NERA
ECONOMIC CONSULTING

The Comparative Efficiency of Telstra

A Report for Telstra

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Project Team

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Executive Summary

NERA was commissioned by Telstra to assess the efficiency of Telstra relative to an appropriate international benchmark. In particular, Telstra asked NERA to evaluate the efficiency of Telstra's 'base year' operating expenditure, which is a key input into the ACCC's building block model that is used to determine fixed line service prices.

We have benchmarked Telstra's operating expenses against those of British Telecom (BT), the incumbent fixed network operator in the UK. The first reason for choosing BT as the comparator is that it is almost alone amongst telecom operators in being obliged to publish detailed accounts showing costs and capital employed by service. A second reason for choosing BT is that previous studies have shown it to be efficient.[1] [2] In addition, BT provides a similar set of regulated services to Telstra and operates in a country with a similar level of per capita income and economic development. There are, however, differences between the UK and Australia in terms of population density and dispersion and these will need to be borne in mind when interpreting the results of this study.

We have compared Telstra's opex with BT's for the following services:

- Unconditioned local loop service (ULLB1-3);
- Wholesale line rental (WLR);
- Fixed originating access service & Fixed terminating access service (PSTN); and
- Wholesale service (WADSL).

These are the services for which BT provides an equivalent service to Telstra.

Although the service definitions between Telstra and BT are broadly comparable, each company may allocate costs differently between services. As a result, comparison of unit opex for each individual service may be misleading. In order to mitigate this problem, we have combined the opex of the services that are being compared. It is also necessary to take account of the fact that BT is much larger than Telstra. To do this we calculate the total opex that Telstra would have if its unit opex for each of the services concerned were the same as BT's (i.e. we multiply Telstra's service volume by BT's unit opex for each of the services and sum the results). We then compare this with Telstra's actual total opex for the services concerned.

The result of the total opex comparison is shown in Figure 1.1.

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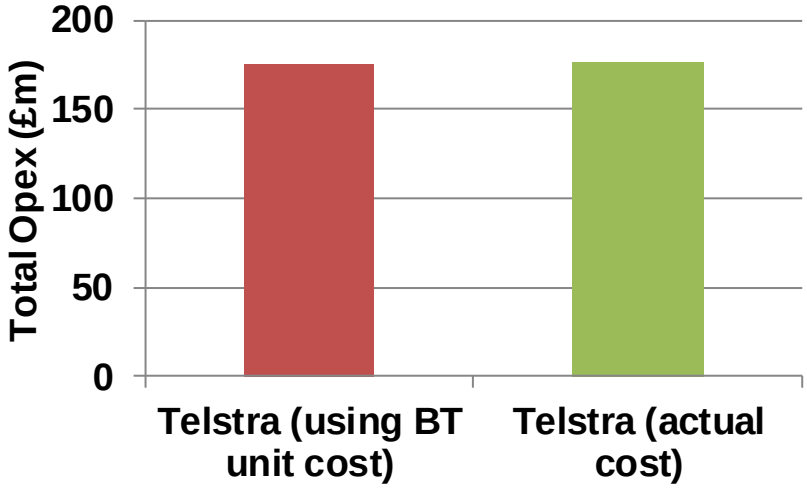
1 For example, see NERA, "The Comparative Efficiency of BT Openreach – A Report for Ofcom", 17 March 2008, which used the US LECs as comparators since detailed data was at that time available for a large number of operators.

2 More recently Deloitte, "Analysis of the Efficiency of BT's Regulated Operations", 19 September 2013, used proprietary information gathered from a set of operators in Europe and outside to benchmark BT's efficiency.

Figure 1.1
Comparison of Telstra Total Opex with Total Opex if Telstra had BT's Unit Costs



Source: NERA analysis of Telstra data and BT current cost financial statements

Figure 1.1 shows that Telstra's total opex across the four services we have considered is 1% higher than it would be if it had BT's unit costs.

The comparison we have made is the best available estimate of Telstra's relative efficiency. Like any such estimate, it is necessarily subject to a margin of error. In this context a 1% difference between Telstra's actual opex and its opex had it had BT's unit costs does not, in our view, constitute evidence of Telstra inefficiency. This is particularly the case given that Telstra is likely also to have a lower customer density than BT (in inhabited areas) and hence, other things being equal, a higher average line length and therefore costs.

Recent studies assessing BT's costs have concluded that BT is efficient. We therefore consider that if Telstra's unit opex is comparable to BT's unit opex (as is implied by Figure 1.1), then that provides one indicator of Telstra being regarded as efficient by international standards - recognising that there are important differences between Australia and the UK in population density and dispersion that would also need to be borne in mind. However, we lack the data that would enable us to quantify the effect of Telstra's likely lower density and higher dispersion on its efficient level of opex, relative to BT.

1. Introduction

NERA was commissioned by Telstra to assess the efficiency of Telstra relative to an appropriate international benchmark. In particular, Telstra asked NERA to evaluate the efficiency of Telstra's 'base year' operating expenditure, which is a key input into the ACCC's building block model that is used to determine fixed line service prices. In the building block model, forecasts of costs are derived by starting with base year costs and then projecting them forward in line with expected demand, capital requirements, input price changes and efficiency improvements. Therefore a necessary step in demonstrating that the forecasts reflect efficient costs is to show that the costs in the base year are at an efficient level. The base year in this context is 2013-4.

Telstra asked NERA to assess only its operating expenditure, and not its asset base and the associated depreciation and capital expenditure. Telstra's asset base has been calculated with a primary aim of maintaining price stability in the transition from the old TSLRIC regime to the building block regime. Telstra's asset base and associated capex and depreciation are not comparable to those of a comparator whose asset base has not been calculated in the same way, and therefore our assessment only focuses on operating expenditure.

We have benchmarked Telstra's operating expenses against those of British Telecom (BT), the incumbent fixed network operator in the UK. The first reason for choosing BT as the comparator is a pragmatic one. BT is almost alone amongst telecom operators in being obliged to publish detailed accounts showing costs and capital employed by service. In the past the US local exchange carriers (LECs) were required to publish cost and balance sheet information at a high level of granularity but now only a handful of small companies have to provide such data.

A second reason for choosing BT is that previous studies have shown it to be efficient.[3] [4] In addition, BT provides a similar set of regulated services to Telstra and operates in a country with a similar level of per capita income and economic development. There are, however, substantial differences between the UK and Australia in terms of population density and dispersion and these will need to be borne in mind when interpreting the results of this study.

The remainder of this report is structured as follows:

- Section 2 outlines our approach for assessing Telstra's base year efficiency;
- Section 3 describes the data sources used and assumptions made;
- Section 4 sets out our findings and their interpretation; and
- Section 5 concludes on Telstra's efficiency and the limitations of this study.

The appendices provide supporting information.

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[3] For example, see NERA, "The Comparative Efficiency of BT Openreach – A Report for Ofcom", 17 March 2008, which used the US LECs as comparators since detailed data was at that time available for a large number of operators.

[4] More recently Deloitte, "Analysis of the Efficiency of BT's Regulated Operations", 19 September 2013, used proprietary information gathered from a set of operators in Europe and outside to benchmark BT's efficiency.

This report has been authored by Nigel Attenborough and Arjun Dasgupta.

Nigel Attenborough is a telecommunications expert with over 28 years of experience in the sector. He has undertaken and directed a wide range of projects for telecommunications companies, regulatory authorities and government departments in Europe, Africa, Asia, Australasia and South America. He has extensive experience of cost allocation, accounting separation, efficiency comparisons, benchmarking studies, licence and company valuations, demand forecasting and financial and price cap modelling, cost benefit analyses and economic impact studies. He has also been involved in the construction of many LRIC models of interconnection costs. In addition he has worked on a whole variety of other topics including market definition and the analysis of competition, the setting of price caps, tariff rebalancing, price discrimination, price squeezes, pricing strategy, the impact of liberalisation, regulation of NGNs, assessment of different regulatory regimes, development of regulatory strategy, universal service, number portability and allocation and spectrum management and allocation.

Arjun Dasgupta works in NERA's Energy, Environment and Networks practice, with a focus on the telecoms sector. He has worked on a number of projects for European telecommunications operators and regulators, including developing a LRIC model for NGA services in Italy, forecasting market entry using the FttH network in the Netherlands and calculating BT's rateable value for setting business rates.

Further details of the authors' experience can be found in their CVs in Appendix C.

The authors acknowledge the Federal Court of Australia's practice note on expert witnesses in proceedings in the Federal Court of Australia.[5]

[5] Allsop, J (4 June 2013): "Expert witnesses in proceedings in the Federal Court of Australia", Practice Note CM7.

2. Service Definitions and Comparative Approach

This section describes the services for which we have assessed Telstra's cost efficiency and the approach we have used to do so.

2.1. Relevant Telstra Services

The ACCC is currently in the process of reviewing the markets for a number of fixed line services and the wholesale ADSL service as part of its final access determination. The ACCC uses a Building Block Model methodology for setting prices for these services.[6] The regulated services are:

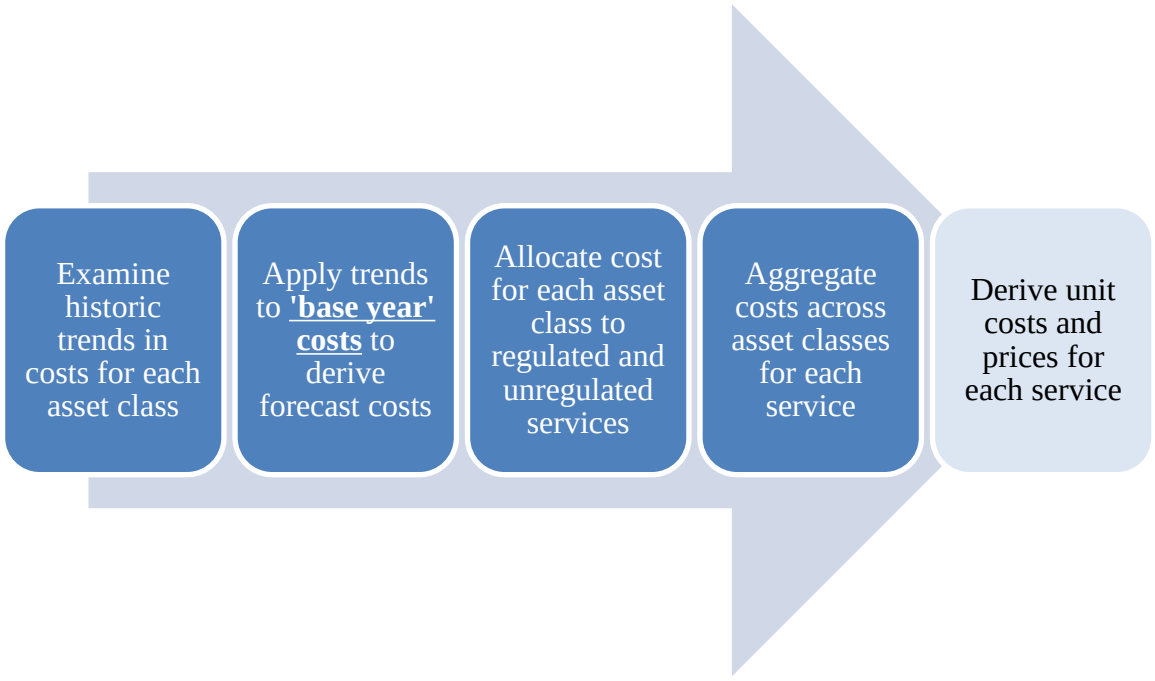
- Unconditioned local loop services (ULLS);
- Line sharing service (LSS);
- Fixed originating access service (FOAS);
- Fixed terminating access services (FTAS);
- Wholesale line rental (WLR);
- Local carriage service (LCS); and
- Wholesale service (WADSL).

The ACCC's model derives the total cost of operating and maintaining Telstra's fixed line network and allocates the total cost between regulated services and unregulated services which use the network. The only exception to this is the line sharing service, which is priced separately.

The ACCC's model uses data provided by Telstra, including capital and operating expenditure and demand forecasts for the five year period up to 2018-19. Within the ACCC's modelling framework, the base year's operating and capital expenditure are used to derive forecast costs. The model allocates the forecast cost pool to the regulated and unregulated services, to derive the cost for each service. Finally, once total costs attributed to each service have been determined, this is divided by the demand for the services to establish unit costs and prices. The ACCC's modelling approach is summarised in Figure 2.1.

[6] ACCC (July 2014): "Public Inquiry into final access determinations for fixed line services – primary price terms – Discussion paper", p viii.

Figure 2.1
ACCC Building Block Modelling Approach



The diagram shows that a crucial step in determining the final prices for each service is the 'base year' cost assumption. If the base year costs are inefficient, all forecasts of costs will also be inefficient. Telstra has requested NERA to assess the efficiency of the base year costs.

2.2. Comparative Cost Assessment Approach

In order to assess the efficiency of Telstra, we have compared its opex to that of BT. The latter was chosen as the comparator for a variety of reasons:

- BT is almost unique amongst major telecoms operators in that it is required to publish data on costs and capital employed by service at a substantial level of disaggregation;
- BT has been found to be efficient in previous comparative efficiency studies. Consequently, if Telstra is found to be as efficient as BT, it can itself be regarded as efficient;
- BT provides a similar range of wholesale services to Telstra; and
- The telecoms markets in the UK and Australia have broadly similar characteristics.

The table below compares some relevant characteristics of the markets in which Telstra and BT operate and suggests that there are broad similarities.

Table 2.1
Comparison of Market Characteristics

Characteristic	Time Period	Telstra	BT
PSTN Household Penetration	2010 - 2013	91.2%	106.7%
PSTN Growth (Annual)	2010 - 2013	-3.7%	-0.8%
Broadband Household Penetration	Mar 2010 – Sep 2014	63.7%	78.7%
Broadband Total Subscriber Growth (Quarterly)	Mar 2010 – Sep 2014	1.5%	2.1%
Broadband Subscriber Market Share	Mar 2010 – Sep 2014	45.2%	30.5%

Source: Telegeography; Note: PSTN penetration is defined as the proportion of households with a PSTN fixed line. PSTN growth is the growth in the number of PSTN fixed lines.

Table 2.1 shows that for the market characteristics shown, Telstra and BT face broadly similar conditions:

- In the PSTN market, Telstra and BT face similar levels of penetration, which have been declining over the past four years.
- In the broadband market, BT faces slightly higher levels of broadband penetration, but Telstra's market share has on average been greater over the past five years.

One area where Telstra and BT differ substantially is the density and dispersion of population in their respective countries. We would expect this to have some impact on relative opex, particularly in the access network but lack the data that would enable us to quantify this effect.

2.3. Comparable Costs and Services

Our primary assessment of Telstra's costs is conducted at the total opex level. In other words, we look at total opex across ULLS, WLR and other fixed line regulated services to reach a conclusion about Telstra's efficiency.

In order to compare Telstra's total opex to BT's for the services under consideration, it is necessary to identify equivalent BT services (see below). It is also necessary to take account of the fact that BT is much larger than Telstra. To do this we calculate the total opex that Telstra would have if its unit opex for each of the services concerned were the same as BT's (i.e. we multiply Telstra's service volume by BT's unit opex for each of the services and sum the results). We then compare this with Telstra's actual total opex for the services concerned. If Telstra's actual costs are higher than the costs calculated using BT's unit costs then, subject to the need to take account of the impact of differences in population density and dispersion, Telstra is less efficient than BT and vice versa.

The reason we focus on total opex for the services under consideration is that the opex of individual services depends on the way that costs, especially common costs, have been allocated between them. Although the principles of cost allocation applied by the two

companies are likely to be similar, Telstra and BT may not allocate costs across services in exactly the same way.[7] By comparing total opex for all the services under consideration, we have sought, as far as we can, to control for differences in cost allocation.

Below, we describe which BT services we compare to the relevant Telstra services and what adjustments we have made to enable like-for-like comparisons.

2.3.1. WLR

Firstly, we compare Telstra's WLR service to BT's Wholesale Analogue Exchange Line service. BT's Wholesale Analogue Exchange Line service provides the link between end users and the concentrator unit at the nearest BT exchange by means of analogue technology.[8] A BT analogue exchange line provides a single 64kbit/s channel, able to support both voice traffic and data. This service is equivalent to Telstra's WLR service.[9]

2.3.2. ULLS

Secondly, we compare Telstra's ULLSB1-3 service to BT's (full) Local Loop Unbundling (LLU). We do not include Telstra's Band 4 ULLS service in our analysis since it is offered only in remote rural areas, and is not directly comparable to BT's service.[10] One complication with this comparison is that BT's financial statements do not provide separate opex information for its LLU service. Instead they combine opex for a number of different unbundling services (including line sharing) under one Wholesale Local Access category. However, data are available showing a detailed breakdown of the cost of BT's LLU service by network component on a fully allocated cost basis. Using other data in BT's financial statements we have been able to isolate the operating expenditure of each network component and thereby derive opex for BT's LLU service. This adjustment and the assumptions made are described in detail in section 3.

2.3.3. Fixed call origination and termination

Next, we compare Telstra's fixed originating and fixed terminating access services (together referred to as PSTN) with BT's fixed network call origination and call termination services. BT's call origination service comprises the conveyance of all signals (including relevant control signals) required to originate calls on a customer's exchange line to the first point in the network where these signals can be accessed by another communication provider.[11] In

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[7] One apparent difference occurs in the case of the allocation of opex between WLR and ULLS. For BT the unit opex relating to copper cable and duct is higher for LLU (ULLS) than for WLR, whereas for Telstra the opposite is true. As a result, other things being equal, comparison of unit costs at the individual service level would lead to the conclusion that BT was more efficient than Telstra in providing and operating WLR, while Telstra was more efficient than BT in providing and operating ULLS. However, in reality this may merely reflect differences in the way that costs have been allocated.

[8] BT Current Cost Financial Statements 2014 including Openreach Undertakings, p33.

[9] ACCC (July 2014): "Public Inquiry into final access determinations for fixed line services – primary price terms – Discussion paper", page vi.

[10] At the same time in 2013-4 Telstra's ULLB4 service was quantitatively insignificant accounting for only 149 lines, compared with 1,482,237 in the case of ULLBS1-3

[11] BT Current Cost Financial Statements 2014 including Openreach Undertakings, p93.

other words it only involves local switching and, where relevant, transmission from a remote concentrator. Its call termination service is similar except that the call travels in the opposite direction. In Telstra's case call origination and termination services also involve the use of trunk switches (where most operators interconnect) and transmission between trunk and local switches. In order to make like-for-like comparisons between Telstra and BT it is necessary to calculate Telstra's opex for services that are equivalent to BT's. Telstra has therefore provided us with the costs for its PSTN services after subtracting any costs for network components that are not included in BT's services.

2.3.4. WADSL

Finally, we compare Telstra's WADSL service with BT's wholesale broadband access (WBA) service. Telstra's WADSL service allows access seekers to purchase a wholesale ADSL product from Telstra and resell internet services to end users. Similarly, BT's WBA service relates to the wholesale broadband products (via ADSL) that communication providers provide for themselves and sell to each other to supply retail broadband offers for end consumers.[12] BT reports WBA costs separately for two different markets – Market 1, which covers BT exchange areas where only BT provides WBA and Market 2, which covers BT exchange areas where two or three wholesale operators (including BT) are present or forecast to be present but where BT's market share is greater than or equal to 50% of the customers in that exchange area. We have combined the costs for these two markets to allow comparisons with Telstra's costs.

Table 2.2 summarises which BT service we consider to be comparable to each Telstra service.

Table 2.2
Comparison between Telstra and BT Regulated Services

Telstra Service	BT Equivalent Service	NERA Service Name
Wholesale Line Rental	Wholesale analogue exchange line services	WLR
Unconditional local loop services (ULLB1-3 only)	Local loop unbundled service	LLU
Fixed originating access service + Fixed terminating access service = PSTN	Call origination on fixed public narrowband networks + Fixed call termination	PSTN
Wholesale service (WADSL)	Wholesale broadband access	WADSL

Source: NERA analysis of BT regulatory financial statements

We have not considered Telstra's local carriage service as there is no equivalent regulated BT service and hence no available comparative data. Also, we have not compared Telstra's line

[12] Ofcom (26 June 2014): "Review of the wholesale broadband access markets – Statement on market definition, market power determinations and remedies", p2.

sharing service with that of BT since Telstra's service appears to be very different from that of BT and has much lower costs.[13]

Our assessment considers the total operating expenditure (opex) for the four service categories above in the base year (2013/14).

In making such comparisons we have converted Telstra's costs to pound sterling. In doing so we have used purchasing power parity (PPP) exchange rates since these are generally regarded as being more appropriate than market exchange rates in the case of those cost items (e.g. labour and local services) that are not traded in the open market.[14]

2.4. BT's Efficiency

Comparing Telstra's costs to BT's costs to determine whether Telstra is efficient is only valid if BT is also efficient. As mentioned earlier, there are previous studies that suggest that BT is efficient. We briefly summarise these below.

In 2008, NERA was commissioned by Ofcom to carry out a comparative efficiency assessment of BT Openreach.[15] The focus was on WLR and unbundled local loop (LLU) services. In order to assess the relative efficiency of Openreach, NERA used a benchmark dataset which comprised data on costs, network size, environmental and quality of service variables for approximately 70 US local exchange companies (LECs) for the years 1999 to 2006. We used stochastic frontier analysis to determine how BT compared to the local exchange companies on costs. The results of our study showed that BT Openreach was more efficient than the upper decile of the US LECs.

More recently, in 2013, BT commissioned a similar study assessing its comparative efficiency.[16] This study analysed the efficiency of a set of European and non-European companies, showing the relation between total costs and various input and output variables including total switched lines, switched minutes, leased lines and ADSL lines times the relative bandwidth and a time trend. The data used was proprietary and confidential and provided by the operators that were the subject of the study. Using a stochastic frontier panel model, the study showed that BT was the most efficient operator within the sample.

The above two studies suggest that BT is efficient and that, if Telstra matches up to BT, it too is efficient. However, as mentioned earlier, differences between Australia and the UK in population density and dispersion will need to be borne in mind when comparing Telstra's costs with those of BT.

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[13] The costs incurred by Telstra's LSS service only include the costs of IT systems and "jumpering" that relates to splitting the line. It does not include any line costs, whereas BT's equivalent service (shared metallic path facility) includes some line costs. This prevents us from making a comparison between the two services.

[14] The IMF notes that PPP exchange rates are more appropriate for non-traded goods and services. Source: IMF (March 2007): "PPP Versus the Market: Which Weight Matters?", Finance and Development, Volume 44, Number 1. http://www.imf.org/external/pubs/ft/fandd/2007/03/basics.htm

[15] NERA (17 March 2008): "The Comparative Efficiency of BT Openreach – A Report for Ofcom".

[16] Deloitte (19 September 2013): "Analysis of the Efficiency of BT's Regulated Operations".

2.5. Limitations of Benchmarking

Our proposed approach of comparing Telstra's total opex to BT's has limitations if Telstra and BT face different topological and demographic conditions. If total opex cannot be adjusted for these factors, the comparison is not on a like-for-like basis, thereby limiting the strength of any conclusions.

One particular factor that may affect the total opex is customer density and the associated average line length. Jamison (2000) conducted a study of network interconnection costs in the US and found that customer density is a significant factor in determining the number of interconnection trunks and number of entrants.[17] The study found that costs of providing telecommunications services are likely to be higher in high density urban areas than in sparse rural areas. Moreover, Falch (2001) has argued that telecommunications services exhibit significant economies of density, related to the fact that network costs per connection decrease with increasing density of connections.[18]

The United Kingdom is much more densely populated than Australia, having a smaller land mass and larger population.[19] We note that Australia has very large uninhabited areas of land, where there are very few customers, if any at all, but on balance we would expect Australia on average to have a less densely concentrated customer base than BT and hence a higher average line length in the local loop, other things being equal. Since a number of operating expenditure items are closely related to average line length, including maintenance of ducts and cables, we would expect Telstra to incur higher unit opex than BT. Unless Telstra is able to make significant cost savings on areas that are not related to average line length, it would have greater opex. We cannot measure the quantum of this expected difference, as we do not have any information on relative average line length in the two countries.

As noted in Section 2.3, comparing total opex across the four services under consideration ensures that differences between Telstra and BT in the way that costs are allocated between the four services are removed. However, our total cost comparison does not allow for any differences in cost allocation between the four services we have compared and other services that we have not included. If Telstra's cost allocation mechanism differs from BT's in a way that affects the relative costs of the services included in the study and those that are not, then the comparison of total opex will not be exactly on a like-for-like basis.

The above limitations mean that Telstra's total costs for the services considered in this study may not be perfectly comparable with those of BT. This needs to be borne in mind when interpreting the results. The study also cannot provide a definitive indication of what the efficient level of opex for Telstra should be, since BT's efficient level of opex may be

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[17] Jamison, M (2000): "Network interconnection and telecommunications competition: The case in the US. Working Paper, University of Florida, p27.

[18] Falch, M (2001): "Cost and Demand Characteristics of Telecom Networks", p113, in *Telecom Reform – Principles, Policies and Regulatory Practices,* edited by Melody, W.

[19] UK population in mid-2013 stood at 64.1m compared to Australian population of 23.1m. By comparison, UK land mass is 0.24m sq km relative to Australia's land mass of 7.7m sq km. Source: Office for National Statistics, Australian Bureau of Statistics, World Bank.

unachievable for an efficient operator in Australia that may potentially face higher line lengths than in the UK.

Nevertheless, our proposed comparison provides a reference point against which to compare Telstra's costs. If Telstra's opex is significantly higher than BT's, then this would warrant a further detailed examination of Telstra's costs from a bottom-up perspective. If instead, Telstra's opex is broadly in line with BT's, this would suggest, albeit not prove, that Telstra is efficient.

3. Data Sources and Methodology

In this section, we describe the data sources and methodology we have used to compare Telstra's costs to BT's.

3.1. Telstra Costs

Telstra has provided us with the same cost and demand data that it submitted to the ACCC as part of its BBM RKR response.[20]

The only adjustment Telstra has made to these costs relates to the costs associated with the PSTN service. As described in section 2.3, BT does not have the exact same service definitions as Telstra for its call origination and call termination services and hence adjustments had to be made to Telstra's PSTN costs to enable a like-for-like comparison to be made.

The final unit opex used for the comparison with BT is calculated using the following steps.

1. Convert Telstra Total Opex to £ Sterling

Telstra's total opex costs are denominated in Australian dollars and we have converted them to Pound Sterling to enable them to be compared directly to BT's costs. In doing so, we have applied a purchasing power parity (PPP) exchange rate. A PPP exchange rate equalises the purchasing power of different countries by eliminating differences in price levels. When converted by means of PPPs, the expenditures for different countries are in effect expressed at the same set of prices so that comparisons between countries reflect only differences in the volume of items purchased.

We have applied a PPP exchange rate of 1.91 for 2014 to the base year Telstra opex,[21] based on OECD estimates.[22]

2. Apply Service Allocation Matrix

In order to compare opex for the particular set of services that we are comparing between Telstra and BT, the total opex must be divided across all the services. Telstra has provided us with an allocation matrix that shows what proportion of the total opex for a particular asset class (e.g. ducts and pipes) is attributed to a particular service in any given year. For example, in 2014, [redacted] of the total opex for ducts and pipes is attributed to the WLR service. We understand that this service allocation matrix is also used in ACCC's Fixed Line Service

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[20] Telstra Corporation Limited (7 February 2014): "Final Access Determinations Inquiry – response to information request under the BBM RKR" – Comparison statement.

[21] Note that we have used the 2014 exchange rate, which is the average exchange rate in 2014. Telstra's year end is in June 2014. The average OECD PPP exchange rate for 2013 and 2014 is 1.93, which has no material impact on our results and conclusions. If we had used the figure of 1.93 Telstra would have marginally lower costs.

[22] Note: We have applied OECD's PPP exchange rate for private consumption since the overall PPP exchange rates includes government purchases of goods and services such as education and healthcare, which are unlikely to be suitable for the exchange rates for opex in telecoms services. For 2014, OECD only publishes the overall PPP exchange rate, so we have assumed the PPP exchange rate for private consumption changes in the same proportion as the overall PPP. Source: stats.oecd.org/Index.aspx?DataSetCode=SNA_Table4

Model as described in the BBM RKR Response.[23] Therefore, the allocation matrix used in our calculations is consistent with the allocations used for forecasting the RAB in the Fixed Line Service Model.

3. Apply Volume Demand

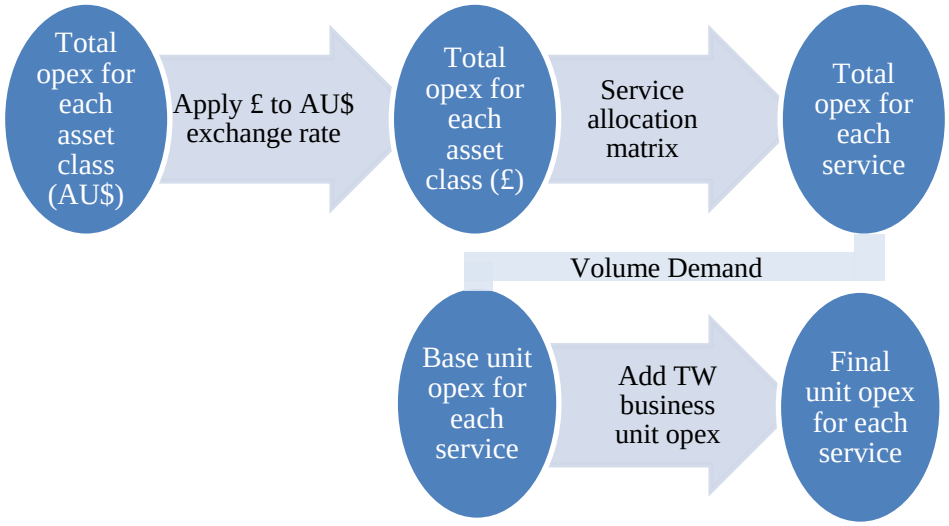
To calculate the unit opex, we divide the total opex for each service by the volume demand for the service. We understand that the volume demand is also based on Telstra's BBM RKR response,[24] which takes into account Telstra's internal demand forecasts and updated information on factors expected to influence demand for the declared fixed line services.

4. Add TW BU Costs to Calculate Final Unit Opex

Telstra provides opex incurred by the Telstra Wholesale Business Unit (TW BU) separately from the remaining opex that is allocated to each service using the process described above. These costs reflect the cost to Telstra of developing, marketing and managing regulated fixed line access services.[25] Telstra has provided this TW BU unit opex for each service and we have added this unit opex to remaining unit opex to calculate the final unit opex for each service. This final unit opex is used for the comparison of costs with BT.

Our calculation of the unit opex from Telstra's data is summarised in Figure 3.1.

Figure 3.1
Calculation of Telstra Unit Opex



Source: NERA analysis

[23] Telstra Corporation Limited (7 February 2014): "Final Access Determinations Inquiry – response to information request under the BBM RKR – Comparison Statement", p4.

[24] Telstra Corporation Limited (7 February 2014): "Final Access Determinations Inquiry – response to information request under the BBM RKR – Comparison Statement", p36.

[25] Telstra Corporation Limited (7 February 2014): "Final Access Determinations Inquiry – response to information request under the BBM RKR – Comparison Statement", p35.

Table 3.1 summarises the opex and volume demand for each of the four services that are considered in this study.

Table 3.1
Analysis of Telstra Opex

	WLR	ULLB1-3	PSTN	WADSL
Opex (AU$ m)	[redacted]	[redacted]	[redacted]	[redacted]
Opex (£ m)	[redacted]	[redacted]	[redacted]	[redacted]
Volume Demand	[redacted]	[redacted]	[redacted]	[redacted]

Source: Telstra data submission

3.2. BT Costs

Our primary analysis compares Telstra's costs in the base year (2013/14) to BT's costs. We have extracted operating expenditure data from BT's current cost financial statements for 2014 (which cover the year ended 31 March 2014).

We have previously explained in section 2.3 that BT's LLU service opex is not directly available from the accounts and must be derived. The procedure that we adopted is as follows:

- For each cost and asset category ("cost component") BT provides information on total combined opex and historic cost (HCA) depreciation, total supplementary depreciation, total holding gains and losses, total cost of capital and hence total fully allocated cost (FAC).[26] [27] From this it is possible to derive the ratio of combined opex and HCA depreciation to FAC for each cost component.
- For all access network assets, we also know the ratio of HCA depreciation to supplementary depreciation.[28] For each access network cost component this ratio is multiplied by supplementary depreciation to obtain HCA depreciation for the cost component. From this the ratio of HCA depreciation to FAC can be calculated for each cost component.
- Having obtained the ratio of combined opex and HCA depreciation to FAC and the ratio of HCA depreciation to FAC for each cost component it is a simple matter to derive the ratio of opex to FAC for each cost component.

BT also provides information on the breakdown of FAC per LLU line by cost component.[29] By applying the previously calculated ratios of opex to FAC for each cost component it is possible to derive opex per line for LLU. The key assumption made in estimating the opex

[26] BT Current Cost Financial Statements 2014, pages 127-128

[27] Fully allocated cost is equal to opex plus HCA depreciation plus supplementary depreciation plus holding losses (gains) plus the cost of capital.

[28] BT Current Cost Financial Statements 2014, page 27

[29] BT Current Cost Financial Statements 2014, page 40

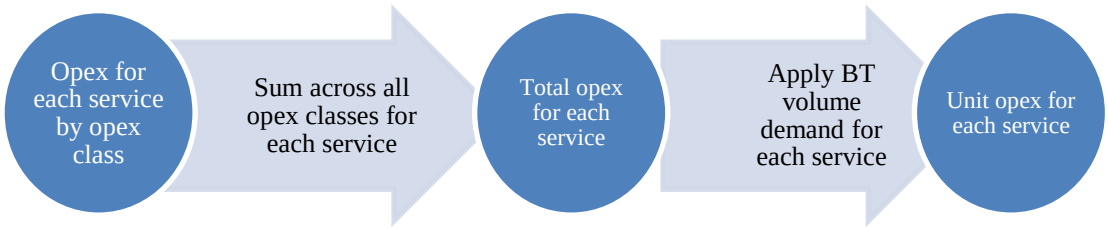
for BT's LLU service is that the ratio of historic cost depreciation for *all access network assets* to supplementary depreciation for *all access network assets* is representative for LLU. We believe this is a reasonable approximation since the use of access network assets (predominantly copper and duct in the local loop) by LLU is similar to that of other access network services.

A further point is that BT's LLU opex appears to contain a number of items, including opex for broadband line testing equipment, that do not appear in Telstra's opex for ULLSB1-3. We have controlled for this by only comparing opex for LLU duct, copper and drop wire.

Our estimation of BT's LLU costs, together with the focus on duct, copper and drop wire, allows a comparison with Telstra's ULLB1-3 service costs. This comparison, along with the comparison for other services, for which we do not need to make any adjustments, is shown in section 4.

Our calculation of the unit opex for each service is summarised in Figure 3.2.

Figure 3.2
Calculation of BT Unit Opex



Source: NERA analysis;

We summarise the data we have used to calculate BT's unit opex for each of the four services we have compared below.

Table 3.2
Analysis of BT Opex

	Wholesale analogue exchange lines	LLU[(1)]	PSTN[(2)]	WBA[(3)]
Total Opex (£m)	793	407	143	153
Volume Demand	17,245,298 lines	7,291,261 lines	119,824m minutes	3,176,250 rentals

Source: BT Current Cost Financial Statements 2014;

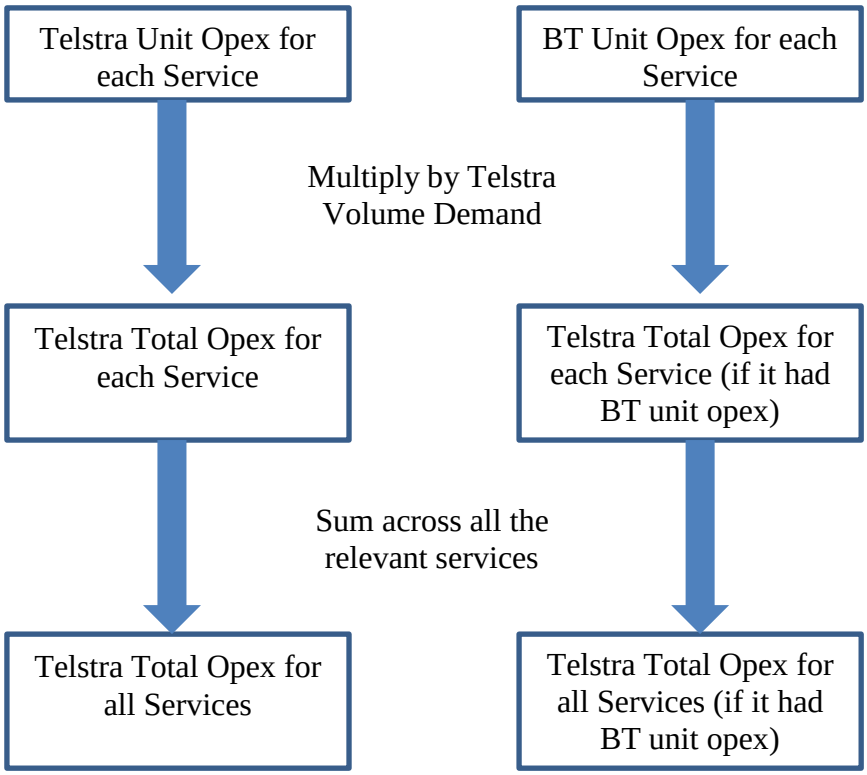
Notes: (1) The LLU costs have been estimated using BT's breakdown of opex for specific cost components, as described in the text above; (2) The PSTN opex combines the opex for BT's call origination on fixed public narrowband networks and fixed call termination services; (3) The WBA opex combines the opex for BT's wholesale broadband access services for Markets 1 and 2; (4) Opex for each service includes provision/maintenance, network support, general support, general management, finance/billing, accommodation, bad debts, and other costs.

3.3. Total Cost Comparison

As described in sections 2.3 and 2.5, we have compared Telstra's total opex to Telstra's total opex if it had BT's unit opex. This is to control for the likelihood that Telstra and BT may allocate opex differently across their services. In order to calculate Telstra's total opex if it had BT's unit opex, we have, for each service, multiplied Telstra's volume demand by BT's unit opex and summed the resulting figures. This then provides a comparison of Telstra's actual opex with Telstra's opex if it had BT's unit opex.

The sum of the total opex for the four services under consideration provides the basis for our final cost comparison. These steps are shown in Figure 3.3.

Figure 3.3
Comparison of Telstra Actual Opex with Telstra if it had BT's Unit Opex



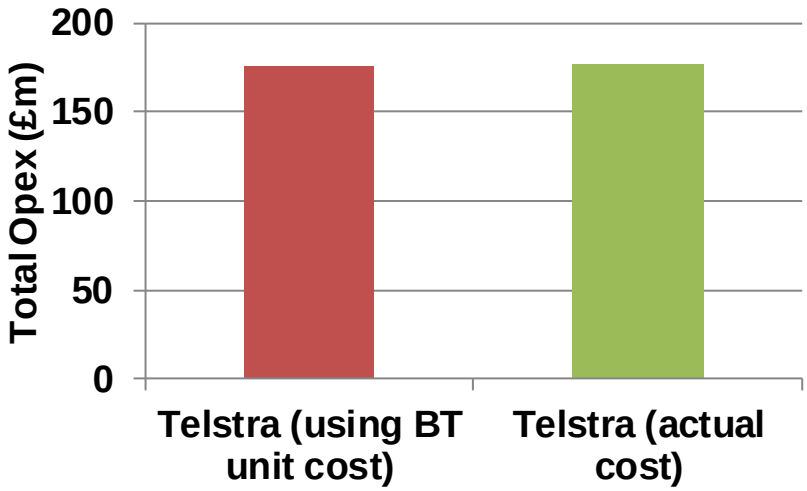
4. Results and Interpretation

In this section, we set out the results of our analysis and interpret our findings.

As noted in sections 2.3, 2.5 and 3 above, we have calculated the total opex Telstra would incur if it had BT's unit opex for each of the services under consideration. To do so, we multiplied BT's unit opex by Telstra's volume demand for each service. We then compared Telstra's total opex across the four services, if it had BT unit opex, with Telstra's actual total cost for the same services.

The result of the total opex comparison is shown in Figure 4.1.

Figure 4.1
Comparison of Telstra Total Opex with Total Opex if Telstra had BT's Unit Costs



Source: NERA analysis of Telstra data and BT current cost financial statements

Figure 4.1 shows that Telstra's total opex across the four services we have considered is 1% higher than it would be if it had BT's unit costs.

The comparison we have made is the best available estimate of Telstra's relative efficiency. Like any such estimate, it is necessarily subject to a margin of error. In this context a 1% difference between Telstra's actual opex and its opex had it had BT's unit costs cannot, in our view, be regarded as evidence of Telstra inefficiency. This is particularly the case given that Telstra is likely also to have a lower customer density and hence higher line length and therefore costs.

We cannot rule out the possibility that there may be some differences that we have not eliminated, relating to the allocation of costs between the four services we have considered and other services. However, even if such differences exist, there is no evidence regarding which way, if any, they would affect the results.

5. Conclusions and Qualifications

This final section concludes on Telstra's efficiency and sets some qualifications to our analysis.

5.1. Conclusion

Our results do not support the conclusion that Telstra is inefficient relative to BT in the base year. With regard to total opex across the four services we have considered, Telstra's total opex is practically the same as it would be if it had BT's unit cost. Even if there are some differences in the way that Telstra and BT allocate costs between the four services under consideration and their other services, we do not know in which direction any such differences would affect relative costs. The comparison we have made of total costs across the four services is the best estimator of relative efficiency that is available to us and this suggests that Telstra is unlikely to be inefficient overall.

5.2. Qualifications

Our analysis must be qualified to account for the assumptions we have made.

One of the main qualifications relates to Telstra's adjustment to its PSTN opex in order to make a consistent comparison with BT's call origination and fixed call termination services. The adjustments made to Telstra's costs to align the service with BT's may not result in complete comparability.

Overall, through our consultation with Telstra and understanding of BT's cost accounting, we have endeavoured to ensure as close comparability between BT and Telstra's opex as possible. We have mapped Telstra's opex categories to BT's and adjusted costs (including LLU opex) to enable a like-for-like comparison.

Finally, this analysis has not controlled for other market differences that BT and Telstra face. For example, there are substantial differences between the UK and Australia in terms of population density and dispersion and the effect of these on relative unit opex have not been considered in our study. Australia has a much larger land mass and a smaller population than the UK, albeit with large sections of uninhabited land where no homes are served, and overall Telstra may have lower average customer density where there is a fixed line network and hence potentially face a higher average line length resulting in higher opex.

Appendix A. Cost Comparison at Service Level

In this appendix, we summarise our results from comparing Telstra's unit opex for each service to BT's unit opex. The comparison does not control for differences in cost allocation between Telstra and BT, but it provides an indication of how the total opex comparison in section 5 is driven.

For the reasons given above it should not be used to draw conclusions about the relative efficiency of Telstra and BT.

The summary of the individual service-level comparisons is as follows:

- WLR: Telstra's opex per line is [redacted] than BT's, but this is likely to at least partly result from differences in cost allocation (see Section 2.3) and it may be that Telstra's average subscriber line length is greater than BT's and hence that its costs are higher;
- LLU: Telstra's opex per line for duct, copper cables and is [redacted] than BT's. Again this difference may at least partly result from differences in cost allocation;
- PSTN: Telstra's opex per millions of minutes is [redacted] than BT's. However, the adjustments made to Telstra's costs to align the service with BT's may not result in complete comparability. Also ,we do not know whether there are differences in the way that Telstra and BT allocate items such as duct shared between the access and core networks and network buildings; and
- WBA: Telstra's opex per line is [redacted] than BT's. The same points about cost allocation apply.

A.1. Wholesale Line Rental

A comparison of Telstra and BT's opex per line for WLR services in 2013/14 is shown below.

Source: NERA analysis of Telstra data and BT current cost financial statements

Figure A.1 shows that Telstra's overall unit opex was [redacted] than BT's in 2013/14.

For the reasons given in Section 3.2, at least part of this difference between Telstra and BT is accounted for by differences in the way that access network costs are allocated between services. This latter problem is avoided by the total opex approach adopted in the main body of the report.

A possible further explanation for the difference in Telstra and BT's opex per line in the case of WLR would be if Telstra's average subscriber line length is greater than BT's. Data confirming whether this is the case is not available to us and we have therefore not been able to control for it in our study. If Telstra average line length is greater than BT's, then, after adjusting costs to take account of this, Telstra unit opex would be reduced.

A.2. Local Loop Unbundling

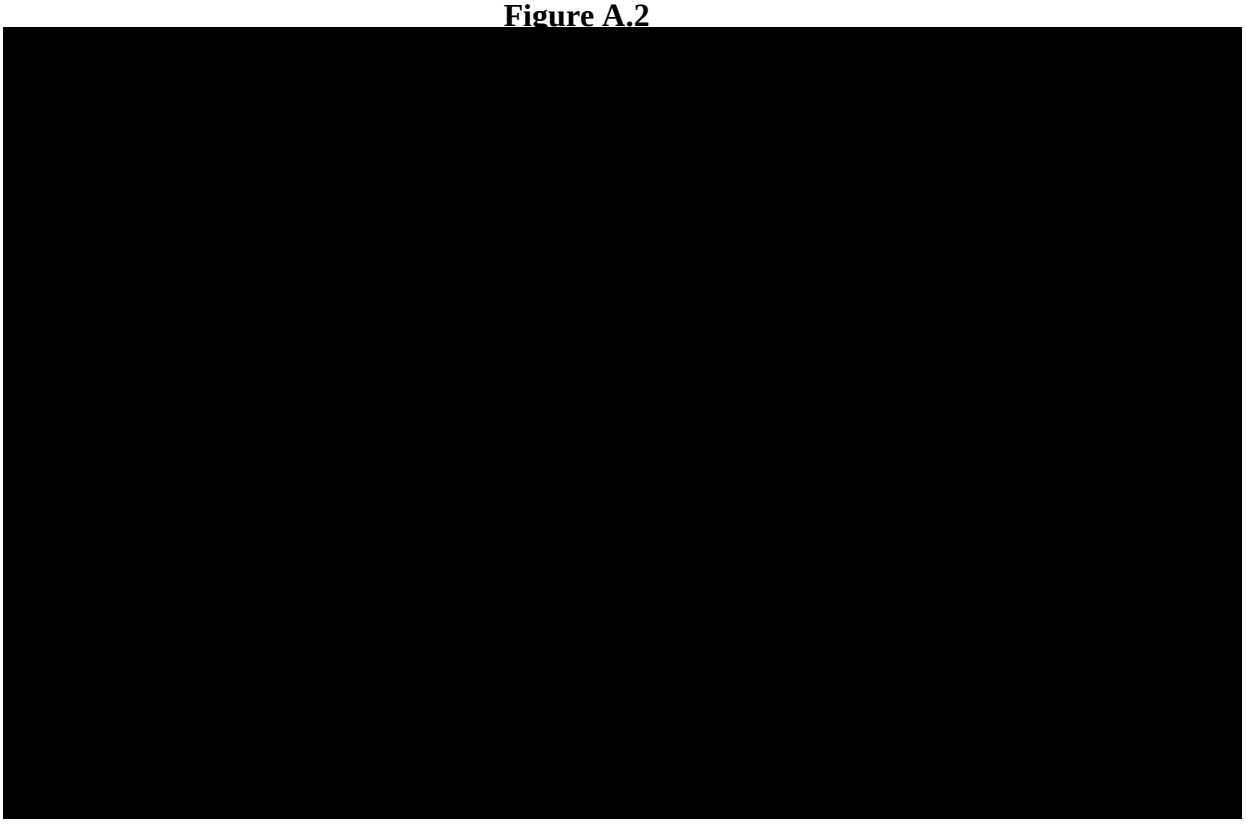
We also compared Telstra's unit opex for ULLB1-3 and BT's unit opex for LLU. We did not include Telstra's ULLB4 service because there is no comparable service in the UK. Also, as already mentioned, ULLB4 is very small and its omission should therefore not materially affect the results.

When we made this comparison we found that Telstra's unit opex was [redacted], while BT's was £55.75 per line. This difference is so large that it suggests that there may be comparability problems. Further examination indicates that this would appear to be the case. In Telstra's case, [redacted] of unit opex per line is accounted for by duct, copper cables and drop-wires, whereas for BT the equivalent figure is 76.2%. We have not been able to fully

explain this difference but it is clear that BT includes some cost categories that Telstra does not.[30] An example is broadband line testing equipment.

In order to try to mitigate the problem of non-comparability we repeated the unit opex comparison for duct, copper cable and drop-wire alone since opex for each of these is included by both Telstra and BT. Figure A.2 shows this comparison of LLU unit opex for duct, copper cable and drop-wire only.

Figure A.2



Source: NERA analysis of Telstra data and BT current cost financial statements

For the reasons given in Section 3.2, at least part of the difference between Telstra and BT is accounted for by differences in the way that access network costs are allocated between services.

This problem is avoided by the total opex approach adopted in the main body of the report.

A.3. PSTN

Figure A.3 compares Telstra's unit opex to BT's for PSTN services in 2013/14. In both cases "PSTN" refers to fixed call origination and termination at the local exchange level.

[30] This same problem is not apparent in the case of WLR. Here the share of duct, copper cables and drop-wire in total opex is broadly comparable for Telstra and BT.

Figure A.3

Source: NERA analysis of Telstra data and BT current cost financial statements

The results indicate that Telstra's opex per minute for 'PSTN' is [redacted] than BT's in the base year. As noted previously, Telstra has adjusted its PSTN opex to allow a more direct comparison with BT's costs. This adjustment takes into account the available information in BT's financial statements. However, the BT financial statements do not provide a comprehensive definition of all the assets used to supply the call origination and termination services and, therefore, Telstra's adjustment may have a substantial margin of error attached to it. In addition, there may be differences in the way that Telstra and BT allocated the cost of duct that is shared by the access and core networks and also the cost of network buildings. This latter problem is avoided by the total opex approach adopted in the main body of this report.

A.4. Wholesale ADSL

Figure A.4 compares Telstra's unit opex to BT's for WADSL services for 2013/14.

Figure A.4

Source: NERA analysis of Telstra data and BT current cost financial statements

Figure A.4 shows that Telstra's total unit opex is [redacted] than BT's in the base year. However, there may be differences in the way that Telstra and BT allocate the cost of duct that is shared by the access and core networks and also the cost of network buildings. Similarly there may be differences in the way that core network costs are allocated between PSTN and WADSL services. These problems are avoided by the total opex approach adopted in the main body of this report.

Appendix B. BT Service Cost Components

This appendix provides a list of the cost components that make up each of BT's services.

B.1. Wholesale Line Rental

Our analysis of BT's opex for WLR includes the following cost components:[31]

- E side copper capital (opex associated with exchange side infrastructure capital);
- E side copper current (opex associated with exchange side infrastructure maintenance);
- D side copper capital (opex associated distribution side infrastructure capital);
- D side copper current (opex associated with distribution side infrastructure maintenance);
- Local exchanges general frames (equipment where local loops terminate and cross connections to competing providers' equipment can be made);
- PSTN line test equipment (the costs of the functionality required to test lines provided to WLR providers);
- Drop wire capital and PSTN network terminating equipment (drop wire from the street to the customer premises);
- Residential PSTN drop maintenance (drop wire from the street to the customer premises);
- PSTN line cards (the electronic cards in the exchange that provide connectivity to the switch);
- Combi Card voice;
- Broadband line testing systems (the costs of the functionality required to test lines provided to WLR providers);
- Sales product management;
- Service centres – assurance;
- Directories; and
- Revenue debtors.

B.2. Local Loop Unbundling

For LLU, we have only included the copper cable, duct and drop wire related costs. Our analysis of BT's opex for LLU includes the following cost components:[32]

- E side copper capital (opex associated with exchange side infrastructure capital);
- E side copper current (opex associated with exchange side infrastructure maintenance);
- D side copper capital (opex associated with distribution side infrastructure capital);

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[31] BT Current Cost Financial Statements 2014 including Openreach Undertakings, section 7.2.2, p36.

[32] BT Current Cost Financial Statements 2014 including Openreach Undertakings, section 7.3.2, p40.

- D side copper current (opex associated with distribution side infrastructure maintenance);
- Drop wire capital and PSTN network terminating equipment (drop wire from the street to the customer premises); and
- Residential PSTN drop maintenance (drop wire from the street to the customer premises).

B.3. PSTN

BT does not provide a breakdown of the cost components for its call origination and fixed call termination services. Therefore, we have are unable to provide a list of the cost components for this service.

B.4. Wholesale ADSL

For the wholesale ADSL service, known as the Wholesale Broadband Access service in BT's accounts, the following cost components are included:[33]

- Combi Card Broadband Access
- 21CN Backhaul Link & Length
- Core/Metro (broadband)
- ADSL connections
- Broadband line testing systems
- ATM customer interfaces
- ATM network interface and switching
- Inter ATM transmissions
- Broadband backhaul circuits
- SG&A Broadband
- DSLAM capital/maintenance
- Edge Ethernet ports
- Core/Metro connectivity
- Revenue Debtors
- EOI Notional Creditors

[33] BT Current Cost Financial Statements 2014 including Openreach Undertakings, section 10.2.1, p105 and section 10.3.1, p111.

Appendix C. Curricula Vitae

C.1. Nigel Attenborough

Special Consultant

NERA Economic Consulting
15 Stratford Place
London W1C 1BE
E-mail: nigel.attenborough@nera.com
Website: www.nera.com

Overview

Nigel Attenborough has a BA in Economics from Cambridge University, an MSc in Energy Economics with Distinction from the University of Surrey and an MBA from Kingston Business School, where he won the BPP prize.

Nigel has undertaken and directed a wide range of projects for telecommunications companies, regulatory authorities and government departments in Europe, Africa, Asia, Australasia and South America. He has extensive experience of cost allocation, accounting separation, efficiency comparisons, benchmarking studies, licence valuations, demand forecasting and financial and price cap modelling, cost benefit analyses and economic impact studies. He has also been involved in the construction of many LRIC models of interconnection costs. In addition he has worked on a whole variety of other topics including market definition and the analysis of competition, the setting of price caps, tariff rebalancing, price discrimination, price squeezes, pricing strategy, the impact of liberalisation, regulation of NGNs, assessment of different regulatory regimes, development of regulatory strategy, universal service, number portability and allocation and spectrum management and allocation.

Nigel has also testified as an expert witness on: the valuation of BT for the purposes of setting business taxes; the setting of mobile termination rates in Australia; two cases involving the estimation of damages in relation to the delayed start up of and restricted access to submarine cables; the estimation of damages relating to breach of a telecommunications revenue sharing contract in Poland; the estimation of damages resulting from the loss of a mobile telecoms licence in a middle eastern country; and the existence of a price squeeze and the related damages in a case involving mobile phone operators in Belgium.

Prior to joining NERA in 1991, Nigel worked for 5 years at BT, latterly as the head of regulatory economics and competition policy. He provided directors and senior managers with advice and analyses on economic issues relating to regulation and pricing, and also managed teams responsible for policy development and analysis of fair trading and competition issues and for dealings with Oftel on matters relating to financial regulation. Earlier he was an economic adviser to the Department of trade and Industry and to the Monopolies and Mergers Commission.

Qualifications

1988-90	**KINGSTON BUSINESS SCHOOL** MBA: Winner of BPP prize
1980-83	**UNIVERSITY OF SURREY** MSc in Energy Economics: Pass with Distinction
1968-71	**TRINITY COLLEGE, CAMBRIDGE** B.A. Economics

Career Details

Time working in telecommunications industry: 28 years
Time working as telecommunications consultant: 23 years

	NERA ECONOMIC CONSULTING, LONDON
2012 – present	Affiliated Industry Expert
1997 - 2012	Director of NERA and Head of NERA's European Telecommunications Practice
1994	Associate Director
1991	Senior Consultant
1990	**BRITISH TELECOM** Manager, Economics and Fair Trading
1988	Manager, Pricing and Regulatory Analysis
1986	Economist/Senior Commercial Analyst
1981	**DTI** Economic Adviser
1978	**DUNLOP LTD** Corporate Planning Department (secondment)
1976	**MONOPOLIES AND MERGERS COMMISSION (secondment)** Senior Economic Assistant/Economic Adviser
1972	**DTI** Economic/Senior Economic Assistant
1971	**ARTHUR YOUNG** Articled Clerk

Project Experience

Expert witness

- Expert evidence in a case where Belgacom, the largest Belgian mobile operator, is being sued by the other operators for implementing a price squeeze and depriving them of customers. The case involves assessing whether there has been a price squeeze and, if so, what is the value of damages (2008 onwards);
- Expert reports on the nature, scope, scale and potential profitability of the UK grey market for mobile handsets (2010-12)
- Expert report on using international benchmarks for setting charges for duct access and sharing (2010);
- Expert report on the ACCC's bottom-up LRIC model (built by Analysys) of the cost of Telstra's local loop infrastructure with particular reference to the cost of providing unbundled local loops (2009);
- Expert report on Telstra's bottom-up LRIC model of the cost of its local loop infrastructure with particular reference to the cost of providing unbundled local loops (2008);
- Expert evidence in an Austrian arbitration case while involved estimation of damages resulting from breach of a revenue sharing contract relating to the Polish long distance telecommunications backbone network (2008-12);
- Expert evidence in a case involving the estimation of damages resulting from the loss of a mobile telecommunications licence in a Middle Eastern country (2007-8);
- Expert evidence in ICC arbitration case regarding the value of damages suffered by FLAG as a result of being prevented from accessing VSNL's submarine cable landing station in Mumbai (2006-7);
- Expert evidence in connection with AJC's claim for losses to be recovered from its insurance policy as a result of delay to launch of cable that resulted from accidental damage (2005-6);
- Expert evidence in connection with judicial review of the ACCC's decision regarding the appropriate mobile termination rate in Australia. Evidence covered how costs should be derived and prices set (2004-5);
- Expert evidence to the Lands Tribunal on behalf of Valuation Office Agency (UK) which, among other things, involved constructing a detailed future cash flow model for BT, as part of producing a rating valuation for BT (1999-2000);
- Appearance before Monopolies and Mergers Commission on behalf of T-Mobile (1998);
- Presentation of T-Mobile's case to Ofcom during an investigation into unfair cross subsidisation (1998);
- Expert evidence on damages caused by the failure of equipment used by an international reseller (1997).

Interconnection (for costing studies – see later section)

- Estimation of charges for third party access to cable TV company networks in Belgium based on retail minus approach (2013);
- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Assessment of interconnection cost benchmarking carried out by the NZ Commerce Commission on behalf of Vodafone NZ (2005/6);
- Review of fully allocated current cost mobile network cost model, used for estimating call termination charges, for an Italian operator (2005);
- Expert witness in judicial review of ACCC's decision on mobile termination charges (2004 and 2005);
- Report for UK mobile operator on impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Review of mobile network cost model, used for estimating call termination charges, for an Italian operator (2004);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Provided advice to the Chinese Academy of Sciences on bottom-up and top-down LRIC cost modelling for fixed and mobile networks (2003);
- Advice on the desirability and feasibility of multiple year price controls for interconnection services and interconnecting leased lines for OPTA, the Dutch regulator (2002);
- Advice on the feasibility and design of a local interconnection roll out policy for OPTA, the Dutch regulator (2002);
- Advice and support to OFTEL in connection with the UK Competition Commission inquiry into charges for calls to mobile phones (2002);
- Advised Telefonica Centroamerica (in Guatemala) in a conflict with the fixed operator about fixed and mobile termination rates. The main focus was the issues affecting the cost of termination on fixed and mobile networks and the implications (2002) for interconnection charges;
- Advice to the Malta Communications Authority on the development of a strategy relating to the implementation of cost based accounting systems in the telecommunications sector (fixed and mobile) (2001);
- Analysis of existing LRIC cost models in Germany, for Mannesmann (2000);
- Regular advice on interconnection charges and cost accounting systems, for a variety of entrants in the UK, including CWC, Scottish Telecom, Worldcom, AT&T and Energis (1991-2001);
- Advice to One2One (now T-Mobile UK) in connection with the MMC inquiry into the price of calls to mobile phones (1998);

- Advice to Esat Digifone on the costs of interconnection, including benchmarking the price of terminating fixed calls on mobile networks and vice versa (1998);
- Advice to Telefonica on how its interconnection costs might be expected to differ from those specified in the benchmarks issued by the European Commission (1998);
- Advice to TeleDanmark on how its interconnection costs might be expected to differ from those of BT (1998);
- Study of the implications of a possible new interconnection charging regime for a regional UK operator (1998);
- Analysis, for Portugal Telecom, of the structure and level of interconnection charges, and the method by which they are set, in 14 European and non-European countries (1996);
- Study of the economic impact of a change in the UK system for determining international interconnection charges, for a new UK operator (1995);
- Advice to a major Asian telecommunications operator on number portability, interconnection and access deficit charges and universal service issues (1995);
- An assessment for Telecom Eireann of different interconnection charging options (1993);
- Helping a new UK operator to negotiate its terms and conditions of interconnection (1992).

Costing studies

- Development of a business case model to estimate market rollout of FttH services in the Netherlands, for ACM, the Dutch regulatory (2014);
- Assistance to a telecoms operator over a dispute over BT's regulated charges for interconnect extension circuits (2013);
- Development of a next generation fixed access network LRIC cost model for Italy, for AGCOM, the Italian regulator (2012-2013);
- Construction of a fixed IP network LRIC cost model for setting interconnection charges in Italy, for AGCOM, the Italian regulator (2012);
- Advice on implementation of accounting separation for telecoms operators in Malaysia for the regulator, SKMM (2012);
- Assistance to a mobile operator in Portugal in responding to Anacom's consultation document on the methodology proposed by Analysys for building a pure LRIC model of MTRs (2011);
- Study for IDA, the Singapore regulator, on the appropriate approach to recovery of copper local loop costs in the face of the roll out of a new fibre based network (2011);
- Construction of a BULRIC broadband access model for an Italian operator (2010);
- Construction of mobile operator LRIC models for MOC, the Israel regulator (2009 - 10);
- Review and assessment of the ACCC's bottom-up LRIC cost model (built by Analysys) for unbundled local loop services (2009);
- Review and assessment of Telstra's bottom-up LRIC cost model for unbundled local loop services (2008);

- Assessment of BT Openreach's relative efficiency using econometric techniques for Ofcom (2007);
- Construction of LRIC cost model for mobile operator in Pakistan. Results of modelling are to form part of submission to regulatory authority (2007);
- Review and critique of the regulatory authority's mobile LRIC model for Netcom, the Norwegian mobile operator (2006 and 2007);
- Development of methodology for top-down LRIC model for an Italian mobile operator and advice on its implementation (2006 and 2007);
- Development of bottom-up mobile network LRIC model for CMT, the Spanish regulator (2006);
- Construction of bottom-up fixed network and mobile network LRIC models for the Oman telecommunications regulator (2006);
- Development of bottom-up LRIC model for an Italian fixed network operator (2005/6);
- Construction of bottom-up fixed network and mobile network LRIC models for the Malaysian communications regulator, MCMC (2005);
- Review of mobile bottom-up LRIC model built for the Romanian telecommunications regulator, on behalf of Orange Romania (2005/6);
- Comparative efficiency assessment of KPN, for the Dutch regulator, OPTA (2005)
- Review of a fully allocated cost model developed by a Israeli mobile operator to estimate its costs of different types of mobile call (including interconnection traffic) and development of top-down LRIC model to estimate mobile termination costs (2004);
- Comparative efficiency assessment of BT's fixed network services, for Ofcom (2004);
- For Korea Telecom, development of bottom-up LRIC model of its access network in a representative sample of areas in order to measure universal service costs (2004);
- Advice to the Chinese Academy of Science on how to construct top down and bottom up LRIC models of the costs of terminating calls on fixed and mobile networks (2003);
- Assessment of the efficiency of NTT West and NTT East for MPHPT, the Japanese Ministry of Communications, (2003);
- Support and assistance to a major European communications operator in its development of a top-down LRIC access cost model (2003);
- For KTF, the Korean mobile operator, the construction of a large LRIC interconnection model for 2G and 3G services (2002);
- Updates of the bottom-up LRIC model of KPN's network costs for OPTA, the Dutch telecoms regulator (2002 and 2003);
- Assessment of comparative cost efficiency for a large European telecommunications operator (2002);
- Assessment and advice on redevelopment of a cost allocation model for a major European cable TV operator (2002);
- Developing a model of the impact of a cost based wholesale access product in the UK for Centrica Telecommunications (2002);

- Validation of costs underlying Eircom's reference interconnection offer for ODTR, the Irish telecoms regulator (2001);
- Construction of bottom-up LRIC models for fixed and mobile networks for CMC, the Communications Commission in Malaysia (2001);
- Construction of a new bottom-up LRIC model of KPN's network, for OPTA, the Dutch regulatory authority (2001);
- Advice to the Irish regulator (ODTR) on the reconciliation of the results of bottom-up and top-down models for the incumbent's costs (2001);
- Construction of unbundled local loop cost model of Deutsche Telekom, for Mannesmann (2000);
- Review of Telecom Italia's estimate of its unbundled local loop charges and its access deficit, for the Italian Telecommunications Authority (2000);
- Advice to the Italian Telecommunications Authority on the definition of an accounting system based on current costs (2000);
- Construction of a bottom-up LRIC model of Eircom's network, for ODTR, the Irish regulatory authority (2000);
- Construction of a bottom-up LRIC model of Swisscom's network, for Bakom, the Swiss regulatory authority (1999);
- Estimate of the costs of different elements of Eircell's GSM network, for Esat Digifone, the Irish mobile telephone operator (1999);
- Interconnection cost study, involving the construction of a bottom-up LRIC model, the review of a top-down embedded direct cost model and the reconciliation of the results, for OPTA, the Dutch regulator (1998 and 1999);
- Estimation, using a hybrid bottom-up and top-down methodology, of LRIC for network and retail services, for Singapore Telecom (1997);
- Construction of a bottom-up model of Telstra's call conveyance and access networks, for the Australian Competition and Consumer Commission (1998 and 1999);
- Estimation of LRIC of France Telecom's conveyance and access networks, for a group of new entrants in France (1998);
- Advice on bottom-up modelling of interconnection costs for NTT in Japan (1999);
- Estimation of the fully allocated, historic costs of terminating calls on Vodafone and Cellnet's mobile networks, for a UK new entrant fixed network operator (1996);
- For O.tel.O, estimation of LRIC for Deutsche Telecom's network Services using a bottom-up model (1997);
- Advice to OFTEL on the methodology and development of bottom-up and top-down models of BT's access and call conveyance network, and reconciliation of the results of the two different approaches (1996 and 1997);
- Estimation of the costs of interconnection and individual services for a regional UK operator and advice on accounting separation and cost allocation (1994);

- Estimating individual service costs for Telefónica in Spain and for the Ministry of Economics in Argentina (1995);
- Modelling the costs of two UK new entrants (1995 and 1996);
- Modelling interconnection and universal service obligation costs for a major European operator (1995);
- Defining and estimating long run incremental costs in the UK (for retail services and for interconnection) using top-down and bottom-up methodologies for Oftel, the UK regulator (1992);
- Modelling the costs of different means of accessing telephone customers, for a UK operator (1995);
- Study of the costs of different mobile telecommunications networks for an Australian operator and, more recently, for a UK operator (1993);
- Study, for a major UK utility, of the costs of outsourcing its telecommunications requirements (1994).

Pricing

- Advice to Vimpelcom on the setting of mobile termination rates in Kazakhstan (2012);
- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Advice and analysis for Vodafone in Germany on the setting of mobile termination rates and the underlying costs (2006);
- Support for UPC in justifying its analogue cable TV tariffs to the Dutch Competition Authority (NMa) (2005);
- Development of interconnection price benchmarking system which takes operator and country differences into account for two German mobile operators (2005);
- Development of financial model for setting price cap for SingTel fixed network services, for IDA, the Singapore regulator (2004);
- Assistance to UPC in the construction of a cost model and the use of its output to justify its prices for analogue cable TV services (2003 and 2004);
- Construction of detailed financial models of NTT West and NTT East for the purpose of setting price caps for switched services and leased lines for MPHPT, the Japanese Ministry of Communications (2003);
- Examination of the possible extent of local tariff rebalancing and its implications, for MCMC the Malaysian regulatory authority (2002);
- Advice on the desirability and feasibility of multiple year price controls for interconnection services for OPTA, the Dutch regulator (2002);
- Market analysis, efficiency assessment, construction of a financial model and economic advice to ODTR, the Irish regulator, as part of the setting of a new retail price cap (2002);
- Advice to a European regulator on the development of pricing structures for voice and Internet traffic, and the impact of pricing on competition (2001);

- Construction of a model and forecasts of the revenue, cost and capital expenditure of KPN to estimate the appropriate value of X in the price cap formula for retail telephone service prices, for OPTA, the Dutch telephone regulator (1999);
- Construction of a UK mobile price index for OFTEL, the UK telecommunications operator (1999);
- Advice to Telecom Italia about the acceptability and justification of volume discounts (1999);
- Advice on feasible tariff rebalancing and price controls in Botswana for the Telecommunications Authority (1999);
- Examination of the impact of liberalisation of international telecommunications services in the Bahamas and the extent of rebalancing required to maintain the viability of Batelco, as part of a pre-privatisation study for the Government of the Bahamas (1998);
- Advice on the impact and effectiveness of price regulation in the UK and US, for NTT in Japan (1997);
- Advice on pricing strategy to Orange (1997);
- Analysis of telephone tariffs in Argentina and recommendations regarding future rebalancing options to Ministry of Economics (1995);
- The development of a pricing strategy model for CWC (1994);
- Development of business planning models for several new UK operators (1994-1997);
- Advice to NTL on a wide range of regulatory issues including its price cap review (1991-1996);
- At various times, advice, analysis and modelling work relating to the review of BT's price cap, for Mercury, the cable TV operators and a number of regional new entrants (1992 and 1996);
- Analysis for and advice to Telefonica on the arguments for and benefits of tariff rebalancing (1993);
- Study of the economic impact (including economic efficiency and welfare implications) of a tariff rebalancing programme by Telecom Eireann (1993);
- Assessment of the possible existence of predatory pricing and cross-subsidisation in the leased lines market, for a UK new entrant (1991);
- Assessment of transfer pricing issues and pricing policy for Royal Mail (1991).

Regulation

- Estimation of charges for third party access to cable TV company networks in Belgium based on retail minus approach (2013);
- Specification of an accounting separation system for telecommunications companies in Malaysia, for the Malaysian regulator (2012);
- Advice and analysis for 3 in Ireland on the case for indefinite mobile spectrum licences (2011);

- Advice to NetVision in Israel on the appropriate form of regulation of wholesale access products including wholesale broadband access and how regulated prices should be set (2011);
- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Assistance to Belgacom Mobile in abuse of dominance case brought by the Belgian competition authority (2008);
- Development of new licensing regime in UAE, for the Telecommunications Regulatory Authority (2007);
- Assessment of the case for licensing MVNOs in Israel and the need for mandated access terms if such licensing occurred, for the Minstry of Communications (2007);
- Advice and analysis for a Norwegian mobile operator on the basis for setting mobile termination charges and support to them in their negotiations with the Norwegian regulatory authority (2006 and 2007);
- Study for Vodafone on the rationale for and development of a model (using econometric estimates of price elasticities) to estimate the value of a network externality surcharge on interconnection charges in African countries (2006 and 2007)
- Advice to Wind in Italy on a variety of regulatory issues including bundling, issues raised by next generation networks, fixed and mobile interconnection charges, cost modelling and accounting separation (2006 and 2007);
- Advice to T-Mobile in Hungary on the development of MVNOs in Europe, the factors leading to success or failure, when regulation is necessary, the circumstances under which access terms should be mandated and the current circumstances in Hungary and their implications for MVNO development (2006);
- Report setting out the arguments relating to deregulation of broadband services and estimation of the potential benefits from doing so in four European countries using detailed input-output analysis, for a major European operator (2005/6);
- Report for UK mobile operator on the impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Advice and analysis for BT in assessing Ofcom's proposals for a modified price squeeze test for broadband services (2004);
- Market definition and assessment of competition in all the main communications markets in Malaysia for MCMC, the Malaysian regulatory authority (2004);
- Various studies for Ofcom, the UK regulator, including:
  - construction of model of BT's OSIS costs (2006);
  - identification of possible new uses for certain parts of the radio spectrum and assessment of the respective costs and benefits, in consortium with Red-M, Cardiff University, Roke Manor and BAE (2005/6);

  - estimation of the costs and benefits of allocating particular parts of the radio spectrum to different uses (2004);
  - assessment of the comparative efficiency of BT's network business (2004);
  - assessment of the comparative efficiency of Kingston Communications (2003);
  - construction of a model for assessing the potential profitability of firms renting exchange lines from BT (2003);
  - assessment of the profitability and efficiency of the UK mobile operators (2001);
  - assessment of the efficiency of BT (2000);
  - cost-benefit analyses of the introduction of number portability and equal access into the UK (1993 and 1995);
  - an analysis of BT's incremental costs and, more recently, a separate series of studies looking at existing models for measuring incremental costs of access and call conveyance and how their results can be reconciled (1992, 1996 and 1997);
  - evaluation of telecommunications provision in Wales and its impact on economic development (1992);
  - analysis of the UK and North American markets for resale (1994);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Advice to the Rwanda government on various aspects of the liberalisation of Rwandatel (2003);
- Study for the World Bank of the comparative effectiveness of regulation in different African countries and the implications for future policy (2003);
- Advice and recommendations to CMC in Malaysia on the scale and possible methods of funding the losses made on line and local call services (2002);
- Advice to ComReg, the Irish regulator, on market definition and assessment of dominance in the context of determining which retail services should be subject to price cap regulation (2002);
- Development of a performance contract with the incumbent operator to address the unmet demand and extend the network for the Egyptian Telecommunications Authority (2000);
- Estimation of Telefonica's universal service obligation costs (2000);
- Advice and recommendations to MCMC in Malaysia on the provision of universal service and the measurement and funding of the costs involved (2000);
- Review of Telecom Italia's estimate of its universal service obligation costs, for the Italian Telecommunications Authority (1999, 2000 and 2001);
- Advice on radio spectrum policy in France for the Ministry of Industry (1999);
- Arguments for and against the introduction of mobile number portability and carrier selection and their application in 8 European countries, for Vodafone Airtouch (1999);

- Advice on the regulatory framework and priorities that should apply given the privatisation of the Bahamas Telecommunications Corporation (1998);
- Assistance to Botswana Telecommunications Authority in the development of a performance contract with BTC, and development of regulatory principles and guidelines for telecommunications prices (1998); A cost-benefit analysis of the introduction of mobile network number portability in Hong Kong, for OFTA (1998);
- Advice to Botswana Telecommunications Authority on the development of a strategy to enable it to meet its mandate (mission statement, organisational structure, staff qualifications, outsourcing needs, funding strategy) (1998-99);
- For DG XIII of the European Commission, study of the regulatory and legal issues associated with the creation of a regulatory authority at the level of the European Union (1997);
- Advice on development of costing system and price setting for OSIPTEL, the Peruvian regulatory authority (1996 and 1997);
- For DG XIII of the European Commission, study examining the implementation and impact of the Open Network Provision (ONP) in Member States (1996);
- Advice and recommendations to the Argentine Ministry of Economics on institutional restructuring of telecommunications regulation (1995);
- A study of the implications of EU telecommunications regulation for a major broadcasting company (1995);
- For a French mobile telecommunications operator, a comparative study of the regulation of fixed wireless local loop services in different countries (1996);
- Advice and analysis for CWC in formulating its strategy in the face of different possible future regulatory scenarios (1998);
- Advice on who should pay what for the costs of number portability, for Oftel in the UK and Optus in Australia (1996).

Liberalisation

- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Assessment of the interconnection and retail service costs and access deficit of Batelco, the Bahamas telephone company, and their implications, as part of the preparation for future privatisation and liberalisation (2003);
- Advice to the Algerian Ministry of Telecommunications on the introduction of competition in the mobile market via the award of a second GSM licence (2001);
- Analysis of the development of competition in the mobile market and the implications for regulation for the Greek regulatory authority (2000); For Vodafone Airtouch, an assessment of the state of mobile telephone competition in 8 European countries (1999);
- Analysis of the Greek mobile telecommunications market, including analysis of the state of competition and the development of a model to facilitate international mobile tariff comparisons, for EETT, the Greek telecommunications regulator (1999);

- Advice and analysis relating to feasible liberalisation options given the privatisation of the Bahamas Telecommunications Corporation (1998);
- Development of a framework for assessing whether a market is competitive, for regulatory purposes, for a group of new entrants in the UK (1996);
- Modelling the impact of various EU liberalisation measures on Portugal Telecom and examining the effectiveness of a number of alternative strategic responses (1996);
- Advice to Energis on its response to the DTI's consultative document on the liberalisation of UK international telecommunications services (1996);
- Forecasting the development of the UK telecommunications market and the share of different operators for a group of new UK operators (1995);
- Analysing and modelling the potential impact of liberalisation, and the sustainability of existing tariff structures in a competitive environment for Telefónica de España (1993).

Mobile telecommunications (for costing studies – see above)

- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Development of demand models for mobile communications in South Africa and their application to assess the size of network externalities (2006/7);
- Estimation of price elasticities of mobile services for a group of European mobile operators (2005);
- Report for UK mobile operator on impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Construction of a LRIC interconnection model for use in Korea to determine the costs to be charged by KTF for the mobile market (2002);
- Advice to KTF on strategic issues (2002);
- In a consortium with BNP Paribas, NERA was selected to advise the Algerian Ministry of Communications on the allocation of a 2G license in Algeria. NERA also provided advice on the valuation of the spectrum (2001);
- Advice as part of a 'due diligence' exercise for PwC India (2001) on behalf of ICICI, who needed to evaluate the potential for funding SCL's (the cellular mobile telephone services provider) expansion and refinancing plans;
- Advice to Ben, a Dutch mobile operator, on the level of call mobile termination charges (2001);
- Construction of bottom-up LRIC models for GSM 900 and GSM 1800 mobile networks for CMC, the Communications Commission in Malaysia (2001);
- Assessment of the economic impact of the UK mobile market for the MTAG (mobile telecommunications advisory group) (2000);

- Analysis and advice to a European operator on the introduction of mobile communications in a subterranean rail network (2000);
- Advice to the Italian Ministry of Communications on the procedures and design of the 3G auction (2000);
- For Vodafone Airtouch, an assessment of the state of mobile telephone competition in 8 European countries (1999);
- Construction of a UK mobile price index, for OFTEL, the UK telecommunications regulator (1999);
- Arguments for and against the introduction of mobile number portability and carrier selection and their application in 8 European countries, for Vodafone Airtouch (1999);
- Analysis of the Greek mobile telecommunications market, including analysis of the state of competition and the development of a model to facilitate international mobile tariff comparisons, for EETT, the Greek telecommunications regulator (1999);
- Advice to One 2 One in connection with the MMC inquiry into the price of calls to mobile phones (1998);
- Advice to Esat Digifone on the costs of interconnection, including international benchmarking of the price of terminating fixed calls on mobile networks and vice versa (1998);
- A cost-benefit analysis of the introduction of mobile network number portability in Hong Kong, for OFTA, the telecommunications regulatory authority (1998);
- Advice on pricing strategy to Orange (1997);
- Estimation of the fully allocated, historic costs of terminating calls on Vodafone and Cellnet's mobile networks, for a UK new entrant fixed network operator (1996);
- Study of the costs of different mobile telecommunications networks for an Australian operator (1993).

Licence applications

- Construction of valuation model (using DCF model of detailed revenue and cost projections based on network roll out plan) for 2nd mobile licence in Algeria for the Algerian Ministry of Communications (2001);
- Development of UPC's business plan in support of its participation in the auction for LMDS licences in Switzerland (2000).
- Advice and inputs into the business and investment plans of Bouygues Telecom, and estimate of the impact on employment and GDP, when it bid for and won the third GSM licence in France (1994);
- Advice and inputs into the business and investment plans of Airtel, and estimate of the impact on employment and GDP, when it bid for and won the second GSM licence in Spain (1995).

Other projects relating to business plans and forecasting

- Examination of the impact of the development of next generation access networks on BT's value for rating purposes, for VOA (2011)
- Forecasting BT's future cash flows for the purposes of determining BT's value for rating purposes, for VOA (2008-9)
- Expert evidence in a case involving the estimation of damages resulting from the loss of a mobile telecommunications licence (2007-8);
- Advice and analysis for VOA in connection with the state aid investigation mounted by the European Commission in connection with the way that the rating assessment of BT had been carried out (2006);
- Expert witness for insurance company regarding assessment of damages relating to delay in completion of trans-oceanic submarine cable (2004);
- Construction of a model and forecasts of the revenue, cost and capital expenditure of KPN to estimate the appropriate value of X in the price cap formula for retail telephone service prices, for OPTA, the Dutch telephone regulator (1999);
- Estimation of employment effects for TIW in respect of its bids for mobile telecommunications licences in Romania, Hungary and the Czech Republic (1997 and 1999);
- Expert assessment of a damages claim relating to the losses incurred by a telecommunications reseller as a result of the failure of its switching equipment (1997);
- Estimation of the impact on employment of liberalising postal services in the UK and France, for UPS (1996).
- Modelling the impact of various EU liberalisation measures on Portugal Telecom and examining the effectiveness of a number of alternative strategic responses (1996);
- Forecasting the development of the UK telecommunications market and the share of different operators for a group of new UK operators (1995); Designing an investment appraisal system for Slovak Telecom and SPT Prague (1995);
- Assistance to Torch Telecommunications in constructing its business plan (1994);

- Estimation of employment effects and advice and analysis in respect of business and investment plans and for the consortia which won the PCN licence in France and the second GSM licence in Spain (1994 and 1995);
- Analysing and modelling the potential impact of liberalisation, and the sustainability of existing tariff structures in a competitive environment for Telefónica de España (1993).

Publications

"Money, Oil and the Sterling Roller-Coaster: An Examination of the Causes of Recent Exchange Rate Changes", MSc Dissertation, *University of Survey*, 1983.

"Employment and Technical Change: The Case of Microelectronic-Based Production Technologies in UK Manufacturing Industry", *Government Economic Service Working Paper* No.74, Department of Trade and Industry, London, 1984.

"Government Regulation and the Development of Public Terrestrial Mobile Communications", MBA Dissertation, *Kingston Business School*, May 1990.

"Economic Effects of Telephone Price Changes in the UK", with Robin Foster and Jonathan Sandbach, *NERA Topics No. 8*, London, September 1992.

"Regulation of Competitive Telecommunications Markets", *NERA Topics No 12*, London, September 1993.

"Pricing and the Development of Competition in UK Telecommunications", published by *Datapro International*, April 1994.

"Measurement and Funding of USO Costs: Some Brief Concluding Thoughts" in "USO in a Competitive Telecoms Environment", *Analysys Publications*, February 1995.

"Are Three to Two Mergers in a Market with Entry Barriers Necessarily Problematic?" with Fernando Jimenez and Gregory Leonard, *European Competition Law Review*, October 2007.

"Regulating Next Generation Access Networks in Europe", Regulatory and Economic Policy in Telecommunications, No. 7, November 2011

Presentations

"Privatisation and Competition: The Impact on BT", paper Presented to *CPC Conference*, Amersham, May 1991.

"What do Users want from the Regulators", Paper presented *to Networked Economy Conference*, Paris, March 1992.

"Local Loop Competition: The Key Regulatory Issues", paper presented *to 5th Economist Telecommunications Conference*, Vienna, September 1993.

"Pricing and the Development of Competition in UK Telecommunications", paper presented to *AIC Conference on Regulation and Infrastructure*, London, December 1993.

"How should Interconnection Charges be Set?", paper presented to *IIR Conference on Negotiating Interconnection Agreements*, London, April 1994, and also October 1994.

"Regulation and the Development of Competitive City Telecommunications", *AIC Conference on City Telecoms Networks*, London, October 1994.

"Measurement and Funding of USO Costs: Some Brief Concluding Thoughts", paper presented to a *Symposium on USO in a Competitive Telecoms Environment*, Magdalene College, Cambridge, December 1994.

"Telecommunications Liberalisation in the UK", paper presented to *IBC Conference on Competition in Asia's Telecom Markets*, Hong Kong, June 1995.

"Economic and Accounting Issues Relating to Interconnection Charges", paper presented to *IBC Interconnection Conference*, London, September 1995.

"Analysis of Proposed EC Interconnection Directive", paper presented *to IIR Cable Telephony Conference*, London, January 1996.

"Using Incremental Costs for Interconnection Charging" paper presented to IIR Interconnection '96 Conference, London, January 1996.

"Funding of Universal Service and Local Access Costs in the UK", *Vision in Business Conference on Costing and Accounting of Interconnection*, London, January 1996.

"Establishing a Regulatory Regime that Promotes Fair Competition", *IIR Conference on Telecoms Regulation*, London, April 1996.

"Liberalisation and Competition in International Services", *AIC Conference on International Telecoms Pricing and Facilities*, London, October 1996.

"Interconnection Charges: Where have we Come from and Where are we Going?", SMi *Conference on Practical Strategies for the Negotiation of UK and European Interconnection Charges*, London, October 1996.

"Economic Aspects of Interconnection Agreements", *AIC Seminar on Interconnection Agreements*, Frankfurt, October 1996.

"Employment Impact of Postal Services Liberalisation", *Satisfying Consumer Needs in the Global Village: The Postal Challenge*, Global Panel, The Hague, December 1996.

"Setting Interconnection Charges: An Evaluation of the Alternatives", *IIR Interconnection '97 Conference,* London, February 1997.

"Impact of Regulation on Profitability of Telecommunications Investments: The Case of Cable Television Networks", *Aspectos Juridicos de Las Telecomunicaciones*, Instituto de Fomento Empresarial, Madrid, March 1997.

"Long-run Incremental Cost and its Use for Setting Interconnection Charges", *Vision in Business Workshop*, Brussels, March 1997.

"Measurement of Universal Service Costs in Telecommunications", *Centre for Asia Telecoms Conference on Cost Allocation in Telecoms,* Singapore, April 1997.

"Current developments in Interconnection charging" *SMi Conference on Practical Strategies for the Negotiation of UK and European Interconnection Charges,* London, April 1997.

"How Should Interconnection Costs be Measured? *Vision in Business 4th International Interconnect Forum,* Brussels, September 1997.

"The Structure of Reform in Telecommunications Interconnection across Europe", *SMi Conference on UK and European Interconnection Charges,* Brussels, November 1997.

"International Interconnection Rates and Costs", *IBC 1997 International Forum on Interconnection,* Amsterdam, November 1997.

"Evaluation of Different Methods of Determining Costs and Setting Interconnection Charges", *IIR Interconnection Conference,* London, January 1998.

"Measurement of Interconnection Costs and Setting Interconnection Charges", *Institute of Telecommunications,* Warsaw, June 1998.

"Why Use Long-Run Incremental Costs?", *IIR Conference on Allocating Costs in the Telecommunications Industry*, London, July 1998.

"Regulation and Number Portability", *IIR Conference on Developing Effective Regulatory Strategies for Telecommunications Operators*, London, October 1998.

"Using Conjoint Analysis to Forecast Demand and Determine Telecommunications Pricing structures", *IIR Conference on Market Forecasting for Telecommunications Operators*, London, November 1998.

Issues Arising from the MMC Inquiry into Charges for Calls to Mobile Telephones in the UK", *European Mobile Telecommunications Regulation and Competition Law Conference*, Brussels, March 1999.

"Regulation of Number Portability and Carrier Pre-Selection", *IIR Interconnection '99 Conference*, London, March 1999.

"Bottom-Up LRIC Modelling: What Does it Involve and How Can it be Used", *Vision in Business Conference on LRIC and Cost Allocation for Interconnection Pricing*, Brussels, April 1999.

"Number Portability: Challenges and Solutions", *IIR Conference on Technical and Commercial Strategies for Telecoms Operators,* London September 1999.

"Control of Mobile Interconnection Prices", *European Mobile and UMTS Regulation and Competition Law Conference,* Paris, April 2000.

"How Regulatory Considerations Affect Business Plans", *Vision in Business Valuation and Bidding Strategies Workshop*, Paris, April 2000.

"Regulating Wholesale Services: The European Experience", *London Business School Conference on Regulating Wholesale Services Prices,* London, April 2001.

"Competing in a Regulated Telecommunications Environment", *Infocom 2001*, Budapest, May 2001.

"Regulation of Dynamic Industries", *BT Conference on "The New World Order in Regulation",* London, September 2001.

"Cost Allocation and Recovery for New Services", *IIR Conference on Cost Control and Profitability in Telecoms,* London, October 2001.

"Applying LRIC to Fixed to Mobile Interconnection", *Vision in Business Conference on Network Cost Reduction in Telecoms,* London, November 2001.

"Applying LRIC to Fixed to Mobile Interconnection", *Vision in Business Conference on Network Cost Reduction in Telecoms,* London, April 2002.

"Cost Based Pricing for Mobile Termination", Vision in Business Conference on Mobile Regulation and Competition Law, Brussels, July 2003.

"Implications of Broadband Deregulation for GDP and Employment in Europe: Some Case Studies Using Input-Output Analysis", London Business School Regulatory Seminar, June 2006.

C.2. Arjun Dasgupta

Research Officer

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Overview

Arjun Dasgupta is a Research Officer in NERA's Energy, Environment and Networks Group based in London, with a focus on the telecoms, regulatory finance and energy sectors.

Arjun has recently worked on a number of telecommunications projects, including the estimation of market rollout of Fibre-to-the-Home services by new entrants in the Netherlands. He has developed a LRIC cost model for a Next Generation Access network in Italy, based on a bottom-up analysis of costs and demand for NGA services. He has recently completed a project on the suitability of different cost methodologies for setting the regulated prices of interconnect circuits.

Arjun has also been involved with cost of capital estimation in the telecommunications, water, electricity and gas industries. This includes analysis of financial models such as CAPM, market to asset ratios as well as debt market analysis.

Qualifications

2012 **UNIVERSITY OF CAMBRIDGE**
Bachelor of Arts, Economics (BA Honours)

Prizes and Scholarships

Geoff Harcourt Prize for Economics 2009

Career Details

09/2012 - present **NERA Economic Consulting**
Research Officer, London

06/2011 – 09/2011 **Goldman Sachs**
Summer Analyst, London

07/2010 – 08/2010 **Social Market Foundation**
Research Analyst, London

08/2008 – 08/2009 **Bank of England**
Foreign Exchange Analyst, London

Project Experience

Telecommunications

- For VOA, a review of the valuation model used to determine BT's rateable value for the purposes of setting business rates. (2015)
- For ACM, estimation of the market rollout of FttH services in the Netherlands. Modelling the probability of entry by alternative market entrants at the regional level, and analysis of the market change in take-up from broadband over copper and cable networks to fibre. (2014)
- For a confidential client, assistance with an expert report on the fair market value of a telecommunications company in Belize. Implementation of a discounted cash flow model using the company business plan and rebuttal of opposing side's valuation methodology. (2013-ongoing)
- For Gamma Telecom, assistance with a dispute about BT's historic charges for Interconnect Extension Circuits. Review of the suitability of Distributed Standalone Cost and Fully Allocated Cost methodologies for the service. (2013)
- For AGCOM, assistance with design and development of an NGAN LRIC model to determine costs of providing wholesale access services in an NGA network. Bottom-up analysis of the market covered by broadband services in Italy and an estimation of the incremental cost of delivering these services using the required network assets. (2013)
- For Belgacom, estimation of the access cost to the analogue TV network in Belgium. Review of regulatory evidence in European countries and implementation of the retail minus methodology. Analysis of market shares of incumbents and access seekers in each network region in Belgium. (2012)
- For VOA, review of valuation model assumptions including the evolution of metallic path facility (MPF) lines in the UK. Model sensitivity analysis under different assumptions on the evolution of broadband take-up and growth in MPF lines. (2012-13)
- For Kartel, assistance with design of benchmarking model to determine appropriate estimate of mobile termination rates. Review of benchmarked countries and assumptions underlying the choice of these countries. Analysis of effect of lowering mobile termination rates on retail prices, penetration levels and quality of service, known as the 'waterbed effect'. (2012)
- For SKMM, analysis of operator responses to a public inquiry report on the implementation of accounting separation in media and communications. (2012)
- For ARCEP, analysis of relationship between mobile revenues and asset betas to determine risk premium for mobile operators. Estimation and analysis of asset betas for fixed line and mobile telecommunications operators. (2012)

Water

- For Anglian Water, estimation of cost of capital in view of the regulator's price control review. Analysis of estimates under various regulatory risk scenarios, including the separation of retail and wholesale activities. (2013)

- For an Australian investor consortium, update of a water company valuation to account for new debt issuances and capital expenditure plans. Review of model debt items including swap arrangements. (2013)
- For United Utilities, estimation of cost of capital in view of the regulator's price control review. Analysis of estimates under various regulatory risk scenarios, including the separation of retail and wholesale activities. Estimation of a company-specific cost of capital in view of the risk of the regulator adopting a company-specific approach. (2013)
- For Water UK, analysis of alternatives methodologies to estimate the cost of equity. Estimation and review of market to asset ratios, market transaction values and cost of debt as a link to the cost of equity. (2012-13)

Energy

- For a confidential client, a review of the ratings agency methodology for setting the rating for government related entities. Assessment of the risk of downgrade as part of a sector reorganisation in a Middle East country. (2014)
- For Scottish Power, produced a report on the implication of a UK Competition Commission determination on the methodology for setting the cost of equity. Responded to Ofgem questions on the risk to financeability and robustness of total market return methodology. (2014)
- For a Northern Irish Gas Company, estimation of cost of capital for future price controls as part of a due diligence process. Analysis of relative risk compared to GB comparators and review of potential financeability tests. (2013)
- For Western Power Distribution, design and simulation of risk scenarios in a financial model in response to UK regulator's review of electricity distribution price control. (2013)
- For Iberdrola, audit and simulation of risk scenarios in a financial model in response to UK regulator's review of the price control. (2013)
- For SPPA & PowerGas, estimation of cost of capital in response to regulator's WACC decision. Estimation of equity beta using adjustments to the regulator's methodology and choice of operators. (2013)

Transport

- For Heathrow, review of the read-across from the UK Competition Commission determination on the methodology for setting the cost of equity. Rebuttal of the CC's methodology for estimating the risk-free rate and equity risk premium. (2014)
- For Dublin Airport Authority, produced a report on the cost of capital for Dublin Airport for the next price control period. Assessment of the asset beta and systematic risks faced by Dublin Airport and estimation of the cost of debt. (2013)

Languages

English: fluent
Bengali: fluent
Spanish: basic

Report qualifications/assumptions and limiting conditions

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