Did Separating Openreach from British Telecom Benefit Consumers?

J. Gregory SIDAK & Andrew P. VASSALLO*

In 2005, Ofcom, then telecommunications regulator in the United Kingdom, implemented functional separation of British Telecom plc (BT), separating its wholesale and retail services. BT established a division within the company, Openreach, to provide equal access to its local access network and backhaul products. The tenth anniversary of this regulatory and corporate experiment is an appropriate moment to ask whether functionally separating Openreach from BT benefited consumers. We find that Openreach's creation generated short-run consumer benefits in the form of lower prices but also led to negative long-run effects, which outweighed the short-term price reduction. Our econometric analysis indicates that prices for broadband and residential fixed-line telephone services are lower than one would expect based on prices in comparable countries. However, telecommunications investment, customer satisfaction, and measures of the United Kingdom's global competitiveness in telecommunications have also fallen. In particular, the United Kingdom's investment in next-generation networks is lagging compared with the rest of the world.

1 INTRODUCTION

In 2005, the government of the United Kingdom implemented 'functional separation' of British Telecom plc (BT) in response to a review of the telecommunications sector conducted by the United Kingdom's regulator and competition authority for the communications industries, the Office of Communications (Ofcom).[1] Ofcom's market research and consultation had argued that BT held a high market share in the British telecommunications market for

* J. Gregory SIDAK, Chairman, Criterion Economics, L.L.C., Washington, D.C. Email: jgsidak@criterioneconomics.com. Andrew P. VASSALLO, Associate Professor, Shippensburg University. Email: avassallo@ship.edu.

1 Ofcom is the United Kingdom's regulator for the 'communications industries, with responsibilities across television, radio, telecommunications and wireless communications services'. BT Group plc, *Privatization*, 2 Archives Information 3 (November 2006) [hereinafter *BT Archives Information*], available at http://www.btplc.com/Thegroup/BTsHistory/Privatisationinfosheetissue2.pdf. Ofcom's functions were transferred from the Office of Telecommunications (Oftel) on 29 Dec. 2003. See Office of Communications, Strategic Review of Telecommunications, Phase 2 Consultation Document, 2004, at 125 (U.K.) [hereinafter Strategic Telecom Review, Phase 2], available at http://stakeholders.ofcom.org.uk/binaries/consultations/telecoms_p2/summary/maincondoc.pdf.

Sidak, J. Gregory & Vassallo, Andrew P. 'Did Separating Openreach from British Telecom Benefit Consumers?'. *World Competition* 38, no. 1 (2015): 31–76.

residential voice services, business retail services, leased lines, wholesale international services, wholesale broadband, and wholesale fixed narrowband, which purportedly prevented consumers from enjoying benefits that Ofcom otherwise expected from more robust competition.[2] In response, BT proposed legally binding undertakings to create a separate division, eventually dubbed Openreach, to provide equality of access to its local access network and backhaul products.[3]

Ten years have passed. Has the functional separation of Openreach from BT benefited consumers? We find that Openreach's creation may have generated short-run consumer benefits in the form of lower prices but that negative long-run effects outweighed these benefits. Although prices may have fallen after the functional separation, investment, customer satisfaction, and the United Kindom's global competitiveness in telecommunications have also fallen. On balance, it would be incorrect to declare that the functional separation of Openreach from BT was a regulatory success for consumers in the United Kingdom.

In Part II, we evaluate whether Openreach's functional separation from BT increased consumer welfare since 2005. First, we analyse the short-term effects that it had on broadband and residential fixed-line telephone prices in the United Kingdom, and whether the functional separation of BT achieved Ofcom's goal of providing more affordable telecommunications services. We develop econometric models that find that prices for these two telecommunications services are actually lower than one would expect based on prices in comparable countries. Our results suggest that Openreach's functional separation has led to increasing demand for fixed-line services, but decreasing or slower growth in the demand for broadband services. Finally, we explain that the reduction in broadband prices does not imply a transfer of wealth from BT shareholders to consumers.

In Part III, we analyse the long-run consumer-welfare effects of Openreach's functional separation. We measure the United Kingdom's investment in telecommunications and customer satisfaction with BT relative to its competitors as measures of the United Kingdom's 'global competitiveness' in telecommunications. The apparently lower prices achieved in the United Kingdom

[2] Office of Communications, Final Statements on the Strategic Review of Telecommunications, and Undertakings in Lieu of a Reference Under the Enterprise Act 2002, 22 Sep 2005, at 25–29 (U.K.) [hereinafter Strategic Review Final Statements], available at http://www.ofcom.org.uk/consult/condocs/statement_tsr/.

[3] See Office of Communications, Openreach Establishment – An Overview, 2006 (U.K.), available at http://stakeholders.ofcom.org.uk/binaries/telecoms/policy/bt/overview.pdf.

themselves have come at a price. The empirical evidence shows that functional separation has presented a trade-off between short-run and long-run economic efficiency, as investment and customer satisfaction have fallen along with prices. We examine the efficiency tradeoff between long-run reductions in investment and short-run price reductions. Although functional separation has offered short-run benefits to UK consumers in the form of lower prices, investment in next-generation networks is lagging in the United Kingdom compared with other comparable countries. This result is consistent with our empirical finding of lower-than-predicted broadband demand. Ofcom appears to have delivered static gains in consumer surplus at the expense of dynamic reductions of consumer surplus that may be vastly greater.

2 SHORT-RUN CONSUMER WELFARE EFFECTS OF FUNCTIONAL SEPARATION

We empirically analyse the extent to which the functional separation of Openreach from BT resulted in an increase of consumer-welfare. First, we measure the short-term effects of Openreach's functional separation, determining whether Ofcom achieved the goal of lower prices for UK telecommunications services. Our models show that prices for these two telecommunications services are actually lower than one would expect based on prices in comparable countries. Despite the short-run price decreases, consumer surplus fell following functional separation. We calculate the lost consumer surplus in the consumption of broadband and residential fixed-line service in the United Kingdom.

2.1 The short-term effects of functional separation on prices in the united kingdom

We analyse the extent to which Openreach has achieved lower prices for telecommunications services in the United Kingdom. We develop econometric models that predict broadband subscription price and residential, fixed-line telephone subscription price in the United Kingdom. Our models show that prices for these two telecommunications services are actually lower than one would expect based on prices in comparable countries.

2.1[a] *Prices for Broadband in the United Kingdom Relative to Comparable Countries*

We chose the Organization for Economic Cooperation and Development (OECD) member countries as the peer group for our analysis, generating a sample size of thirty-four countries (the United Kingdom plus the other thirty-three

OECD member countries).[4] OECD members are generally representative of the United Kingdom with respect to telecommunications indicators such as economic development, computer penetration, and income.[5] We estimate demand and price equations for fixed-line telephony and broadband for the thirty-four countries' sample using annual data from 2008 to 2010. The results of the analysis show that the prices for broadband and fixed-line telecommunications services in the United Kingdom were lower in 2010 than predicted from our regression models based on cross-country comparisons on observable factors.

2.1[a][i] Broadband Prices in the United Kingdom Relative to OECD Countries

For broadband subscription information, we rely on data from the International Telecommunications Union (ITU).[6] Gross domestic product (GDP) data comes from the World Bank.[7] Table 1 lists the economic and broadband telecommunications characteristics of the United Kingdom and its peer countries.

Table 1 2010 Economic and Telecommunications Indicators Ranked by GDP per Capita

Country	*GDP per Capita*	*Computer Penetration*	*Broadband Demand*	*Broadband Price*
Luxembourg	$103,574	90.2%	87.7	$38.41
Norway	$85,443	90.9%	80.9	$49.47
Switzerland	$70,561	86.9%	87.3	$32.60
Denmark	$56,486	88.0%	82.7	$44.27
Australia	$51,086	81.1%	63.4	$36.65
Sweden	$49,360	89.5%	66.7	$34.54
Netherlands	$46,623	92.0%	88.6	$33.11
United States	$46,612	75.5%	70.4	$19.95

4 *Members and Partners*, Organization for Economic Cooperation & Development, http://www.oecd.org/about/membersandpartners/.

5 See Table 1 below.

6 International Telecommunications Union, World Telecommunications/ICT Indicators Database 2011 (15th ed. 2011) [hereinafter ITU Database], available at http://www.itu.int/ITU-D/ict/publications/world/world.html.

7 Data–GDP per Capita (Current USD), World Bank, http://data.worldbank.org/indicator/NY.GDP.PCAP.CD [hereinafter World Development Indicators].

Country	*GDP per Capita*	*Computer Penetration*	*Broadband Demand*	*Broadband Price*
Canada	$46,212	83.9%	78.0	$26.22
Ireland	$45,873	76.5%	71.2	$33.10
Austria	$44,916	76.2%	56.2	$39.60
Finland	$43,864	82.0%	62.9	$35.63
Japan	$43,063	83.4%	72.0	$23.01
Belgium	$43,006	76.7%	75.4	$25.03
Germany	$40,164	85.7%	66.6	$39.67
Iceland	$39,522	93.0%	86.0	$24.95
France	$39,170	76.4%	81.9	$30.33
United Kingdom	$36,256	82.6%	75.5	$24.71
Italy	$33,787	64.8%	56.9	$26.42
New Zealand	$32,407	83.9%	66.6	$28.80
Spain	$29,956	68.7%	66.6	$26.36
Israel	$28,522	77.0%	87.1	$8.02
Greece	$25,832	53.4%	61.5	$18.99
Slovenia	$22,898	70.5%	70.2	$34.44
Portugal	$21,358	59.5%	56.3	$26.48
Korea (Rep. of)	$20,540	81.8%	91.0	$24.26
Czech Republic	$18,910	64.1%	35.9	$31.42
Slovak Republic	$16,036	72.2%	28.6	$26.11
Estonia	$14,062	69.2%	65.6	$21.94
Hungary	$12,863	66.4%	50.2	$20.92
Chile	$12,640	46.8%	39.5	$39.18
Poland	$12,303	69.0%	36.2	$18.21
Turkey	$10,050	44.2%	43.0	$19.29
Mexico	$9,128	29.8%	43.3	$17.32

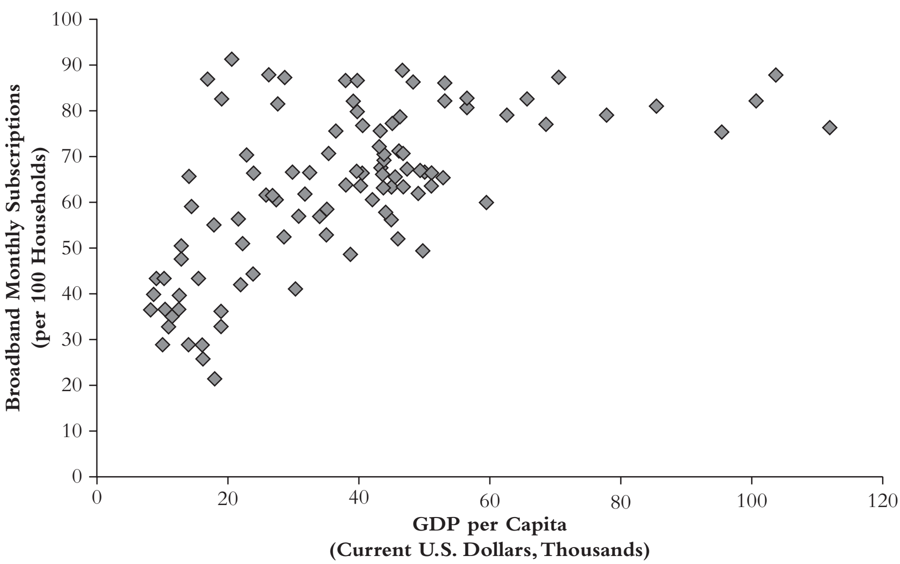
Notes: All variables are 2010 values. GDP per Capita is in current US dollars based on the Atlas Method.[8] 'Computer penetration' is the percentage of the population with a computer. 'Broadband demand' is

8 The World Bank's Atlas Method uses a three-year moving average, price-adjusted conversion factor to smooth exchange rate fluctuations. See Data – World Bank Atlas Method, The World Bank: Data & Statistics, http://econ.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20452009~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html.

broadband subscriptions per 100 households. Broadband price is the monthly broadband subscription price measured in US dollars.
Sources: ITU Database, note 6 below; World Development Indicators, note 7 below.

GDP per capita in current US dollars for the OECD countries range from a high of USD 103,574 (Luxembourg) to a low of USD 9,128 (Mexico). GDP per capita in the United Kingdom in 2010 is USD 36,256 – only USD 599 less than the average across the thirty-three peer countries. Norway and Luxembourg are outliers, with GDP per capita outside the 95% confidence interval. Figure 1 shows that broadband subscriptions increase as a function of GDP per capita until a GDP per capita of approximately USD 60,000, at which point demand stabilizes.

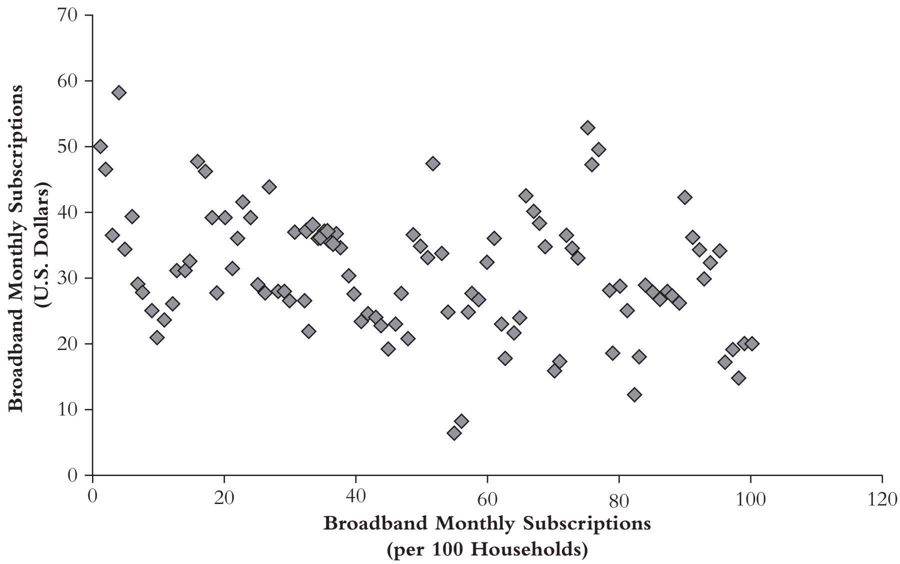
Figure 1 Broadband Subscriptions and GDP per Capita for OECD Member Countries, 2008 to 2010



Source: ITU Database, note 6 below.

The relationship between broadband subscriptions and broadband price for the OECD member countries is slightly positive, as Figure 2 indicates. However, the correlation between subscriptions and price is low, indicating that other factors drive broadband demand.

Figure 2 Broadband Subscriptions and Price for OECD Member Countries, 2008 to 2010



Source: ITU Database, n. 6 below.

The United Kingdom's computer penetration, measured by percentage of households with a computer, is greater than the average for OECD peer countries by 10.9 percentage points. Broadband service penetration, measured by subscriptions per 100 households, was higher for the United Kingdom in 2010 than for the average peer group. BT and Ofcom settled upon the legally binding Undertakings in September 2005; Openreach commenced operations shortly thereafter in January 2006. Since 2005, broadband penetration in the United Kingdom has increased by 92%, from thirty-nine to seventy-six subscriptions per 100 households. Over the same time period, the average broadband penetration across peer countries has increased by 87%. The United Kingdom has the eleventh-highest broadband penetration and the eleventh-lowest monthly broadband subscription price (in US dollars) within the OECD countries.

Table 2 Comparison of 2010 United Kingdom and OECD Summary Statistics for Telecommunications Indicators

Variable	*United Kingdom*	*Peer Average*	*Peer Standard Deviation*	*Lower 95% Confidence Value*	*Upper 95% Confidence Value*
Broadband Penetration	75.5	66.2	17.2	32.5	100.0
Broadband Price	$24.71	$28.81	$8.84	$11.49	$46.13
Computer Penetration	82.6%	74.5%	14.6	45.8%	103.2%
GDP per Capita (000s)	$36,256	$36,855	$21,150	–$4,599	$78,310

Note: All variables are 2010 values.
Sources: ITU Database, note 6 below; World Development Indicators, note 7 below.

2.1[a][ii] Econometric Estimate of the United Kingdom's Broadband Demand

We analyse broadband demand and broadband prices in the United Kingdom using the OECD member countries as our sample. These countries had similar economic and telecommunications characteristics to those of the United Kingdom over the period in question (2008 to 2010). We estimate broadband demand and price equations for the thirty-four countries' sample using annual data. The dependent variable in our broadband demand model is the log of monthly broadband subscriptions. The independent variables are the log of price, log of GDP per capita, computer penetration, and broadband speed (as an indicator of broadband service quality). We log transformed demand, price, and GDP to convert the price-demand relationship into a measure of elasticity. Doing so has the effect of interpreting the coefficients as the percentage change in the dependent variable (broadband demand) for a 1% increase in the independent variable (GDP per capita or broadband price). Table 3 lists the variables in our demand model.

Table 3 Broadband Demand Equation Variables

Broadband Variable	*Description*	*Units*
Broadband Subscriptions	Monthly broadband subscriptions	Subscriptions per 100 households
Broadband Price	Monthly broadband subscription price	US dollars
GDP per Capita	Gross domestic product per capita	US dollars
Computer Penetration	Percentage of households with a computer	Units
Broadband Speed	Fixed broadband internet speed	Megabits per second

Note: Computer penetration and broadband speed are presented as follows: a 0.95 observation for computer penetration is interpreted as 95%; speed is scaled down by 100 to more clearly interpret regression results; therefore, a 0.2 observation for speed should be interpreted as twenty megabits per second.
Sources: ITU Database, note 6 below; World Development Indicators, note 7 below.

Our panel data set represents multiple variables (including prices and subscriptions) observed from 2008 to 2010 for the thirty-four sample countries. Panel data regression allows for the observation of information reflected in the differences between the sample countries as well as information concerning changes across variables over time. Ordinary multiple regression techniques on panel data may result in omitted variable bias, whereas panel data regression allows for the control of certain types of omitted variables that differ between the countries but are constant over time.

We expected broadband price to be an endogenous variable – that is, we expected other variables in the model to affect price. Endogeneity is problematic, because correlation between variables results in autocorrelation, or correlation among observations of the error term, which violates the ordinary least squares (OLS) assumptions. One can use an instrument to adjust for this violation. An appropriate instrumental variable should be correlated with the endogenous variable (price) but uncorrelated with the error term. Therefore, we needed an instrument that affects broadband demand through its effect on broadband price.

Jerry Hausman and William Taylor suggest using the average price for the sample countries (excluding the one in question) to approximate cost as an instrument for price.[9] We used the average broadband price in US dollars in countries with similar GDP per capita as the Hausman-Taylor instrument by categorizing the sample of countries into five levels of income, based on 2008 GDP per capita percentiles. For example, classification '0' contains the lowest 10% of GDP per capita values. This level contains a low of USD 7,852 (Mexico, 2009) and a high of USD 12,863 (Hungary, 2010). Table 4 lists the classifications, percentiles, and minimum and maximum values of GDP per capita.

Table 4 OECD Member Countries and Income Classification

Income Classification	*Percentile*	*Minimum GDP per Capita*	*Maximum GDP per Capita*
0	10%	\$7,852	\$12,863
1	25%	\$13,886	\$21,627
2	50%	\$22,016	\$40,447
3	75%	\$42,000	\$51,186
4	90%	\$52,731	\$62,596
5	100%	\$65,790	\$112,029

We tested the strength of broadband cost as an instrument for broadband price. Jeffrey Wooldridge defines a weak instrument as one having low but non-zero correlation with the independent variable.[10] We estimate this correlation by conducting a simple regression of log cost on log price. The *F*-statistic of the regression is 4.99.[11] The 5% critical value of the *F*-statistic is 3.95. Based on the five-percent critical value, we reject the hypothesis that cost is a weak instrument for price. Therefore, as a valid instrument, we include cost in our demand estimation equation to obtain consistent estimates of the coefficients.

We estimated the demand equation using a two-stage least square (2SLS) random effects regression based on the results of the Hausman specification test.[12] Fixed-effects estimators enable the regression to control for omitted variables that differ between the countries but are constant over time. For example, regulatory constraints in the broadband market may differ across countries but may be

[9] Jerry A. Hausman & William E. Taylor, 'Panel Data and Unobservable Individual Effects', Econometrica 1377 (1981): 49.

[10] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, 4th ed. (Mason, OH: South-Western Cengage Learning, 2009), 516.

[11] The *F*-statistic has 1 numerator degree of freedom and ninety-six denominator degrees of freedom.

[12] Jerry A. Hausman, 'Specification Tests in Econometrics', Econometrica 46 (1978): 1251, 1273–1291.

consistent for each country from 2008 to 2010. Although fixed-effects estimation will give unbiased results, it may not generate the most efficient model. By comparison, random-effects estimators are more efficient but may not be consistent. To determine the preferred model, we applied the Hausman specification test.[13] If the Hausman test statistic is significant, as determined by the Chi-squared test statistic for a given *p*-value and given degrees of freedom, then one rejects the null hypothesis that the coefficients estimated by the random-effects estimator and the fixed-effects estimator are not statistically different. If the results of the Hausman test suggest that the coefficients are statistically different, then fixed-effects estimators will be unbiased. If the coefficients are not statistically different, then random-effects estimation will yield the superior model specification because it is a more efficient estimator. Table 5 displays the results of the Hausman test.

Table 5 Results of the Hausman Specification Test for the Broadband Demand Equation

Variable	*Fixed-Effects Coefficient [A]*	*Random-Effects Coefficient [B]*	*Difference [A] – [B]*
Log Broadband Price	–0.921	–2.489	1.569
Log GDP per Capita	0.696	1.149	–0.452
Computer Penetration	1.383	–0.525	1.908
Broadband Speed	0.498	1.011	–0.512

Our test returned a negative Hausman test statistic of 0.71 with a *p*-value of 0.9499 (with four degrees of freedom), which is insignificant at both the 5% and 10% critical levels.[14] Therefore, we fail to reject the null hypothesis that the coefficients are statically different, and we apply random effects as the appropriate estimator.

We present the results of our demand model in Table 6 using four regressions: OLS, generalized least squares (GLS) with endogenous regressors (price), GLS without endogenous regressors (replacing price with the cost proxy), and

13 *Ibid.*

14 The 5% critical value of the Chi-square distribution with four degrees of freedom is 9.49, and the 10% critical value is 7.78.

instrumental variable (IV) regression. Table 7 shows the predicted broadband demand for the United Kingdom in 2010, based on our demand model.

Table 6 Estimation of Broadband Demand Equations

Variable	*OLS [1]*	*Random Effects GLS (Endog. Var.) [2]*	*Random Effects GLS (Exog. Var.) [3]*	*G2SLS Random Effects IV [4]*
Log Broadband Price	–0.200** (0.072)	–0.205*** (0.063)		–1.894 (3.150)
Log GDP per Capita	0.306** (0.122)	0.131* (0.070)	0.102 (0.066)	0.896 (1.336)
Computer Penetration	0.668* (0.364)	1.402*** (0.205)	1.348*** (0.257)	–0.011 (2.287)
Broadband Speed	0.739** (0.310)	0.355** (0.0912)	0.255*** (0.083)	0.917 (1.116)
Broadband Cost	–	–	–0.217** (0.096)	–

Notes: Standard errors are in parentheses. *** indicates significance at 1%, ** at 5%, and * at 10%. All models contain ninety-seven observations due to five missing observations in 2008. The OLS model [1] is a pooled regression with robust, clustered standard errors that includes dummy variables for years 2009 and 2010 (with 2008 as the constant). The GLS model with endogenous regressors [2] is a random effects model with robust standard errors that includes the independent variable price with no instrument. The GLS model with no endogenous regressors [3] replaces price with the exogenous variable cost and contains robust standard errors. The instrumental variable model [4] is random effects generalized 2SLS model with robust standard errors that includes cost as an instrument for price.

Table 7 Predicted and Actual Broadband Demand for the United Kingdom Based on the Demand Models, 2010

Value	*OLS [1]*	*Random Effects GLS (Endog. Var.) [2]*	*Random Effects GLS (Exog. Var.) [3]*	*G2SLS Random Effects IV [4]*
Predicted Demand [A]	79.9	77.2	77.2	101.3
Actual Demand [B]	75.5	75.5	75.5	75.5

Value	*OLS [1]*	*Random Effects GLS (Endog. Var.) [2]*	*Random Effects GLS (Exog. Var.) [3]*	*G2SLS Random Effects IV [4]*
Actual vs. Predicted Demand [B]/[A] – 1	–5.5%	–2.2%	–2.2%	–25.5%

The results of the first two demand models indicate that the coefficient for price is significant and negative and that the coefficients for computer penetration and broadband speed are significant and positive, as expected. Under all four demand models, actual broadband demand was below predicted demand. Actual broadband demand in 2010 for the United Kingdom was 75.5 subscriptions per 100 households; the OLS model predicted 79.9 subscriptions per 100 households. The random effects GLS models predicted 77.2 subscriptions, which was 2.2 percentage points above actual broadband demand. The results of the instrumental variable (IV) regression suggest a much greater difference between predicted and actual demand; however, all of the coefficients in the IV regression were insignificant with high standard errors, rendering the predicted value from this regression unreliable. Nevertheless, the results of all four models suggest that broadband demand in the United Kingdom did not greatly outperform model expectations and may have actually underperformed.

2.1[a][iii] Econometric Estimate of the United Kingdom's Broadband Prices

We also estimated broadband price equations, again using the other OECD member countries as the peer group over the same years, 2008 to 2010. The dependent variable was the log of monthly broadband subscriptions prices (measured in US dollars). The two independent variables were a proxy for broadband cost and the log of GDP per capita (in US dollars). The proxy for cost is the same variable as the cost instrument for price in the broadband demand equations above. We did not apply an instrument in the broadband price model, because we expected both independent variables to be exogenous.

We applied the Hausman test to determine the appropriate model specification (fixed-effects or random effects). The Hausman test generated a test statistic of 8.16 with a p-value of 0.0169. Therefore, we rejected the null hypothesis that the difference in the coefficients between the random-effects and fixed-effects models is insignificant, and applied fixed-effects as the proper model specification.[15] Table 8 shows the results of our price model with ninety-eight observations. Table 9 compares the predicted and actual price for broadband service in the United Kingdom.

Table 8 Estimation of Broadband Price Equations

Variable	*OLS* [1]	*Fixed-Effects GLS* [2]
Log Cost	–0.402 (0.309)	0.213 (0.249)
Log GDP per Capita	0.308*** (0.095)	0.665** (0.262)

Note: Standard errors are in parentheses. Each regression included 100 observations. *** indicates significance at 1%, ** at 5%, and * at 10%. The OLS model [1] is a pooled regression with robust, clustered standard errors that includes dummy variables for years 2009 and 2010 (with 2008 as the constant). The fixed-effects model [2] is a panel regression with no instruments and robust standard errors.

Table 9 Predicted and Actual Broadband Prices for the United Kingdom Based on the Price Models, 2010

Variable	*OLS* [1]	*Fixed-Effects GLS* [2]
Predicted Price [A]	$29.41	$30.51
Actual Price [B]	$24.71	$24.71
Actual vs Predicted Price [B]/[A] – 1	–16.0%	–19.0%

We found a positive, significant coefficient for log of GDP per capita. Although, contrary to expectations, cost returned a negative coefficient in the OLS regression, the coefficient is statistically insignificant and contains high standard errors. Based on the predictions of both models, the United Kingdom's broadband

15 The 5% critical value of the Chi-squared distribution with 2 degrees of freedom is 5.99.

prices in 2010 are lower than expected. Under the fixed-effects model, the actual broadband price in the United Kingdom in 2010 was USD 24.71, whereas the predicted values for broadband price based on our price models were USD 29.41 and USD 30.51. Thus, the United Kingdom outperformed the predicted broadband price by between 16% and 19% in 2010.

2.1[b] *Prices for Residential Fixed-Line Telephony in the United Kingdom Relative to Comparable Countries*

We conduct the same analysis as above with respect to fixed-line telephone services in the United Kingdom.

2.1[b][i] Residential Fixed-Line Prices in the United Kingdom Relative to OECD Countries

For fixed-line subscription and pricing information, we again relied on data from the ITU.[16] We used the same GDP per capita data used in the broadband demand equations. We excluded business demand and pricing from our analysis because those factors may distort penetration: a residence typically does not have more than one fixed-line, whereas a large business may have several. This exclusion eliminated several countries from our data set due to lack of residential-exclusive data.[17] Thus, for our fixed-line estimates, we use a sample set of twenty-six countries, including the United Kingdom. The twenty-two countries that have available data for both residential fixed-line price and demand in 2010 are listed in Table 10.

Table 10 2010 Economic and Telecommunications Indicators Sorted by GDP per Capita

Country	*GDP per Capita (USD)*	*Residential Fixed-Lines per 100 Households*	*Monthly Subscription Price (USD)*
Luxembourg	$103,574	92.2	$24.37
Norway	$85,443	55.0	$26.31
Sweden	$49,360	81.0	$20.12

16 World Telecommunications/ICT, Indicators Database (15th ed. 2011).

17 The countries for which disaggregated residential demand data were unavailable for all time periods in question were Australia, Switzerland, Germany, Denmark, France, Greece, and The Netherlands.

Country	*GDP per Capita (USD)*	*Residential Fixed-lines per 100 Households*	*Monthly Subscription Price (USD)*
United States	$46,612	73.3	$12.78
Ireland	$45,873	113	$26.49
Finland	$43,864	26.1	$11.01
Japan	$43,063	57.5	$23.33
Belgium	$43,006	68.5	$25.03
Iceland	$39,522	89.9	$13.62
United Kingdom	$36,256	91.6	$14.67
Italy	$33,787	73.8	$21.30
Spain	$29,956	84.4	$21.83
Slovenia	$22,898	91.2	$14.48
Portugal	$21,358	87.8	$20.29
Korea (Rep. of)	$20,540	121.5	$4.95
Czech Republic	$18,910	30.7	$21.30
Slovak Republic	$16,036	30.6	$13.03
Estonia	$14,062	67.7	$8.38
Hungary	$12,863	59.0	$17.02
Chile	$12,640	47.5	$22.49
Poland	$12,303	38.0	$15.97
Mexico	$9,128	54.8	$14.74

Note: All variables are 2010 values.
Sources: ITU Database, note 6 below; World Development Indicators, note 7 below.

Ireland and Korea had the most residential fixed-lines per household in 2010, with Korea's penetration falling outside the 95% confidence interval. Korea also has the lowest monthly broadband subscription price, at USD 4.95, again outside the 95% confidence interval. Although price and demand for fixed-line services in the United Kingdom lie within peer-determined confidence intervals, the country has below-average price and above-average demand for residential fixed-line telephone service, as illustrated in Table 11.

Table 11 Comparison of the United Kingdom and OECD Averages for Residential Fixed-Line Telephony, 2010

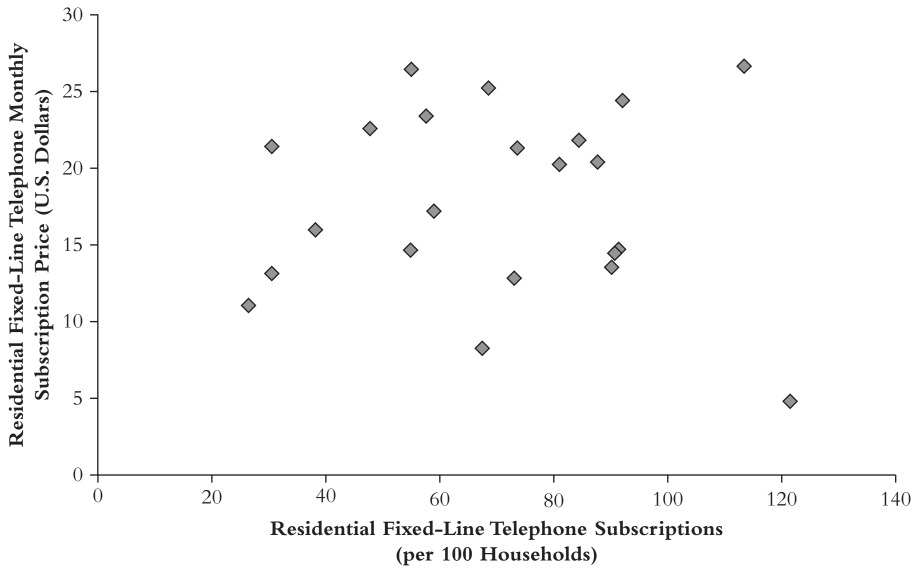
Variable	*United Kingdom*	*Sample Average*	*Sample Standard Deviation*	*Lower 95% Confidence Value*	*Upper 95% Confidence Value*
Fixed-Line Demand	91.6	68.7	26.2	17.3	120.2
Fixed-Line Price	$14.67	$18.04	$6.07	$6.14	$29.94
GDP per Capita	$36,256	$34,514	$24,217	–$12,951	$81,980

Note: All variables are 2010 values.
Sources: ITU Database, note 6 below; World Development Indicators, note 7 below.

Penetration for residential fixed-line telephone service, measured by subscriptions per 100 households, was higher for the United Kingdom in 2010 than for the average peer country. The United Kingdom has the eighth-lowest residential fixed-line monthly subscription price across the sample countries. Penetration for fixed-line residential telephone, measured by residential fixed-lines per 100 households, was 18% higher in the United Kingdom in 2010 than the average of the peer countries.

A scatter plot of 2010 subscription prices and demand in Figure 3 suggests a slightly negative relationship between price and demand, as expected. However, the correlation is only –2.1% in 2010 for the sample countries. After removing Korea, which falls outside the 95% confidence value for price, the correlation is stronger, –24.7%. This result suggests that there are additional explanatory factors for residential fixed-line prices in the sample countries.

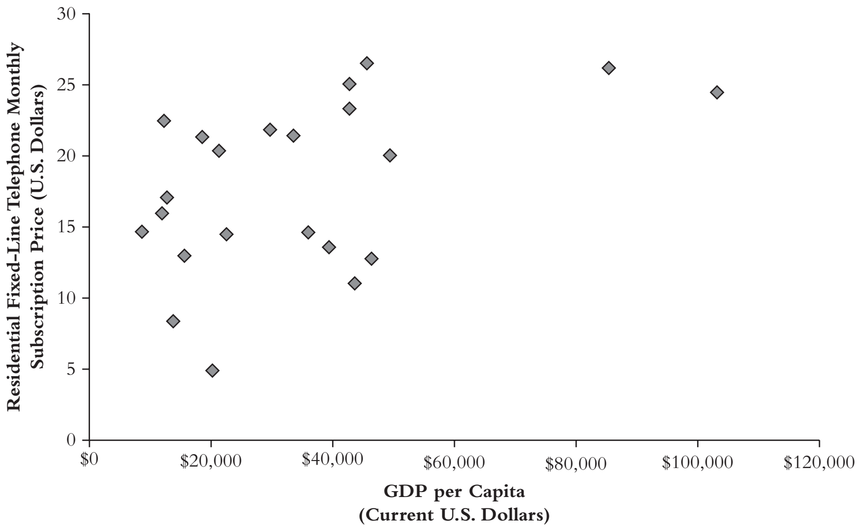
Figure 3 *2010 Residential Fixed-Line Telephone Subscriptions and Monthly Residential Subscription Price for Sample Countries*



Source: ITU Database, note 6 below.

The relationship between GDP per capita and both fixed-line price and demand is slightly stronger. The correlation between GDP per capita and residential fixed-line demand for the sample countries in 2010 is 23.3%. Removing outliers Luxembourg and Norway, the correlation becomes 30.9%. The correlation between GDP per capita and residential fixed-line price is 47.8%. After removing the outliers, this correlation decreases to 28.8% because of above-peer-average fixed-line pricing in Norway and Luxembourg. Figure 4 shows the relationship between the residential fixed-line subscription price and GDP per capita.

Figure 4 Residential Fixed-Line Telephone Subscription Price and GDP per Capita for Sample Countries, 2010



Sources: ITU Database, note 6 below; World Development Indicators, note 7 below.

From 2005 to 2010, residential fixed-line penetration fell by 3% for the United Kingdom, compared with the 14% decrease for the peer country average. The increase in mobile penetration may partially account for this global decline. From 2005 to 2010, mobile penetration, measured by mobile subscriptions per 100 inhabitants (we use inhabitants instead of households as generally individuals, not households, are associated with mobile subscriptions), increased by 20% for the United Kingdom and 27% for the peer group average.

2.1[b][ii] Econometric Estimate of the United Kingdom's Residential Fixed-Line Demand

We estimated fixed-line demand on the basis of demand for total monthly residential fixed-line telephone subscriptions. The dependent variable is the log of fixed-line penetration. The independent variables are log of price, log of GDP per capita, and log of mobile penetration. Table 12 describes the variables.

Table 12 Residential Fixed-Line Telephone Service Demand Equation Variables

Fixed-Line Variable	*Description*	*Units*
Fixed-Line Subscriptions	Monthly residential fixed-line telephone subscriptions	Subscriptions per 100 households
Fixed-Line Price	Monthly residential fixed-line subscription price	US dollars
GDP per Capita	Gross domestic product per capita	Current US dollars
Mobile Penetration	Inhabitants with a mobile subscription	Number of subscriptions

We expected fixed-line residential subscription price to be endogenous. As an instrument for price, we used the percentage of the population living in urban areas ('urban').[18] Population density is likely to be inversely correlated with the cost of providing residential telephone services due to the high fixed costs of installing telephone wires. Thus the density of the region will influence residential demand through its effect on residential pricing. We conducted a test for endogeneity and failed to reject that OLS is consistent.[19] We also tested the strength of the variable urban as an instrument for fixed-line price by regressing urban on the log of fixed-line price. Based on the 5% critical value of the *F*-Statistic, we failed to reject the null hypothesis that the instruments are weak.[20] Lacking a stronger instrument, we accept that our regression coefficients might be biased.

We modelled a random-effects panel data regression based on the results of the Hausman specification test.[21] Because we failed to reject that OLS is consistent, we included OLS as a demand model in our predictions. In addition, we included random effects GLS regressions: one GLS model included the

[18] Data–Urban Population (% of total), World Bank, http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS.

[19] The regression of urban on fixed-line residential demand generated a test statistic of 0.04 with a *p*-value of 0.8333, which is insignificant at the 5% and 10% critical values of the Chi-squared distribution with one degree of freedom.

[20] The *F*-statistic of 0.89 failed to exceed the 5% critical value of the Chi-squared distribution with one degree of freedom.

[21] The test statistic was 4.67, distributed as Chi-squared with three degrees of freedom and a *p*-value of 0.1979, which is insignificant at both the 5% and 10% critical values of the Chi-squared distribution.

endogenous variable (price) and the other replaced price with the exogenous variable urban. Table 13 shows the results of the regressions.

Table 13 Estimation of Fixed-Line Residential Demand Equations

Variable	*OLS* [1]	*Random Effects GLS (Endog. Var.)* [2]	*Random Effects GLS (Exog. Var.)* [3]	*G2SLS Random Effects IV* [4]
Log of Fixed-Line Price	–0.121 (0.240)	–0.102 (0084)	–	–0.012 (1.17)
Log of GDP per Capita	0.120 (0.122)	0.210*** (0.072)	0.138** (0.068)	01505 (0.515)
Log of Mobile Subscriptions	0.011 (0.030)	–0.036 (0.027)	–0.040 (0.027)	–0.008 (0.037)
Urban	–	–	0.041 (0.547)	–

Notes: Standard errors are in parenthesis. *** indicates significance at 1%, ** at 5%, and * at 10%. Predicted and actual fixed-line residential demand values are for 2010. All regressions contain sixty-nine observations. The OLS model [1] is a pooled regression with clustered standard errors that includes dummy variables for years 2009 and 2010, with 2008 as the constant. The first GLS model [2] is a random effects model with robust, clustered standard errors and no instrumental variables. The second GLS model [3] is a random effects model with robust standard errors and no instrument that replaces the endogenous variable price with the exogenous variable urban. The instrumental variable model [4] is a random-effects generalized 2SLS model that includes urban as an instrument for price.

All the demand models show a negative coefficient for fixed-line price; however, none of the models indicates that price is a significant variable. The only significant variable is the log of GDP per capita in each of the two GLS random effects models. Table 14 shows that all four specifications yield similar predictions for fixed-line residential telephone subscriptions in the United Kingdom in 2010. Each prediction demonstrates that fixed-line residential telephone demand in the United Kingdom exceeds the level that the models would have predicted.

Table 14 Predicted Value for the United Kingdom Based on Demand Models, 2010

Value	*OLS [1]*	*Random Effects GLS (Endog. Var.) [2]*	*Random Effects GLS (Exog. Var.) [3]*	*G2SLS Random Effects IV [4]*
Predicted Demand [A]	70.3	65.1	63.9	67.3
Actual Demand (B)	91.6	91.6	91.6	91.6
Actual versus Predicted Demand [B]/[A] – 1	30.3%	40.7%	43.3%	36.1%

Based on the above results, the United Kingdom outperformed the predicted fixed-line demand in our models by between 30.3 and 40.7 percentage points in 2010.

2.1[b][iii] Econometric Estimate of the United Kingdom's Residential Fixed-Line Prices

We estimated price with a fixed-effects panel data regression model, based on the results of the Hausman test.[22] We did not specify an instrument because we expected the independent variables to be exogenous. The dependent variable is the log of fixed-line monthly residential subscription price (measured in US dollars). The independent variables are the log of GDP per capita (in current US dollars), the log of mobile penetration, and the log of average price as a proxy for cost. This proxy for cost follows the same method of grouping countries by levels of GDP per capita used in the broadband price equations (shown in Table 10). We included mobile penetration as substitute good for fixed-line telephony. Table 15 shows the results of our model for fixed-line residential telephone price.

22 The test statistic was 12.34 distributed as Chi-squared with 3 degrees of freedom and a *p*-value of 0.0063, which is significant at the 1% level.

Table 15 Estimation of Residential Fixed-Line Price Equations

Variable	*OLS* [1]	*Fixed-Effects GLS* [2]
Log GDP per Capita	0.441*** (0.100)	1.067*** (0.191)
Log Cost	–0.342 (0.253)	–0.235* (0.117)
Log of Mobile Subscriptions	0.002 (0.042)	–0.154 (0.219)

Notes: Each regression contains ninety-eight observations. *** indicates significance at 1%, ** at 5%, and * at 10%. The OLS model [1] is a pooled regression with robust, clustered standard errors that includes dummy variables for years 2009 and 2010, with 2008 as the constant. The GLS model [2] is a fixed-effects model with robust standard errors and no instrumental variables.

The coefficient for GDP per capita was positive and the only significant variable at the 1% level. The coefficient on GDP per capita was positive, as expected. The coefficient on cost was negative although statistically insignificant in the OLS model and only significant at the 10% level in the fixed-effects model. The increase in demand for mobile telephones may account for the negative cost coefficients. Mobile telephones have chipped away at consumers with the more price-elastic demand; consequently the profit-maximizing price for the remaining inelastic consumers has increased.[23] Table 16 compares the actual and predicted prices for residential fixed-line services in the United Kingdom.

Table 16 Predicted and Actual Residential Fixed-Line Prices for the United Kingdom Based on Price Models, 2010

Price	*OLS* [1]	*Fixed-Effects GLS* [2]
Predicted Price [A]	$18.50	$16.02
Actual Price [B]	$14.67	$14.67

23 The pricing of long-distance telephone in the United States manifested an analogous increase in margins on consumers who continued to pay the full tariff price following the proliferation of discount plans for frequently called numbers. See Jerry A. Hausman & J. Gregory Sidak, 'Why Do the Poor and the Less-Educated Pay More for Long-Distance Calls?', 3 B.E. J. Econ. Analysis & Pol'y 3 (2004): Art. 3.

Price	*OLS* *[1]*	*Fixed-Effects GLS* *[2]*
Actual vs. Predicted Price [B]/[A] – 1	–20.7%	–8.4%

Actual fixed-line residential price in the United Kingdom in 2010 was USD 14.67, whereas the OLS model predicted USD 18.50 and the fixed-effects model predicted USD 16.02. Thus, fixed-line prices in the United Kingdom were lower-than-predicted by 8.4% to 20.7% in 2010, based on our price models.

2.2 Lost consumer surplus in the broadband market

From 2008 through 2010, UK consumers received a consumer surplus of USD 2.9 to USD 4.5 billion greater than the surplus (or loss) that one would expect based on relative countries. This increase in surplus is due to lower-than-predicted broadband prices based on OECD peer countries. We use the estimated coefficients from our four broadband demand equations and the predicted prices from our two broadband price equations to estimate the additional surplus to UK consumers from lower broadband prices compared with our models' predicted prices for 2008, 2009, and 2010.[24]

Consumer surplus is a measure of the value realized by consumers for consuming a good or service and is represented by the difference in price between what consumers are willing to pay for the good and the price actually charged by the market. Jerry Hausman recommends use of the following formula for approximating consumer surplus for a linear demand curve:[25]

$$CS = (0.5P_1Q_1)/\varepsilon,$$

where P_1 represents the observed price, Q_1 the observed quantity, and ε the own-price elasticity of demand. This formula is a modification of the basic geometric formula for the area of a triangle: one-half base times height. However, this simple linear approximation can overestimate or underestimate consumer surplus.[26] Consider Figure 5, where P_1 represents market price and Q_1 represents

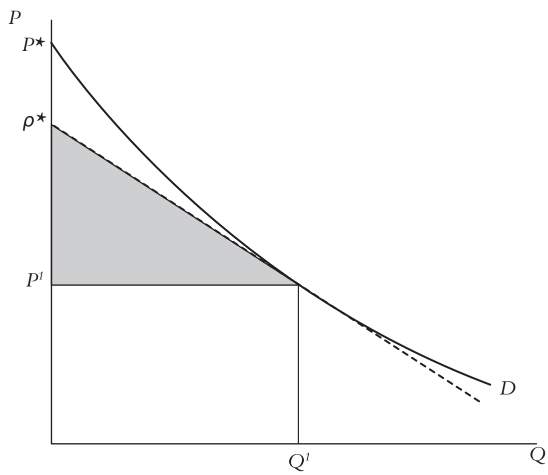
24 For a step-by-step calculation of consumer surplus, see Jerry A. Hausman & Agustin J. Ros, 'Correcting the OECD's Erroneous Assessment of Telecommunications Competition in Mexico', CPI Antitrust Chron. (June 2012).

25 Jerry A. Hausman, 'Sources of Bias and Solutions to Bias in the CPI', J. Econ. Persp. 17 (2003): 23, 27.

26 *Ibid.* at 27. This formula provides an approximation for consumer surplus for a linear demand curve. It therefore relies on an estimate of P^* based on the slope at the point where the demand curve and

quantity demanded at P_1, and D is the demand curve. The under- or over-approximation is the difference between $P^\star$ (the price consumers are willing to pay) and $\rho^\star$, the approximation of $P^\star$ given by the linear demand consumer surplus formula.

Figure 5 Illustration of Estimation of Consumer Surplus



Source: Hausman, note 25 below, at 27.

For non-linear demand functions, such as our demand equations for broadband, the one-half base times height formula will not hold, and the consumer surplus formula can be approximated by the following equation:[27]

$$CS = P_1 Q_1 \;/\; (1 - \varepsilon), \text{ for } \varepsilon < 1.$$

The elasticity, ε, is in absolute terms. We provide the formula where the elasticity is less than one because this is consistent with the elasticities produced by our broadband demand equations for broadband in Part IV.A.1. The change in consumer surplus, that is, the change in quantity demanded Q_1 at price P_1 to quantity demanded Q_2 at price P_2, is therefore given by:[28]

$$\Delta CS = [(P_2 Q_2) \;/\; (1 - \varepsilon)] - [(P_1 Q_1) \;/\; (1 - \varepsilon)],$$

P_1 and Q_1 intersect. If the demand curve is not linear in fact, then the actual location of predict price $P^\star$ will vary and therefore result in an under estimation or overestimation of the total consumer surplus.

27 Hausman, n. 25 below, at 28.

28 *Ibid.*, at 31.

which we reduce to:

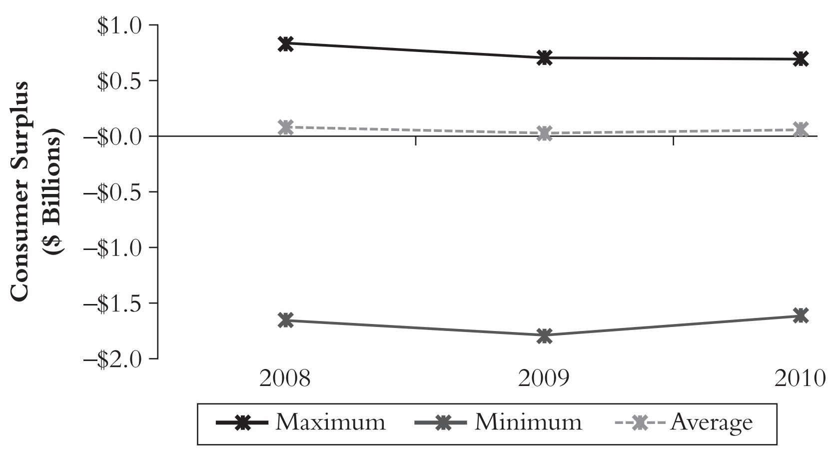
$$\Delta CS = (P_2 Q_2 - P_1 Q_1) \ / \ (1 - \varepsilon),$$

where P_2 and Q_2 are the predicted prices and quantities estimated by our models in Part II.A.1, and ε is the price elasticity of demand, given by the coefficient on broadband price estimated by our broadband demand models. Although elasticity varies slightly over time, we use the elasticity predicted by the panel data regressions in our models as a steady state estimate for elasticity.

We analysed the change in consumer surplus in the United Kingdom relative to the consumer surplus that our models predicted. The eight calculations we produced (based on the four demand models and the two price models) produced a range over the three years of a consumer loss of USD 5.1 billion to a consumer surplus of USD 2.2 billion. Six calculations estimated a change in consumer surplus between USD 1.4 billion and USD 2.2 billion. Two models resulted in a change in consumer loss between USD 4.5 billion and USD 5.1 billion. The two consumer loss equations included the G2SLS random effects instrumental variable demand equation. The three other demand equations predicted a consumer surplus.

In five of the six models predicting a change in surplus,[29] the change in consumer surplus was lower in 2010 than in 2009. Figure 6 shows the maximum, minimum, and average consumer surplus estimates for the eight models over the three years.

Figure 6 Estimation of the Change in Broadband Consumer Surplus in the United Kingdom, 2008 to 2010



[29] The exception is the surplus calculation using estimates from the OLS demand equation and the OLS price equation.

The decline in consumer surplus is counterintuitive – as prices decline below what consumers are willing to pay, consumer surplus should increase. However, the declines in consumer surplus are consistent with increasing elasticity of demand. Although demand elasticity for broadband based on our models is low – except for the instrumental variable regression model[30] the coefficients for broadband price in our first three demand models range between -0.200 and 0.217[31] – elasticity has been slightly increasing. For example, in the OLS model, elasticity increased from -0.106 in 2008 to -0.277 in 2010.[32] As elasticity increases, the total amount of consumer surplus, *ceteris paribus*, decreases. If consumer elasticity for broadband continues to increase, consumer surplus may continue to decline.

2.3 Lost consumer surplus in the residential fixed-line market

We calculate consumer surplus for residential fixed-line telephony in the same manner in which we calculated broadband consumer surplus above. We use the price elasticity from our four fixed-line demand equations, and the predicted fixed-line prices from our two fixed-line price equations, for a total of eight consumer surplus equations. Table 17 shows that although actual residential fixed-line prices in the United Kingdom in 2010 are lower than our model-predicted prices, in 2008 and 2009 actual prices are higher than our predictions.

Table 17 Predicted and Actual Residential Fixed-Line Prices for the United Kingdom, 2008 and 2009

Price	*OLS [1] 2008*	*OLS [1] 2009*	*OLS [1] 2010*	*Fixed-Effects GLS [2] 2008*	*Fixed-Effects GLS [2] 2009*	*Fixed-Effects GLS [2] 2010*
Predicted Price [A]	$21.46	$18.01	$18.50	$19.36	$15.65	$16.02
Actual Price [B]	$21.60	$19.47	$14.67	$21.60	$19.47	$14.67

30 The coefficient on price is -1.894. See Table 6 below.

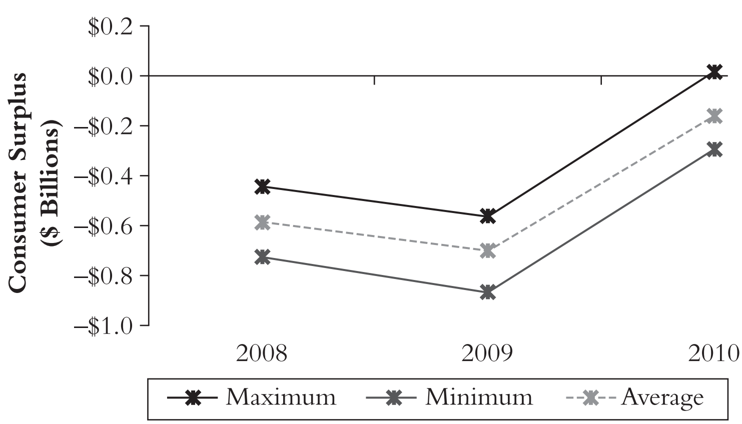
31 The four models were as follows: [1] OLS, [2] Random Effects GLS with the endogenous variable, [3] Random Effects GLS with the exogenous variable, and [4] G2SLS Random Effects Instrumental Variable. See Table 6 below.

32 Calculations are based on repeating the regressions for a single year (2008, 2009, and 2010).

Price	*OLS [1] 2008*	*OLS [1] 2009*	*OLS [1] 2010*	*Fixed-Effects GLS [2] 2008*	*Fixed-Effects GLS [2] 2009*	*Fixed-Effects GLS [2] 2010*
Actual vs. Predicted Price [B]/[A] – 1	0.6%	8.1%	–20.7%	11.6%	24.4%	–8.4%

In 2008, our model predicts prices in the United Kingdom to be 0.6% to 8.1% lower than actual prices. In 2009, our model predicts lower prices by 11.6% to 24.4%. Based on our consumer surplus calculations, consumers in the United Kingdom experienced a loss over 2008 to 2009 of USD 1.0 to USD 1.9 billion, and an average of USD 1.4 billion. Figure 7 shows the average consumer surplus per year for the eight models. Only the equation using the OLS demand and price models predicts a surplus in 2010, when our model predicted lower prices by 8.4% to 20.7%. The decrease in consumer surplus in the United Kingdom after Openreach, relative to peer countries, is robust to different functional forms for the demand estimation.

Figure 7 Estimation of the Change in Fixed-Line Consumer Surplus in the United Kingdom, 2008 to 2010

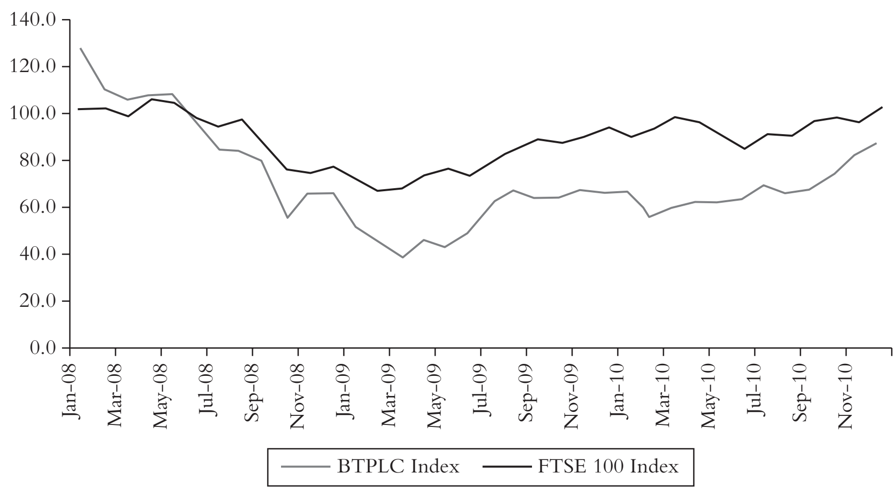


Based on our models of predicted fixed-line prices and quantities, the United Kingdom has experienced a greater loss in consumer surplus over the three-year period than one would expect due to higher-than-predicted fixed-line pricing in 2008 and 2009.

2.4 Was the reduction in broadband prices a transfer of wealth from BT shareholders to consumers?

We considered whether the reduction in broadband prices could simply be a transfer of wealth from BT shareholders to consumers. We examined BT's A shares stock returns[33] from 2008 through 2010 on three dimensions: first as a raw return, second as a market-adjusted return, and third as a model-adjusted return. The raw return is the actual return of BT's A shares. The market-adjusted return is the raw return minus the return of the Financial Times Stock Exchange 100 share index (FTSE 100), an index of average share prices for the 100 largest, actively traded companies on the LSE.[34] We chose the FTSE 100 for our market return because BT is a component of this index and it is commonly used as a benchmark for investments. Figure 8 shows the BT and the FTSE 100 returns indexed to 2008.

Figure 8 BT.A and FTSE 100 Monthly Returns Indexed to 2008, 2008 to 2010



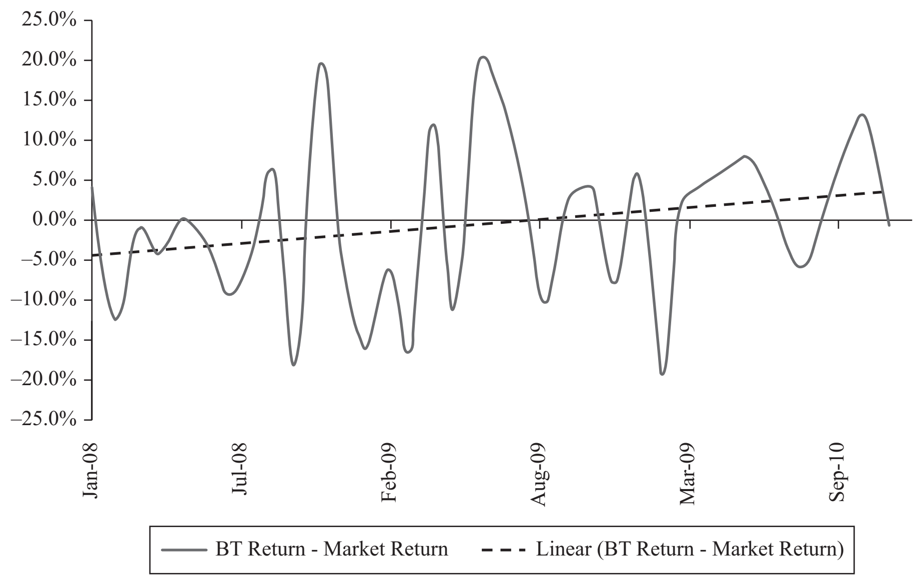
Source: Yahoo! Finance UK & Ireland, http://uk.finance.yahoo.com/ (search 'Lookup Symbol' for 'BT Group plc' and select 'BT Group-A.L' for A shares listed on the LSE; follow 'Historical Prices' hyperlink under 'More on BT-A.L'; select 'Monthly' in 'Set Date Range'; select 'Get Prices'; refer to 'close' prices);

[33] London Stock Exchange (LSE) Ticker: 091357/ISIN: GB0030913577.
[34] FTSE 100, Financial Times Lexicon, http://lexicon.ft.com/Term?term=FTSE-100.

(search 'Lookup Symbol' for 'FTSE 100' and select 'FTSE 100'; follow 'Historical Prices' hyperlink under 'More on FTSE'; select 'Monthly' in 'Set Date Range'; refer to 'close prices').

As Figure 8 shows, BT's return has underperformed the market over the period from 2008 to 2010. This is further confirmed by our calculation of the market-adjusted return. Figure 9 shows the market-adjusted return for BT's A shares and a linear trend line.

Figure 9 BT Market-Adjusted Return, 2008 to 2010



Source: Yahoo! Finance UK & Ireland, http://uk.finance.yahoo.com/ (search 'Lookup Symbol' for 'BT Group plc' and select 'BT Group-A.L' for A shares listed on the LSE; follow 'Historical Prices' hyperlink under 'More on BT-A.L'; select 'Monthly' in 'Set Date Range'; select 'Get Prices'; refer to 'close' prices); (search 'Lookup Symbol' for 'FTSE 100' and select 'FTSE 100'; follow 'Historical Prices' hyperlink under 'More on FTSE'; select 'Monthly' in 'Set Date Range'; refer to 'close prices').

The average market-adjusted monthly return from 2008 to 2010 is -0.4% with a standard deviation of 10.1%. Based on this result we are unable to identify a transfer in wealth to shareholders.

The model-adjusted return calculates the expected BT share return based on the coefficient of the market return, also known as beta, based on a regression of BT stock returns on market stock returns from 2008 to 2010. We again used the FTSE 100 as the market rate. The regression produced a beta of 1.010, signalling the stock's movement is closely correlated with the stock market. Unsurprisingly, the difference between the BT return and the model-predicted return is zero between 2008 and 2010. Removing the effect of the stock market (effectively setting the coefficient on the FTSE 100 index to zero) from the BT returns from 2008 through 2010 would similarly result in a predicted BT stock return of zero. Therefore we are again unable to identify a transfer in wealth to shareholders.

3 THE LONG-RUN CONSUMER-WELFARE EFFECTS OF FUNCTIONAL SEPARATION

A regulatory intervention resulting in lower prices does not necessarily imply that consumers are better off. Consumers also benefit from having access to new and better products and services. Lower prices for old technology that does not satisfy consumers needs does not significantly increase consumer welfare. If a regulation does not give providers incentives to invest in new and better products, benefits from lower prices may be overridden. Ofcom studies showed that 'businesses and consumers want much more than basic, reliable telecoms services at low prices: they also want choice, and rapid innovation and introduction of new services'.[35] Thus, Ofcom aimed not only to lower prices, but also to increase productivity and competitiveness in the telecommunications field.

To evaluate the long-run effects of Openreach's functional separation on consumer welfare, we analyse UK investments in telecommunications; customer satisfaction with BT relative to its competitors; and, the United Kingdom's global competitiveness in telecommunications. Our analysis shows that long-run consumer welfare losses outweighed short-run gains from lower prices.

3.1 The United Kingdom's Investment in Telecommunications

The United Kingdom has steadily decreased investment in telecommunications since 2005, the year before Openreach's functional separation. The compound annual growth rate (CAGR) in telecommunications investment between 2005 and 2010 is -15.9%.[36] The CAGR for the total of the OECD countries over the same

[35] Office of Communications, Final statements on the Strategic Review of Telecommunications, and Undertakings in lieu of a Reference Under the Enterprise Act 2002: Statement, at 1 (U.K.), available at http://stakeholders.ofcom.org.uk/binaries/consultations/752417/statement/statement.pdf.

[36] Organization for Economic Cooperation & Development, OECD Communications Outlook 2013,July 2013,at 81 (U.K.), available at http://www.oecd-ilibrary.org.

time period is 0.0%. Therefore, the United Kingdom has significantly underperformed the OECD countries in telecommunications investment.

Figure 10 United Kingdom Public Telecommunications Investment, 2005 to 2010

Source: OECD Communications Outlook 2013, note 36 below, at 81 tbl.3.6.
Note: Investment excludes spectrum fees.

Suppose the United Kingdom had maintained its USD 18.8 billion in annual investment for 2006 through 2010. Maintaining 2005 investment levels would have produced an additional USD 29.6 billion from 2008 to 2010 and USD 30.5 billion of investment from 2006 to 2010. The range of the change in consumer surplus between USD 1.4 billion to USD 2.2 billion represents only 4.8% to 7.4% of the forgone USD 29.6 billion. This loss is even more discouraging in light of our estimates showing consumer losses from USD 4.5 to USD 5.1 billion in broadband and between USD 1.0 and USD 1.9 billion in fixed-line residential telephony.

Additionally, gains in consumer surplus observed from lower-than-predicted broadband prices are offset by losses in consumer surplus resulting from higher-than-predicted fixed-line pricing. We calculated the average annual change in consumer loss for each of the eight fixed-line consumer surplus equations and compared the results with the average annual change in consumer gains for the eight broadband models. Table 18 displays the results.

Table 18 Average Annual Change in Consumer Surplus for Broadband and Residential Fixed-Line Telephony, 2008 to 2010

Service	*2008*	*2009*	*2010*
Broadband [A]	$95.4	$29.9	$44.9
Fixed-Line [B]	–$581.6	–$699.6	–$151.4
Net Effect [A] – [B]	–$486.2	–$669.7	–$106.6

Net effect represents the net change in consumer surplus or loss due to telecommunications pricing between 2008 and 2010. Based on our models, the average change in consumer surplus to UK consumers between 2008 and 2009 is a loss of over USD 1.2 billion, despite the lower-than-predicted prices for both broadband and fixed-line residential telephony in 2010.[37] Thus, while the short-run benefits from functional separation were ambiguous but small, the long-run benefits are unambiguously negative.

3.2 Customer satisfaction with BT relative to its competitors

In 2009, Ofcom commissioned international research company GfK to conduct a series of surveys studying perceptions of the quality of customer services in the broadband, mobile, fixed-line, and pay TV services in the United Kingdom.[38] The survey results reflect the opinions of consumers based on their most recent interaction with their provider's customer service centre. In the broadband market, the studies divide end users' provider interactions into three categories: billing issues, fault and repair issues, and general issues (which cover all other inquiries).[39] The first study, conducted in October 2009, included the broadband providers BT Retail, Virgin Media, Sky, Talk Talk, Tiscali (which Talk Talk acquired in June 2009),[40] and Orange.[41] The latest study, conducted between July and September

[37] See Table 18 below.

[38] *About Us*, GfK, http://www.gfk.com/about-us/Pages/default.aspx.

[39] GfK, Quality of Service 8, 30 (13 Jul. 2010), http://stakeholders.ofcom.org.uk/binaries/consultations/topcomm/annexes/qos-report.pdf; GfK, Customer Service Satisfaction Wave 4, at 10, 33 (4 Dec. 2012), http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/customer-satisfaction.pdf.

[40] Mark Jackson, *EU Approves TalkTalk Acquisition of Rival Broadband ISP Tiscali UK*, ISPreview (30 Jun. 2009), http://www.ispreview.co.uk/story/2009/06/30/eu-approves-talktalk-acquisition-of-rival-broadband-isp-tiscali-uk.html.

[41] GfK, Quality of Service, n. 39 below, at 10.

2012, included the broadband providers BT Retail, Virgin Media, Sky, Talk Talk, and Orange.[42]

In the United Kingdom, both vertically integrated providers and non-vertically integrated providers supply broadband services. Non-vertically integrated communications providers use wholesale products that Openreach supplies, such as wholesale line rental or local loop unbundling. Virgin Media, the largest vertically integrated provider by annual turnover in the United Kingdom,[43] provides its customers end-to-end solutions, from owning and managing a network to managing end-user relationships. Virgin Media is responsible for all customer inquiries – billing, fault and repair issues, and general – and has no need for Openreach's services. As a result of its functional separation, BT Retail (like Sky, Talk Talk, and Orange) Openreach's customer and must contact Openreach to solve many end-user inquiries. Openreach engineers solve faults and repairs that have been referred to downstream communications providers' customer service centres.[44] Openreach also provides services to address general issues like installation.[45] The communications providers' retail customer services deal with billing issues.

A comparison of the GfK surveys conducted in 2009 and 2012 shows that end-user satisfaction improved only slightly over the three years. The scale measuring customer satisfaction ranged from one (completely dissatisfied) to ten (completely satisfied). The studies grouped customer ratings from seven to ten as satisfied, four to six as neutral, and one to three as dissatisfied.[46] From 2009 to 2012, the share of customers surveyed who chose a customer satisfaction rating from seven to ten increased by only two percentage points – from 60% in 2009[47] to 62% in 2012.[48]

In 2012, the fixed broadband market had the lowest share of satisfied customers in relation to fixed-line, mobile, and pay TV services.[49] Table 19 shows the shares of satisfied customers reported in the 2009 and 2012 surveys.

---

42 GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 12.

43 BT Group includes BT Retail, BT Wholesale, which provides managed network service, and Openreach. BT Group plc, Annual Report & Form 20-F 2012 (9 May 2012), available at http://www.btplc.com/Sharesandperformance/Annualreportandreview/pdf/BTAnnualReport2012_smart.pdf.

44 *Your Service Provider and You*, Openreach, http://www.openreach.co.uk/orpg/home/aboutus/aboutusmiscellaneous/enduser.do.

45 *Ibid.*

46 See GfK, Quality of Service, n. 39 below, at 10; GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 12.

47 GfK, Quality of Service, n. 39 below, at 10.

48 GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 12.

49 *Ibid.* at 3, 12.

Table 19 Customer Satisfaction by Sector, 2009 & 2012

	2009	*2012*
Fixed broadband	60%	62%
Fixed-line	58%	64%
Mobile	69%	67%
Pay TV	66%	69%

Sources: GfK, Quality of Service, note 39 below; GfK, Customer Service Satisfaction: Wave 4, note 39 below.

In 2009 and 2012, the most common reasons why customers had most recently contacted their broadband providers for faults and repairs were slow network connection speeds, time required for the broadband provider to repair a fault, scheduling an engineer visit, and poor line quality. The most common general issues reported to providers were changing a bundle or service, asking a technical inquiry, arranging an installation, and buying service. The most common billing issues reported were payment issues, account details, receipt of a bill higher than expected, and receipt of an inaccurate bill.[50] The majority of the calls to broadband providers involved fault and repairs issues and general inquiries.[51] Those two categories typically require the involvement of both the communications providers' retail service and Openreach's customer service. In the 2009 study and the 2012 study, customers' main reason for contacting a broadband provider was slow connection speed.[52] Moreover, in 2012 approximately 17% of faults and repair issues were reported as unresolved, the highest rate of irresolution among all customer satisfaction issues.[53]

Compared with its competitors that rely on Openreach's wholesale services, Virgin Media was the least contacted provider in 2009. Only 13% of Virgin Media's customers contacted it about an issue, compared with an average of 17.6% for end users of providers using Openreach's wholesale products (BT Retail, Sky,

---

50 GfK, Quality of Service, note 39 below, at 30; GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 33.

51 GfK, Quality of Service, note 39 below, at 29; GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 32.

52 GfK, Quality of Service, n. 39 below, at 30; GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 33.

53 GfK, Quality of Service, n. 39 below, at 32; GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 34.

Talk Talk, Tiscali, and Orange).[54] Virgin Media's customer satisfaction rate was 66%, compared with an average of 55.8% for end users of Openreach's retail customers.[55] Finally, Virgin Media achieved the highest customer satisfaction for completely resolving customers' faults and repairs issues, at 60%, compared with an average of 47.4% for end users of Openreach's customers.[56]

In 2012, Virgin Media was contacted more often by its customers than its rivals were. 25% of Virgin Media's customers contacted it about an issue, compared with an average of 14.3% for end users of Openreach's customers.[57] Nevertheless, Virgin Media's customer satisfaction rate in 2012 was 72%, compared with an average of 67% for end users of Openreach's retail customers.[58] Virgin Media also had the highest customer satisfaction for completely resolving customers' faults and repairs issues, at 56%, compared with an average of 49.75% for end users of Openreach's customers.[59] Table 20 compares the customer satisfaction rates of Virgin Media with the average customer satisfaction rates of the communications providers using Openreach in 2009 and 2012.

Table 20 Customer Satisfaction of Virgin Media and Openreach, 2009 & 2012

	2009		*2012*	
	Virgin Media	*Openreach*	*Virgin Media*	*Openreach*
Contacted by end-customer	13.0%	17.6%	25.0%	14.3%
Customer overall satisfaction	66.0%	55.8%	72.0%	67.0%

54 GfK, Quality of Service, n. 39 below, at 28.

55 Customer satisfaction ranged from one (completely dissatisfied) to ten (completely satisfied). The study grouped ratings from seven to ten as satisfied, four to six as neutral, and one to three as dissatisfied. See *ibid.* at 10, 35.

56 Here satisfaction was grouped as completely resolved, partly resolved, and not resolved at all. See *ibid.*, at 32.

57 GfK, Customer Service Satisfaction: Wave 4, n. 39 below, at 30.

58 Customer satisfaction again ranged from one (completely dissatisfied) to ten (completely satisfied). The study again grouped ratings from seven to ten as satisfied, four to six as neutral, and one to three as dissatisfied. *See ibid.* at 12, 36.

59 Here, satisfaction was grouped as completely resolved, partly resolved and not resolved at all. *See ibid.* at 34.

	2009		*2012*	
Customer satisfaction for completely resolving customers' faults and repairs issues	60.0%	47.4%	56.0%	49.8%

Source: GfK, Quality of Service, note 39 below; GfK, Customer Service Satisfaction: Wave 4, note 39 below.

The customer satisfaction surveys do not support the prediction that the functional separation of BT would improve the quality of the end-user experience with respect to fixed broadband services in the United Kingdom.[60] Table 19 illustrates that customer satisfaction for fixed broadband is poor relative to other telecommunications markets. Table 20 illustrates that Virgin Media – a vertically integrated company – has the highest overall customer satisfaction and the highest customer satisfaction for completely resolving customers' faults and repairs issues.

The findings of the studies should not be surprising, as it is widely accepted that vertical integration benefits consumers. In addition to reducing costs throughout the supply chain, vertical integration improves coordination and quality control between the upstream network owner and the downstream communications provider. Vertical integration also aligns the upstream network owner's incentives with those of the downstream communications provider. For example, a vertically integrated network operator benefits directly from increased customer satisfaction with downstream services. In contrast, when Openreach invests in improving quality, only the downstream communications providers benefit, so Openreach has less incentive to invest in quality control and improvements compared with a vertically integrated provider.

Furthermore, according to a study carried out by the Fibre to the Home (FTTH) Council Europe, a non-profit organization that aims to 'accelerate FTTH adoption through information and promotion . . . to enhance the quality of life,

60 See, e.g., Anna Tims, *BT Openreach Is Always Out of Reach*, Observer (23 Feb. 2013), http://www.guardian.co.uk/money/2013/feb/24/bt-openreach-out-of-reach-complaints; André Langlois, *BT Criticised Over Weeks of Disruption*, Get Surrey (11 Mar. 2013), http://www.getsurrey.co.uk/news/s/2130549_bt_criticised_over_weeks_of_disruption; Kelly Fiveash, *Telco Claims Missed Appointments Have Fallen*, Register (12 Mar. 2013), http://www.theregister.co.uk/2013/03/12/bt_missed_appointments/; Mark Jackson, *BT Openreach UK Warns Broadband Engineer Delays to Last for Months*, ISPreview (6 Sep. 2012), http://www.ispreview.co.uk/index.php/2012/09/bt-openreach-uk-warns-broadband-engineer-delays-to-last-for-months.html.

contribute to a better environment and increased competitiveness',[61] the United Kingdom has lagged behind other European countries in deploying super-fast broadband. As of June 2012, only 0.05% of UK households were connected to FTTH.[62] The FTTH Council's research also highlights that, whereas many Asian countries reached fibre maturity by 2009 due to a high penetration of FTTH, and several European countries are expected to reach such maturity by 2020, the United Kingdom might not reach similar maturity before 2022 based on current trends.[63] The FTTH Council expects that at least 50% of homes in the United Kingdom will have connection speeds of 100 Mbps by 2022. However, according to the FTTH Council, by that time, consumers will require download speeds of 170 Mbps and upload speeds of 100 Mbps.[64] The FTTH Council's study describes the United Kingdom as facing a continuous 'broadband speed gap' between the pace at which demand for broadband speed grows and the pace of broadband providers' investments in superior technology.

The evidence above is consistent with the conjecture that functional separation has deterred investment in superior broadband technology in the United Kingdom. Communications providers have indicated that they have no intention of laying their own fibre. Moreover, they have announced intentions to rent Openreach's fibre at the same low prices that they pay for access to copper broadband.[65] One would expect Openreach, as a non-vertically integrated network operator, to have little incentive to invest in fibre given its limited ability to earn a return on its investments in next-generation technology. Openreach's active fibre-based services are subject to non-discrimination, or 'equality of access' obligations, thus limiting BT Openreach's share of rewards to its investments.[66] Hence, while other countries have raced to replace copper networks with FTTH, Openreach has been investing in a cheaper infrastructure – laying fibre to street

---

[61] See Nadia Babaali & Valérie Chaillou, *Creating a Brighter Future*, Fibre to the Home Council Europe 4 (16 Oct. 2012), http://www.ftthcouncil.eu/documents/Presentations/20121016PressConfBBWF.pdf.

[62] See *ibid.*, at 10, 23; Dan Worth, *UK Languishes Bottom of European Fibre-to-the-home League*, V3.co.uk (10 Oct. 2012), http://www.v3.co.uk/v3-uk/news/2215987/uk-languishes-bottom-of-european-fibretothehome-league; Kelly Fiveash, *Copper-Obsessed BT Means UK Misses Out on Ultrafast Fibre Gold*, Register (10 Oct. 2012), http://www.theregister.co.uk/2012/10/10/ftth_council_uk_penetration_knocked_again/.

[63] *See* Babaali & Chaillou, n. 61 below, at 23; Worth, n. 62 below.

[64] *See* Babaali & Chaillou, n. 61 below, at 23, 25; John Fintan Kennedy, *Failure to Invest in Fibre Broadband Could Make Europe an Economic Backwater*, Siliconrepublic (15 Feb. 2013), http://www.siliconrepublic.com/comms/item/31512-failure-to-invest-in-fibre.

[65] Juliette Garside, *Why Britain's Broadband Is Heading for the Slow Lane*, Guardian (7 May 2012), http://www.guardian.co.uk/technology/2012/may/07/broadband-britain-heading-slow-lane.

[66] BT Group plc, *Response to the European Commission's Questionnaire for the Public Consultation on Costing Methodologies for Key Wholesale Access Prices in Electronic Communications* (28 Nov. 2011), available at http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/cost_accounting/40_BT.pdf.

cabinets to be connected to the old copper network to carry the broadband signal to household doorsteps.[67] While other countries have been building all-fibre networks that can deliver speed of 1,000 Mbps or more, Openreach has focused on copper-fibre networks, whose speed is limited to eighty Mbps.[68]

In short, economic theory predicts that vertical integration enhances coordination between upstream and downstream activities, which deters free riding and encourages firms to innovate. Integration between upstream and downstream activities enables the network owner to receive a high share of the rewards from the successful development of a new product. Actual experience in the United Kingdom is consistent with these conjectures. As a vertically integrated firm, Virgin Media has stronger incentives to invest in innovations that meet changing consumer demand than does the functionally separated upstream network operator, Openreach.

3.3 The United Kingdom's Global Competitiveness in Telecommunications

Telecommunications infrastructure is one of the pillars of a country's competitiveness. According to the World Economic Forum, 'a solid and extensive telecommunications network allows for a rapid and free flow of information, which increases overall economic efficiency by helping to ensure that businesses can communicate and decisions are made by economic actors taking into account all available relevant information'.[69] A country's competitiveness directly affects consumer-welfare. Competitiveness can be defined as 'the set of institutions, policies, and factors that determine the level of productivity of a country'.[70] The level of productivity, in turn, 'sets the level of prosperity that can be earned by an economy' and 'the rates of return obtained by investments . . . , which . . . are the fundamental drivers of its growth rates'.[71] Put differently, 'a more competitive economy is one that is likely to sustain growth'.[72]

In this part, we analyse three relevant indicators of the United Kingdom's competitiveness in telecommunications: broadband speed, domain name registrations, and secured servers. Broadband speed is a relevant factor in a country's competitiveness. Doubling the broadband speed for the economy of an

---

67 Garside, n. 65 below.

68 *Ibid.*

69 World Economic Forum, *The Global Competitiveness Report 2012–20013: Full Data Edition 5* (2012), http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf.

70 *Ibid.* at 4.

71 *Ibid.*

72 *Ibid.*

OECD country on average increases its GDP by 0.3%.[73] Domain name registrations indicate countries interest in adopting a presence on the Internet.[74] Finally, secure servers are Internet servers that support any of the major security protocols used by Internet browsers and web servers to communicate sensitive personal and commercial information, such as passwords and credit card numbers. Ensuring the protection of users' and clients' data is indispensable to conduct secure electronic transactions and, therefore, to sustain and promote business growth through the Internet.[75] Comparing the United Kingdom's performance with the rest of OECD countries, we found that Openreach's functional separation did not lead to an increase the United Kingdom's competitiveness in telecommunications.

3.3[a] *Broadband Speed*

In September 2012, the United Kingdom's average advertised download speed was slightly over the OECD average.[76] Also, when compared with members of the European Union, the United Kingdom's actual download speed is below average in all xDSL, cable, and FTTx technologies.[77] The same underperformance is found when measuring actual upload speed.[78]

Additionally, broadband performance in the United Kingdom has undergone significant gaps between advertised speeds and the actual speeds consumers may experience. Ofcom reported that the average gap increased from 7.6Mbit/s in November and December 2010 to 8.7 Mbit/s in November 2011. Also, consumers experienced broadband speed of only 7.6 Mbits/s in 2011, on average half of the advertised speed of 16.3 Mbit/s.[79] The United Kingdom's gap between advertised and actual speeds is among the largest between members of the European Union, in both upload and download speeds in each of xDSL, Cable, and FTTx technologies during peak hours.[80] Put simply, consumers in the United Kingdom

---

73 *Doubling Broadband Speed Leads to 0.3% GDP Growth in OECD*, Telecompaper (27 Sep. 2011, 11:52 AM.), http://www.telecompaper.com/news/doubling-broadband-speed-leads-to-03-gdp-growth-in-oecd--829373.

74 OECD Communications Outlook 2013, n. 36 below, at 152.

75 *Ibid.* at 160–63.

76 *Ibid.* at 106.

77 European Commission, Directorate-General of Communications Networks, Content & Technology, *Quality of Broadband Services in the EU* 86–87 (March 2012) [hereinafter *EU Quality of Broadband Services*], available at https://ec.europa.eu/digital-agenda/en/news/quality-broadband-services-eu-march-2012.

78 *Ibid.*, at 90–91.

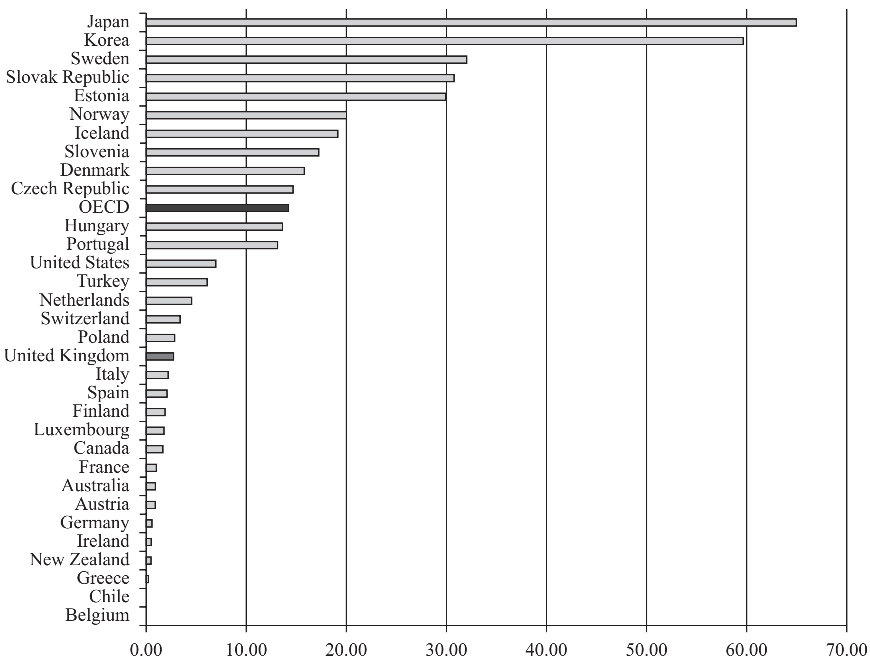
79 OECD Communications Outlook 2013, n. 36 below, at 107.

80 *EU Quality of Broadband Services*, n. 77 below, at 84–85, 88–89.

are not getting the Internet speeds they are paying for, and they are in a worse position when compared with consumers in other EU Member States.

Finally, in the long-run, the United Kingdom's broadband speed risks causing the United Kingdom to substantially underperform compared with the rest of the OECD countries. In June 2012, the percentage of United Kingdom's fibre connections in total broadband subscriptions was substantially below the OECD average. Also, the United Kingdom presented the lowest performance among OECD Member States in fastest advertised connection offered by surveyed fibre operators.[81]

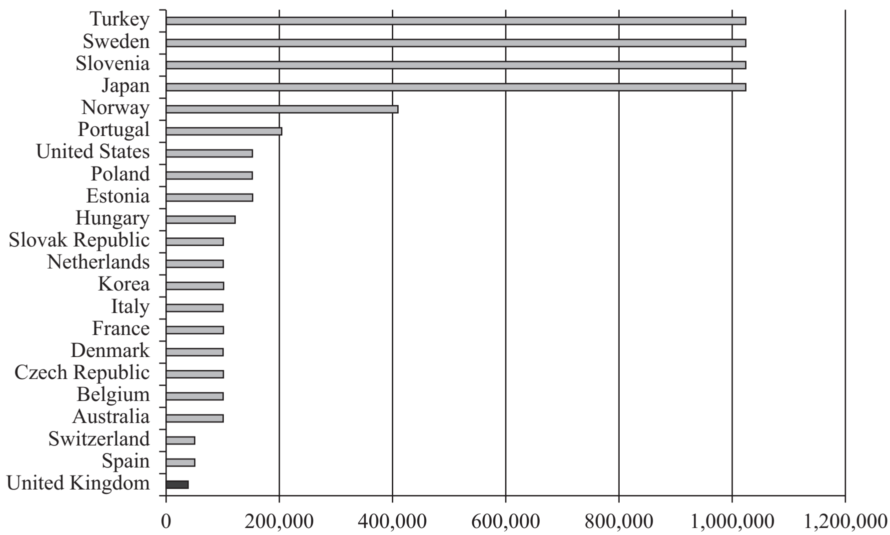
Figure 11 Percentage of Fibre Connections in Total Broadband Subscriptions, June 2012



Source: OECD Communications Outlook 2013, note 36 below, at 40 fig. 2.1.

81 Organisation for Economic Co-operation and Development, *OECD Broadband Portal* (30 Sep. 2013) [hereinafter *OECD Broadband Portal*], available at http://www.oecd.org/sti/ieconomy/oecdbroadbandportal.htm.

Figure 12 Fastest Advertised Broadband Speeds, Using Fibre, kbit/s, September 2011



Source: OECD Broadband Portal, note 81 below.

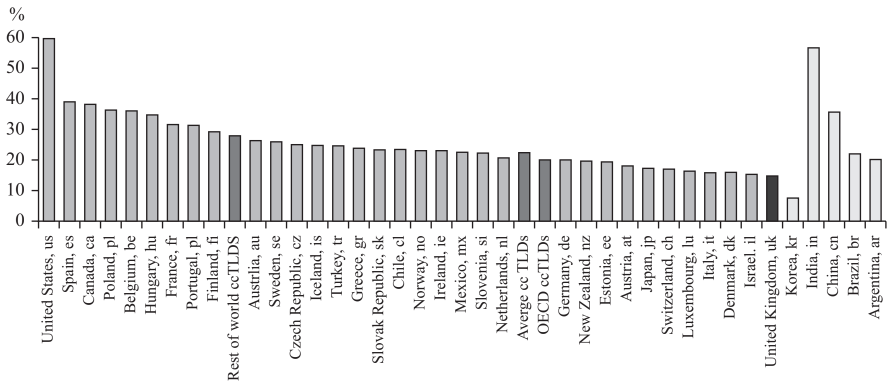
3.3[b] *Domain Name Registrations*

The United Kingdom (.uk) has the second-most domain name registrations within the set of OECD member countries, with a little over ten million registrations of the United Kingdom's country code Top Level Domain (ccTLD).[82] However, the United Kingdom also has the second lowest average annual growth in domain name registrations between 2000 and 2012, among OECD's countries, as Figure 13 indicates. During that period, the United Kingdom's average annual growth rate was 14.8%, lower than the 19.9% averaged by OECD Member States. For the period between 2000 and 2004 (before Openreach's functional separation), the United Kingdom's annual growth rate in

[82] *Ibid.*

domain name registrations was 25.3%, which was also below OECD's average, but higher than its current rates.[83]

Figure 13 Average Annual Percentage Growth in Domain Name Registrations by Domain, 2000 to 2012



Source: OECD Communications Outlook 2013, note 36 below, at 154 fig.5.12.

Thus, domain name registrations in the United Kingdom have not changed after functional separation. The analysis shows that functional separation has not helped to improve the United Kingdom's growth in domain name registrations, and therefore the United Kingdom's presence on the World Wide Web.

3.3[c] *Secure Servers*

The United Kingdom ranks highly among OECD member countries in secure servers. In July 2012, the United Kingdom had third-most secure servers (105,541) in the OECD, and ranked ninth in terms of number of secure servers per 100,000 inhabitants.[84] However, the United Kingdom is in the same position that it was before July 2004, before functional separation, when it ranked eighth among OECD countries in terms of number of secure servers per 100,000 inhabitants.[85]

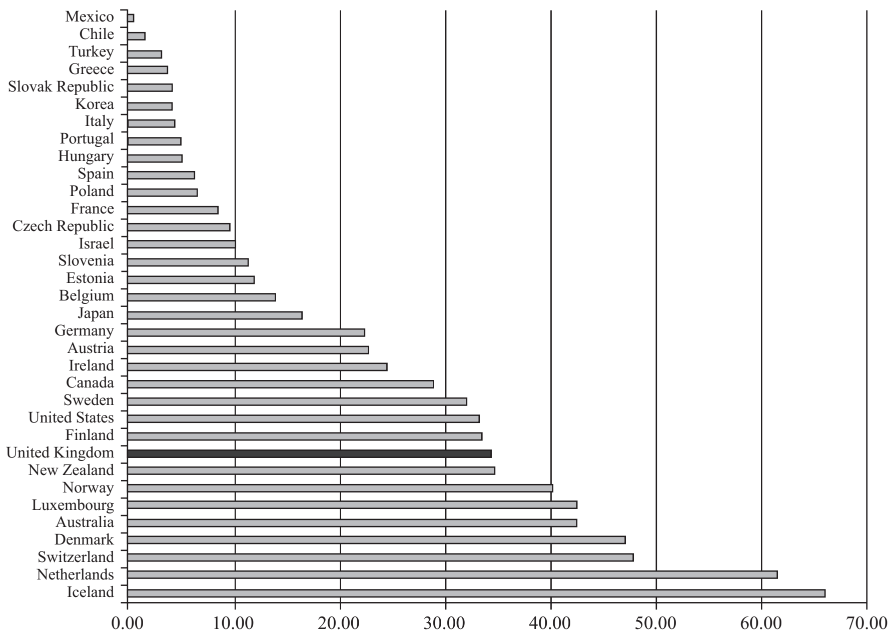
---

83 Organization for Economic Cooperation and Development, OECD Communications Outlook 2005,at 104 (U.K.) [hereinafter OECD Communications Outlook 2005], available at http://www.oecd-ilibrary.org.

84 OECD Communications Outlook 2013, n. 36 below, at 161–62.

85 OECD Communications Outlook 2005, n. 83 below, at 135–136.

Figure 14 Number of Secure Servers per 100,000 Inhabitants, July 2012



Source: OECD Communications Outlook 2013, note 36 below, at 162 fig. 5.16.

Similar as domain name registrations, the presence of secure servers in the United Kingdom has not been influenced by functional separation.

In short, the analysis of indicators of the United Kingdom's competitiveness in telecommunications is consistent with our conclusion that, in the long-run, functional separation has not contributed to the United Kingdom's global competitiveness. The United Kingdom's broadband speed is underperforming comparable countries, particularly in the case of technologies providing faster connections, and the fall of investment in telecommunications suggest that this situation should not change in the near future. Regarding domain name registrations and secure servers, the analysis shows that the elements encouraging investment and the development of those these indicators of Internet infrastructure have not improved with functional separation.

4 CONCLUSION

Based on our econometric models, the United Kingdom has outperformed predicted pricing for broadband and fixed-line residential telephony in 2010. In the short-run, based on these models alone, it appears that the functional separation of Openreach from BT, in its first ten experimental years, has achieved its goals of lowering prices for both broadband and fixed-line telecommunications services. With respect to demand, our models suggest that the separation has led to increasing demand for fixed-line services but decreasing or slower growth in the demand for broadband services.

Despite the apparently lower prices in the United Kingdom, there is a long-run tradeoff to functional separation. Investment has fallen and quality (and customer satisfaction) has fallen in the United Kingdom since 2005. On balance, although functional separation has offered short-run benefits to UK consumers in the form of lower prices, investment in next-generation networks is lagging compared with the rest of the world. This result is consistent with our empirical finding of lower-than-predicted broadband demand. Whether the functional separation of Openreach from BT has been a success or a failure depends on whether one values long-run consumer welfare more or less than short-run consumer welfare.