $102 and $378 per year multiplied by an increase in subscription from handset subsidies and lowered subscription charges of 10.8 per cent or 1.5 million new subscribers.

Hausman is right (paragraph 81) that potential mobile subscribers will increase their subscription rate if handset subsidies are increased and subscription fees reduced. His calculation (in paragraph 69) of the number of mobile subscribers generated by subsidies from MTAS surcharges was unclear from the text and required further explanation by Optus, that stated:[62] [redacted] Hausman thus assumes that reduced MTAS charges lead to increased subscription prices with 100 per cent passthrough. He further assumes a current subscription fee of [redacted] per month and applies a subscription elasticity of [redacted] to the changed

62 In a letter of September 20 2005 to the ACCC.

subscription fee.[63] It remains unclear why Hausman has not provided ranges in this case. Since the demand for subscriptions could range from linear to constant elasticity in the two extremes, the claimed reduction in subscription would depend on this shape. For the same subscription fee increase the reduction would be *smaller* for a constant elasticity demand than for a linear demand (because the constant elasticity curve becomes steeper with an increase in price).

While Hausman assumes a full waterbed effect in paragraph 69, his model in the Appendix only shows that the subscription fee of a profit-maximising mobile operator will increase if the MTAS charge is reduced. In the derivation of the Appendix and in paragraph 69 he assumes that the handset subsidies are given so that he never formally analyses the effect of handset subsidies on subscription. In principle, the change in number of subscribers from a change in the MTAS charge could be derived with the help of the analysis in the Appendix, provided one has all the data. The hints in paragraph 69, however, are insufficient to justify a full waterbed effect.[64]

This criticism does not mean, however, that the actual quantitative analysis of the change in subscription is necessarily out of line. If one compares US and Australian mobile penetration and relates that difference to MTAS charges the reduction of 10.8 per cent could be plausible for a cross-sectional comparison. However, in a dynamic analysis it is unlikely that Australian mobile penetration will actually fall by such an amount once it has reached the current level.

Hausman also totally neglects any effects that the attraction of new subscribers to the mobile networks has on fixed network subscription. As argued in Section 2.6.5 above, the markets for mobile telephony have matured, any reduction or increase in mobile subscription has begun to be associated with a change in fixed network subscription. In some countries this effect is more pronounced than in Australia but the fixed-to-mobile substitution of both calls and subscriptions seems to be a worldwide trend. Since subscribers to fixed networks generate similar social gains as subscribers to mobile networks, any contrary effects on fixed network subscription would have to be netted against benefits from increased mobile subscription.

Hausman adds the consumer surplus gain to new mobile subscribers from subscriber subsidies, which again is a range given by the assumed shape of the demand curve.

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63 In our view, a change in the subscription elasticity would have a proportionate effect on the loss/gain in mobile subscription. Thus, if the subscription elasticity were -.45 as assumed by CRA (2004) the change in subscription would be [redacted] per cent instead of 10.8 per cent.

64 It also is unclear to us, what the assumption about the reduction in MTAS charges is. We would conjecture that the reduction assumed by Hausman is from $0.22 per minute to $0.12 per minute (as he assumes in paragraph 70) and that the hint at marginal costs of $0.02 per minute relates to the profit contribution from MTAS charges. Why the marginal costs would be so much lower than the TSLRIC of $0.12 per minute is unclear to us. The difference between $0.12 per minute and $0.02 per minute would influence termination profits on the change in total FTM minutes. For Hausman's analysis this would play a role by influencing the waterbed effect.

This addition would be standard. He does not report the results but from his other calculations we infer them to be in the range of $49 to $52 million per year, based on a 10.8 per cent loss in subscriptions.

### 3.2.2 Possible efficiency costs of termination surcharges

Hausman's analysis of the gains to FTM callers from a reduction in MTAS charges (in paragraph 70) is again quite confusing and, in our view, incorrect. Hausman assumes a reduction in the FTM price from $0.40 per minute to $0.30 per minute, in line with the assumed reduction in the MTAS price. He then correctly proposes to calculate the consumer surplus increase "for FTM callers for all their calls, not just calls to *additional* mobile subscribers" (emphasis added). He further uses "the same bounds approach" (presumably as for the calculation of the surplus gain from additional subscribers). However, (1) because of the reduced subscription subsidies there would be a decrease in mobile subscribers, not an increase, and (2) the analysis has to be different because the consumers have a trapezoid gain, not a triangular gain. Thus, a correct analysis would first shift the demand for FTM calls inward by 10.8 per cent (i.e. at previous price from 4.24 billion minutes to 3.782 billion minutes). The 10-cent price reduction would have to be applied to this amount, giving a $378 million consumer surplus rectangle gain. At the same time, the reduced price leads to an increased demanded quantity of 540 million minutes (for which the bound analysis would apply), leading to additional consumer surplus triangle in the amount of $28 million for linear demand. For constant elasticity demand the additional amount would increase beyond the $28 million. The sum of $406(+) million is well over ten times larger than Hausman's range of $32-37 million, which seems to refer to the triangle only.[65] Thus, Hausman's numbers are more than $370 million off. This would again have to be increased about proportionately if the true number of call minutes were 6.037 billion instead of 4.24 billion. In contrast, the effect of a change in the FTM demand and the mobile subscription demand elasticities would be quite small (because they only affect the price effects on changes in call volume).

### 3.2.3 Calculation of the net social gain/loss

Not only the FTM callers benefit from the reduced FTM charges but also the mobile subscribers, who receive more calls *per subscriber*. While one can argue about the

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65 This is confirmed in a letter of 20 September 2005 by Optus to the ACCC, where it is stated [redacted] Hausman repeatedly used such triangles as represented in the above formula in his 1981 article but only in reference to deadweight losses or Harberger triangles. Here, however, he is concerned with the consumer surplus change only. Thus, the rectangle has to be added which would cancel out if profit effects were included.

benefits to receiving parties of individual calls, there can be no doubt that receiving parties are net beneficiaries and this is expressed in their willingness-to-pay for subscriptions. Thus, the increase in FTM calls should shift the demand for mobile subscriptions outward. The empirical extent of this effect is unknown to us, because there do not seem to exist robust cross elasticity estimates of the demand for mobile subscription with respect to the price of FTM calls. Hausman, however, does consider this effect in Footnote 84, where he implies that more incoming calls lead to higher mobile subscription, which seems to reduce the subscription loss from increased subscription fees by about 15 per cent (or from 1.5 million to 1.275 million).[66] Thus, the effect is certainly not going to fully compensate for the reduction in subscriptions due to the increased subscription fees. However, Hausman's calculated loss to FTM callers from the reduction in mobile subscriptions as a result of an MTAS charge reduction from $0.22 to $0.12 per minute is reduced to a range between $130 and $483 million. This compares to a $406(+) million gain to FTM callers from the reduced FTM prices. This gives a benefit ratio of the high termination charge of 0.32-1.19 compared to Hausman's estimate of 4.1-13.2 without the consumer surplus change for new mobile subscribers. If we add $41.7 to $44.2 million per year for the consumer surplus gain for new subscribers,[67] we get a range of ratios between 0.42 and 1.30.

Thus, even if one accepts all of Hausman's assumptions, simply adjusting for the calculation error of the consumer surplus gain for FTM calls from the FTM price reduction leads to an ambivalent rather than the clear result that Hausman claims. In fact, on average the result goes in the opposite direction.

### 3.2.4 The waterbed effect

#### 3.2.4.1 Hausman's position

In the absence of a waterbed effect termination surcharges would only generate welfare losses and have no redeeming quality. With only a partial waterbed effect the benefits in the form of subsidised subscriptions (and/or lower charges for outgoing mobile calls) would be "watered" down. In his quantitative analysis (paragraph 69) Hausman assumes a full waterbed effect in the form of an increased mobile subscription charge and reduced handset subsidies that would result from a regulated reduction of MTAS

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66 In its letter of September 20 2005 to the ACCC Optus clarifies that Hausman used [redacted]. Using this more exact number would change the loss in number of subscribers in the text above from 1.275 million to [redacted] million.

67 This takes account of the adjusted loss in subscriptions from 1.5 million to 1.275 million.

charges. He does not consider (but also does not exclude) increased prices for outgoing mobile calls, which would also affect mobile subscriptions but in addition cause a deadweight loss in usage.[68]

Hausman is correct that even an unconstrained monopolist passes on at least part of a cost increase and the amount of pass-on increases with the intensity of competition (for a given shape of the demand) (paragraph 77). However, Hausman fails to identify the cost increase as either marginal or not. A reduction in MTAS charges prima facie might either act like an increase in fixed costs or in marginal costs.[69] A monopolist would generally not respond to a fixed cost increase with any price increase; and firms in other, more competitive, situations will respond with entry and exit decisions (and resulting output adjustments) that will trigger price increases. However, Katz (2004, p. 29) argues quite convincingly that a reduction in MTAS charges can be seen as a marginal cost increase for subscriptions. This would hold because the MTAS charges create a profit contribution that is directly attributable to individual mobile subscribers.

In the Appendix Hausman identifies another avenue, by which the MTAS charge is linked to the mobile subscription fees. He uses a monopoly-type analysis to show that a decrease in the MTAS charge will lead to an increase of the profit-maximising mobile subscription charge. This happens because a decrease in the MTAS charge makes incoming calls less attractive. That also reduces the attractiveness of new customers receiving such calls. It thus increases profits to increase subscription fees, reducing the number of customers and increasing their average profitability. The same can be shown for the price of outgoing mobile calls and for the handset subsidies (which will be reduced; Hausman, 2004, Footnote 96). These are, what Hausman calls two-sided market effects. While this analysis is highly simplified, the effects described (though not their magnitude) appear to be quite general and would suggest the presence of some waterbed effect.

For an empirical demonstration of the waterbed effect Hausman analyses UK price data for 2003/2004 in order to show that mobile service prices increased as a result of MTAS charge reductions. He states that “mobile price began to increase at the time of the regulatory imposed change in mobile termination prices and has continued to increase although at a slower rate“ (paragraph 80). It is first worth noting that the Ofcom report ”The Communications Market“ for 2004 does not contain direct price data but only “average revenue per subscriber“ and aggregate call volume data, but these numbers would not allow one to derive any precise price data. This is confirmed by a very tentative report on mobile price trends in the ”January 2005 Quarterly Update“ of the Ofcom

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68 As far as we can see, the whole discussion about waterbed effects leaves out MTM calls because they are entirely internal to the mobile sector and therefore, in some sense, cancel out. This does not, however, mean that changes in MTM prices (off-net) have no allocative effects that would count in a proper efficiency analysis.

69 Literally it is not a cost increase at all.

report. There we find "average UK mobile unit revenue indices" from 2002Q3 to 2004Q3 separately for pre-pay and contract customers with 2002Q3 = 100. The pre-pay series has some similarity with Hausman's Figure 1, only that the price rise already starts between 2002Q4 and 2003Q1, indicating that that price rise has little to do with the regulatory termination charge decrease in mid-2003. Also the pre-paid series peaks in 2003Q4 and has slightly declined since then. The contract customer series looks entirely different. It is almost constant over the entire period. There is therefore little reason to believe in Hausman's assertion that UK mobile prices increased as a result of termination charge reductions. Even if one accepts Hausman's price series at face value it tells little because the trend is upward all the time and we do not know what happened before 2003Q1, when Hausman's series begins.[70] Hausman's comparison with the US Bureau of Labor Statistics CPI for wireless telephone services is also inadequate. Competitive conditions in the US (e.g., bucket rates) are quite different from the UK and the inclusion of the price of incoming calls in the US means that the baskets are different as well. Thus, Hausman's numbers of the US case are not convincing.

Hausman's comparison of price reactions of mobile carriers with those of Telstra's FTM prices (in paragraph 78) is inadequate. As a result of MTAS charge reductions Telstra experiences a straightforward marginal cost decrease for FTM calls. It would therefore be totally correct for ACCC to assume that Telstra will reduce FTM prices in response to lower MTAS charges and still reject the waterbed effect with its implicit increase in mobile subscription charges (and outgoing call charges and reduced handset subsidies). However, as explained above, some waterbed effect can be derived independent of the level of mobile competition.

#### 3.2.4.2 Position of others

While Hausman (2004, Appendix) only shows that there will be some adjustment of other prices in response to a reduction in MTAS charges,[71] Frontier (2005) claims that the other price effects will fully compensate so that profits are unchanged, and that this can happen, irrespective of the level of competition. For example, Frontier claims that the waterbed effect will be 100 per cent for a monopoly under constant elasticity demand curves. However, all the action here would have to come from the cross effects. Without cross effects in demand the profit-maximising monopoly prices for all mobile services would be infinite, given that demands are inelastic. They would therefore be independent of any cost changes. Negative cross effects (indicating complementarity) could compensate so that profit-maximising prices could become finite, but that is an empirical question that does not automatically suggest that there would be a 100 per cent waterbed effect.

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70 See also Marsden Jacob Associates (2005a, p. 65), who reproduce UK mobile price trends that substantially differ from Hausman and are not upward sloping in the relevant time frame.

71 Although he makes a full adjustment in his quantitative analysis.

The assumption of a full waterbed effect, as done by NERA, would be very questionable. Even in a fully competitive industry the waterbed effect would require entry and exit of firms so that the required price changes become equilibrium values. This would hold because all firms' average costs would be increased (or their average revenues decreased). In the meantime, profits or losses induce firms to enter or exit. Similar problems would arise under contestability. In contestable markets with a small number of firms, most results in the literature are derived for equilibria for a fractional number of firms (see, e.g., Baumol, Panzar and Willig, 1982). Since there can only exist integer numbers of firms in a market, large price changes would either lead to long-term profits or losses or large entry or exit. Thus, even if mobile markets are close to contestable there is unlikely to be a full waterbed effect. The opposition of mobile operators against MTAS charge reductions is easily understandable only if there is no full waterbed effect.

Gans (2005, p. 14) claims something contrary to the waterbed effect. Based on theoretical results by Gans and King, Armstrong, and Wright he claims that mobile operators would have an incentive to set MTAS charges *above* the joint monopoly level. Thus, a reduction in these charges could actually increase profits and therefore would be accompanied by a reduction in those other prices. While this argument is theoretically correct, it does not seem to hold empirically. Otherwise, the demand for mobile termination at the current prices could not be inelastic (which it obviously is).

#### 3.2.4.3 Conclusions on waterbed effects

According to Hausman's model (Hausman, 2004, Appendix), some waterbed effect has to be expected, given the demand interactions between mobile services. There is, however, no empirical or theoretical evidence that the waterbed effect is going to reach 100 per cent. In particular, mobile competition is neither perfect nor perfectly contestable. Furthermore, part of any profit increase from increased termination charges increases handset subsidies and other customer acquisition expenses (including advertising) that do not fully expand total mobile subscription but just take away subscribers from other mobile competitors. The non-productive costs of increasing mobile penetration at already very high levels are likely to be high and increasing rapidly in further penetration.

### 3.2.5 Corresponding analyses by NERA

"Bend it like Beckham"

It looks as if NERA has bent its own data in the direction most unfavorable to the regulation of termination charges. The only unbiased estimate is the one with parameter values related to those of the ACCC. The result here is a reduction of social surplus from regulating MTAS charges of about $150 million per year.

However, it looks as if NERA has neglected to include the profit gain from increased subscription charges (while the profit reduction from reduced FTM call charges is included). This omission, which we already alluded to in Section 2.3.2 above, is similar to the one by Hausman and results in about $200 million change in net outcome under the linear demand analysis (NERA's analysis assumes a reduction in MTAS and FTM charges of 5 cents per minute instead of Hausman's 10 cent change).

### 3.2.6 Conclusions on Hausman's consumer welfare analysis

Hausman does not perform a B-R pricing analysis but concentrates on consumer welfare only and he does not calculate optimal prices but rather only makes a comparison for two MTAS charges and their consequences on other prices. Hausman's main conclusion is that a reduction in MTAS charges rather than benefitting consumers would severely hurt them. Our analysis has shown that by correcting a single number, about which he is by more than $370 million in error, Hausman's conclusion no longer holds, because the gain to FTM callers from the resulting FTM price reduction is over ten times as high as calculated by Hausman. Thus, even if one accepts all of Hausman's assumptions, simply adjusting for the calculation error of the consumer surplus gain for FTM calls from the FTM price reduction leads to an ambivalent rather than the clear result that Hausman claims.

There are several additional concerns that bias Hausman's results.

(1) He claims that the main difference between his and the ACCC's and Armstrong's analysis is that he includes a "new goods" effect from the expansion of the mobile subscriber base through handset subsidies and low subscription charges. However, he overlooks that there exists a close substitute for mobile services in the form of fixed network telephony. Thus, not all the gain he derives from his consumer surplus analysis of demand for FTM calls is a net gain. Rather, a potentially sizable fraction of this gain is likely to come at the expense of FTF calls, leading to a consumer surplus reduction there.

A second potential substitute for FTM calls to a "new" mobile subscriber is an FTM call to an "old" mobile subscriber, who has only become a "new" subscriber as a multi-SIM

user. Since this is a phenomenon of saturated penetration, it means that the percentage of multi-SIM users among new subscriptions is likely to be substantial. Multi-SIM users can be reached on several mobile numbers, which are substitutes for the FTM caller.

(2) Hausman neglects any effects of an increase in mobile subscription on fixed network subscription.

(3) Hausman neglects possible nonlinearity of the demand for mobile subscriptions.

(4) Hausman's results are sensitive to assumptions about FTM call minutes. Both costs and benefits increase roughly proportionately in call minutes so that the net magnitudes but not the signs are likely to change with call minutes. In contrast, the main elasticity assumptions concern predominantly the claimed benefits of termination surcharges and much less the costs. The benefits increase/decrease roughly proportionately in these elasticities, while the effect on the cost side is only about 10 per cent of the proportionate amount.

(5) We are not convinced that the FTM demand for calls to new mobile subscribers equals the average FTM demand to all mobile subscribers. Rather, our arguments suggest that it is lower as assumed by Rohlfs (2002) for the UK and CRA for Optus.

Thus, a move from MTAS charges proposed by Optus to TSLRIC will not lead to a net efficiency loss but rather to an efficiency gain. This does not mean that MTAS charges at TSLRIC levels cannot be improved upon.

## 3.3 Methods to determine externality surcharges

### 3.3.1 Marginal subscribers

The method for determining the size of mobile network externalities used by Hausman (2004) relies on an estimate of the value of the marginal mobile subscriber to FTM callers and on multiplying this value with the number of subscribers generated by a reduction in mobile subscription charges. The size of this reduction in mobile subscription charges is related to the MTAS surcharge via the assumption of a full waterbed effect that would translate any net profit gain from the surcharge into an equivalent subscriber subsidy.

The value of the marginal mobile subscriber to FTM callers is calculated by looking at the consumer surplus gain for FTM calls caused by the shift in the FTM call demand caused by an additional subscriber. Here, Hausman assumes that this value is the same for a marginal mobile subscriber as it is for an average mobile subscriber. As a

result he gets an outward shift in FTM demand that is proportional to the number of mobile subscribers.

In order to do the calculations Hausman has to assume the shape of demand functions and has to know the direct demand elasticities for mobile subscriptions and for FTM calls. He further has to know prices, costs and quantities. He does not have to know cross elasticities (which are implied by the assumption about the effects of marginal subscribers).

### 3.3.2 Cross-elasticities

Network externalities can be identified by the cross elasticities of usage demands with respect to the subscription price. These externality effects actually work through cross-price elasticities that are driven by changes in the number of subscribers that themselves come about in response to changes in the price for subscriptions. Rohlfs (2002) assumes the cross-price elasticities shown in Table 3-1.

Table 3-1: Cross elasticities of usage with respect to the subscription price

| Quantities | Subscription price |
|---|---|
| Mobile usage (on-net) | - 0.10 |
| FTM usage | - 0.02 |
| Mobile usage (off-net) | - 0.11 |

Source: Rohlfs (2002), p. 8.

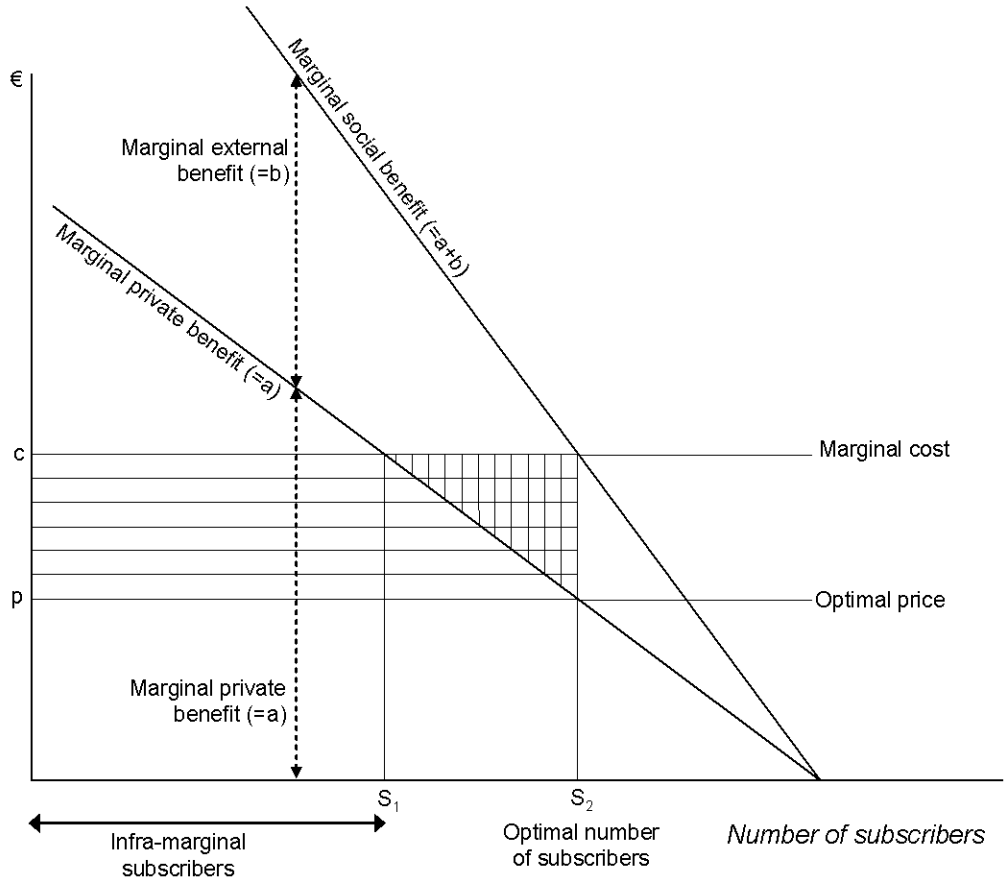
Both CRA and Frontier also postulate demand functions for outgoing mobile calls and for fixed-to-mobile calls that contain elasticity parameters that are coupled to the own-price elasticity of subscriptions. These effects lead to externality effects as there are no corresponding symmetric cross-price elasticities of subscriptions with respect to the price of subscriptions. Larger volumes of calls by themselves do not induce any increase of subscriptions so that there is no tendency for the subscriber number driven effects on call volumes to be offset and as an end effect the super elasticity for subscriptions has a larger negative value which in turn induces a lower mark-up. The effect may become so strong to actually cause a negative value for the mark-up.

### 3.3.3 The Rohlfs-Griffin factor

In a study prepared for Oftel, Rohlfs (2002) has introduced the Rohlfs-Griffin factor ('R-G factor') as a way or tool of describing the amount of external benefit that is generated

by additional subscribers. The R-G factor is defined as the ratio of the marginal social benefit of an additional mobile subscription ((a)+(b) in Figure 3-1) to the marginal private benefit (a) in Figure 3-1. The marginal private benefit line is represented by the classical downward sloping demand curve for network access. The value existing subscribers attribute to the addition of new subscribers is represented by the dotted line 'marginal external benefit'. The marginal social benefit of new subscribers for the economy as a whole is represented by the curve summing up marginal private and external benefits. The R-G factor sometimes also is referred to as the gross externality factor.

Figure 3-1: Network externalities and subsidies




Source: Oftel.

Two major issues have to be and also have been discussed with regard to the R-G factor:

1. What is the appropriate level of the R-G factor?

2. Is the R-G factor constant and (therefore) independent of penetration?

(1) A low level of the R-G factor implies fewer external benefits from additional subscribers and less justification for (high) subsidies. A value of 1 for the R-G factor implies that there are no externalities or that they are entirely internalised. A value of 2 would imply that the external benefit to existing subscribers is as large as the private benefit obtained by marginal subscribers. Oftel (2003b) and Ofcom (2004) regarded a value of 2 as a reasonable upper bound of the R-G factor without being able to empirically verify this assumption. The reason is that the private marginal valuation of subscription equals the sum of consumer surplus of the marginal subscriber from calling and being called and the option values of calling and being called by all other subscribers. The additional social or externality value equals the sum of consumer surplus from calling and being called by the marginal subscriber and the option values for all other subscribers. Under the assumption that – on average – the values of both parties to calls are symmetric an R-G factor of 2 would be plausible. Assuming relevant degrees of internalisation of the external benefit, Oftel believed a reasonable range for the R-G factor to be 1.3 to 1.7. For his welfare calculations, Rohlfs assumed the midpoint of this range throughout his calculations and scenarios. In our view it is hard to exclude a R-G factor above 2 for a priori or theoretical reasons. It simply remains an empirical question. Theoretically, the R-G factor could be higher than 2. Nevertheless, we believe it is plausible to assume an upper bound value of 2.

(2) There is the argument that the R-G factor is not constant over time[72] but depends on penetration, and becomes smaller at higher penetration. On the basis of empirical facts there is evidence that the private benefit of mobile subscription is falling together with penetration. A constant R-G factor then means that the external and the social value of additional subscribers is also falling requiring lower levels of subsidies to internalise externalities. There is, however, no direct empirical evidence whether the ratio of social and private benefit of subscription also decreases. We have to keep in mind that a marginal external benefit also relates to marginal subscribers which are already connected to a mobile network to whom FTM calls are being placed, and not only to current non-subscribers. Therefore we believe it is plausible to assume a constant Rohlfs-Griffin factor over time. Only a survey-based empirical analysis can finally prove whether a corresponding assumption, that the R-G factor decreases as the level of penetration nears saturation, may be plausible.

### 3.3.4 The effect of subsidies on subscription

The effectiveness a surcharge on call termination might have on increasing mobile penetration has two components. These are first the degree with which any surcharge is passed through to the relevant subsidy and second the effect the subsidy has on mobile penetration. Only if the mobile retail markets are perfectly competitive will all profits

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**72** See e.g. ACCC (2004), p. 164.

on call termination (due to any surcharge) be competed away in the sense and form that they are passed through to mobile customers, e.g. in the form of a subsidised subscription. Incomplete pass-through of a surcharge as a subsidy would have the effect of reducing the number of additional subscribers that a given surcharge on call termination attains. Optimal externality surcharges determined in a welfare maximising model applied in an environment of imperfect competition in the mobile retail markets leads to economically inefficient results. The assumptions on pass-through are very sensitive in determining the optimal surcharge. In a scenario calculated by Rohlfs[73] for the UK where MNOs only partially use mark-ups on termination for subscription subsidies, the optimal externality surcharge becomes nearly negligible. We have dealt with this relationship in more detail in section 2.6.4.

If we assume that any externality surcharge is passed through to subsidise the subscription of marginal subscribers the question arises whether marginal subscribers at lower levels of subscription need lower levels of subsidy than marginal subscribers at higher levels of penetration. If late coming subscribers derive less benefit from subscription one may argue that they need higher amounts of subsidies than earlier subscribers.

### 3.3.5 The optimal size of subsidies

The optimal subsidy to internalise the externality and to reach the socially optimal level of penetration can directly be derived from Figure 3-1. If the price of joining the network equals the marginal cost c, everyone up to $s_1$ will become a subscriber. If no externalities were present, $s_1$ would also represent the socially optimal number of subscribers. In the case of externalities the optimal number of subscribers is at a level where the marginal social benefit equals the marginal cost of subscription. To reach the socially optimal number of subscribers, prices have to be subsidised up to the level of p. If MNOs cannot discriminate in their pricing among customers, the maximum amount of subsidy $S_{Max}$ is required.

$$S_{Max} = (c\text{-}p)\ s_2$$

In this case all subscribers including the infra-marginal ones receive the same below-cost price. If subsidisation can be limited or targeted to marginal subscribers only, then the minimum subsidy level $S_{Min}$ would be

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**73** See Ofcom (2004), p. 171.

$$S_{Min} = \frac{1}{2}(c-p)(s_2 - s_1)$$

Minimum subsidies require perfect price discrimination such that each person gets exactly that amount of subsidy necessary in order to make him a subscriber. Theoretical analysis shows that optimal or minimal subsidies can only be a fraction of subsidies which do not take care of targeting. As we discussed in section 2.6.4 the scenario of perfect discrimination may be unrealistic in the real world. It is also not appropriate to assume that no opportunities for price differentiation do exist.

Because the funding of the relevant subsidies through overpricing certain wholesale and retail telecommunications prices generates distortions in consumption patterns and therefore efficiency losses, the analysis developed so far has to include this countervailing effect. These (marginal) deadweight losses have to be added to the cost of subscription to determine the optimal number of subscribers and the optimal amount of subsidies. The welfare losses incurred from financing the subsidies reduces the optimal level of subsidies and of subscribers as derived from Figure 3-1.[74] The optimal level of subscription is reached where the marginal social cost of subscription (sum of TSLRIC and marginal deadweight loss of subsidisation) equals the marginal social benefit of subscription.

### 3.3.6 Methodological approaches for calculating the externality effects in the context of B-R pricing

Both CRA (2004) and Frontier (2004) do not discuss in detail how they incorporate the effects of externalities in the B-R modelling. It could, however, be ascertained that these effects are captured in both models in two ways:

- Adding to the surplus function to be maximised a term representing the net externality factor, mainly due to the option value of being able to make calls to new subscribers.
- Introducing cross-price elasticity effects that come about through the impact on call services of the addition of new subscribers to the network. These are cross-price elasticity effects that are non-symmetric, i.e. in the elasticity matrix there are no non-zero counterparts across the diagonal. The reason for this is as follows: Price-induced increases in the number of subscribers call forward increases in the volumes of calls that are made by the new subscribers whereas changes in calls have by themselves no tendency to induce changes in the number of subscribers. The

74 For a more detailed presentation of this context see Albon and York (2005a, pp. 10 ff).

externality that is created by the new subscribers making calls is captured by this effect.

CRA points out that it refrains from considering any usage externality; therefore in its modelling the corresponding surplus function would not include any term for them. This, however, is not explicitly developed. Although Frontier does not make any reference to this point, it appears that it also adds to the surplus function only a term for the net externality factor on account of additional subscriptions.

In the following, we critically discuss the approaches used by CRA and Frontier together.

(1) Net externality factor

The discussion and assessment follow here Appendix C "Mathematical Economic Analysis" of Rohlfs (2002). It is shown there that total consumer surplus (S) derived from subscriptions can be expressed as the sum of two terms as follows:

$S = S_S + (e-1)*P_SQ_S$

where $S_S$ is the usual surplus, roughly identified as the area under the demand curve but above the price line, and (e-1) is the value of the net externality factor above 1 which is evaluated at the price $P_s$ of subscriptions and multiplied by the number of subscriptions $Q_S$. Rohlfs shows how e is determined starting from a gross externality factor. Whether CRA and Frontier also carry out such a determination is not made transparent by them. For the purposes of evaluation, however, it makes no difference if it is assumed that both of them actually inputted exogenous values for e. Both consultants' calculations of prices are consistent with this assumption. To allow feasible solutions to the maximisation problem, Rohlfs puts $P_S$ at its initinal value and as far as we can tell CRA and Frontier did so as well.

(2) Externality effects via cross-price elasticities.

Both CRA and Frontier model cross-price elastic effects besides those that are due to externalities. They are modelled to be symmetric as required by standard economic theory. Symmetry means here that cross-price effects that are placed diagonally are of the same value when expressed as partial derivatives - provided the services are generated within the mobile sector. As regards fixed-to-mobile services, this symmetry is not maintained because the reactions of demanders for FTM calls are supposed to be outside the decision sphere of the demanders for mobile services. In general, the cross-price elasticities discussed in this paragraph are a subject under B-R modelling and not under externalities. When they are symmetric they largely cancel each other with respect to their impact on the magnitude of the mark-ups for the two services concerned; relative to other services their super elasticities change which means that the mark-up will become rela-

tively larger or smaller depending on whether the cross-price effect is negative or positive.

Externality effects that work through cross price elasticities are driven by changes in the number of subscribers that themselves change in response to changes in their prices. Thus both CRA and Frontier postulate demand functions for outgoing mobile calls and for fixed-to-mobile calls that contain elasticity parameters that are coupled to the own-price elasticity of subscriptions. In this case there is no symmetry as larger volumes of calls by themselves do not induce any increase of subscriptions. Thus there is no tendency for the subscriber number driven effects to be cancelled and as an end effect the super elasticity for subscriptions has a larger negative value which in turn induces a lower mark-up. The effect may become so strong to actually cause a negative value for the mark-up. In this context we point out that when an imposed linear demand structure has the effect of leading to a negative mark-up, the negativity of that mark-up has nothing to do with an externality effect.

By identifying the appropriate terms in the surplus functions, it is possible to calculate the value of the corresponding externality and put it in relation to the price of the service. The resulting value corresponds to the R-G factor realized via the cross-price elastic effects. Frontier explicitly carries out this calculation whereas CRA does not provide it.

# 4 Empirical Analysis

## 4.1 Input variables for price determination, in particular common costs

### 4.1.1 Approaches by Optus and Vodafone

CRA and Frontier had been requested to determine prices that apply to the whole mobile sector of Australia. Besides price elasticities and externality factors, provided by CRA and Frontier themselves, the required data for these exercises consisted of the values for the modelled services' incremental costs, the relevant common cost, as well as the initial values of the prices and quantities of the services needed to calibrate the demand functions. The price and cost data were in each case established on the basis of data from the cost accounting systems of the two MNOs while the quantity data were derived from market statistics. The analysis of the cost data had previously been carried out in the case of Optus apparently also by CRA and in the case of Vodafone by Price Waterhouse Coopers (PwC). Tables 4-1 and 4-2 show for each of the two companies the relevant data.

Table 4-1: Incremental costs (LRIC), initial prices and quantities

| | Optus/CRA | | | Vodafone/Frontier | | |
|---|---|---|---|---|---|---|
| | LRIC | Prices | Quantities in million | LRIC | Prices | Quantities in million |
| Subscriptions | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Mobile outbound (dimension: minutes) | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| Fixed-to-mobile (dimension: minutes) | [redacted] | $0.408 | [redacted] | [redacted] | $0.385 | [redacted] |
| Off-net (for Optus only) (dimension: minutes) | [redacted] | [redacted] | [redacted] | | | |

Table 4-2: Common costs

| | Optus | | Vodafone | | | |
|---|---|---|---|---|---|---|
| | | | Scenario 1 | | Scenario 2 | |
| | In million | Relative to total LRIC* | In million | Relative to total LRIC* | In million | Relative to total LRIC* |
| Common Cost | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

* These shares are calculated relative to the total costs consisting of the totals of LRIC resulting from initial quantities and incremental costs as shown in Table 4-1 and the common cost shown here. The common cost amounts could also be expressed in relation to the totals of LRIC alone, giving [redacted] and [redacted], respectively. These percentage figures would then correspond to the values of the mark-ups if an equal proportionate approach to determining theses mark-ups were used.

With respect to the market volume data presented by both Optus and Vodafone we see no reason to critique their derivation. There are differences between the volumes but this was to be expected. The fact that in the case of Optus the off-net calls are separated out as a different service has to do with CRA's strategy of closely following the general approach by Rohlfs (2002); there is actually little logic in this.

The cost data cover the year 2003/04 in the case of Optus and 2002/03 in the case of Vodafone. The resulting price and cost figures were extrapolated to apply to the year(s) covered by the calculations. In the case of Optus the extrapolations cover the years 2003/04 through 2006/07 while in the case of Vodafone the extrapolation applies only to the year 2004. We have not verified the substance of the cost and price determinations as presented in the cost analysis. This is the task of another consultancy commissioned by ACCC.[75] What we can do here is to make a number of observations regarding the differences in the results for the two companies.

[redacted] As regards the high incremental cost figures for subscriptions, [redacted]

75 [redacted]

[redacted], we believe that they reflect the inefficiency of the practice by the MNOs of spending large amounts on customer acquisition with the primary intent and effect of drawing customers away from competitors.

The common costs shown are in each case derived from the common cost of the particular MNO in question which are being scaled up to represent the common cost of the whole sector. The two amounts of [redacted] and [redacted], derived respectively on the basis of Optus's and Vodafone's data, appear to be approximately comparable. Also their shares in total costs of [redacted] for Optus and of [redacted] for Vodafone's first scenario correspond to what is generally known about the relation of common to total cost. In contrast, the share of [redacted] for Vodafone's second scenario appears to be relatively high. We would believe that the corresponding amount of [redacted] includes items that are not actually common cost. This is supported by the fact that for this scenario the LRIC for subscription is set at [redacted] instead of [redacted] which means that this higher common cost figure now includes items that were in the first scenario allocated to subscriptions. From the observation that the lower common cost figure appears more in line with general observation, and given that in this context MNOs have the tendency to allocate to common cost what is actually causally related to the acquisition of new customers, we presume that the lower common cost figure shown for Vodafone is the relevant one to be used in the model calculations.

We have argued in the discussion on the methodology of B-R pricing in Section 3.1 that only fixed common cost should be allocated on the basis of the B-R principle. From other analyses we know that network common cost can be approximately set at 5 per cent of total network cost which in the present cases would amount to [redacted] and [redacted] respectively when the costs of subscriptions is excluded, which is mostly non-network cost, or [redacted] and [redacted] respectively on including the costs of subscriptions. To these should be added a share of organisational common cost which must also be considered as fixed. Our analyses below will be based on what we consider to be relatively high amounts of fixed common costs, i.e. in each case 50 per cent of the reported total amounts. The remainder of the common cost will be considered as variable which means that it varies with the volume of all activities and has to be covered by a mark-up according to the EPMU rule. This mark-up will be added to the LRIC of each service, using the share that it had in the initial situation, before the B-R allocation of common cost is carried out. The effect will be that a smaller amount of common cost will be distributed to the various services according to the B-R principle with the consequence that generally the variation in the magnitudes of the mark-ups will be reduced.

### 4.1.2 Submissions of interested parties

#### 4.1.2.1 Submissions regarding Optus/CRA

AAPT (2005, pp 23/24 and Appendix A) raises fundamental critique against the concept of fixed and common costs as used by CRA. The way in which CRA is defining and using common costs relates to a short-run and not to a long-run cost concept as required by the TSLRIC concept. "The only costs that do remain constant over the short and long run are those joint, common or shared costs of production that cannot be directly attributed or allocated to any one service."[76] Because "fixed costs" as defined by CRA are already included in the TSLRIC, AAPT argues that the CRA model leads to double-counting of common costs.

Hutchison (2005a, p. 29) in particular rejects the joint production assumption that mobile outputs are produced in fixed proportions, referring to a similar discussion for the fixed network. According to Hutchison, MTAS is a separable service.

While Telstra (2005a, p. 22) finds NERA's (2004a) analysis that mobile termination and subscription are jointly produced goods useful to some extent, it concludes that this assumption does not provide support one way or the other for the prices set out in Optus's Undertaking.

#### 4.1.2.2 Submissions regarding Vodafone/PwC

Although Hutchison (2005 b, p. 30) gives merit to the PwC approach to define a number of coverage-related cells as common, it states that PwC has not provided an adequate explanation of its choice of cells and therefore the methodology cannot be thoroughly assessed. Marsden Jacob and Associates on behalf of Hutchison states that the FAC approach of PwC is generally unable to identify the extent of common costs. With reference to international experience, Hutchison suggests that the extent of network related fixed and common costs should be set at 5 per cent of total annual MTAS service costs. Therefore PwC overestimates the extent of network common costs significantly. As a matter of principle Hutchison submits that it is appropriate to include non-network fixed and common costs as part of TSLRIC+. It notes, however, that PwC provides insufficient information and detail on the nature and extent of the non-network fixed and common costs which are mainly related to overhead functions.

Without making comments on the amount of fixed and common costs as calculated by PwC, Telstra (2005b, p. 24) agrees that fixed and common costs should be related to

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**76** AAPT (2005), p. 24.

(certain) base stations. Furthermore, non-network fixed and common costs should be included in that cost category.

## 4.2 Determination of B-R Prices

The discussion in this part focuses on the results of B-R modelling leaving out of consideration externality effects. These will be added on and discussed below in Section 4.3. By focusing in this first step on B-R prices alone it is possible to identify the effects on the results of other assumptions that are not related to network externalities and to assess these effects separately.

As we discussed in the methodological part, prices calculated on the basis of a B-R model can be strongly influenced by the choice of the particular functional form and particular parameter values. As we will see, this is particularly the case in the current context. To make this clear we will proceed as follows. Taking the models of both CRA and Frontier as specified by them we calculate B-R prices with the externality effects excluded. We then introduce corrections to the deficiencies in the specifications that we pointed out earlier. The differences in the results then show to what extent the final results of their models are influenced by these deficiencies in the model structure and parameter specifications.

### 4.2.1 Optus

#### 4.2.1.1 Optus's model calculations

The various model runs to trace the various distortions caused by CRA's model structure and specifications are listed below in terms of what characterises the particular model run. Note that the first run is the base case in that it represents CRA's results without including the externality factors:

- Linear demand functions and only own-price and symmetric cross-price elasticities
- Constant-elasticity functions and only own-price and symmetric cross-price elasticities
- Magnitude of fixed common cost set at 50 per cent of reported common cost
- Increase the size of the own-price elasticity for FTM calls
- Correcting for wrong sector specification

The changes will be cumulative in the sense that each time the additional change is added to those of the preceding steps. In each case we will discuss the reasons for and consequences of making the change.

In Table 4-3 we show again the values used by CRA for incremental costs and the initial values of prices and quantities. It will be remembered that the initial values for prices and quantities are needed to complete the specification of the demand functions underlying the modelling. The amount for common cost, to be covered by the mark-ups on the LRIC figures to be determined in the modelling, is [redacted] million.

Table 4-3: Initial values of variables for 2004-05 used by CRA

| | LRIC | Initial prices | Initial volumes in million |
|---|---|---|---|
| Subscriptions | [redacted] | [redacted] | [redacted] |
| Mobile outbound | [redacted] | [redacted] | [redacted] |
| Fixed-to-mobile (both mobile and fixed parts) | [redacted] | [redacted] | [redacted] |
| Off-net mobile calls | [redacted] | [redacted] | [redacted] |

- *Own-price and symmetric cross-price elasticities only with linear demand functions*

  With this and the following assessment round we intend to show what the effect of the linear structure on the B-R results is. For this purpose we calculate results with own-price and symmetric cross-price elasticities being effective only, using in this first round linear demand functions as does CRA. The symmetry of cross price elasticities is imposed using a requirement that follows from economic theory, in the present case when there are no externalities.[77] Those that CRA uses are shown in Table 4-4. The results of the model using this parameterisation are shown in Table 4-5.

77 The symmetry of cross price elasticities is imposed due to a requirement that follows from economic theory in the present case when there are no externalities. See Appendix C "Mathematical Economic Analysis" of Rohlfs (2002).

Table 4-4: Own-price and symmetric cross-price elasticities used by CRA

| | Subscription | Mobile outbound | FTM | Off-net |
|---|---|---|---|---|
| Subscription | -0.44 | -0.23* | 0 | -0.17* |
| Mobile outbound | -0.15* | -0.59 | 0 | -0.06* |
| Fixed-to-mobile | 0 | 0 | -0.31 | 0 |
| Off-net mobile calls | -0.15* | -0.08* | 0 | -0.59 |

* Symmetry between cross-price elastic effects exists when expressed in terms of partial derivatives, not shown here.

Table 4-5: Results with own-price and symmetric cross-price elasticities only, based on linear demand functions as used by CRA

| | Calculated price | Mark-up | Change in model volume relative to initial volume |
|---|---|---|---|
| Subscription | [redacted] | [redacted] | [redacted] |
| Mobile outbound | [redacted] | [redacted] | [redacted] |
| Fixed-to-mobile | [redacted] | [redacted] | [redacted] |
| Off-net mobile calls | [redacted] | [redacted] | [redacted] |

According to the logic of the B-R principle, i.e. when the inverse elasticity rule applies, the margins for common cost added to incremental cost to determine prices should be inverse-proportional to the elasticities of the corresponding services. In Section 3.1.2 we had given an illustrative example. Here, one needs to take into account the effects of the cross price elasticities that change the relationships. Nevertheless we should in the present case not expect such dramatic changes as shown in Table 4-5 where the service with the second-lowest own price elasticity (subscriptions) has the lowest mark-up ([redacted]) and one of the services with the highest elasticity (off-net calls) has the highest mark-up ([redacted]). The reason for these unreasonable results lies in the fact that under a linear structure, where the concrete specification is calibrated according to initial prices and quantities, the calculated prices are always biased away from their correctly calculated values, and they diverge the more that the initial values diverge from the solution values. [redacted]

- *Own-price and symmetric cross-price elasticities only with constant-elasticity functions*

  Given that the linear demand structure causes the greatest distortion from correctly calculated prices, this deficiency should be the first one to be corrected. Thus imposing constant elasticity demand functions, not changing anything else, provides the results shown in Table 4-6.

Table 4-6: Results with own-price and symmetric cross-price elasticities, based on constant elasticity specification

| | Calculated price | Mark-up |
|---|---|---|
| Subscription | [redacted] | [redacted] |
| Mobile outbound | [redacted] | [redacted] |
| Fixed-to-mobile | [redacted] | [redacted] |
| Off-net mobile calls | [redacted] | [redacted] |

We note that now the mark-ups added on LRIC to determine prices are much closer to what one would expect for a B-R inverse-elasticity rule; actually they are now inverse-proportional to the so-called super elasticites that take into account cross-price elasticities. Note that the mark-up for FTM has declined from [redacted] under the linear structure to [redacted] after the present correction.

It is true that in reality elasticity values do change from one point on the demand curve to the other. They, however, do by far not change as much as implied by linear demand functions for which the own price elasticity at the various solution points change to values up to several times the original value. In any case, the argument for using a B-R pricing approach with the stated price elasticities implies that these elasticity values hold at the solution points, which is the case in the present calculation.

- *Magnitude of fixed common cost set at 50 per cent of reported common cost*

  We have argued in the discussion on methodology in Section 3.1.2 that only fixed common cost should be allocated on the basis of the B-R principle. In Section 4.1.1 we noted that of the reported total common cost only about 50 per cent should be accepted as being fixed, i.e. 50 per cent of [redacted] or [redacted], the rest being variable and changing with the total volume of activities. The amount of 50 per cent of reported common cost for fixed common cost would include fixed network common cost as well as a share of organisational common cost. In order that also variable common cost is covered by the prices, a mark-up

according to the EPMU rule of [redacted] is added to the LRIC of each service. The results are reported in Table 4-7.

Table 4-7: Results with constant own-price and symmetric cross-price elasticities and only 50 per cent of reported common cost considered as fixed

| | Calculated price | Mark-up | Incremental mark-up (in addition to EPMU portion of mark-up) |
|---|---|---|---|
| Subscription | [redacted] | [redacted] | -0.4 % |
| Mobile outbound | [redacted] | [redacted] | 4.9 % |
| Fixed-to-mobile | [redacted] | [redacted] | 10.5 % |
| Off-net mobile calls | [redacted] | [redacted] | 12.9 % |

This change has the effect of levelling the sizes of the mark-ups. The main reason for this is that 50 per cent of reported common cost are allocated beforehand according to the EPMU rule which means that without any further addition the mark-up would have been [redacted]. The remaining 50 per cent of common cost, the fixed part, is then allocated according to the model's B-R implementation. It is the incremental portion, in addition to the one based on EPMU, shown in the fourth column of Table 4-7, that is determined by the B-R rule. Relative to the preceding scenario, the mark-up for FTM has declined from [redacted] to [redacted].

- *Increase of the size of the own-price elasticity for FTM calls*

The relatively high mark-up on incremental cost of FTM services is to a large extent due to the value of that service's own-price elasticity being lower than the own-price elasticities of the other call services. The elasticity values cited by CRA correspond to point estimates from econometric studies which means that each of them represents a mid point of a statistical confidence interval that could possibly cover a range from zero up to double the value of the point estimates. The difference between the average elasticity value for fixed-to-mobile calls and the corresponding average elasticity value for the other call services, which obviously is also a statistical estimate, will have an equally large confidence interval. It is then very likely that this difference is statistically insignificant, i.e. it must be considered not to be significantly different from zero. In other words, on the basis of the evidence presented by CRA it is not justified to claim that the fixed-to-mobile services have a different, in particular a lower, price elasticity than the other services.

The calculations should therefore be carried out with an own-price elasticity for FTM calls being equal to the one for mobile outbound and for on-net calls. Table 4-8 shows the corresponding results after changing the FTM elasticity accordingly.

Table 4-8: Results with own-price and symmetric cross-price elasticities, only 50 per cent of reported common cost considered as fixed, and the own-price elasticity of FTM calls equal to that of other call services

| | Calculated price | Mark-up |
|---|---|---|
| Subscription | [redacted] | [redacted] |
| Mobile outbound | [redacted] | [redacted] |
| Fixed-to-mobile | [redacted] | [redacted] |
| Off-net mobile calls | [redacted] | [redacted] |

This change has the effect of lowering the mark-up for FTM at the expense of the mark-ups for the other services. The mark-up for FTM has decreased relative to the previous scenario from [redacted] to [redacted].

- *Correcting for wrong sector specification*

This change concerns not merely a change in functional form or values of parameters but rather in the types of services modelled. The criticism is that lumping together business demand on the one hand and mass market demand for mobile services on the other hand substantially distorts the results. This is to be expected because business demand especially for subscriptions should be highly price inelastic and therefore be a service able to carry a high share of fixed common cost. Thus the change implemented is the separation of the demands for subscriptions and mobile outbound calls in a part that comes from business and a part that comes from the mass market where the former have relatively low own-price elasticities and the own-price elasticities for the mass market demand is correspondingly higher. Business subscribers are assumed to have about 25 per cent of the total number of subscriptions but to make about 50 per cent of the volume of outbound calls. Table 4-9 shows the elasticity values that were assumed.

Table 4-9: Elasticities for 6 services

| | Subscription mass market | Mobile outbound | FTM | Off-net | Subscr. business | MO business |
|---|---|---|---|---|---|---|
| Subscriptions - mass market | -0.56 | -0.23* | 0 | -0.17 | 0 | 0 |
| Mobile outbound (MO) - mass market | -0.15* | -0.59 | 0 | -0.06* | 0 | 0 |
| Fixed-to-mobile | 0 | 0 | -0.59 | 0 | 0 | 0 |
| Off-net mobile calls | -0.15 | -0,08 | 0 | -0.59 | 0 | 0 |
| Subscriptions - business | 0 | 0 | 0 | 0 | -0.10 | -0.108 |
| Mobile outbound - business | 0 | 0 | 0 | 0 | -0.033 | -0.59 |

Note that the low own-price elasticity for business subscription demand has been compensated by increasing accordingly the own-price elasticity for mass market demand. The own price elasticity of business MO call demand has been put at the same value as for the mass market, and the two cross-price elasticities have been defined analogously as for the mass market. The results from this model run appear in Table 4-10.

Table 4-10: Results with own-price and symmetric cross-price elasticities, only 50 per cent of reported common cost considered as fixed, the own-price elasticity of FTM calls equal to that of other call services, and with demand for subscriptions and MO calls separated into a mass market and a business segment

| | Calculated price | Mark-up |
|---|---|---|
| Subscription – mass market | [redacted] | [redacted] |
| Mobile outbound – mass market | [redacted] | [redacted] |
| Fixed-to-mobile | [redacted] | [redacted] |
| Off-net mobile calls | [redacted] | [redacted] |
| Subscription – business | [redacted] | [redacted] |
| Mobile outbound – business | [redacted] | [redacted] |

We observe that now the mark-ups for the call services have moved together to such an extent that they do not lie apart by more than 1.3 percentage points. The

mark-ups for all call services, in particular also for FTM, lie below a mark-up that would be determined on the basis of an EPMU rule which in this scenario would be [redacted].[78] The mark-up for FTM relative to the one determined in the preceding scenario has decreased from [redacted] to [redacted].

After having introduced into CRA's model the four changes as discussed above – constant-elasticity demand functions, reduction of the magnitude of fixed common cost, increase in the absolute value of the own-price elasticity of FTM calls, separation of the mobile market in a mass market and a business segment – all changes that are well grounded in theory and fact, there remains no evidence that on the basis of B-R pricing alone the mark-up in the price of FTM calls should be higher than according to the EPMU rule.

The above conclusion would most probably be strengthened if the interrelationship of the mobile with fixed sector services were also modelled. This assertion rests on the fact that there is a substitution going on between fixed and mobile subscriptions which involves a positive cross-price elasticity which in turn implies a lower super elasticity of mobile subscriptions. From this again follows that the price for mobile subscriptions should be higher meaning that the mark-ups for calls can be lower. To model this with sufficient precision for our purpose would require information that is not available and for which we hesitate to substitute our intuition. It would in any case be beyond the scope of this study.

Whether the inclusion of externality factors will make a large difference will be discussed in Section 4.3.1.

#### 4.2.1.2 Submissions of interested parties

Telstra (2005a, pp. 18 - 21) supports the use of B-R pricing principles for cost recovery in relation to the MTAS. Given the lack of detailed industry information on elasticities, Telstra regards the CRA approach of using elasticity estimates from available econometric studies in other jurisdictions as appropriate. According to Telstra, applying the Rohlfs model tends to generate too low termination charges because marginal subscribers make and receive more than one third of the calls made and received by an average subscriber.

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78 In the initial situation total common cost of [redacted] amounted to [redacted] relative to total incremental cost. Of these [redacted], half is treated as fixed and the other half as variable. In the present scenario with an increase of services and revenues, the fixed common cost is spread over a larger total amount of incremental cost while the share per unit of service of variable common cost has remained constant. This is the reason for the ratio of total common cost to total incremental cost, which would also be the value of the EPMU, having decreased.

Although AAPT (2005) is not generally rejecting a Boiteux-Ramsey approach for pricing the MTAS, it takes a critical approach towards the CRA B-R pricing model. Firstly, AAPT is critical of CRA's decision to exclude SMS and data services in the modelling approach and from the allocation of common costs. The addition of another (relevant) service in a B-R framework would be welfare improving if this service makes some contribution to the recovery of the common costs. This would lead to a decrease in the allocation of common costs and therefore the price of other services in the model, which means in particular the FTM price. Secondly, AAPT exhibits reservation against the use of elasticity estimates in the CRA model:

- It is unclear whether the elasticities used are appropriate in an Australian market context.

- Given the importance of the elasticity values for deriving model result, why do CRA (for Optus) and Frontier Economics (for Vodafone) use so different elasticity values?

- Does the introduction of cost-based regulation for the MTAS itself have an impact upon the estimated demand elasticities that should be used?

- The elasticities used are derived from econometric studies using constant elasticity assumptions. CRA, on the other hand, uses linear demand functions having the implication that the elasticities must be changing as the prices move from the initial to the socially-optimal prices.

Hutchison (2005a) believes that the costs (and price) of the MTAS should include a mark-up for common costs. This mark-up should, however, not be calculated according to Ramsey pricing principles but according to an EPMU rule.

Hutchison (2005a) also submits that the Optus' Ramsey mark-ups are not reasonable and are not calculated with adequate precision for the following reasons:

- Ramsey mark-ups are very sensitive to elasticity estimates; the uncertainty about elasticities makes the optimal Ramsey mark-ups also very uncertain.

- Ramsey mark-ups are not welfare-maximising if they are not implemented across all (relevant) prices, wholesale and retail. Setting wholesale and retail prices is, however, impractical and undesirable.

- No other international regulator has chosen to implement Ramsey prices but all have chosen an EPMU approach.

Hutchison has allocated fixed costs to all services using an EPMU approach on the basis of the CRA numbers. This approach leads to costs-based prices for the MTAS

from [redacted] cpm in 2004-05 and [redacted] cpm in 2006-07. Such costs are consistent with the ACCC's own cost estimates in its June 2004 decision.

Marsden Jacob Associates (2005a) provides detailed analysis of the elasticities used by CRA and provides its own estimates which are different and proves that relevant elasticities can be expected in a broad relevant interval until reliable estimates are available for the Australian market.

#### 4.2.1.3 Optus's reply comments

In its reply comments to submissions made on its Undertaking, Optus (2005) generally argues that Ramsey pricing cannot be rejected on the sole argument that it has been applied imperfectly. A Ramsey approach, so argues Optus, should only be rejected if it can be demonstrated that there exists an alternative approach that will deliver greater consumer welfare.

Otpus brings a variety of arguments and evidence to the table which shall prove that competition in the Australian mobile retail market has increased over the last twelve months and that competition is effective. Thereby, Optus intends to reject the argument that Boiteux-Ramsey pricing cannot be applied if the mobile service markets are not competitive enough.

Against the evidence that B-R pricing is not used by other regulators internationally in the mobile industry, Optus mentions that Ramsey pricing principles have been applied in the US and Victoria's rail regulation.

Although Optus recognises the uncertainties in the use of elasticities for applying a Ramsey model, it rejects these uncertainties as relevant arguments against the application of a Ramsey approach. Regulators must frequently make decisions with imperfect information on relevant variables which are not different to the uncertainties with regard to elasticities.

### 4.2.2 Vodafone

#### 4.2.2.1 Vodafone's approach and model calculations

As was done in Section 4.2.1.1 as regards Optus, we look in this section at prices determined for Vodafone by Frontier on the basis of the B-R modelling approach, without considering at this moment any effect on account of externality factors. Frontier has provided the files for all the model versions for which it has calculated B-R prices. We consider only the scenario with the lower common cost amount and from the corre-

sponding sub-scenarios only the one with the most realistic combination of own-price elasticities, i.e. -0.3 for subscriptions and -0.6 for the call services. The other scenarios with either a higher elasticity for subscriptions or lower ones for the call services do not agree with our understanding of the realistic values for these elasticities.

Different from the discussion regarding Optus, we do not make a step-by-step comparison to trace in detail the distortions in the results due to the various instances of an unrealistic specification in the model. Instead we compare directly the results presented by Frontier with those based on the corrected version of the model. The corrections are analogous to those implemented in the CRA model for Optus. They are as follows:

- Constant-elasticity instead of linear demand functions.
- Reduction of the magnitude of fixed common cost to 50 per cent of the value used by Frontier. Given that the amount for common cost used by Frontier is [redacted], the amount considered as fixed is thus [redacted]. The remainder is considered variable and added to the measures of LRIC by means of a mark-up according to the EPMU rule at the rate of [redacted] which corresponds to the relation between variable common cost and total LRIC in the initial situation.
- Changes in the values of elasticities to accord with the evidence. Frontier sets the own-price elasticity for mobile outbound services at -0.97. It includes a round-about effect attributed to changes in the prices of outbound services that affect subscriptions and through changes in subscriptions have a further impact on outbound services. It is our opinion that if there were such a round-about effect it would be captured by the measured value for that cross price elasticity, which we understand is at -0.6, so that no further adjustment to that value is necessary. Furthermore, to define the cross-price elasticity for mobile outbound with respect to the price of subscriptions, Frontier sets the average rate at which new subscribers make calls relative to the average rate at 0.7 instead of 0.33 as is used by Rohlfs and also by CRA. We rather follow Rohlfs in this and have accordingly changed that parameter value.
- Separation of the mobile market in a mass market segment and a business segment. Businesses are assumed to have in the initial situation 25 per cent of subscriptions and account for 50 per cent of calls. The own-price elasticity of their demand for subscriptions is assumed to be -0.1 while that for mobile outbound calls is assumed to be equal to the one assumed for the mass market segment.

The comparison of the results is shown in Table 4-11.

Table 4-11 Comparison of Frontier Economics' results (without externality effects) with corresponding results from corrected model version

| | Frontier's calculation | | Calculation with corrected model | |
|---|---|---|---|---|
| | Price | Mark-up | Price | Mark-up |
| Subscriptions (in case of corrected version: mass market segment only) | [redacted] | [redacted] | [redacted] | [redacted] |
| Mobile outbound (in case of corrected version: mass market segment only) | [redacted] | [redacted] | [redacted] | [redacted] |
| Fixed-to-mobile | [redacted] | [redacted] | [redacted] | [redacted] |
| Subscriptions (in case of corrected version: business market segment) | | | [redacted] | [redacted] |
| Mobile outbound (in case of corrected version: business market segment) | | | [redacted] | [redacted] |

Note that here the distortion of the results due to Frontier's particular model specification is not as glaring as in the case of the calculations carried out by CRA for Optus. [redacted] Furthermore Frontier uses values for cross-price elasticities that affect demand and thus prices for subscriptions in a way that these prices are put at a relatively lower level.

Nevertheless, we observe that under the corrected model structure, the mark-up on the LRIC for FTM calls decreases from [redacted] to [redacted]. As in the case of Optus, there remains no evidence that on the basis of B-R pricing alone the mark-up in the price of FTM calls should be higher than one according to the EPMU rule. Whether the inclusion of externality factors will make a large difference will be discussed in Section 4.3.

#### 4.2.2.2 Submissions of interested parties

Major comments relating to the Frontier welfare-maximising calculations are provided by Hutchison (2005b). Identifying mark-ups on incremental costs in the range from [redacted] to

[redacted] per cent, Hutchinson regards the Frontier estimates as contrary to all international precedents in this area and qualifies them as unreasonable for the following reasons:

- the estimate of fixed and common costs is excessive and therefore unreasonable;
- the Ramsey mark-ups vary considerably from [redacted] to [redacted] per cent of total cost which raises serious questions of appropriateness;
- the zero-profit constraint and a full "waterbed" effect are assumptions in the Frontier model for which there is insufficient evidence;
- the Frontier comments on the "waterbed" effect only relate to abstract strategic interactions between market players and is not related to the relevant conditions of the Australian market.

In detail Hutchison regards the elasticity estimates as provided by Marsden Jacob Associates (2005b) as more appropriate than those used in the Frontier model. Generally, Marsden Jacob Associates (2005b, p. 71) regards elasticity estimates for welfare analysis as notoriously difficult to calculate. Therefore, any point estimate is too uncertain. A range of estimates has to be considered and sensitivity analysis has to be conducted for final judgement of results. Marsden Jacob Associates discusses international experience with elasticity estimates and suggest intervals of alternative estimates of elasticities as being used by Frontier.

## 4.3 Externalities

### 4.3.1 Optus

#### 4.3.1.1 Approach and calculations of Optus

Optus[79] claims that the prices for MTAS should also include an externality surcharge to enable mobile subscribers "to capture some proportion of the benefits to others associated with their mobile subscription."[80] The size of the benefit is, according to Optus, reflected in the individual demand for calls to a mobile subscriber. Optus points out that it has not included any option value to call a mobile subscriber not reflected in the actual

79 Optus (2004) at 7.5 to 7.19.
80 Optus (2004) at 7.7.

calls made.[81] Considering such option values would increase the optimal externality surcharge.

CRA (2004) calculated the magnitude of the externalities in the model to determine welfare maximising prices by using the Rohlfs model as presented to Oftel in 2002. To rely on a conservative approach, CRA adopted the parameter values of the Rohlfs model which have been considered reasonable by Oftel. Table 4-12 reports the parameters used by CRA.

Table 4-12: Assumed Externality Factors by CRA

| Externality and elasticity parameter | Rohlfs's value |
|---|---|
| Gross network externality | 1.5 |
| Mobile-originated externality | 1 |
| FTM usage externality | 1 |
| Off-net usage externality | 1 |
| Proportion of internalised cross-elastic MO externality accruing to mobile subscribers | 0.8 |
| Proportion of internalised cross-elastic off-net externality accruing to mobile subscribers | 0.7 |
| Fraction of total cross-elastic externality that is internalised by MNOs | 0.4 |
| Fraction of fixed-to-mobile consumer surplus to fixed subscribers internalised by MNOs | 0 |
| Fraction of off-net consumer surplus internalised by MNOs | 0.91 |
| Fraction of option surplus internalised by MNOs | 0.1 |
| Ratio of usage of marginal subscriber to that of average subscriber | 0.33 |

Source: CRA (2004), p. 40.

The main externality assumption relates to the ratio of the total social value of subscription to the private value accruing to the mobile subscriber (the so-called Rohlfs-Griffin factor). Much of this Gross Externality Factor is represented by cross-elasticities between the services. The assumed value of 1.5 reflects significant internalisation by MNOs. As Rohlfs CRA assumes that there are no calling externalities for all three types of calls or in other words that all calling externalities are internalised. MNOs internalise externalities to a certain degree. This externality aspect is modelled in three factors fixing different degrees of internalisation. One factor addresses the benefits to mobile subscribers only (0.8); the second refers to off-net usage (0.7) and a third one to fixed and mobile subscribers (0.4). As Rohlfs (and different to the statement of Optus[82]) CRA

81 Optus (2004), footnote 19.
82 See Optus (2004), footnote 19.

takes care of externalities apart from those relating to usage. CRA assumes an option value externality, which reflects the subscriber benefits from the option to call a new mobile subscriber with a relatively small value of 1.1.

As in the Rohlfs model CRA assumes that marginal subscribers only make and receive one third of the calls made and received by an average subscriber, which is regarded as a conservative and sensitive assumption. The way in which the externality surcharge is calculated in the CRA model does not allow to directly observe the magnitude of the externality mark-up. The results calculated are a combined externality and Ramsey mark-up. To estimate the proportion of the overall mark-up that is attributed to the network externality, Optus set the R-G factor equal to 1 rather than 1.5.[83] The consequence of this calculation exercise was that the optimal termination charge in the model falls by 2.12 cpm. Optus takes this amount as the network externality surcharge.

Hausman (2004) on behalf of Optus calculates the magnitude of the mobile network externality for FTM users in terms of consumer surplus.[84] On the basis of certain elasticity assumptions Hausman calculates the (external) benefit that FTM users gain from a new mobile subscriber to be in the range of $102 and $378 per year. Furthermore, he calculates the welfare effects of handsets subsidies. According to his assumptions and analysis 10.8 per cent or 1.5 million subscribers would leave the network if there were no handset subsidies. The associated (external) benefit of those mobile subscribers to FTM users would be between $153 and $568 million per year. These values represent according to Hausman the generated network externalities.

#### 4.3.1.2 Optus's model calculations for externalities

In this section we first redo CRA's calculations for the surcharge on account of externality factors in the price for FTM calls using its version of the B-R model. For this we run the model without the externality factors implemented and then with these factors included. By comparing the results from the two runs, one obtains the size of the externality surcharge according to the CRA model in its uncorrected form. We then use the model as presented at the end of Section 4.2.1.1 with the four changes implemented as discussed in that section to carry out analogous calculations and compare the results with those derived by CRA.

In the CRA's B-R model, externalities become effective essentially at two places. The one place is the social surplus function to which is added a term to reflect the option value of additional subscribers. As we could replicate, CRA puts this option value at 0.0552 of the initial price of a subscription which, following Rohlfs, corresponds to a net externality factor on account of the option value of 1.064. The other place is the elastic-

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**83** See Optus (2005), para 4.22.
**84** See Hausman (2004), pp. 31-33.

ity matrix into which cross-price elasticities of call services (mobile out, fixed-to-mobile, and off-net) with respect to the price of subscriptions are introduced that reflect the impact on the demand for these call services due to the increase in the number of subscriptions. The additional consumer surplus created by these additional calls can be called an externality of additional subscriptions as these calls would not be coming forward without them. These cross-price elasticities have no symmetric counterparts. The reasoning supporting this is as follows. When the number of subscriptions change because of changes in its own price, this will call forward demand for calls from these new subscriptions. On the other hand, if volumes of call services increase these increased volumes by themselves do not call forward additional subscriptions. We follow CRA – and thereby Rohlfs – in this argument. The problem comes with the implementation of the ideas.

Table 4-13 shows the calculated surcharge from the two model versions.

Table 4-13: FTM price and surcharge included in that price due to externalities, calculated with the model as implemented by CRA and as implemented with corrected model version

| | CRA model specification | Corrected model specification |
|---|---|---|
| Price/minute with externality factor not included | [redacted] | [redacted] |
| Price/minute with externality factor included | [redacted] | [redacted] |
| Increase in price due to externalities | $0.0216 | $0.0058 |

We should first note that in our replication of CRA's result we arrive at a surcharge on account of network externalities of $0.0216 instead of the $0.0212 as reported by CRA itself. This negligible difference may be due to rounding errors or the use of a different algorithm than the one CRA has used.

The essential result is that while the CRA model version comes up with a surcharge of $0.0216, the corrected model version shows that this surcharge should be $0.0058 or about 27 per cent of that what has been proposed by CRA. This bias is due to CRA's choices regarding model structure and model parameterisation. These choices had the perhaps even more important effect of bringing about in general a grossly distorted level of the FTM retail price ([redacted]) that is about 40 per cent higher than the one that the corrected model would produce ([redacted]).[85]

85 [redacted].

To close this section, we look at the volumes of services that the two different model versions predict in comparison with those that were inputted as holding in the initial situation. The comparison is in Table 4-14. The volumes shown correspond to the model versions including the effective network externalities as discussed in this section.

Table 4-14: Service volumes as predicted by CRA's model version, the corrected model version and as shown for the initial situation

| | Initial | CRA model version | Corrected model version |
|---|---|---|---|
| Subscriptions (in million) | [redacted] | [redacted] | [redacted] |
| Mobile outbound (in million minutes) | [redacted] | [redacted] | [redacted] |
| Fixed-to-mobile (in million minutes) | [redacted] | [redacted] | [redacted] |
| Off-net mobile calls (in million minutes) | [redacted] | [redacted] | [redacted] |

The most remarkable thing is that the CRA model version predicts that demand for subscriptions would decrease by [redacted]. This is wholly unrealistic. Also some of the call service volumes would decline. In contrast, according to the corrected model version, the level of subscriptions is maintained, increases even by about [redacted], and the volume levels of all three services show increases relative to the initial situation of between [redacted] and [redacted]. These volume results are due to the relatively inelastic demand for subscriptions and the relatively elastic demands for call services – both remaining constant even as prices increase or decrease. Provided the elasticity values used are realistic, and in particular hold at the model's solution values, as they should, the corrected model version would obviously predict a much more efficient market result than is predicted by the CRA model version. Nevertheless we strongly urge to consider the corrected model results as only indicative, having the primary purpose of identifying the problems in the CRA results and not of providing alternative proposals.

#### 4.3.1.3 Submissions of interested parties

Major discussion of the externality concept, the magnitude of externalities and the consideration of externality surcharges in the prices for the MTAS is contributed by the submission of AAPT (2005), Hutchison (2005a) and their advisors. Telstra (2005a, p. 21f.) supports the use of externality mark-ups to encourage economically efficient outcomes. Telstra also regards the use of the Rohlfs approach in the UK as applied by CRA as appropriate and states the lack of detailed industry information in Australia. Telstra strongly supports the CRA view that using the Rohlfs parameters lead to a con-

servative estimate of the magnitude of relevant externalities. Telstra in particular refers to parameters relating to internalisation and relative call volumes of marginal subscribers and urges the ACCC to consider evidence which may lead to higher values of externality surcharges.

The Hutchison submission which is supported and backed by Marsden Jacob Associates (2005a) and which in its result is rejecting the appropriateness of including externality surcharges in the price of the MTAS is remarkable because Hutchison 3G is one of the four MNOs in the Australian market. Given the rationale Optus has expressed for applying an externality mark-up, Hutchison (2005a, pp 8-11) argues that the ACCC needs to consider:

- is the economic profit made by Optus in supplying the MTAS competed away in the form of higher subscription subsidies?
- if so, what is the nature and value of those higher subscription subsidies?
- do those subscription subsidies in fact encourage higher mobile penetration or have other consequences that can properly be described as welfare-enhancing?

  and

- if so, do those welfare-enhancing consequences exceed any welfare loss consequences?

Hutchison further argues, if anyone of these issues cannot be answered adequately by Optus's analysis then the network externality mark-up is unsustainable.

Hutchison questions that the Australian mobile market is effectively competitive. Therefore, there is no or only a limited waterbed effect. Any reduction in the profits that MNOs make on the MTAS will not lead to an equal reduction in the subscription subsidy. Hutchison provides as evidence a recent observation from the Australian market: Vodafone no longer offers significant subscription subsidies and has stopped the subsidisation policy. Vodafone, however, is not forced to adopt its retail prices to compete away the extra profits from the savings in subscription subsidies. Because of the oligopolistic structure of the retail markets profits from overpriced MTAS are not fully competed away in the mobile retail market.

Hutchison questions whether subscription subsidies increase penetration given that mobile penetration in Australia is approaching 100 per cent of available customers.[86] Hutchison provides as evidence the experience of Korea which has a similar mobile penetration as Australia in 2003 despite the fact that handset subsidies have been

86 See IDC (2005).

banned in Korea since June 2000. Hutchison points out that the major relevance of subscription subsidies is to signal risk adverse customers high benefits of mobile subscription. This effect is of major relevance only at low degrees of penetration. Hutchison supports its view with statements made by a Vodafone industry representative.

Hutchison argues that call externalities related to incoming calls are relevant and may be offsetting the network externalities without offering supporting quantitative evidence. Further distortions arise when infra-marginal subscribers benefit from subscription subsidies compared to fixed-line subscriptions.

Hutchison also criticises that the magnitude of the network externality surcharge is not made explicit in the CRA calculations. Instead Marsden Jacob Associates (2005a) calculated the magnitude of the network externality by replacing the approach which the Competition Commission (2003) developed for the UK to the Australian market. In applying the UK Competition Commission's assumptions to Australian market data Marsden Jacob calculate the level of subsidy required to induce a marginal subscriber to join the network to a value of $66.67. The externality surcharge required to provide the level of subsidy sufficient to induce marginal existing and non-subscribers to subscribe at that level of external benefit amounts from 0.16 cpm to 0.62 cpm. The difference of the two values depends on how effectively operators can target the subscription subsidy to marginal subscribers.

Marsden Jacob Associates (2005a, p. 51) contribute the observation from international experience that only two countries out of 15 they have examined[87] have taken account of network externalities. These are the UK and Israel. They also refer to the Swedish regulator PTS[88] which has argued that the network externality is negligible and can be ignored in the case of Sweden because of the high level of mobile penetration already reached in Sweden (more than 90 per cent).

AAPT (2005) is sceptical towards the relevance of network externalities and the proper way of calculating them in the CRA approach and recommends to ignore it in the pricing of the MTAS. In summary AAPT bases its position on the following arguments:[89]

(1) AAPT cites several economic analysts who highlight a negative correlation between the significance of network externalities and penetration. On that basis AAPT concludes that the Australian mobile market has reached a level of penetration (and saturation) such that the marginal network externality either has diminished in importance, or simply has disappeared.

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87 Israel, Malaysia, South Korea, Sweden, UK, USA (California, Florida, New York), Denmark, Germany, Ireland, The Netherlands, Portugal, Spain, Norway.
88 PTS (2004).
89 AAPT (2005), p. 23.

(2) It remains unclear what is the appropriate value of the R-G factor in the Australian market. The use of an incorrect value could lead to a greater inefficiency than would arise if the network externality were simply ignored.

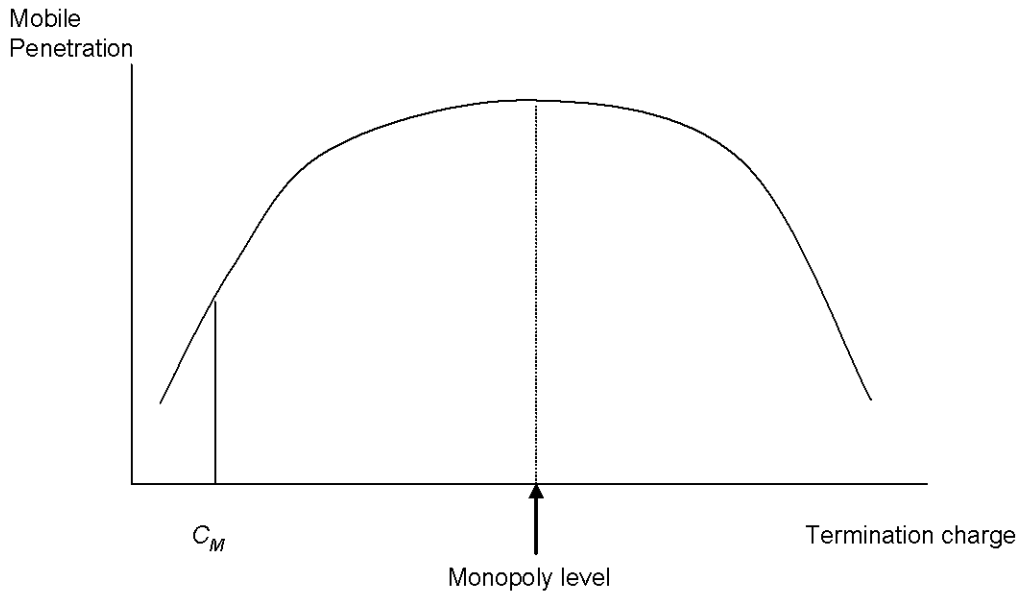
(3) With increased fixed-to-mobile substitution the fixed network externality may soon be of greater significance than the mobile network externality.

(4) Call externalities which have the opposite impact on the MTAS price compared to the network externality are becoming of increasing importance with higher levels of subscription.

(5) Call as well as network externalities may already be sufficiently internalised without further efficiency improvements to be gained by corrective pricing.

AAPT also presents a report of Joshua Gans (2005) which illustrates the relationship between termination rates and mobile penetration rates as shown in Figure 4-1. Figure 4-1 illustrates the well known theoretical result derived by Armstrong (2002), Wright (2002) and Dewenter and Haucap (2004) that unregulated termination charges will be above the monopoly level and mobile penetration is not at its optimal level.

Figure 4-1: Relationship between termination charges and mobile penetration




Source: Gans (2005), p. 15.

#### 4.3.1.4 Optus's reply comments

In its reply comments to submissions of interested parties Optus (2005) first of all rejects all arguments and evidence which question the effectiveness of competition in mobile retail markets. Optus specially refers to competitive developments in the last twelve months. Vodafone, MNOs and resellers have taken away market share from the larger operators and this has intensified competition.

Optus does not provide (new) empirical data on the marginal benefits of marginal mobile subscribers, but repeats its understanding of relevant data that marginal subscribers are called as often (if not more than) the average subscriber. In any case the marginal external value of marginal subscribers does not diminish at current penetration levels. Even MNOs currently subsidise certain groups of marginal subscribers.

Optus notes a (very) limited ability to target marginal subscribers. MNOs (currently) only use a handful of pre-pay tariffs. In Opus's view marginal subscribers are not necessarily low-volume users without giving empirical evidence from its own customer base which should give the relevant answer to this important question. Hausman claims that Optus has provided confidential data about incoming calls for pre-paid customers. They are not necessarily marginal, though. Optus rejects the Marsden Jacob Associates (2005a) calculations of an externality surcharge by using the UK Competition Commission's approach on the basis of theoretical but not empirical arguments.

#### 4.3.1.5 Assessment

The calculation approach chosen by CRA does not directly separate the externality surcharge on FTM calls from the Ramsey mark-up on the TSLRIC. Therefore the implicit surcharge cannot be directly compared to explicit surcharges as calculated by Frontier for Vodafone or with the Rohlfs calculations for the UK. Nevertheless, CRA's externality surcharge (as calculated by WIK-Consult) amounts to 2.16 cpm compared to externality surcharges between 4.23 cpm and 8.29 as calculated by Frontier, meaning that CRA's implicit externality surcharge is significantly lower than those calculated by Frontier.

Nevertheless the assumptions and results are not necessarily conservative as argued by Optus and CRA. Considering the various scenarios calculated by Rohlfs as presented in Table 2–1 shows that Oftel itself has not used conservative assumptions to calculate the externality surcharge. In particular the degree of targeting and internalisation will have improved through more sophisticated pricing structure of the MNOs and the increased level of penetration. The CRA approach is furthermore suffering from not relying on market information and data relating to the Australian market. In this context the calculations made by Marsden Jacob Associates (2005) give some relevant indication on the quantitative implication of applying the UK approach to the current market conditions in Australia. Applying the Competition Commission's approach of the UK to

Australia leads to a significantly lower externality mark-up in Australia as compared to the UK.[90]

Given our theoretical analysis as presented in sections 2.6 and 3.3 CRA is overestimating the quantitative relevance of externality surcharges for the following reasons:

1. Call externalities are neglected.

2. Fixed-line externalities and the effects of fixed-mobile substitution are ignored.

3. The assumption of effective competition in the mobile retail market is consistent with the assumptions of Oftel but not with the assessment of ACCC and our own assessment as discussed in section 3.2.4 for the Australian mobile retail market. Rohlfs has shown that a limited waterbed effect could significantly reduce the optimal externality surcharge.

The calculations on the externality effects presented by Hausman are not consistent with those of CRA because his calculations assume implicitly a much higher R-G factor than 1.5.

### 4.3.2 Vodafone

#### 4.3.2.1 Approach and calculations of Vodafone

Vodafone (2005) takes the position that welfare-maximising prices which adopt Ramsey pricing principles in allocating fixed and common costs as well as a mark-up to reflect network externalities are most consistent with the statutory criteria. The results of such a welfare maximising approach have been developed by Frontier (2005) on behalf of Vodafone. Despite this position, Vodafone does not propose in its Undertaking a price based on welfare maximising principles as mentioned above and does not use the outputs of the Frontier model as a base for the target MTAS price set out in the Undertaking. Instead, Vodafone proposes to set the target MTAS price at the level of the forward-looking efficient cost of production (as calculated by PwC (2005) on behalf of Vodafone). We understand that this is more a procedural and tactical position and that the welfare maximising approach prepared by Frontier needs to be critically assessed.

Vodafone rejects the ACCC position on externalities in its final decision of June 2004. In particular, Vodafone argues that the ACCC cannot dismiss the relevance of the externality argument; even if that is difficult to quantify. These difficulties are not a reason to ignore altogether the externality effects in determining the appropriate MTAS price.

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**90** At market conditions in 2002.

Frontier considers three aspects or forms of externalities which are of relevance in determining the welfare-maximising price for subscription:

(1) The change in the volume of FTM calls due to a change in the number of mobile subscribers. This is a ("pure") externality effect because all these calls are made by people other than the subscribers themselves. Frontier measures the magnitude of this externality by these quantity-on-quantity effects and the own-price elasticity of mobile subscription. Quantitatively Frontier relies on its econometric calculations for the UK where they calculated the elasticity of FTM calls to mobile subscribers at 0.4.

(2) Frontier proposes that the change in the volume of mobile outbound calls from a change in the number of subscribers also entails from externality effects, which is represented by the number of calls generated by parties other than the new subscribers. Again based on UK estimates, Frontier assumes an elasticity value of 0.9; of this 0.7 represents the private effect of new subscribers and 0.2 the externality effect of people making MTM calls to the new subscriber.

(3) A third externality effect relates to a change in the volume of mobile subscriptions from a change in the number of subscribers. Frontier in the end ignores this externality by arguing that it is mostly exhausted as mobile penetration increases towards saturation and is captured by the other two quantity-on-quantity effects mentioned above.

Frontier assumes the approach of the R-G factor and assumes quantitatively the UK value of 1.5 for their own calculations. Approaching the network externalities on the basis of the R-G factor has an impact on the volume elasticities mentioned above. A certain value of the R-G factor sets a cap on these elasticities. Therefore Frontier de facto uses an elasticity value of the elasticity of FTM calls to subscribers of 0.11 (instead of 0.4) and 0.055 (instead of 0.2) for the elasticity of mobile outbound calls to subscribers.

Depending on the scenario (defined by different assumptions on the amount of common and fixed costs) and the run (defined by different assumptions on price elasticities), Frontier calculates externality mark-ups as part of welfare maximising prices for MTAS between 4.23 cpm and 8.29 cpm as part of efficient MTAS prices. This is a very significant mark-up if compared to the mobile termination TSLRIC which has been calculated by Frontier to be between [redacted] and [redacted]. The externality mark-up amounts from [redacted] per cent to [redacted] per cent of the relevant TSLRIC. This compares to a 10 per cent mark-up of the externality surcharge on TSLRIC as applied in the UK.[91] This gives al-

91 Ofcom sets an externality surcharge of 0.5 ppm which is independent of the level of TSLRIC. Therefore the mark-up is 10 per cent for 1800 MHz operators and 11 per cent for the 900/1800 MHz operators.

ready some indication that the modelling approach of Frontier is quite different to the one used by Ofcom in the UK.

#### 4.3.2.2 Vodafone's model calculations for externalities

We first redo Frontier's calculations for the effect of externality factors on the price for FTM calls using its version of the B-R model. For this we use the model results without the externality factors and then with these factors included. The difference between the results for FTM prices from the two calculations equals the size of the externality surcharge according to the Frontier model. We then use the model as presented at the end of Section 4.2.2.1 with the four changes implemented as discussed in that section to carry out analogous calculations and compare the results with those derived by Frontier.

In Frontier's B-R model, externalities become effective essentially at two places. The one place is the social surplus function to which is added a term to reflect the option value of additional subscribers. As we could replicate, Frontier puts this option value at 0.363 of the initial price of a subscription which we surmise is to correspond to a net externality factor on account of the option value of 1.363. This value is, however, exaggerated. It implies that the value of the mere option of being able to call new subscribers is worth 36.3 per cent of the price of a subscription. We follow Rohlfs here in placing that value of the net externality factor at 1.10.

The other place to incorporate externality effects is the elasticity matrix into which cross-price elasticities of call services (mobile outbound and fixed-to-mobile) with respect to the price of subscriptions are introduced that reflect the impact on the demand for these call services due to the increase in the number of subscriptions. The additional consumer surplus created by these additional calls can be called an externality of additional subscriptions as these calls would not be coming forward without them. These cross-price elasticities have no symmetric counterparts. The reasoning supporting this is as follows. When the number of subscriptions changes because of changes in their own price, there will be demand for calls from these new subscriptions. On the other hand, if volumes of call services increase these increased volumes by themselves do not call forward additional subscriptions. We follow Frontier – and thereby Rohlfs – in this argument. The problem comes with the implementation of the ideas.

Table 4-15 shows the calculated surcharge from the two model versions.

Table 4-15: FTM price and surcharge included in that price due to externalities calculated with the model as implemented by Frontier and as implemented with corrected model version

| | Frontier model specification | Corrected model specification |
|---|---|---|
| Price/minute with externality factor not included | [redacted] | [redacted] |
| Price/minute with externality factor included | [redacted] | [redacted] |
| Increase in price due to externalities | $0.044 | $0.003 |

While Frontier's calculations come up with a surcharge of $0.044, the corrected model version shows that this surcharge should be merely $0.003 or about 7 per cent of that what has been proposed by Frontier. As in the case of Optus, the choices of structure and parameters also bring about a generally increased level of the FTM retail prices ([redacted]) that is about 21 per cent higher than the one that the corrected model would produce ([redacted]).

To close this section, we look at the volumes of services predicted by the two different model versions in comparison with those that were inputted as holding in the initial situation. The comparison is in Table 4-16. The volumes shown correspond to the model versions including the effect of network externalities as discussed in this section.

Table 4-16: Service volumes as predicted by Frontier's and the corrected model versions and as shown for the initial situation

| | Initial | Frontier model version | Corrected model version |
|---|---|---|---|
| Subscriptions (in million) | [redacted] | [redacted] | [redacted] |
| Mobile outbound (in million minutes) | [redacted] | [redacted] | [redacted] |
| Fixed-to-mobile (in million minutes) | [redacted] | [redacted] | [redacted] |

The fact that Frontier's model results for Vodafone are not as strongly distorted as those presented by CRA for Optus also shows up in the volumes predicted by the model. In particular, the demand for subscriptions decreases only moderately in relation to what could be expected by a massive price increase. On the other hand the volumes for mobile outbound calls decrease substantially. The corrected model version also predicts decreases in the demand for subscriptions while it shows increases in the volumes of all call services. Given the strong increase in outbound calls, this outcome probably still

represents a more efficient market result than that corresponding to Frontier's model results.

One reason for the less pronounced volume changes arrived at by the corrected model for Vodafone compared to those for Optus (where we noted positive volume changes from [redacted] to [redacted]) has to do with the different assumptions regarding the values of the cross-price elasticities. [redacted].

As before, we request that the model results be considered as indicative only given that they have primarily been derived to identify the problems in Frontier's model calculations.

#### 4.3.2.3 Submissions of interested parties

Major discussion of the externality concept, the magnitude of externalities and the consideration of externality surcharges in the prices for the MTAS is contributed by the submissions of Hutchison (2005b) and its advisor Marsden Jacob Associates (2005b). Most of the arguments and positions repeat the arguments presented by Hutchison (2005a) in its submissions regarding Optus's Undertaking. In this section we only take up new arguments, specific arguments related to the Vodafone submission and the Frontier modelling calculations as well as those which we did not yet take up. For all other arguments and positions we refer to section 4.2.1.2 of this paper.

Hutchison restates its position that it would be inappropriate to supplement the efficient cost of providing the MTAS with a surcharge to reflect the existence of network externalities. The ACCC should place little if any weight on the mark-up suggested by Frontier. Hutchison regards the R-G factor of 1.5 as assumed by Frontier as appropriate. Given the lack of detailed Australian evidence Hutchison also supports the assumption of a constant R-G factor over time of 1.5 as reasonable. Although Hutchison accepts the notion of a network externality and potential efficiency gains from an externality surcharge. Hutchison, however, considers the possibility that efficiency costs associated with the surcharge may result in a net welfare loss to the market. "Given the current state of the mobile telecommunications market, the efficiency gains from subsidising mobile subscription is likely to be minimal or non-existent."[92]

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**92** Hutchison (2005b), p. 38.

# 5 Summary and Recommendations to the ACCC

*Externalities and Ramsey pricing in the ACCC June 2004 decision*

1. In its June 2004 decision the ACCC concluded that none of the MNOs has specified a set of relevant Ramsey prices. At the empirical level the ACCC believed that mark-ups based on Ramsey principles are difficult to measure. In its overall judgement, the ACCC rejected the application of Ramsey pricing principles because, inter alia, Ramsey pricing required market power and therefore the ability to set prices above costs which is not consistent with the outcome of a competitive market.

2. Concerning externalities the ACCC points out that not only the mobile network externality should be taken into consideration but all externalities that affect the interaction between the FTM, retail mobile and mobile termination services. Although the ACCC accepted the notion and relevance of network externalities it points out that efficiency gains of externality surcharges have to be traded-off against the welfare losses due to financing the surcharges or subsidies. Taking all aspects together the ACCC was not convinced that mobile network externalities justify a surcharge on the MTAS prices over and above relevant costs.

*Fixed and common costs*

3. The basic cost concept, to which MTAS charges are related, is TSLRIC. Fixed service-specific costs are included in TSLRIC. In addition, fixed common cost reflect economies of scope and those scale economies that are not included in service-specific fixed costs. The fixed common costs have to be recovered in the prices of all mobile services including MTAS.

4. There could also exist variable common costs that reflect economies of scope but no economies of scale. A specific example of this would be joint costs requiring fixed output proportions. Joint costs in this sense are not relevant for mobile termination services. Variable common costs should be recovered under peak-load pricing principles.

5. Relevant fixed common costs include network common costs and organisational common costs. Other non-network costs often specified as common include customer acquisition costs, which we consider as direct costs of subscribers or subscription. However, because high prices make it hard and low prices make it easy to attract new customers the customer acquisition cost curve may shift up or down with prices charged by a mobile operator for subscription, calling and termination.

6. A prerequisite for the fruitful application of B-R pricing principles would be the presence of economies of scale at the optimal output level, because otherwise marginal cost pricing would be optimal in the absence of externalities. Given that TSLRIC would form the base for a practical application of B-R pricing, only fixed common costs would be reflected in inverse-elasticity mark-ups. The fixed common costs should not on average exceed 10 per cent of TSLRIC. This holds in particular, since the Australian mobile industry is highly mature so that economies of scale should matter fairly little.

*Conceptual applicability of B-R pricing principles to the MTAS*

7. Boiteux-Ramsey (B-R) pricing principles refer to welfare-maximising prices subject to a viability constraint on the regulated firm or sector. They are in principle the correct starting point for the regulation of MTAS charges. However, they have not been explicitly applied anywhere yet. The main arguments for the rejection include the perceived uncertainty about the relevant demand elasticities, the capture of fixed costs and part of the externality effects through non-linear pricing and other forms of price discrimination and the deviation of prices for other mobile services (and FTM prices) from their respective B-R levels.

8. On top of that comes a lack of good models in the B-R tradition to capture the competitive interactions in the mobile and fixed network markets involved. A number of B-R concepts have been developed outside strict monopoly markets. Models assuming that all relevant prices follow B-R principles achieve good efficiency results but their prices are not able to be implemented because the regulator only controls the MTAS charge. In contrast, principal-agent models, in which only the MTAS charge needs to be regulated, are not really mature yet for application.

9. While the textbook definition of market power relates to the ability of a firm to set prices above marginal costs, the relevant factor for regulation is the ability of the firm to exclude rivals and to make long-run economic profits. In that sense, Ramsey pricing does not necessarily reflect market power. Rather, the relevant competitive benchmark in the presence of scale economies is contestability. It is well known that Ramsey prices are compatible with or even implied by contestable markets. This, however, neither means that prices in the mobile sector are Ramsey prices nor that they are necessarily competitive.

10. If B-R prices are calculated and only the resulting MTAS charge is regulated all other prices are most likely going to deviate from their B-R levels. The exception would be if all the other markets are contestable. This is unlikely to be the case. It is also questionable if regulating MTAS charges at their B-R levels - while leaving other prices to the market - improves efficiency over other imperfect pricing principles.

11. Since the ACCC is and should be concerned with both the mobile and fixed networks and since the fixed and mobile markets interact, an appropriate Ramsey pricing analysis would have to include both sectors. Models which do not consider all relevant demand interrelationships between both sectors fail to meet economically efficient outcomes.

*Trade-off between efficiency costs and efficiency gains*

12. Under an optimisation approach the net marginal benefits from subsidising subscription have to equal the marginal welfare costs of termination surcharges. In contrast, Hausman and NERA do not determine an optimum but rather only compare two states described by different termination charges and assumptions about a full waterbed effect and pass-through of termination charge changes in FTM prices. They therefore compare an aggregate welfare (or, in the case of Hausman: consumer surplus) loss from a termination surcharge with an aggregate welfare (consumer surplus) gain from subscriber subsidies. This is methodologically correct if the choice is only between two states.

13. The efficiency costs from a surcharge on mobile termination result from the increase in price for calls to the terminating network. There may be additional efficiency costs to the originating networks in the form of reduced profits if they cannot fully pass on the termination surcharges, while in this case the distortion from the price increase is less. If one neglects these latter costs the efficiency costs include consumer surplus losses by callers to the terminating network and by receivers of a reduced amount of calls.

14. The efficiency costs of surcharges tend to increase at an increasing rate, meaning that surcharges create particularly high efficiency costs if prices are already above marginal costs. This effect is enhanced by double marginalisation through additional mark-ups downstream.

15. On the consumer side, possible efficiency gains from subscription subsidies and lower calling prices derive from an increase in the number of mobile subscribers. FTM callers gain consumer surplus from calling these subscribers. As NERA and Hausman correctly observe, this gain can be approximated by the value of calling the marginal subscriber multiplied by the number of subscribers gained. The main factor for assessing possible efficiency gains and costs from subsidising mobile subscribers is the social value of additional mobile subscriptions, which Hausman argues to be as high as for average subscribers.

16. There will also be consumer surplus gains (and profit gains) from additional MTM calls made by the new mobile subscribers. This would also extend to MTF calls. Not included in Hausman's and NERA's analysis are consumer surplus changes from reduced or increased outgoing mobile call charges.

17. Not included in Hausman's and NERA's analysis are efficiency costs from handset subsidies. They treat handset subsidies as costs of subscription services or as customer acquisition costs. This neglects potential distortions in the handset market, which arise, when handset subsidies are paid in the competitive process as a means of keeping customers or attracting them from other mobile providers rather than attracting new customers to mobile services.

18. In a second-best analysis the costs of financing mobile subscription subsidies in the form of termination surcharges have to be set against the gains from subsidies. As a result, the (second best) optimal subsidies are such that the social benefits of the marginal mobile subscriber have to exceed the marginal costs of including this subscriber to the network by the marginal efficiency costs of termination surcharges necessary to subsidise this subscriber. Furthermore, under a second-best approach the marginal social cost ratios (including the costs of mobile termination surcharges and possibly fixed network universal service costs) of fixed and mobile subscriptions would have to be equal to their marginal social benefit ratios. Because they only concentrate on the comparison of two states Hausman and NERA fail to meet such an optimum.

*The waterbed effects*

19. As Hausman's model (Hausman, 2004, Appendix) shows convincingly, some waterbed effect has to be expected, given the demand interactions between mobile services. There is, however, no empirical or theoretical evidence that the waterbed effect is going to reach 100 per cent. In particular, mobile competition is neither perfect nor perfectly contestable. Furthermore, part of any profit increase from increased termination charges increases handset subsidies and other customer acquisition expenses (including advertising) that do not fully expand total mobile subscription but just take away subscribers from other mobile competitors. The non-productive costs of increasing mobile penetration at already very high levels are likely to be high and increasing rapidly in further penetration.

20. Both, in the absence of price regulation and under price cap regulation it is likely that MTAS charge reductions will not translate into FTM price reductions of equal magnitude. Under binding price caps there may be a long lag for any FTM price reductions to occur. However, price caps currently do not seem to constrain Telstra's FTM pricing behaviour. It seems to be more constrained by competition, so that at least a partial price adjustment can be expected.

*Alternatives to B-R pricing*

21. Nonlinear and optional prices reduce the requirement for raising fixed common costs from mark-ups on marginal costs or TSLRIC. They are economically efficient and a common practice in Australian and other mobile markets.

22.1 EPMU are in practice superior to the explicit application of B-R pricing principles

- if the unregulated prices would in practice deviate substantially from their B-R levels, once MTAS are regulated at their B-R levels,
- if uncertainty about sizes of elasticities is high and
- if a large fraction of other costs is mis-specified as fixed common costs.

22.2 We believe that all these conditions are fulfilled in the Australian mobile sector. Furthermore, the application of B-R pricing principles is likely to generate substantial procedural delays and costly legal disputes.

22.3 As long as "fixed and common costs" are not correctly measured, there is a place for EPMU. If, as we suspect, true fixed and common costs exist in the mobile sector but are smaller than claimed a compromise approach could be to first apply EPMU to the extent of suspected variable costs and then B-R pricing principles to the remainder.

*Hausman's consumer welfare analysis*

23. Hausman does not perform a B-R pricing analysis but concentrates on consumer welfare only and he does not calculate optimal prices but rather only makes a comparison for two MTAS charges and their consequences on other prices. Hausman's main conclusion is that a reduction in MTAS charges rather than benefiting consumers would severely hurt them. Our analysis has shown that by correcting a single number, about which he is by more than $370 million in error, Hausman's conclusion no longer holds, because the gain to FTM callers from the resulting FTM price reduction is over ten times as high as calculated by Hausman. Thus, even if one accepts all of Hausman's assumptions, simply adjusting for the calculation error of the consumer surplus gain for FTM calls from the FTM price reduction leads to an ambivalent rather than the clear result that Hausman claims.

24. There are several additional concerns that bias Hausman's results.

24.1 He claims that the main difference between his and the ACCC's and Armstrong's analysis is that he includes a "new goods" effect from the expansion of the mobile subscriber base through handset subsidies and low subscription

charges. However, he totally neglects that there exists a close substitute for mobile services in the form of fixed network telephony. Thus, not all the gain he derives from his consumer surplus analysis of demand for FTM calls is a net gain. Rather, a potentially sizable fraction of this gain is likely to come at the expense of FTF calls, leading to a consumer surplus reduction there. A second potential substitute for FTM calls to a "new" mobile subscriber is an FTM call to an "old" mobile subscriber. This is made possible through the fact that 5 per cent of mobile subscriptions are now multi-SIM users. Since this is a phenomenon of saturated penetration, it means that the percentage of multi-SIM users among new subscriptions is likely to be substantially higher than 5 per cent. Multi-SIM users can be reached on several mobile numbers, which are substitutes for the FTM caller.

24.2 Hausman neglects any effects of an increase in mobile subscription on fixed network subscription.

24.3 Hausman neglects possible nonlinearity of the demand for mobile subscriptions.

24.4 We are not convinced that the FTM demand for calls to new mobile subscribers equals the average FTM demand to all mobile subscribers. Rather, our arguments suggest that it is lower as assumed by Rohlfs (2002) for the UK and CRA (2004) for Optus.

24.5 Hausman's results are sensitive to (proper) assumptions about FTM call minutes.

25. Thus, a move from MTAS charges proposed by Optus to TSLRIC will not lead to a net efficiency loss but rather to an efficiency gain. This does not mean that MTAS charges at TSLRIC levels cannot be improved upon.

*Relevant externalities*

26. We see the following externalities directly related to mobile subscription:

26.1 Major parts of the network externality are directly related to usage: The change in the volume of FTM calls from a change in the number of mobile subscribers.

26.2 There is also a usage related network externality involved in mobile outbound calls from a change in the number of mobile subscribers.

26.3 The willingness to become a subscriber to a certain degree depends on the subscription of other users.

26.4 There may also be an option value involved in mobile subscription from just having the option to call a new subscriber.

27. In our view call externalities remain valid in the determination of economically efficient pricing. It is too easy to ignore them by assuming that they are totally internalised. In our view, the whole termination problem and the difference between termination charges under CPP and RPP results because call externalities are not efficiently internalised.

28.1 Similar to mobile network externalities there are also externality effects associated with fixed network subscription when economically efficient FTM prices have to be determined. The most relevant externalities are the following:

(1) Surcharges on FTM prices above costs would have a negative impact on fixed-line subscription.

(2) Due to fixed-mobile substitution there are relevant cross-price effects of mobile and fixed-line subscriptions.

28.2 Although fixed-mobile substitution currently is at a lower level in Australia than in Europe, that only indicates that process to accelerate in the next few years. We believe that given the relative developments of penetration, regulatory policy should be more concerned with the decline of fixed-line penetration than with further increasing mobile penetration.

29. Ignoring the symmetry of externalities between mobile and fixed networks does not only fail to meet second-best economically efficient MTAS prices, it also distorts competition between mobile and fixed networks. Given that the ACCC has abolished ADC contributions for fixed-line interconnection charges for competition and efficiency reasons, it would be implausible to us to introduce externality surcharges on the MTAS.

*Internalisation of externalities*

30. Network externalities are often overestimated because the degree of internalisation by consumers and by MNOs actually occurring is underestimated. Consumers internalise externalities themselves when they share certain costs of subscription. In particular at high levels of penetration such arrangements are a driver for penetration. The most important instrument of MNOs to internalise externalities is to offer a broad set of non-linear, multipart or optional retail tariffs. Australian mobile carriers have also been quite successful in developing complex pricing options to differentiate their pricing structures.

31. Subsidising subscription to internalise network externalities can be related to all elements of the price of subscription: one-off charges for subscription, the price of handsets and the price of monthly rentals. Major parts of subsidising subscription and handsets in particular can not be attributed to exploiting externalities in a wel-

fare economic sense. Handset subsidies are also used by MNOs to keep customers tied to a particular mobile network or to motivate customers to switch from one network to another. There are no welfare gains involved in such activities. The high degree of handset subsidies is more an indicator of imperfect competition in the mobile retail markets and causes significant distortions and waste of resources.

*Externality surcharges*

32. Because the benefits from network externalities can clearly be associated to telecommunications users by the MNOs, there is no reasoning for external subsidies. Corrective pricing to recover the cost of subsidies should be directed to usage charges for fixed and mobile users, if network externalities are significant.

33. A properly defined welfare model which determines efficient Ramsey prices including externality effects balances in a simultaneous way the trade-off between the benefits (or welfare gains) form price corrections to take care of externalities (by subsidising subscription) and raising the price of other services to fund the subsidy. A second best Ramsey model allocates the costs of the subsidies for subscription not only to mobile termination rates for FTM calls but to all other mobile services too.

34. Positive welfare effects of network externalities are only related to marginal subscribers. There are no positive welfare effects associated with subsidies provided to infra-marginal subscribers. Subsidies to infra-marginal subscribers are, however, not welfare-neutral as often assumed. Instead, they have a negative impact due to the need to finance the subsidies. When MNOs often claim they are unable to target marginal subscribers, that is an argument against externality surcharges because non-targeting significantly increases the probability that the welfare losses of the subsidies exceed the benefits generated by them. The degree of targeting is empirically a very sensitive parameter on determining optimal surcharges. De facto price differentiation enables MNOs to target marginal subscribers significantly. The typical instruments are non-linear and optional tariffs and other instruments.

35. Although economic analysis clearly states that subsidised mobile subscription (partially) financed by externality surcharges on the MTAS can enhance economic efficiency, the welfare losses generated by funding such subsidies can outweigh such economic benefits. In particular if the degree of targeting the subsidies to marginal subscribers is small and the pass-through of surcharges to subscription subsidies is limited, it is possible that the welfare effects of externality surcharges will be negative.

36. The potential for incomplete pass-through of termination profits to retail prices should be a relevant factor in considering externality surcharges. It would be socially

wasteful for an externality surcharge to be levied if this did not ultimately end up in lower subscription prices for marginal subscribers.

*The R-G factor*

37. The Rohlfs-Griffin factor, the ratio of the marginal social benefit of an additional mobile subscriber to the marginal private benefit, is a useful concept to quantify network externalities. We believe it is reasonable to assume a constant R-G factor over time. That also means the marginal social benefit will be decreasing over time with penetration. For theoretical reasons relevant R-G factors are between 1 and 2. Given that there are no empirically derived values available for the Australian market, we believe the relevant level of R-G factor should be around 1.5.

*Externalities in the CRA model*

38. The externality related assumptions in the CRA model seem to be plausible to us. The way in which the externality surcharge is calculated does, however, not allow identification of the magnitude of the externality mark-up. By setting the net externality factor at a level of 1.06 in the model, the externality surcharge as part of the mark-up amounts to 2.16 cpm. Given our analysis we believe that the implicit externality surcharge definitively is overestimated if it exists at all:

    (1) The externality assumptions are not necessarily conservative given the various scenarios calculated by Rohlfs.

    (2) Targeting of subsidies is underestimated.

    (3) Assuming a full waterbed effect overestimates the degree of competition in the mobile retail markets.

    (4) Call externalities are ignored.

    (5) Fixed network externalities and the effect of fixed-mobile substitution are ignored.

*Methodological issues regarding application of Ramsey and network externality principles*

39. Both CRA and Frontier carry out the modelling exercise using a system of linear demand functions. Linear demand functions have different values of the price elasticities at each point along their curves. When then basing arguments on elasticity values one needs to take into account to what point on the linear demand curve any particular elasticity value is to apply. When introducing the elasticity values in their

reports neither CRA nor Frontier make statements to this effect. According to the Ramsey concept the relevant values should be valid at the solution point, i.e. at the points on the demand curves which according to the solution represent the optimal price/quantity combinations. Both CRA and Frontier use these elasticity values to calibrate their linear demand functions on the basis of initial prices and service volumes. This means that the selected price elasticity values hold at the corresponding points on the demand curves and new values result at the solution points. This fact by itself risks invalidating the whole exercise.

40. Subscriptions are treated as one category and are expected to be a subsidised service because of the network externality effect. The subsidisation is expected to come from call services. Even if one accepts the premise that there should be some subsidisation, one should recognise at least two categories of subscription, i.e. one consisting of what may be called the mass market, which would be the target category for subsidies, and the other consisting of subscriptions by the business sector having, as is true for fixed subscriptions, very low price elasticity and which actually should be considered a source for the subsidy funds and not a target for obtaining any.

41. A large share of common cost is not fixed but variable changing with the total volume of business. Since variable common cost is thus caused by the totality of a company's activities, which means equally by each of its services, it is to be allocated to the various services on an equal proportionate basis. Only fixed common costs are to be distributed to the various services via the Ramsey mechanism. They essentially amount to the fixed network common cost that to our knowledge of the cost structure of mobile networks amounts to about 5 per cent of total network cost.

42. The significant result of the Ramsey exercise, i.e. the high mark-up on incremental cost of termination in mobile networks, is to a large extent due to the value of the termination service's own-price elasticity being lower than the own-price elasticities for the other call services. The elasticity values cited by CRA correspond to point estimates from econometric studies which means that each of them represents a mid point of a statistical confidence interval that could possibly cover a range from zero up to double the value of the point estimates. The difference between the average elasticity value for fixed-to-mobile calls and the corresponding average elasticity value for the other call services, which obviously is also a statistical estimate, will have a comparably large confidence interval. It is then very likely that this difference is statistically insignificant, i.e. it must be considered not to be significantly different from zero. In other words, it is not justified to claim that the fixed-to-mobile services have a different, in particular a lower, price elasticity than the other services.

43. By the way, we are not aware of other econometric studies that provide estimates of the relevant price elasticities. It would in any case, however, be very unlikely that

having a few more such estimates would significantly ameliorate the problems referred to in the preceding two comments.

44. CRA and Frontier cover with their Ramsey price modelling only mobile services (as by the way all the known exercises on the subject matter do). This, however, is not acceptable. The mobile telecommunications market is a part of a larger market that in particular includes fixed network services with which mobile services stand in a substitutive relationship. Furthermore the fixed network services are also regulated by the ACCC. For example, what fixed-to-mobile is for the mobile sector is mobile-to-fixed for the fixed sector. Leaving the corresponding relationship out of the calculations is arbitrary and will lead to biased results.

45. In following the methodology that Rohlfs used for his work for Oftel/Ofcom, the consultants, in particular CRA, apparently expect that this approach would be acceptable to the ACCC. The Rohlfs approach, however, also has its limitations as it does not treat separately the business and mass market segments, neglects interrelationships with the fixed market and employs a categorisation of call services that is problematic. This categorisation comprises:

    - outbound on-net calls that include calls to the fixed network,
    - outbound off-net calls to other mobile networks,
    - fixed-to- mobile calls.

    While on the one hand off-net mobile-to-mobile calls, although internal to the Australian mobile sector as a whole, are treated separately the mobile-to-fixed calls are included with the on-net calls. It would have been much more natural to treat mobile-to-fixed instead of off-net mobile-to-mobile as a separate category because of their symmetry with the fixed-to-mobile category.

46. In the Rohlfs approach the issue of network externalities is tackled in two ways. For one a term is added to the social surplus function capturing the option value of adding additional subscribers to the networks. The other avenue is through cross-price elasticities that reflect the impact of additional subscriptions on actual demand for calls. Actually what Rohlfs does to implement this second part is to calculate the values of most of these cross-price elasticities on the basis of the directly estimated own-price elasticities. We have no particular criticism regarding his approach. What of course must hold is that the relationship between the basic own-price elasticities and the cross-elasticities derived from them must also hold at the solution point. Given the intervening changes in the overall elasticity values moving from the initial point to the solution point, this is not the case.

*Costing issues*

47. Both CRA and Frontier categorise all common cost as fixed common cost. They do not discuss the possibility that the largest share of common cost is actually variable that should not be subject to Boiteux-Ramsey allocation.

48. Since the following point is the most glaring in respect of Optus, we discuss it with reference to the cost data reported by this MNO. CRA apparently allocates all customer acquisition and maintenance costs to the service of subscription which would be consistent with the notion that costs are to be assigned to services according to causality. Noteworthy in this context is, however, that of a total of about [redacted] a share of [redacted] is shown to be for customer acquisition.[93] If one scales this up to the whole market according to Optus's market share one arrives at more than [redacted]. Given an increase of about 2.3 million subscriptions in Australia during the period 2003 to 2004, this implies an amount of more than [redacted] in terms of acquisition cost per additional customer.

49. Any relevant expense for customer acquisition should be capitalised over the time horizon of the whole Australian mobile market. It should not be capitalised over the average length of the contract that a customer has with an operator. The reason is that once a person is a mobile subscriber he/she is very unlikely to drop out again as a mobile customer altogether. Furthermore, as the market matures, the number of subscribers should approach the saturation level and should be expected to permanently stay put at this level. What certainly happens is that customers change operators and this they do the more readily the more attractive the inducements are, for example in terms of a subsidised handset. The latter then causes the customer acquisition cost for the individual operator but it would not be one from the point of view of the whole sector. If the customer acquisition cost expended to attract truly new customers is isolated and if that expense is then capitalised and only interest and amortisation were recognised as cost, a much lower figure than the one shown in the preceding item should be expected.

*Consequences of raised issues for the computed results*

50. The most remarkable aspect of the CRA solution is not that it proposes a mark-up for fixed-to-mobile calls of [redacted] but the fact that it proposes a price for subscription that is [redacted] than the initial, i.e. the currently valid one, and the fact that according to the postulated demand curve the number of subscribers should decrease by [redacted], i.e. from more than [redacted] to about [redacted].

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[93] I.e. 'subscription acquisition' as against 'subscription service' which apparently means maintenance of customers; see worksheets 'Optus Volumes and Cost' and 'Cost Summary Sheet' in MS Excel file 'CRA Termination Model')

51. CRA's result is due to the feature regarding elasticity values of linear demand functions pointed out under 'Conceptual issues'. CRA's solution value for subscriptions lies on a point of the demand function that is quite a distance away from the initial point. Actually, while the initial position was lying on an inelastic portion of the demand curve with an own-price elasticity of -0.44, the solution point lies up high on the elastic portion of the demand curve where the elasticity value is about -2.5. In contrast all the solution points for the call services lie on points of their demand curves where the elasticities have lower absolute values than initially, i.e. they move from -0.31 to -0.22, from -0.59 to -0.33, and from -0.59 to -0.17. All this should make for low mark-ups for subscriptions, or even negative ones considering cross-price elasticities, and for higher ones for the call services.

52. Frontier calculates prices for Vodafone that appear also distorted although not as badly as those by CRA for Optus. The quantity results obtained by Frontier also do not show such adverse volume reactions in the number of subscribers as in the case of the CRA model. Both effects appear to be due to the very high numerical values of cross-price elasticities used.

53. To correct for the deficiencies in the model structures and specifications we introduced the following corrections:

    - Replacing the linear demand functions with constant elasticity demand functions.
    - Reducing the value of fixed common cost to 50 per cent of total common cost reported.
    - Separation of subscriptions into businesses and mass market with different price elasticities.
    - Adjustment of the value of the own-price elasticity for fixed-to-mobile calls to correspond to the values used for on-net and off-net calls.

    Correcting for the disregard of the interaction with the fixed sector would have been beyond the scope of the consultancy. Theoretical considerations, however, show that such a correction would strengthen the results reported with the following sentences. The corrections had the effect of levelling the mark-ups on the various services to the extent that - except for subscriptions - they are all in a narrow corridor around what would be an equal proportionate mark-up. The surcharge for externalities is reduced to a small fraction of what was calculated by CRA and Frontier. The results obtained are by no means intended to provide the correct values for the mark-ups and prices at issue. They show, however, that the values calculated by the CRA and Frontier models do not come close to those that a correctly specified model would come up with.

*Final conclusions*

54. Our review of economic analysis has shown that Boiteux-Ramsey pricing principles are theoretically sound and in principle applicable to the MTAS. However, only properly specified B-R pricing models have the potential of improving economic efficiency. This means in particular in the context of the MTAS that all inter-relations between the fixed and the mobile network(s) have to be properly modelled. Besides proper modelling, any useful application of B-R pricing requires:

    (1) a proper specification and identification of fixed and common costs;

    (2) a proper specification of all relevant elasticities and cross-elasticities;

    (3) relevant empirical quantifications for the Australian market;

    (4) a realistic prospect that all prices resulting from the modelling will actually be implemented.

    If these criteria are not (properly) met, prices calculated will fail to meet economic efficiency and can be worse compared to applying a EPMU rule for allocating fixed and common costs.

55. These conditions for any useful application of a B-R model are the reason that according to our knowledge and findings Ramsey pricing principles have not been applied to the regulation of MTAS in any other country. Only in the UK and Israel externality surcharges have been explicitly applied in the MTAS pricing. Although the UK regulator has commissioned a Ramsey pricing modelling approach for mobile termination, it rejected the application of Ramsey pricing principles.

56. According to our theoretical and empirical analysis the model outcomes presented by CRA and Frontier cannot be a proper basis for MTAS pricing and a substitute for the TSLRIC+ pricing rule of the ACCC. This conclusion is best demonstrated by the heavily distorted results brought about by wrong model structures and specifications that diverge substantially from the results that a property specified model would produce.

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