Review of Wholesale Broadband Access Markets

Second consultation of August 2010

Response to the review by Professor Verboven of econometric modelling in BT's first consultation submission

Non-confidential version

Report prepared on behalf of BT

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28 September 2010

1. Introduction

In a peer review of the econometric work which I prepared and submitted as an annex to BT's response to Ofcom's first consultation of March 2010 on broadband markets, Professor Verboven raises a number of issues primarily on the robustness of the modelling. I address these in this short response paper with an additional model on the lines which he proposes. Professor Verboven does not think that these issues will affect the substance of the findings and the evidence in this paper supports that conclusion.

The main technical issues raised are:

- The original report considered models for the penetration ratios of BT, ✂and ✂rather than models for total penetration.
- The models were estimated using panel data procedures over a large data set and allowed for heterogeneity in the levels of penetration in each exchange but imposed homogeneity in growth rates in each exchange.
- The appropriateness and specification of the functional form used for the modelling.
- The concentration on growth rather than level effects in the conclusions drawn from the econometric study.

I set out detailed responses to these points in the following section and in section 3 report on some additional modelling which incorporates two alternative specifications which Professor Verboven proposes. I provide brief conclusions in section 4.

2. Response to the Econometric Issues raised by Prof. Verboven

The specific points raised by Professor Verboven are addressed below:

(i) 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.

Response:

Although the national graphs shown in the first report do show decelerating growth in the latter data period, the graphs depict totals or averages over all exchanges and, especially for smaller CPs, there are many exchanges where the growth starts from zero and accelerates over the whole period. Since the models reported in this note use data from 2008 to 2010 for exchanges in markets 2 and 3 and are for Total penetration then, as can be seen from the mean total penetration levels in Figure R1, the S-shape functional form is not likely to describe the data as well as alternative forms such as the linear function reported below.

(ii) 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.

Response:

In this note I do not estimate a diffusion model when considering total penetration and so the issue raised in (ii) does not arise. Some sensitivity analysis was conducted on the models in the original report and it was found that for the models where BT's share was the dependent variable, there were no major changes to the reported relative or absolute growth effects. When ✂and ✂were the dependent variable, although the estimated trend coefficients changed, the relative growth effects did not change significantly. Professor Verboven's final conclusion on this matter therefore is correct.

(iii) *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.*

Response:

The model reported below for total penetration does incorporate individual heterogeneity for growth effects and I discuss the relevance of this issue.

(iv) *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 ✂and ✂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.*

Response

The primary focus of the original report was the effect on BT's share of the entry of competing LLUs and so estimation of model (5) separately in markets 2 and 3 was not reported. I agree that it may have been preferable to consider a constant specification but as far as I can determine, the overall conclusions would not have been altered.

(v) *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.*

Response

Of the 5558 exchanges, 3543 are in market 1, 721 are in market 2 and 1290 are in market 3. There is missing data on 4 exchanges and cases where the calculated shares are not less than unity are excluded. The first tables just consider models for markets 2 and 3 and later results include all exchanges.

3. A Model of Total Penetration allowing for Individual Level and Trend effects in each exchange.

In this section a model of total penetration is considered. This allows for heterogeneity in both the level and growth rate in each exchange and so allows for possible correlation between exchange-specific level and growth effects. The models are estimated using observations for exchanges in the (current) markets 2 and 3 and over the period from October 2008 to March 2010 where a consistent data set is available.

For this period and these exchanges the data on Total penetration ratios does not strongly support the S-shaped diffusion models considered previously and so an alternative functional form is used (log-linear). The estimated trend effects from this model supports the previous findings as do the new estimated level effects; I do not find any significant difference in total penetration levels and growth rates between exchanges where there are 2 and 3 LLU competitors to BT once heterogeneity in levels and growth rates in individual exchanges is allowed for.

The data used in the original report was monthly data for BT wholesale and LLU circuits at the exchange level. Virgin Media data is not available over the whole periods models considered and so there is a difficulty in calculating total broadband penetration rates. There is a significant correlation between Virgin Media's presence in an exchange and the number of LLUs present and so to study the effect of competition, Virgin Media cannot be ignored. ✂ , I can estimate the Total penetration of fixed−line (ADSL and cable) broadband per household.

The total penetration ratio in exchange *i* at time *t* is defined as:

$$P_{it}^{ALL} = y_{it}^{ALL} \Big/ y_i^*$$

with

y_{it}^{ALL} = number of BT Wholesale and LLU live circuits in exchange *i* at time *t* plus the number of ✂subscribers in exchange *i* in June 2009.

and

y_i^* = number of premises in exchange area i.

Figure R1 shows the average levels of Total Penetration in Markets 2 and 3 for all exchanges and for exchanges with differing numbers of competing LLUs.

Factors such as population density, income and other demographic characteristics are likely to explain the difference in penetration rates in exchanges with different numbers of LLU CPs but by including exchange specific level and growth terms such factors can be allowed for and estimates of the specific effect of extra completion can be obtained.

Figure R1✂

Note: For each point in time the above ratios are calculated as $\sum_i y_{it}^{ALL} \Big/ \sum_i y_i^*$ where the summation is taken over the exchanges in the seven groups above.

It can be seen form figure R1 that the mean Total penetration essentially follows a constant trend growth since 2008 and so as an alternative to the diffusion S−shaped models considered for individual CPs I now consider a linear model given by:

$$P_{it}^{ALL} = \alpha_i^0 + \beta_i^0 TR_t + \sum_{K=1}^{5} \alpha_K SK_{it} + \sum_{K=1}^{5} \beta_K (SK_{it} * TR_t) + \varepsilon_{it}$$

where to allow for estimates of the effects on the level and growth rates of LLU competitors I have included dummy variables SK defined as:

SK_{it} = 1 if there are K LLU competitors to BT in exchange i at time t, otherwise SK_{it} = 0 (K = 1,2 3, 4,5).

TR_t = Time trend (in years)

The model above allows for individual level (α_i^0) and growth effects (β_i^0) in each exchange and is estimated over the period from September 2008 to March 2010, a period where consistent monthly data is available. The α_i^0 and β_i^0 coefficients allow for heterogeneity in each exchange (differing population density, income and other demographic characteristics) while the α_K and β_K coefficients will give specific effects of competition on total penetration after these other aspects of exchange heterogeneity has been taken into account.

The model is estimated using a Fixed Effects panel-data estimator and so no estimates are available for time-invariant variables such as the Social Class variable considered in the original reports; any such heterogeneity is allowed for by the individual exchange level effects.

The estimates of the α_K and β_K parameters for the above model are given below and summarised in Table R1. The estimated effect on the level of Total penetration of the entry of one, two or three LLU CPs is to increase the level by ✂The entry of one, two or three LLU CPs is estimated to slightly reduce the growth rate in Total Penetration; by about ✂

There is an estimated significant effect on the total penetration level of there being five competing LLUs – an increase of ✂

✂

t−statistics in brackets, ** and * indicate significance at the 1% and 5% levels.

No. Observations = 35846, R^2 = 1.00, No. exchanges = 1993

Table R1: Total Fixed−Line Broadband Household Penetration.
Level and Growth Effects of LLU CPs October 2008 to March 2010

	Number of LLU CPs competing with BT				
	1	2	3	4	5
Estimated Level Effects	0.8%	0.8%	0.8%	0.6%	1.2%
Estimated annual Growth Effects	−0.3%	−0.3%	−0.2%	−0.1%	−0.2%

4. Conclusions

I am pleased to note that Professor Verboven does not think that the issues he has identified will affect the substance of the findings and the evidence in this paper supports that conclusion.

Specifically, I have provided a model for total broadband penetration and which also allows for heterogeneity in both levels and growth rates across exchanges. I discuss the effects on total penetration levels of the entry of competitors to BT and the findings provide additional support to the conclusions made in BT's submission to the first consultation. The effect of the entry of a third competitor is not estimated to be very much different than the effect of the entry of a second competitor on both the level and growth rate in Total penetration.