Discussion of the econometric evidence on broadband penetration in the UK

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1 Summary of the econometric evidence

As part of BT's response to Ofcom's review of the wholesale broadband access market, Professor John Nankervis has written the report "Econometric modelling of broadband penetration in the UK (1 June 2010, revised 21 June 2010). The non-confidential version of this report is available as Annex 4 of BT's responses.[1] The report assesses how the growth of BT's broadband penetration has been affected by competition from other Communication Providers (CPs), in particular the three largest CPs (Virgin Media, Sky, CPW). An unpublished supplementary report extends this analysis to ask how the growth of broadband penetration of other CPs (CPW and Sky) has been affected by competition.

1.1 Data

The analysis is based on a rich panel dataset on circuits per CP:

- at the local exchange level (rather than the national level)
- during 4 years (July 2006-March 2010, with separate analysis since October 2008, because of a change in data recording).

1.2 Objectives

According to BT's main submission (Annex 2), the study has the following three related objectives:

- Evaluate the strength of competition, in particular between the 4 largest CPs;
- See how additional CPs affect the dynamics of competition in local exchange areas;
- Determine the effects of LLU entry on BT's and the other CPs' market position.

1.3 Econometric model

To achieve these objectives, Nankervis estimates a logistic diffusion model. This model specifies a CP's broadband penetration, per local exchange or "market", to follow an S-shaped growth process. The model in principle enables one to estimate the effects of extra competitors on both a CP's penetration level and its growth.

Econometrically, the model is a linear model where:

[1] See http://stakeholders.ofcom.org.uk/binaries/consultations/wba/responses/BT_annex4.pdf.

- The dependent variable is the CP's broadband penetration rate (log odds ratio).

- The explanatory variables (competition variables) can enter as main effects ("levels" or "location parameters") as interaction effects with a time trend ("growth parameters"), or both.

1.4 Results

The main results of the first report, on the effects of competition on BT's growth, can be summarized as follows:

- Number of CPs

    - For BT Wholesale, the presence of one CP removes all BT's growth, a second CP has an additional negative effect on BT's growth, and further CPs no longer have a significant effect on BT's growth.

    - For BT Retail, there are significant effects on BT's growth for additional CPs beyond the second.

- Effect of different CPs

    - The effects on BT's growth are similar if the entry is by Sky or CPW.

BT concludes from these results that effective competition is feasible with less CPs than Ofcom assumes in its consultation and that two CPs in addition to BT provide sufficient competitive pressure.

The main results of the supplementary report, on the effects of competition on other CPs' growth, are:

- The presence of (✂ Redacted) tends to reduce the growth rate of (✂ Redacted) to one half or even one third in the recent period.

- The presence of (✂ Redacted) also tends to reduce the growth rate of (✂ Redacted), but the effect is more modest.

- Regarding the number of CPs, BT concludes that for all three CPs, the biggest impact of competition on growth is when an additional competitor enters beyond BT itself.

Hence, the supplementary report does not induce BT to alter its conclusions.

2 Discussion

My overall opinion regarding the presented econometric evidence is as follows. First, the data set is very rich and generally carefully handled. Second, the econometric analysis is generally careful, and although I point out some issues regarding the econometrics, I do not think they would affect the substance of the findings. Third, my main concerns relate to the conclusions that BT draws from the econometric results.

- In particular, I am concerned that the focus is almost exclusively on growth effects with very limited attention to the level of penetration.

- Furthermore, I am concerned that the focus is only on growth effects for BT and other individual CPs, whereas it would have been more informative to look at total penetration (level and growth).

I now explain these comments in more detail.

2.1 Data handling

The data set is very rich, and because it refers to panel data at the exchange area level, it is considerably richer than any other academic study in this area. The author has carefully dealt with complications such as the change in data recording (by using interpolation and doing separate analysis on subsamples).

I would just like to point out one question regarding the data. I was puzzled with the number of exchanges in Tables 1 and 2 of the first report. In Table 1, for BT there are 721 exchanges for market 2 and 1,290 for market 3 (and similar numbers in tables 2 and 3). Yet there are 5,558 exchanges and later results (with reduced data from October 2008 onwards) cover over 5,000 exchanges (if sample not restricted to markets where Virgin Media is present). Some more explicit further discussion on why the number of exchanges is so small in the first tables would be useful.

2.2 Econometric analysis

The econometric analysis is also careful, and although there are some issues, it does not seem this would affect the substance of the results. I would like to point out the following specific issues.

First, a logistic diffusion model is specified. This assumes an S-shaped pattern. It has the advantage that one can specify an upper bound on market penetration. Yet the national graphs shown at the start of the first report do not seem to support the S-shape, as it appears one is immediately in the decelerating part of the diffusion curve. However, while the logistic specification may not be accurate and can affect the growth estimates, it does not seem likely that the substance of the results will be affected by very much with a more realistic functional form for the diffusion curve.

Second, the upper bound in the diffusion function is specified as the total number of premises in the exchange area. If this would be a diffusion model for total penetration, this would be a very reasonable choice. But since this is a diffusion model for penetration at the level of the individual CP, the upper bound on penetration may not necessarily be appropriate, as it cannot be true for all CPs. An alternative would be to specify the upper bound as the total number of premises divided by the number of CPs (though this may lead to other complications). But again, it does not seem that the substance of the results on growth effects is likely to change by very much when alternative definitions would have been used as sensitivity checks.

Third, the model allows for heterogeneity in the location or level effects across exchange areas *i* (random effects, fixed effects). But I would suspect that there is also a possibly strong heterogeneity in the growth effects across exchange areas *i*. Intuitively, it is plausible to expect that growth is stronger in areas that start at low levels (late-coming markets that catch up), and vice versa. So empirically there is likely a correlation between the market-specific level and growth effects. It is not obvious whether this would bias the results in one way or another, but a discussion on the assumption of homogeneous growth rates could be useful.

Fourth, the choice of included variables is sometimes slightly arbitrary across different models. In the first report for example, model (5) (which is for all CPs) includes both market 2 and market 3 in the sample, and adds a dummy for market 3, as well as interaction for market 3 with time trend. Model (6) (which is for BT only) aims to look at the separate effect of Sky and CPW on BT's penetration growth, but it also breaks down the analysis by separate samples for market 2 and market 3 (so that now all parameters are allowed to differ between markets). This may not affect the conclusions, but it would have been preferable to use a consistent specification throughout the models.

2.3 Conclusions drawn from the report

Most of my comments relate to the conclusions that BT draws from the econometric results.

First, I am concerned that the focus and conclusions relate almost exclusively to the growth effects and there is very little or almost no attention to the effects on the level of penetration. While the diffusion model allows the effects of CPs such as Sky and CPW to affect both the location and the growth parameters, the discussion by Nankervis and the conclusions by BT focus almost exclusively on the growth effects. For example, Table 2 of the first report finds that the presence of Sky and CPW has a negative and significant effect on BT's growth, as discussed on p. 10. However, Table 2 also shows that the presence of Sky and CPW has a positive and highly significant effect on BT's location parameter or its level of penetration. Combining the results on both the location and growth effects, one can interpret this as follows: Sky and CPW tend to enter in exchange areas where BT has already reached a higher level, so that it is not that surprising that BT has a lower subsequent growth rate, as it has already moved further along the S-shaped diffusion curve in these areas. (This is because growth rates tend to be declining in the decelerating part of the diffusion curve.) In sum, an almost exclusive focus on the growth effects may be misleading as it does not account for the penetration levels that BT starts from. Just as it is possible to transform the growth parameters, one can also transform the location parameters to interpret the effects of Sky and CPW (and the number of other CPs) on the penetration levels, and it could be informative to pursue this.

Second, I am concerned that the focus is only on penetration per individual CP and there is no analysis of total penetration of all CPs in exchange areas. It is not so surprising that additional entry leads to lower or negative growth for individual CPs since the market has to be shared by more firms. But from the perspective of analyzing competition effects, it would be more informative to show whether additional entry leads to an increase in total penetration and growth (i.e. penetration summed over all CPs). Given the rich data on different CPs, this would be feasible to do, and it would have the advantage of simplicity

(and it would make the specification of the upper bound as total number of premises an obvious choice, see an earlier comment in section 2.2). A finding that additional competition would lead to higher total penetration or total growth would reveal more convincingly that competition has this effect (rather than that it transfers market shares from some players to other players).

A final, less important comment relates to some conclusions drawn from the supplementary report. The econometric analysis generally supports the conclusions regarding the effects of competition from extra CPs on growth rates. This is largely true regarding the first report (effects on BT's growth). However, more caution may be required regarding the supplementary report (effects on other CPs' growth): here BT's suggestion (in its own note regarding Nankervis' supplementary report) that the biggest impact on growth comes from the second CP is somewhat misleading, since negative growth effects occur up to the sixth CP (Figure 1 on p. 2 in BT's own note regarding Nankervis' supplementary report).