Annex 6

Relevant Empirical Studies

Introduction

1. This section summarises the results of a number of empirical studies that are relevant for this Consultation.

2. The papers are grouped in three main categories:

   - The impact of the choice of wholesale termination regime on mobile take-up and diffusion;

   - The presence of the so-called "waterbed effect" – i.e. the link between the level of mobile termination rates and retail prices; and

   - The implications of the presence of an on-/off-net price differential.

Wholesale Termination Regime and Mobile Diffusion

3. In the recent economic literature there are several empirical studies discussing the drivers of the rate of diffusion of mobile services. The "rate of diffusion" refers to the growth rate of mobile phones take-up. Annex 7 presents a novel econometric study on this issue that we commissioned to CEG and Professor Pesendorfer.

4. The studies of particular interest for this Consultation estimate the effect that the wholesale termination regime has on the rate of mobile phone diffusion.[1]

5. The widely held belief is that CPNP leads to higher take-up than B&K. There are several possible explanations. For example, under B&K, RPP may emerge. In order to avoid unwanted calls, mobile subscribers could keep their mobile phones switched-off, not give out their numbers and/or not answer all the calls. This could be driven by a desire either to avoid unwanted SPAM calls or to avoid to pay for receiving calls, if recipient charges applied. It is also possible that mobile consumers have a strong preference for paying to make rather than receive calls probably because they can better control their spending and, on average, value more making calls. This appears to be the case according to the results of our own survey (Annex 7.2). As a result, it could be that when a number of users keep their mobile phones switched-off, mobile phones become less valuable and, hence, less worth having. Perhaps more importantly, with termination rates set at zero, the absence of a termination "rent" associated with a new consumer provides reduced incentives for mobile operators to offer attractive tariffs to subscribers that do not make many outbound calls.

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[1] Most of the studies formally use the terms Receiving Party Pays (RPP) – in particular this identifies pricing arrangements where there are recipient call charges - or Calling Party Pays (CPP). However, this terminology is not precise as RPP or CPP refer to whether or not retail subscribers are directly charged to receive calls (through recipient calls charges) rather than to the wholesale regime – i.e. B&K or CPNP. Given that in practice wholesale regimes (i.e. B&K and CPNP) are correlated with retail pricing arrangements (i.e. RPP and CPP), this distinction has no significant implications for interpreting the results. In this Annex we use the terms CPNP and B&K for consistency even when these terms were not used in the original studies.

6. Most of the econometric studies examine the impact of the wholesale termination regime on the rate of diffusion of mobile subscriptions. This evidence seems to suggest that B&K has a negative effect on the rate of diffusion of mobiles, although results are not fully clear-cut. Crucially, these studies do not directly assess whether the latter has an impact on the level of mobile penetration that could be achieved in the long run.

7. Zehle[2] examines the impact on penetration of a switch from B&K (with recipient charges) to CPNP in a number of countries[3]. Most of the countries examined switched regime in a short period of time between 1999 and 2000 - the exceptions are Argentina, Peru and Uruguay which switched a few years earlier. Zehle's conclusions are that the pattern shows that:

- CPNP was a contributing factor in accelerating the growth in mobile subscribers;

- Average monthly terminated minutes per customer increased; and

- The introduction of CPNP led to an increase in gross margins for fixed and mobile operators.

8. Zehle's main claim is that the regime switch increased the rate of mobile diffusion at least in the short run. However, he carefully qualifies his conclusions[4] and he does not suggest that B&K (with recipient charges) would limit the overall level of mobile penetration that could be achieved in the long run.

9. A number of econometric studies also analyse the effect of the wholesale termination regime (proxied by a dummy variable) on the rate of diffusion. Note at the outset that the use of a dummy variable (describing a country as either having a B&K regime, whereby termination is set at zero or close to zero, or CPNP with positive termination charges) could be very simplistic because it is the *level* of the mobile termination rates that it is likely to be more directly important than the *label* attached to the wholesale termination system. This seems to be exemplified by the case of Korea that nominally is a CPNP country but has wholesale mobile termination rates that are set very close to zero (See Annex 10). In Annex 7 we attempt to improve on this by

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[2] Zehle S. (2003), CPP Benchmark Report, available at
http://www.coleago.co.uk/uploads///Downloads/CPP%20Benchmark%20Report%20SZ%20Jun%2003.pdf. There are also other case studies which argue that the switch to CPNP increased the take-up rates especially in the period soon after the policy change. See for example ITU (2003), "Mobile Overtakes Fixed: Implications for Policy and Regulation" available at
http://www.itu.int/osg/spu/ni/mobileovertakes/Resources/Mobileovertakes_Paper.pdf.
[3] These consist mainly of Central and South American countries (Mexico, Chile, Argentina, Uruguay, Peru, El Salvador and Guatemala) and others (Pakistan and some Caribbean countries).
[4] See Zehle, footnote 2, pp. 13-14. He claims first that there is no statistical correlation between penetration and either CPNP or RPP. While he concludes that RPP has held back growth in the US and Canada, some countries such as Hong Kong and Singapore have achieved very high penetration rates without moving to CPNP. Second, he argues that it is difficult to separate the effect of CPNP from other factors, such as the introduction of prepaid, lower handset prices or more competition. Nevertheless he finds that all operators who changed to CPNP reported an immediate surge in customer numbers. That this is due to the introduction of CPNP is supported by primary market research. Third, looking at the incremental penetration following the introduction of CPNP in Chile, El-Salvador and Mexico and Pakistan, he argues that it is not easy to separate the effect of the introduction of CPNP from the general growth trend. In all cases the product life cycle was in the accelerating growth phase. However, he concludes that examining the incremental penetration in the 12 months after CPNP was introduced, it is apparent that there had been an above trend increase in the penetration rate.

using the level of termination rates rather than the type of regime as the relevant explanatory variable.

10. The results of these studies should also be treated with caution, because the penetration rate data generally relates to subscriptions or SIM cards rather than unique mobile users. Therefore, in countries where consumers have multiple subscriptions, penetration rates may be overestimated (see discussion in Annex 5).

11. Dewenter and Kruse[5] and Jang, Dai and Sung[6] estimate the impact of a number of variables, including a B&K regime dummy, on the rate of diffusion of mobile services. Both studies use diffusion models, but they differ in the estimation technique used and in the data used. Jang, Dai and Sung find that CPNP is the most important explanatory variable and that CPNP increases the rate of diffusion. Dewenter and Kruse initial results suggest a similar, though less marked, conclusion. However, they claim that their results may suffer from an endogeneity problem in that political and institutional factors affect the decision to deregulate and change policy (see Annex 7 for a discussion). When they re-run the estimation to take this into account (using instrumental variables), they no longer find a statistically significant impact of CPNP on the rate of diffusion (that is, there is no statistically significant difference between CPNP and B&K regimes once the other key variables are controlled for).

12. Littlechild[7] assesses the impact of a B&K regime on the *level* of diffusion, rather than the *rate* of diffusion of mobiles. He concludes that there is no difference between B&K and CPNP in this respect. These results appear to be consistent with Zehle's finding that the switch from B&K to CPNP increases growth in the short term, but its effect on the long term level of diffusion is not clear.

13. Other related studies have examined the impact of standardisation and market entry on both prices and diffusion. This may be an important variable, in addition to the type of wholesale regime in call termination, explaining differences, for example, in mobile take up between the US and European countries. Koski and Kretschmer[8] consider the impact of standardisation[9] on the degree of price competition and the rate of mobile diffusion. The data they use are very similar to those used by Jang, Dai and Sung. According to their estimation, standardisation has two countervailing effects. Firms compete less fiercely, presumably, they argue, because the consequences of falling behind are not as consequential. On the other hand, controlling for price as an endogenous variable, standardisation appears as a statistically significant facilitator of diffusion.

14. The impact of standardisation on welfare is, therefore, not clear. It appears to increase diffusion which has a positive effect, but also to increase prices,

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[5] Dewenter, R. and Kruse, J. (2005), "Calling Party Pays or Receiving Party Pays – The Diffusion of Mobile Telephony with Endogenous Regulation", mimeo, 18 November.

[6] Jang, S.L, Dai, S.C. and Sung, S. (2005), "The Pattern and Externality Effect of Diffusion of Mobile Telecommunications: the Case of the OECD and Taiwan", *Information Economics and Policy*, 17, 133-148.

[7] Littlechild, S. (2006), "Mobile Termination Charges: Calling Party Pays versus Receiving Party Pays", *Telecommunications Policy*, 30(5-6), 242-277.

[8] Koski, H. and Kretschmer, T. (2005),"Entry, Standards and Competition: Firm Strategies and the Diffusion of Mobile Telephony", *Review of Industrial Organization*, 26(1), 89-113, available at http://eprints.lse.ac.uk/801/1/324_Koski_Kretschmer_Final.pdf.

[9] This refers to industry standards such as (for example) the effect of setting GSM as a standard in the EU versus the coexistence of different standards in the US and other countries.

which has a negative impact compared to the situation when there is competition in standards. These findings may be broadly consistent with the Merrill Lynch (ML) data on mobile diffusion and usage (see Annex 5). The ML data show that penetration may be higher with standardisation –Europe's penetration is higher than penetration in the US or Canada – but average prices are also higher – i.e. average Revenues per Minute (RpM) are higher in Europe than in the US.

"Waterbed effect"

15. A "waterbed effect" exists, according to Schiff[10], when regulation of one price of a multi-product firm causes one or more of its unregulated prices to change as a result of the firm's profit-maximizing behaviour. Mobile (and fixed) telecommunications operators are multi-product firms. They sell a range of services to retail customers and wholesale termination services to mobile and fixed operators.

16. Schiff shows that a waterbed effect arises when the marginal revenue and/or marginal cost of the unregulated product(s) depends on the price or quantity of the regulated product[11]. That is, it arises when demands and/or marginal costs are interdependent, firms use nonlinear pricing, or there is a zero-profit constraint or Global Price Cap.[12]

17. A waterbed effect in our case exists if a reduction in wholesale mobile termination rates leads to higher prices for subscribers' services. In other words, countries with lower wholesale mobile termination rates (approaching zero as under a B&K regime) in the presence of a waterbed effect should have all else equal higher retail charges. For example, as discussed in Section 6, a reduction in mobile termination rates could lead to a reduction in call charges and an increase in subscription fees.

18. Littlechild[13] runs a cross-country regression on a sample of 44 countries for a single year. Using a dummy variable for B&K countries, he finds that a measure of outbound prices (measured as average industry revenue per minute per subscriber) is lower on average in countries that have adopted B&K than CPNP.

19. Two recent papers have estimated the size of the waterbed effect.

20. Genakos and Valletti[14] test whether the waterbed effect in mobiles exists and, if so, its significance. They consider whether the introduction of regulation on fixed-to-mobile termination charges has affected the structure of prices but not the overall profitability of mobile operators. They use a price index

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[10] Schiff, A. (2008), "The Waterbed Effect and Price Regulation", *Review of Network Economics*, 7(3), 392-414, available at http://www.rnejournal.com/artman2/uploads/1/schiff_RNE_sept08.pdf.

[11] One could consider the waterbed effect definition as being inclusive of that of a two-sided market (Rochet and Tirole). The latter refers to the presence of cross-group externalities between the two sides of the market – i.e. links on the demand side whereby demand on one side depends on usage or membership on the other side – while the waterbed effect also includes links on the supply side in Schiff's definition. See Rochet, J.C. and Tirole, J. (2006), "Two-Sided Markets: A Progress Report", *RAND Journal of Economics,* 37, 645-667.

[12] A Global Price Cap - Laffont and Tirole (2000), *Competition in Telecommunications*, MIT Press - is a price cap that includes all upstream and downstream services provided by the regulated firm, which remains free to set the relative prices within the overall cap.

[13] See footnote 7.

[14] Genakos, C. and Valletti, T., (2007), "Testing the "Waterbed" Effect in Mobile Telephony", mimeo Paper No' CEPDP0827, available at http://cep.lse.ac.uk/pubs/download/dp0827.pdf.

(supplied by Teligen) for mobile prices rather than the average price data used by Littlechild. They conclude that:

- average retail prices in countries that experienced a reduction in mobile termination rates were lower before the regulatory decision to reduce them;

- the reduction of termination rates has a clear positive impact on an index of retail prices. This effect becomes progressively stronger as termination rates are further reduced;

- a reduction in termination rates of about 10%, led to a more than 3% increase in mobile outgoing prices on average under their preferred specification; therefore

- the waterbed effect is large, but probably incomplete.

21. Andersson and Hansen[15] examine the waterbed effect by looking at whether a change in mobile termination rates affected the overall profitability of mobile operators. In other words they assess whether or not overall profits are affected by a decline in wholesale termination rates (profit neutrality assumption). They first examine the claims on profit neutrality in the theoretical literature and they argue that the results have been obtained only in the case of a symmetric duopoly. They extend these results to many mobile networks with asymmetric shares of subscribers and find that the profit neutrality result extends to this set-up provided that: 1) demand for calls is inelastic; 2) calling patterns are uniform; and 3) there is full participation (i.e. all consumers subscribe to a mobile phone). These are obviously fairly restrictive assumptions. They then empirically test the profit neutrality assumption on a panel of data covering European mobile operators and find that they cannot reject the hypothesis that the profit of mobile operators is unaffected by an identical change in all mobile-to-mobile termination rates in the market (note crucially that they do not include a change in fixed-to-mobile termination rates).

On-/off-net Call Differential

22. Birke and Swann examine empirically the importance of "social networks". They test whether consumers co-ordinate *ex ante* their choice of network in order to take advantage of cheaper on-net calls.

23. They first test the relative importance in consumers' choice of network of the network effects (i.e. the size of the mobile operator) and of the consumers' social network. The latter defines a group of consumers that routinely and frequently take turns to call each other[16]. They start from the observation that a large differential between on- and off-net calls existed in the UK in the late 90s and early 00s, with off-net prices being between twice and five times more expensive than those for on-net calls. They suggest that this differential provided incentives for consumers on the same social network to coordinate their choice of network to take advantage of the lower on-net call charges.

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[15] Andersson, K. and Hansen, B., (2007), "Network Competition: Empirical Evidence on Mobile Termination Charges and Profitability", mimeo (version of 15 December 2007).

[16] Birke, D. and Swann, G. M. P. (2006), "Network Effects and the Choice of Mobile Phone Operator", *Journal of Evolutionary Economics*, 16, 65-84.

They base their estimation of the determinants of network choice on three UK household surveys in 1998, 2000 and 2001. Because of data restrictions, they define the social network as the members of the household that have a mobile phone.[17] They find that, by far, *at the time* (with a large on-net/off-net differential) the main determinant of network choice was the network choice of other household members. This had a much stronger estimated impact than variables such as price or size of the mobile network. In particular, they found that the impact on consumers' network choice of an additional household member belonging to the network is equivalent to 9.2 million other subscribers belonging to the network.

24. In a separate (later) paper they also test the degree of mobile operator coordination of some student groups in UK, Italian, Dutch and Malaysian universities[18]. This was undertaken through surveys that, among others, asked students to state the other class members they communicated with. They find that, where an on-/off-net price differential exists, students tend to co-ordinate their subscription decisions. On the other hand, in the Netherlands, where there was no on-/off-net price differential at the time, coordination was found not to be very important. In particular, they find that the overall network size is not particularly relevant in explaining the students' choice of operator, but the social network within the university class is. Their UK findings appear the most relevant ones because of sample size considerations.[19] They find that the nationality is particularly important in the UK sample. Students of the same nationality stated that they communicated mostly with each other and they were by and large on the same networks. Such result applied to British students as well, but to a significantly less extent. The UK results where less strong a year later when operators launched special international call discounts. This resulted in students giving more weight to call rates to their home countries – i.e. family rather than social networks within the university.

25. These results suggest that consumers coordinate, at least in part, their behaviour to take advantage of lower on-net call rates. They also indicate that when the on-/off-net price differential is low the importance of the social network decreases.

26. This may perhaps have some implications for call externalities and their degree of internalisation. If there are call externalities, it seems likely that operators would be able to internalise them for on-net but not for off-net calls (See discussion in Section 6). This suggests that if consumers coordinate their choice of mobile network in response to cheaper on-net call charges, most of the calls would be on-net calls where call externalities are internalised. Therefore, for most calls (i.e. those within the social networks) call externalities would be internalised by consumers' behaviour.[20]

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[17] The authors acknowledge that this may be a limitation, as the social network often is not restricted to the household.

[18] Birke, D. and Swann, G. M. P. (2006), "Network Effects, Network Structure and Consumer Interaction in Mobile Telecommunications in Europe and Asia", mimeo, available at https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=res2007&paper_id=324.

[19] The samples used for the UK consist of 236 and 268 students for 2005 and 2006, respectively, while the Malaysian, Dutch and Italian cohorts are much smaller consisting of 48, 71 and 111 students, respectively.

[20] Birke and Swann caution from extrapolating their results to the British population because of the significant proportion of international students in their sample.