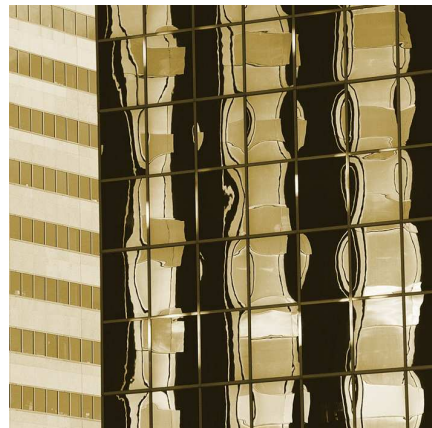# International benchmarking of Australian wholesale transmission capacity – Public Version

Prepared for Telstra

Author: Mike Smart
Date 7 July 2010

About LECG

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1 Introduction

1. My name is Michael Smart. I am a Director of economic consulting firm LECG. I have been asked by Telstra to opine on the appropriateness of international benchmarking as a methodology to determine pricing for the declared Domestic Transmission Capacity Service ("DTCS").

2. Specifically, I have been asked to address the following questions:

    a) What are the key factors that should be considered (and potentially adjusted for) when conducting a comprehensive international benchmarking exercise, including those factors referred to by the Australian Competition Tribunal in *Re Optus Mobile Pty Limited & Optus Networks Pty Limited (2006) ACompT 8*?

    b) Practically, how could these factors be applied in a DTCS international benchmarking context? What is the nature of any adjustments that would be required?

    c) What unique features of Australia, if any, may affect the suitability of international benchmarking of DTCS prices?

3. The assumptions I have made in preparing this report are listed in Annexure 1, along with the reasons for making them. The list of documents I considered is contained in Annexure 2. My instructions are contained in Annexure 3. My curriculum vitae, including relevant qualifications and experience, is included in Annexure 4.

4. I have read the Federal Court's practice direction 'Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia' and prepared this report accordingly, making all inquiries I consider to be appropriate, having regard to the instructions from Telstra.

2   Summary of opinions

5. International price benchmarking is a type of empirical investigation that is intended to establish a standard relationship between price and all relevant drivers by statistically examining price measurements from a set of sample countries. It can usefully test the reasonableness of pricing, provided that the following conditions are satisfied.

6. First, the statistical method must be analytically sound. Second, the price measurements must relate to the same or equivalent services observed simultaneously and expressed in consistent units. Third, all relevant price drivers must be included in the analysis. Fourth, the sample must be representative and sufficiently broad to capture an appropriate range of input values.

Robustness of statistical method

7. Multiple linear regression is an established method for benchmarking. So long as the particular regression hypothesis is consistent with economic theory, the sample is sufficiently large, and the range of variation in the main variables is sufficiently wide, the method should be applicable. Standard tests of goodness of fit should be applied.

Comparability of services

8. The equivalence of wholesale transmission capacity services offered by incumbent network owners is relatively easy to establish, subject to one important proviso. The standard DTCS offered by Telstra includes route redundancy. For the foreign price data I analyse in this report it has not been possible to affirmatively establish whether or not the services include route redundancy. If the prices for a particular country include redundancy, then the comparisons presented in this report are valid. If the foreign prices do not include route redundancy, then the international price benchmark would be set too low relative to a Telstra-equivalent service.

9. Further comparability issues arise with respect to foreign currency conversion. In this report I have used foreign exchange rates from 2007,[1] since the majority of foreign prices were sampled in that year. Since that time, the Australian dollar has appreciated as a result of the Global Financial Crisis, particularly in relation to the Euro, the British Pound and the US dollar. This appreciation, if reflected in the study, would tend to inflate the predicted benchmark Telstra price expressed in Australian dollars relative to these foreign counterparts.

Completeness of key price factors

10. The four questions I have been asked to address principally concern the selection of price drivers, or "key factors" that should be considered in any international benchmarking endeavour. In my view, so long as service and currency comparability are adequately dealt with, the most important of these factors are:

- Distance over which data is transmitted;

- Bandwidth of transmission service;

- Utilisation of transmission infrastructure;

- Cost of capital; and

- Regulatory status of the jurisdiction.

11. I have constructed an international benchmark model that incorporates all of these factors. For the avoidance of doubt, I do not propose that this benchmark model be employed by the ACCC or others to determine regulated DTCS prices for Australia. In my view, this model is too simple to be used for this purpose. My purpose in presenting this model is to

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[1] Prices were converted to AUD units, based on exchange rates calculated as a 50-50 blend of OECD Purchasing Power Parity rates for 2006, and 10 year average exchange rates to 30 June 2007.

indicate how serious the distortions to regulated prices could be if some of these factors were omitted. A secondary purpose is to illustrate why, in Australia particularly, factors such as utilisation so strongly influence results. The reason is that Australia is an extreme outlier on this measure compared to other OECD states.

12. To construct this model, I incorporate distance, bandwidth and regulatory status in the straightforward manner. I employ each country's 101 year average equity risk premium as a proxy for the cost of capital. Other measures could be used, but most of these are highly correlated to the equity risk premium.

13. The particular contribution of this report is the introduction of a new method of measuring national average utilisation of transmission infrastructure. This utilisation measure is expressed as the ratio of total national internet usage (number of unique IP addresses X average connection speed) to the route length of the minimum spanning tree for the 60 largest cities in the country. National utilisation is normalised to Australia = 1. While the selection of 60 cities may appear arbitrary, it turns out that the normalised utilisation figures for each country change very little if the 10 largest cities are used instead, or the 30 largest.

14. In section 4, I estimate this benchmark model for a sample of countries that comprises Canada, USA, UK, France, Italy, and the Netherlands. I demonstrate that the inclusion of the utilisation variable substantially improves the explanatory power of the model.

15. I compare actual yields for Telstra's inter-capital and regional defined routes to the benchmark. Among these routes, many are exempt from the DTCS declaration. Exempt routes are of particular interest for this comparison because they are subject to competitive price discipline, meaning that their prices should be equivalent to unregulated US transmission prices once adjustments are made for all relevant price drivers. The comparison reveals that Telstra's prices are reasonably close to predictions based on this benchmark model.

Representativeness and breadth of sample

16. Australia is an outlier on at least three of the five factors shown to be important for transmission price benchmarking: utilisation, cost of capital, and distances. The international sample used in the benchmarking work that is presented in this report does not contain any observations with such low utilisation, such high cost of capital, or such large distances as are found in the Australian observations. In other words, the sample is not representative of the range of conditions that is experienced in Australia. This situation is not ideal because small measurement errors within an international sample may become magnified through the process of extrapolation of coefficients to extreme input values.

17. For this reason, the benchmark model presented in this report should not be used to set regulated DTCS prices. Further, it is unclear how the utilisation coefficient in the benchmark model should be translated to the utilisation on a particular domestic route. The regression coefficients were estimated for national average utilisation. While Australia was at the extreme low end of international averages, there are undoubtedly many routes in Australia on which utilisation is far below the national average. The use of this benchmark model for specific routes may involve further extrapolation errors.

18. To generalise, my conclusion is that, despite the usefulness of international benchmarking for a range of purposes, it would be premature to attempt to employ it to set regulated DTCS prices for Australia. Until the issues I have raised above concerning the route-specific measurement of utilisation, the selection of a representative sample set, and the comparability of services can all be confidently addressed, international benchmarking may distort prices away from the long run marginal cost standard.

19. As an alternative, there may be some scope for domestic benchmarking based upon the model specification discussed in this report. At least with domestic benchmarking, fewer adjustments are required and the relevant variables can be more readily measured.

20. The remainder of this report provides the reasons for these opinions.

3 Key factors international benchmarking

21. The first question I was asked to address is, "*what are the key factors that should be considered (and potentially adjusted for) when conducting a comprehensive international benchmarking exercise, including those factors referred to by the Australian Competition Tribunal in (2006) ACompT 8?*"

22. Of the four conditions set out in paragraph 6 above, the third was specifically addressed by the Australian Competition Tribunal in establishing preconditions for the acceptance of international benchmarking analysis.[2] The Tribunal stated that benchmarking must take due account of:

- the regulatory environment within which prices were determined;

- the state of the relevant markets; and

- the socio-economic environment in which the benchmarked services were operative.

23. The regulatory environment encompasses:

- Pricing and costing methodologies employed by regulators;

- The historic pattern of development of communication networks;

- Pricing structures and practices of both regulators and commercial operators; and

- Other regulatory issues, including both USO subsidy schemes and quality of service regulation.

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[2] Re Optus Mobile Pty Limited & Optus Networks Pty Limited [2006] ACompT 8 (22 November 2006), @297.

24. Relevant aspects of the state of relevant markets include:

- The degree of competition in benchmarked markets;

- The extent of vertical and horizontal integration of services; and

- Network design:

    a) Network usage and scale effects;

    b) Equipment choices;

    c) Network resilience (including route and terminal equipment, redundancy and other fault mitigation tactics);

    d) Scope of services offered.

25. The socio-economic environment encompasses:

- Population density within urban areas;

- Distances between major urban centres;

- The level of demand for the service relative to the fixed cost increments of capacity required for the delivery of the service;

- The degree of spread of regional and rural populations; and

- Other geographic factors, such as terrain, topology of the road network.

26. This catalogue of variables that are potentially relevant to price-setting is extensive. The need to consider them all is a significant hurdle for any benchmarking effort to overcome. Nevertheless, the characteristics of transmission services lend themselves to a degree of simplification that may prove useful.

27. The relationship between prices and costs is fundamental to economic efficiency. Competition, in general, constrains prices to long run marginal costs. Regulation attempts to do the same thing when competitive discipline is missing. If it is justified to assume that prices are

approximately equal to long run marginal costs, either because the services are regulated or because they are subject to vigorous competition, then it is possible to simplify the analysis of the regulatory environment and the state of the markets. The analysis of the socio-economic environment is also simplified if the primary focus is on the cost-causing features of that environment.

28. By emphasising costs, the benchmarking programme can avoid having to explore in detail the demographic, historic, institutional, engineering and commercial characteristics of each country in the sample. Such a simplified programme would satisfy the Tribunal's requirements by attending to all relevant drivers of cost for transmission services in each jurisdiction. The ability to make this simplification is entirely dependent, however, on the validity of the assumption that prices used in the benchmarking exercise equal long run marginal costs.

29. This assumption is certainly not valid for all telecommunications services that have been the subject of international benchmarking analyses. For example, I pointed out in a previous report[3] that prices for individual services may diverge from costs for a variety of reasons, including subsidy, market power, regulatory objectives other than zero economic profit, regulatory bias or error, and common costs. These issues strongly affect the price-cost comparisons for fixed line services such as ULLS, WLR, LCS, LSS and PSTN OTA.

30. In the case of domestic transmission capacity services, however, these concerns are less acute.[4] While I do not regard the case as positively established, for the sake of argument I will proceed on the basis of an assumption that transmission prices in the international sample are approximately equal to the long run marginal costs.

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[3] Mike Smart, "Assessment of Analysys Mason benchmarking ." Submitted to the ACCC by Telstra, 6 October 2009.

[4] The concerns are less acute for transmission because transmission assets tend to be single-purpose, subsidies are less commonly applied to transmission services, and market power is reduced by the comparative ease of bypass.

31. The key factors that influence long run marginal costs of transmission capacity can most easily be understood by contemplating a typical point-to-point transmission link. This link consists of a fibre-optic cable located either in a trench or duct, with transmission or receiving equipment at each end, and potentially signal regenerating equipment at regular intervals for long routes (and if route redundancy applies, there would be two links that traverse different geographical routes).

32. Fibre-optic cable itself is relatively inexpensive per kilometre, but the construction of trenches and ducts (including obtaining necessary planning consents) represents a significant fixed cost per kilometre of route distance.[5] The cost of terminating equipment depends on the data density per fibre. High density technology, such as DWDM, is more expensive than the technology that would be used on low density routes.

33. The cost of the link is an increasing function of the route distance. As this cost is almost entirely a capital cost, it is also an increasing function of the owner's weighted average cost of capital ("WACC").

34. Higher bandwidth services consume more of the available capacity on a transmission link. Therefore, long run marginal costs are an increasing function of bandwidth.

35. The long run marginal cost of a particular transmission service is closely related to the average cost. The presence of relatively high fixed costs for trenching and ducting implies that long run marginal costs and average costs are high for lightly utilised transmission links. For this reason, asset utilisation is also an important cost driver. Long run marginal costs and average costs are a decreasing function of utilisation.

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[5] This cost is "fixed" in the sense that it varies only very slightly with the number of cables contained in the trench or duct. Therefore it is quite insensitive to the capacity (bandwidth) of the link.

36. In summary, for the sake of argument I have adopted the simplification that the key factors for international benchmarking of transmission capacity prices are:

- distance,

- bandwidth,

- cost of capital, and

- utilisation.

37. This simplification of the Tribunal's requirements is predicated on the validity of the assumption that transmission prices in the sample countries are approximately equal to long run marginal costs. The validity of that assumption for transmission services is not yet established, in my view, but it appears plausible for the jurisdictions considered later in this report.[6]

4 Application of key factors for DTCS

38. The second question I was asked to address is "*practically, how could these factors* [outlined in the previous section] *be applied in a DTCS international benchmarking context, and what is the nature of any adjustments that would be required?*"

39. In this section I respond to this question by setting out an empirical method for estimating the relevant national values for utilisation and cost of capital. For the distance and bandwidth factors I follow the approach taken in previous international benchmarking work for transmission pricing. In order to articulate the adjustments required for each of these

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[6] These jurisdictions are Canada, UK, France, Italy, Netherlands, and the United States.

four factors, I present and evaluate an expanded benchmark model from which possible adjustment values can be determined statistically.

40. In elucidating the application of the factors discussed in section 3 above to the DTCS, it will be convenient to refer to a specific international benchmarking study for transmission services performed by LECG in 2008 and submitted to the New Zealand Commerce Commission ("the NZ study").[7] That study considered a sample of non-redundant Ethernet transmission services at various dedicated bit rates and three distance bands (metro, provincial and regional). The countries sampled were Canada, the United Kingdom, France, Italy, and the Netherlands. A log-log regression model was employed to establish the relationship between prices and key drivers. Only two drivers were included in the study: distance and bandwidth.

41. The purpose of the NZ study was to inform the New Zealand Commerce Commission in its deliberation over the establishment of regulated transmission prices for New Zealand. I understand that the introduction of regulated prices based on this analysis was relatively uncontroversial in New Zealand in that affected parties to the decision had the option, once these prices were determined, to request the Commerce Commission re-determine these prices by reference to a TSLRIC model, but none did.

42. In the remainder of this section, I build on the NZ study, but expand it in two important ways. I enlarge the sample to include transmission prices in the USA,[8] and I include in the set of drivers the cost of capital and an

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[7] Shepherd, S. and D. Nutsford, "PRICE BENCHMARKING OF UCLL and UBA BACKHAUL SERVICES", LECG, 14 March 2008.

[8] I did not include New Zealand in the sample set because prices there were determined by the regulator on the basis of international benchmarking, rather than a forward-looking cost-based model or competition in the market. It would be inappropriate to use benchmarking results as an input to a benchmark model.

estimate of utilisation.[9] I do not claim that the expanded benchmarking study is sufficiently well-developed to form the basis of regulated transmission pricing in Australia—in my view it is not. The purpose of this expanded study is to highlight and quantify the importance for Australian conditions of the variables that were omitted in the New Zealand study.

43. Utilisation is a particularly difficult quantity to measure for benchmarking purposes. It varies considerably from route to route. Measuring utilisation is difficult enough when commercially sensitive data on custom and capacity by route can be obtained, but vastly more difficult for foreign jurisdictions. Nevertheless, I present a method of gauging national differences in utilisation of transmission infrastructure which will be used later in this report. Section 4.1 discusses the utilisation measurement. Section 4.2 discusses international variations in the cost of capital.

44. Armed with a rough indication of relative utilisation by country, I proceed in section 4.3 to construct a log-log regression model for transmission prices based on the drivers: distance, bandwidth, cost of capital and utilisation. Section 4.4 provides results from this model, which confirm that inclusion of the omitted variables improves the predictive power of the benchmark model and that the omitted variables are quantitatively important for Australia.

4.1 Measuring utilisation

45. I adopt the following measure of utilisation for transmission systems:

$$U = B / D$$

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9   I understand from my LECG colleagues who undertook this study that the USA price data was omitted due to the New Zealand regulatory pricing requirement that benchmarking was to be with respect to jurisdictions with "forward-looking cost-based pricing method". Utilisation and cost of capital variables were omitted from the NZ study due to the absence of verifiable data on these variables at that time.

where U represents utilisation;

B is a proxy for the total Mbits/s of internet usage for a given country and year; and

D is a proxy for the route length of that country's trunk transmission system.

46. B is calculated as follows:

B = (# unique IP addresses) X (avg connection speed in KBPS)

47. These two variables are available from the Akamai "State of the Internet" report for Q2 2009 for all countries in the sample.[10] I also considered data on international internet bandwidth per internet user and internet users per 100 inhabitants, but ultimately chose the Akamai data set because it represented a more direct measurement of usage.[11] A full discussion of alternative usage measurements, including data from the OECD broadband portal, is presented in Appendix 2.

48. Detailed information about trunk transmission networks of different countries is not publicly available, to the best of my knowledge.[12] In order to overcome this information gap, I use the following procedure, the full details of which are contained in Appendix 1:

   a) Identify the 60 most populous cities in each country;

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[10] Akamai Technologies, Inc. "The State of the Internet," Vol.2 No.2, Q2 2009, Section 7: Appendix, p. 38. Sourced from http://www.akamai.com/stateoftheinternet/ 3 June 2010.

[11] International Telecommunications Union, "Information Society Statistical Profiles 2009—Americas," statistical tables 3 and 4, pp. 76-77.

International Telecommunications Union, "Information Society Statistical Profiles 2009—Europe v1.01," statistical tables 3 and 4, pp. 70-71.

[12] Until 2007, the Federal Communications Commission published industry statistics on sheath-kilometres of fibre-optic cable laid in the United States as part of its ARMIS report. After 2007, this metric was no longer published in the ARMIS reports. No comparable statistic appears to be available for any of the other jurisdictions.

b) Based on the latitude and longitude of these cities, calculate the great circle distances between each pair;

c) Employing Kruskal's algorithm,[13] find the minimum spanning tree that connects all of these cities;

d) D is set equal to the route length of that minimum spanning tree.

49. I recognise that this procedure involves a number of simplifications. The following assumptions are implicit in this approach:

- Average utilisation of transmission assets is inversely proportional to the length of a country's trunk transmission network;

- Average utilisation is relevant to the transmission prices measured in the benchmark sample;

- The route length of each country's trunk transmission network is proportional to the route length of the minimum spanning tree for the 60 largest cities, with the same proportion applying to all countries in the sample and Australia;

- The selection of 60 cities in each country adequately delineates the geographic extent of that country's trunk transmission network;[14]

- To the extent that the need for route redundancy and for transmission routes to follow roadways may increase the route length of the trunk transmission network relative to the minimum spanning tree, the

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[13] J. B. Kruskal, "On the Shortest Spanning Subtree of a Graph and the Traveling Salesman Problem," Proc. Amer. Math. Soc., 7, 1956 pp. 48–50.

[14] If the top 10 cities is used instead to construct the minimum spanning tree ("MST"), the total length of each tree is shorter. Nevertheless, the ratio of lengths between each country and Australia is nearly the same for the 10, 30 and 60-city MSTs. The details of this comparison are presented in Appendix 1. Consequently, the estimates of relative utilisation are quite insensitive to the number of cities chosen.

proportionality of this increase would be approximately the same for all countries.

50. I do not claim that any of these assumptions hold exactly, merely that they are plausible in the context of an illustrative calculation that seeks to rank utilisation across countries.

51. The resulting utilisation estimates are set out in Table 1 below.

Table 1. Summary of utilisation calculation

country	unique IP addresses	Avg speed (kbps)	B = Mbits/s in total--all traffic	D = Min spanning tree (km) top 60 cities	U (mbps /km)	relative intensity of utilisation
AUS	7,208,137	2,698	19,447,554	11,163.93	1,742	1.00
CAN	10,717,995	3,983	42,689,774	7,994.21	5,340	3.07
USA	115,323,620	3,814	439,844,287	17,531.14	25,089	14.40
UK	18,549,665	3,362	62,363,974	2,404.87	25,932	14.89
FRA	20,071,871	3,202	64,270,131	3,907.25	16,449	9.44
NED	6,515,239	5,126	33,397,115	1,040.16	32,108	18.43
ITA	9,104,612	2,733	24,882,905	3,641.71	6,833	3.92

52. As expected, the compact geographies of the European nations lead to short route lengths, particularly for the Netherlands and UK. Australia, Canada and the United States have much longer minimum spanning trees. Internet penetration per inhabitant is relatively uniform across the countries considered, but the intensity of internet data usage per user varies greatly. This factor, combined with Australia's low overall population, makes it an outlier on the measure B, and therefore also on the measure of interest, U. The last column of Table 1 shows the relative intensity of transmission asset utilisation, with Australia set to 1. Apart from Canada, which has 3 times the utilisation of Australia, and Italy, with 3.9 times the utilisation, all of the other jurisdictions in the benchmark sample have utilisation that is more than nine times as high as Australia's.

53. Some simplistic assumptions were made in arriving at this comparison, but the results are so stark that the general character of this conclusion

appears robust. Australia requires a vast transmission network to serve its small population, but that population does not use transmission services as intensely as the populations of the comparator countries. European countries, in particular, serve much larger, much more data-intensive populations with relatively compact, inexpensive transmission systems. Even the North American counterparts utilise their transmission systems more intensely than does Australia. These North American systems are approximately as vast as Australia's but the populations using them are considerably larger and more data intensive.

4.2   Cost of capital

54. Data transmission is capital-intensive. The cost structure of data transmission capacity services is dominated by investment costs associated with fibre routes and terminating equipment. Consequently, the cost of capital is highly relevant to the cost of providing these services.

55. International differences in the cost of capital can be significant. For example, in a 2007 report, ComReg reported a significant range in regulatory WACC values across European jurisdictions.[15] Of course, differences in capital costs are important also for jurisdictions in which prices are determined by competitive forces, rather than regulation.

56. An important driver of international differences in the cost of capital is the differential in market risk premium (or, equivalently, equity risk premium) across countries. A 2003 study presented national equity risk premia calculated for sixteen countries over the period 1900-2002.[16] The data in Table 2 below is taken from that source. Of the four available equity risk premium measurements, I selected the geometric mean relative to

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[15]   Review of Eircom's Cost of Capital, ComReg 07/88, November 2007

[16]   Dimson, E., P. Marsh and M. Staunton, "Global Evidence on the Equity Risk Premium," Journal of Applied Corporate Finance, Volume 15 Number 4, Summer 2003, 8-19. Accessed from http://wehner.tamu.edu/finc.www/FINC-Cuny/equity%20premium.pdf on 31 May 2010.

bonds because the value for Australia on that measure most closely matched the conventional Australian regulatory setting of MRP = 6.0%.

Table 2. Equity risk premiums *(from Dimson, Marsh and Staunton 2003)*

Country	Geometric mean equity risk premium relative to bonds (percent per year) 1900-2002
Australia	6.0
Canada	4.0
France	3.6
Italy	4.1
The Netherlands	3.8
United Kingdom	3.8
United States	4.4

57. The market risk premium is related to the Vanilla WACC through the following formula:

$$WACC = (D/V)*R_d + (E/V)*(R_f + \beta_a*MRP)$$

58. The ratios (D/V) and (E/V) represent the capital structure parameters debt to value and equity to value. R_d is the cost of debt. R_f is the risk-free rate. β_a is the asset beta. If these five parameters are held constant, then the vanilla WACC is a linear function of MRP.

59. I have elected to use MRP, rather than WACC, for reasons of simplicity. It seems to me that little is lost by making this simplification, as WACC is closely correlated with MRP.

4.3   Motivating the expanded benchmark model

60. Economically efficient transmission prices would be equal to the long run marginal cost of providing the relevant services. This pricing approach, which is embodied in the TSLRIC and TELRIC methodologies, is allocatively efficient (absent multi-part tariffs). The classical difference between long run and short run marginal costs is that in the long run, all costs are avoidable, including the cost of long-lived investments in plant and equipment.

61. As long as capacity is not inefficiently over-provisioned and the costs of acquiring and installing the plant and equipment reflect best practice at the time, average costs should approximate long run marginal cost reasonably well in this case.[17] The average cost of a transmission system is the total cost divided by usage.

62. Since transmission costs are principally capital costs, the total cost per year is directly related to the cost of capital and the investment cost. The investment cost is an increasing function of both the route length and the bandwidth of the transmission links.

63. Usage is difficult to observe at the level of individual transmission links in an international benchmarking exercise. Instead, national average asset utilisation, which is observable indirectly, can be applied to the capacity of a transmission link to obtain an estimate of usage on that link. Section 4.1 above explained the method I employed to estimate national average asset utilisation figures, which are expressed in units of Mbits/s per route kilometre of trunk transmission network (estimated using the minimum spanning tree algorithm set out in Appendix 1.)

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[17]   The proposition that average costs equal long run marginal costs does not hold in general. However, regulated firms would not accept prices lower than average cost. As long as total costs are prudently incurred, and asset utilisation is consistent with prudent provisioning decisions for the level of demand that is reasonably foreseeable, a regulator would have no reason to object to prices that recover total actual costs. For this reason, the focus on average cost prices is consistent with economic efficiency.

64. The discussion in the previous three paragraphs can be expressed algebraically as follows. The price for a transmission service on a particular route, if based on average cost, would be given by:

$$P = Cost(route) / Usage(route) \quad (1)$$

65. Assuming a power law functional form for costs, the cost of a particular transmission service on a particular route would depend on the proxy measurement for cost of capital (MRP), the length of the route (km), and the bandwidth of the service (mbps). The exponents would all be positive, but the precise values are yet to be determined.

$$Cost = \alpha_1 \, MRP^{\beta_1} \, km^{\beta_2} \, mbps^{\beta_3} \quad (2)$$

66. Again assuming a power law functional form, the usage for a particular route would be a positive power of the product of national average asset utilisation (U) and the route length (km).

$$Usage = \alpha_2 \, (U*km)^{\beta_4} \quad (3)$$

67. Combining equations, (1), (2) and (3), and simplifying:

$$P = (\alpha_1/\alpha_2) \, MRP^{\beta_1} \, km^{(\beta_2 - \beta_4)} \, mbps^{\beta_3} \, U^{-\beta_4} \quad (4)$$

68. Taking the natural logarithm of both sides of equation (4):

$$\ln(P) = constant + \beta_1 \ln(MRP) + (\beta_2 - \beta_4)\ln(km) + \beta_3 \ln(mbps) - \beta_4 \ln(U) \quad (5)$$

69. It will prove convenient to refer to MRP, rather than the natural logarithm of MRP. Consequently equation (5) will be used in the following modified form (with coefficients renamed for convenience):

$$\ln(P) = constant + \theta_1 \, MRP + \theta_2 \ln(km) + \theta_3 \ln(mbps) - \theta_4 \ln(U) \quad (6)$$

70. Equation (6) is the basic form of the expanded benchmark regression model applied in the remainder of this report. Note that this model differs from the NZ Study benchmark model, which is summarised in equation (7) below.

$$\ln(P) = constant + \theta_2 \ln(km) + \theta_3 \ln(mbps) \quad (7)$$

71. In the following section, I will demonstrate that the omission of the capital cost and utilisation terms in the NZ Study benchmark model would have a number of serious implications for the application of international benchmarking to Australian domestic transmission capacity services.

4.4 Results from the expanded benchmark model

72. The NZ Study applied the regression model equation (7) to dedicated bit rate ethernet transmission prices at a range of distance and bandwidth points for Canada, France, Italy, Netherlands, and the United Kingdom. That study expressed prices in NZD, but for the present analysis I have converted all prices to Australian dollars, using the foreign exchange rates that applied in 2007.[18]

73. Regression on equation (7) for the original sample of countries yields the following results:

Linear regression

Number of obs   = 36
F(2, 33)   = 32.95
Prob > F   = 0.0000
R-squared   = 0.6184
Root MSE   = .65421

Lnaud	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
lnkm	.466	.0980	4.76	0.000	.267	.666
lnmbps	.587	.0977	6.00	0.000	.388	.786
_cons	4.104	.5827	7.04	0.000	2.918	5.289

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[18] Since 2007, the global financial crisis has impacted these countries differentially. Specifically, there has been an appreciable strengthening of the Australian dollar relative to the Euro and the British pound. The use of 2010 exchange rates would tend to artificially inflate the relative prices of Australian transmission, even though underlying transmission prices may not have changed significantly since 2007 in their native currencies.

74. These results are identical to those reported in the NZ Study, except for the constant, which reflects the conversion of currency units from NZD to AUD.

75. If the final term of equation (6) (the natural logarithm of utilisation) is added to equation (7), then applied to the same data set, the results change in the following way.

Linear regression

Number of obs   =   36
F(3,   32)   = 35.25
Prob > F   = 0.0000
R-squared   = 0.7586
Root MSE   = .52842

Lnaud	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
Lnkm	.300	.0861	3.48	0.001	.124	.475
Lnmbps	.682	.0821	8.31	0.000	.515	.850
Lnutilis	-.639	.1361	-4.70	0.000	-.916	-.362
_cons	5.347	.5297	10.09	0.000	4.268	6.426

76. The inclusion of the utilisation variable has significantly improved the R-squared value. Further, the utilisation variable has the expected sign (i.e., negative, meaning that prices are higher at lower utilisation, all else being equal) and a high absolute t-value, meaning that this variable is statistically significant at better than a 0.1% confidence interval. Including utilisation has improved the explanatory power of the benchmark model.

77. To put this finding in another way, the omission of utilisation from the benchmark model worsens its explanatory power, even for the relatively uniform sample of countries considered in the NZ Study. For a country, such as Australia, which is an extreme outlier on the utilisation measure, this omission would be likely to significantly bias results.

78. It is desirable to include two further factors: the cost of capital, and the potential impact of regulation on prices. Equation (6) contains a cost of capital term. The impact of regulation can be gauged by including price data from the United States, in which transmission prices are constrained by competition, rather than regulation. This effect may be captured by including a USA dummy variable in equation (6). The results for regression on the modified equation (6) are shown below.

Linear regression

Number of obs   =   72
F(5,   66)   = 72.02
Prob > F   = 0.0000
R-squared   = 0.7987
Root MSE   = .64598

Lnaud	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
Lnkm	.503	.0720	6.99	0.000	.359	.647
Lnmbps	.761	.0589	12.92	0.000	.644	.879
Lnutilis	-.598	.211	-2.83	0.006	-1.02	-.176
MRP	-.181	.854	-0.21	0.832	-1.89	1.52
USA	.269	.594	0.45	0.652	-.917	1.45
_cons	4.78	3.77	1.27	0.209	-2.75	12.31

79. The measurement of US prices is discussed in Appendix 3. Including the United States has doubled the number of observations. While this step has given substantial weight to observations from the United States, the fact that pricing differs from state to state means that it is reasonable to treat the USA not as a single jurisdiction but rather as a collection of jurisdictions.

80. In this expanded benchmark model, the sign of the capital cost term is negative, contrary to expectation, but not statistically significant. The low t-value for this term is not surprising. Table 2 above shows that the MRP varies over a narrow range (between 3.6 and 4.4) for the countries considered in this regression, making it difficult to clearly discern the

impact of this variable for these countries. In my opinion, the low t-value for the MRP term does not necessarily indicate that cost of capital is not an important explanator of prices.

81. The sign of the USA dummy variable is positive, but not statistically significant. This result may tend to indicate that the dichotomy between regulated and non-regulated status does not have a statistically significant impact on prices, once other variables are taken into account.

82. It is interesting to consider how Australian transmission prices compare to the predictions of this expanded benchmark model. In order to make a comparison of this type it is necessary to select a representative sample of Australian transmission prices. I select inter-exchange transmission services (x.162) on all inter-capital and regional defined routes for which yield data is available. I consider a range of bandwidths from 2 to 622 Mbps. These services include route redundancy, and I am unable to say whether they are strictly comparable to the services in the international sample in this respect (as some may not include route redundancy).

83. [Confidential information removed.]

84. I make this comparison by calculating the prices predicted for each of these services based on the expanded benchmark model and plotting actual versus predicted prices. [Confidential information removed.]

Figure 1. Actual versus predicted monthly prices [removed as it contains confidential information]

85. [Confidential information removed.][19]

86. This section of my report has provided a worked example of how the key factors noted in section 3 could be incorporated in an international benchmarking exercise. This analysis, which is necessarily preliminary in nature, highlights the importance of utilisation as a cost driver. Studies which omit this variable are likely to substantially bias the results when applied to a country such as Australia, which is an outlier on this measure. When it is included, along with cost of capital and regulatory status, Telstra's actual yields on inter-capital and regional defined routes appear to conform well to the resulting benchmark price predictions.

87. The analysis I have presented so far has tended to focus on cost-related issues. Other factors would need to be diligently explored in any benchmark-based price-setting exercise. The purpose of this analysis was not to present a benchmarking model that is recommended for adoption by the ACCC. In many respects, the expanded benchmark model specification is unsatisfactory for that purpose. Instead, the intention was to highlight the importance of omitted variables, particularly cost of capital and utilisation, which is particularly hard to measure.

88. Other matters, such as subsidy, regulatory objectives, and comparability of benchmarked services, have not been explored in detail. That does not imply that I regard these factors as unimportant or insignificant even in the context of transmission pricing. Unless adequately dealt with, the omission of these factors could well compromise the usefulness of any benchmarking study.

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[19] [Confidential information removed.]

5 Unique features of Australia

89. The fourth question I was asked to address is "*what unique features of Australia, if any, may affect the suitability of international benchmarking of DTCS prices*?"

90. Australia is an extreme outlier on three of the five factors shown to be important for transmission price benchmarking: utilisation, cost of capital, and distances. The international sample used in the benchmarking work that is presented in this report does not contain any observations with such low utilisation, such high cost of capital, or such large distances as are found in the Australian observations.

91. Furthermore, the actual yield data, which is based on wholesale transmission services actually sold by Telstra, contains a large number of observations for 2 mbps and 8 mbps services. The NZ Study did not include any observations at bandwidths lower than 50 mbps, and the US data was for DS-3 (45 mbps) and above. This difference may reflect the tendency of Australian internet users to have lower average connection speeds (as indicated by the Akamai data) than those in the comparator countries. In any case, these facts suggest that Australia may also be an outlier with respect to bandwidth.

92. In other words, the international sample is not representative of the range of conditions that is experienced in Australia. This situation is not ideal because small measurement errors within an international sample may become magnified by extrapolation. For this reason, care should be applied in any attempt to use the benchmark model presented in this report to set regulated DTCS prices.

93. Further, in a practical vein, before such a benchmark model could be used to set specific prices, a method would need to be established to apply the model utilisation coefficient to the utilisation on a particular

domestic route.[20] The regression coefficients were estimated for national average utilisation. While Australia was at the extreme low end of international averages, there are undoubtedly many routes in Australia on which utilisation is far below the national average. The use of this benchmark model for specific routes would also potentially involve further extrapolation errors.

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[20]   The main difficulty is in quantifying usage (mbps) on a specific route in a manner that is consistent with the measurement of national usage.

Appendix 1: Minimum spanning trees

94. This appendix describes the method employed to derive minimum spanning trees for the 60 most populous cities in each country.

95. Data on city population, latitude and longitude were sourced from http://population.mongabay.com/, which lists cities for each country in decreasing order of population. The population figures are only used to determine the identity of the 60 largest cities in each country. Any differences between countries in the method of counting city populations should not affect the results, as long as the method is consistent within each country.

96. For each country, the spherical law of cosines formula was used to calculate the great circle distance between each city pair from latitude and longitude information.

97. Kruskal's algorithm was used to identify the 59 arcs that connect all 60 cities together with minimal total path length, avoiding any circularity. That collection of arcs is the minimum spanning tree ("MST"). Kruskal's algorithm begins by selecting the shortest arc between any of the city pairs. In each subsequent step, the algorithm selects the shortest remaining arc that does not create a closed loop with arcs that were previously chosen. Kruskal's theorem guarantees that the spanning tree generated using this algorithm will have the shortest possible route length.[21]

98. The seven following charts show the 60-city minimum spanning tree as calculated for each of the countries considered. A stylized map of the national borders is superimposed to provide context. The axes are longitude and latitude, expressed in radians.
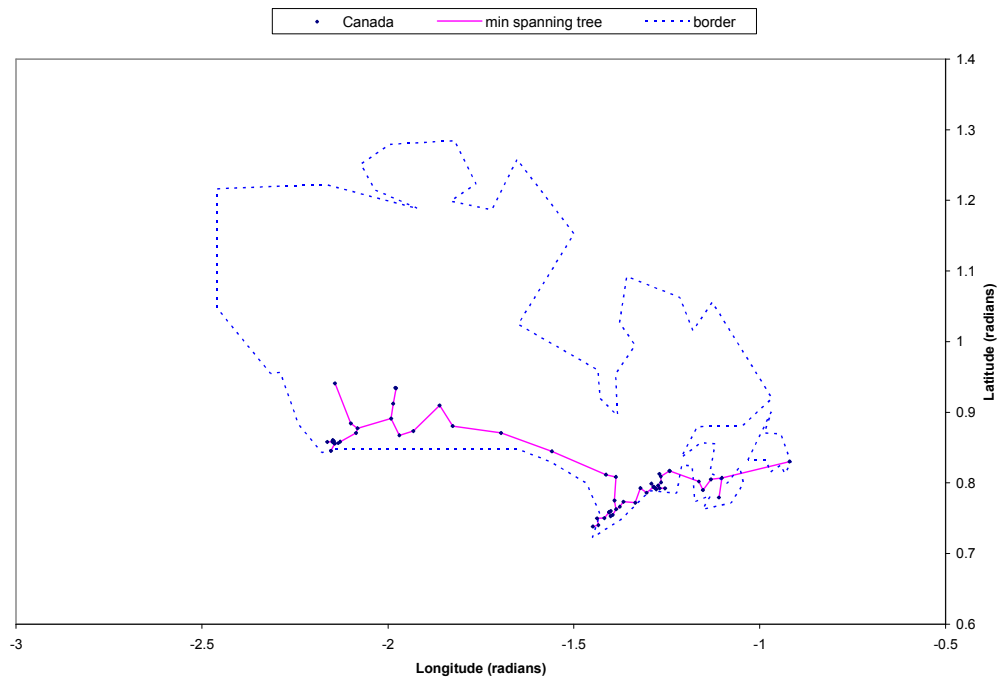
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[21] J. B. Kruskal, "On the Shortest Spanning Subtree of a Graph and the Traveling Salesman Problem," Proc. Amer. Math. Soc., 7, 1956 pp. 48–50.
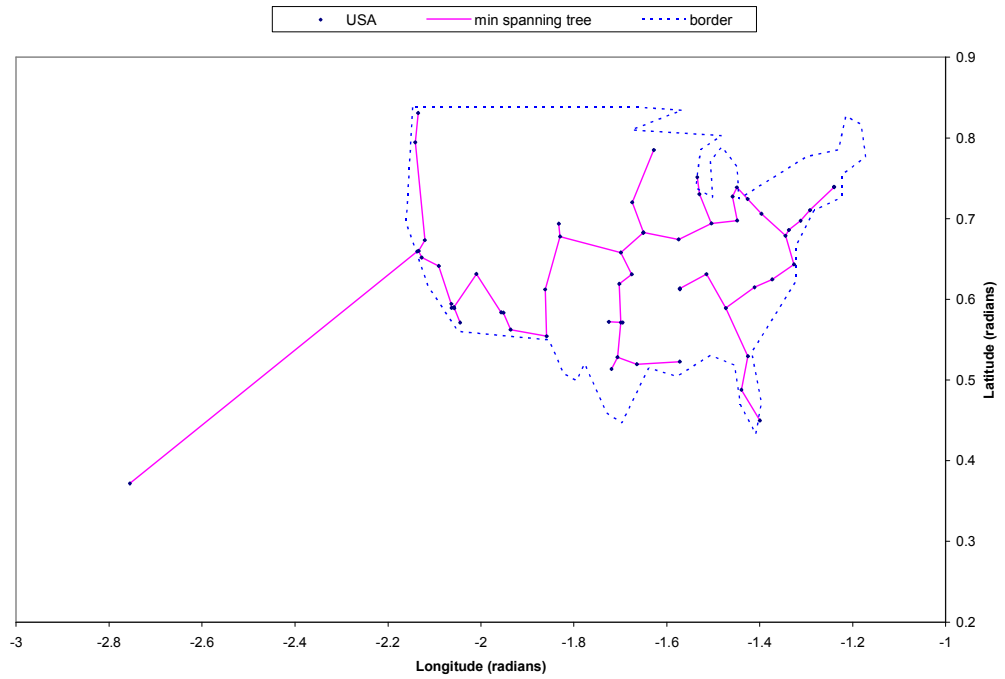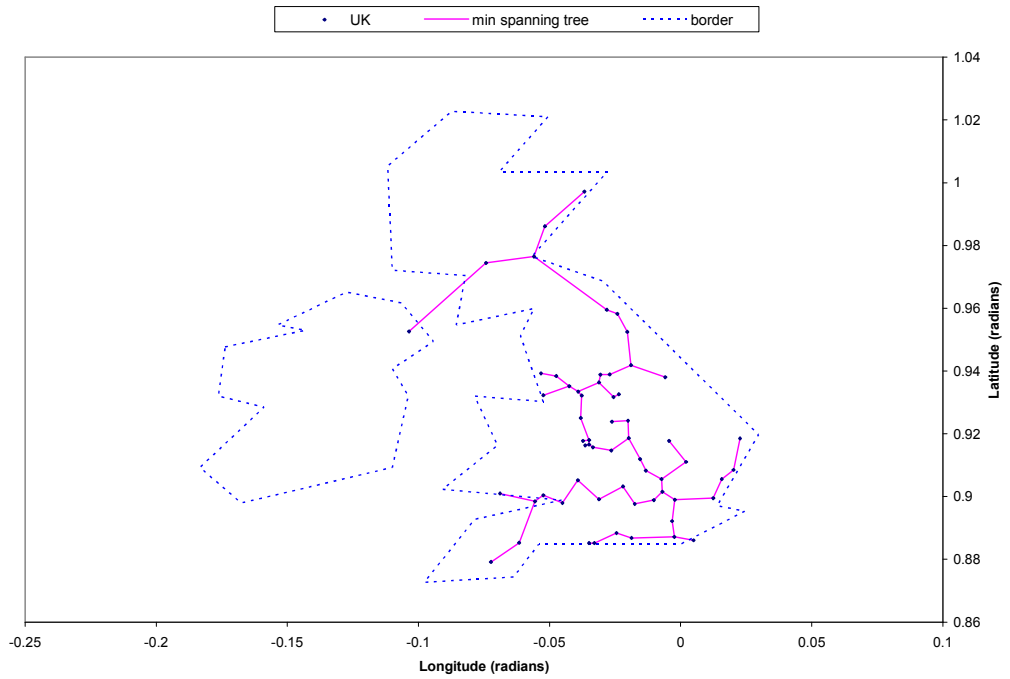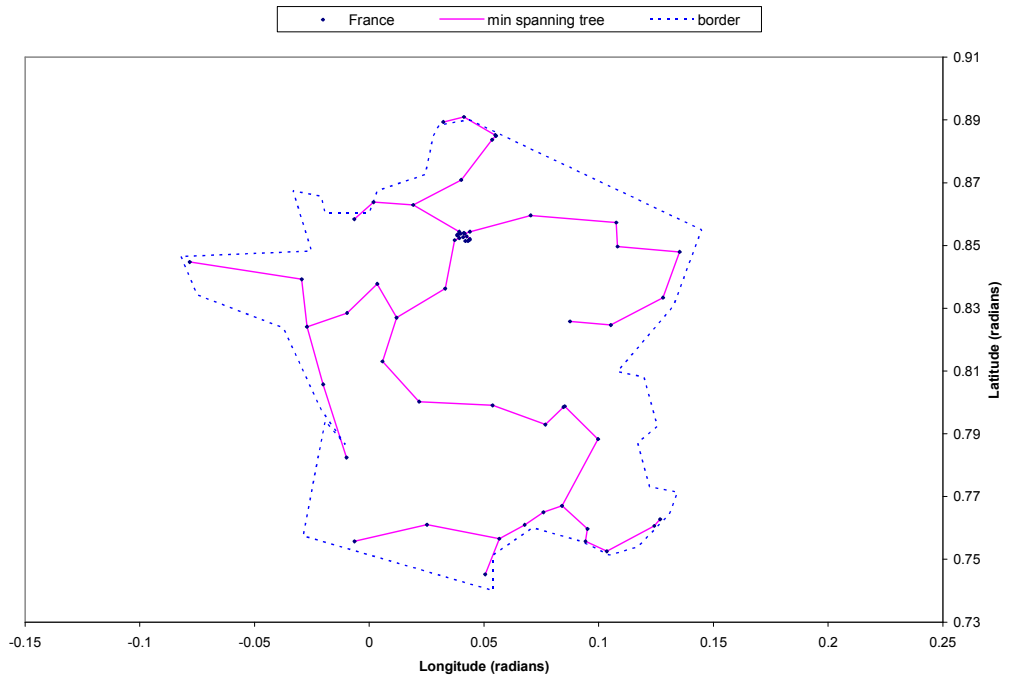
99. Australia
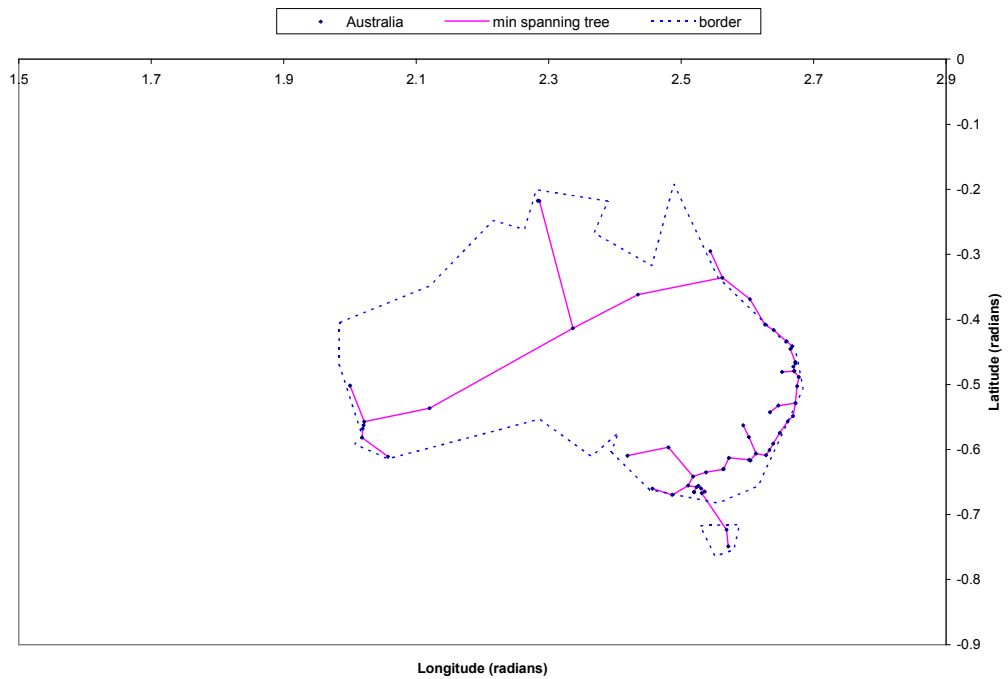
100. Canada
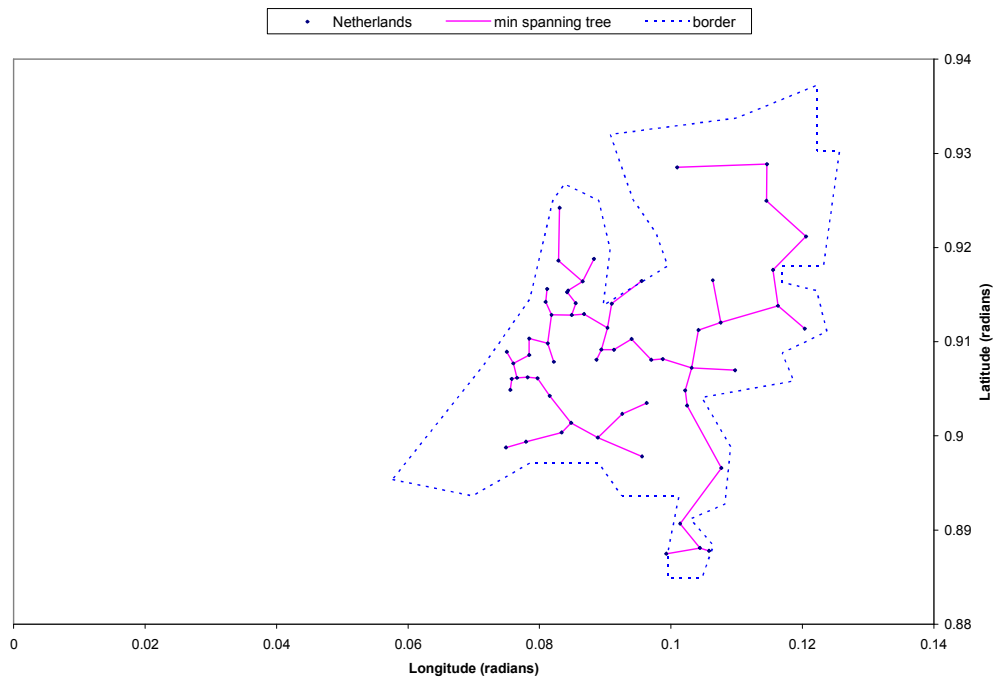
101.   United States

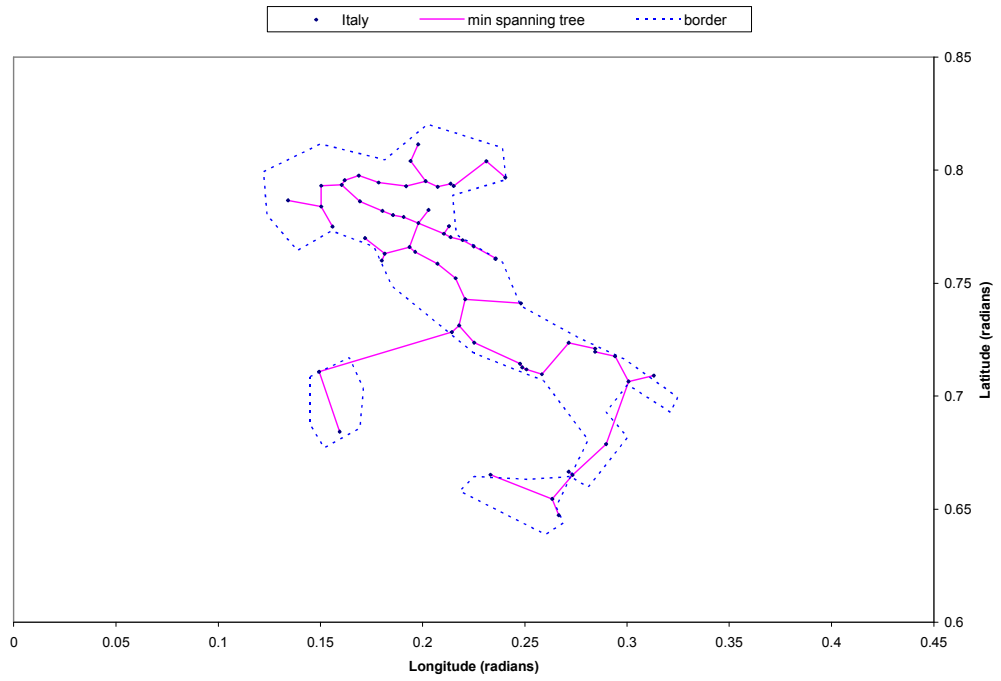102.   United Kingdom

103.   France

104. Netherlands

105.   Italy

106.   The selection of 60 cities in each country may appear somewhat
         arbitrary. In order to investigate the possible impact of selecting a
         different number of cities, I also constructed minimum spanning trees for
         the 10 largest cities in each country and for the 30 largest. As might be
         expected, these MSTs had shorter total path lengths than the 60-city
         MSTs. However, the relativity between countries was preserved despite
         the change to the number of cities considered.

107.   I first calculated the inverse of the route length of each MST. Then I
         divided each country's inverse MST length by Australia's inverse MST
         length for the same number of cities. This process normalises each set
         of inverse MST lengths to Australia = 1. The similarity between 60, 30
         and 10-city normalised inverse MST length for each country is shown in
         the bar chart comparison below.

1/MST length (km) normalised to AUS = 1
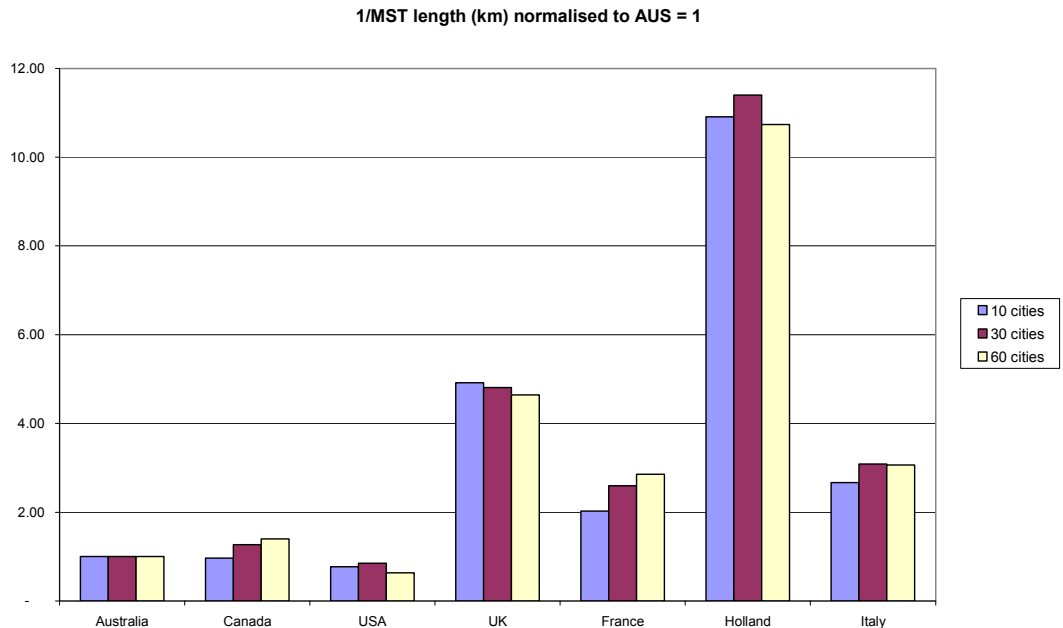
108.   As the normalised inverse MST length figures for each country vary so little between the 10, 30 and 60 city cases, I conclude that the utilisation metric is not strongly affected by the number of cities selected to construct the MST. Rather, this analysis suggests that the normalised inverse MST length indicates something intrinsic to each country's demographic and geographic character.

Appendix 2: Utilisation estimates

109.   The path length of the minimum spanning tree for each country is used as the denominator in the ratio which is used to calculate the utilisation variable used in this report. The numerator is formed by multiplying the number of unique IP addresses in each country by the average connection speed, using data from the Akamai Q2 2009 State of the Internet report. The Akamai data is summarised in the table below.

Data from Akamai Q2 2009 State of the Internet report

country	unique IP addresses	Avg speed (kbps)	B = Mbits/s in total--all traffic
AUS	7,208,137	2,698	19,447,554
CAN	10,717,995	3,983	42,689,774
USA	115,323,620	3,814	439,844,287
UK	18,549,665	3,362	62,363,974
FRA	20,071,871	3,202	64,270,131
NED	6,515,239	5,126	33,397,115
ITA	9,104,612	2,733	24,882,905

110.   Two alternate sources of data on intensity of internet traffic by country were also considered: the OECD and ITU. The OECD data is shown in the table below.

Data from OECD Broadband Portal

country	Broadband subscribers (Dec 2009)	avg advertised BB download speed kbps (Oct 2009)	B = Mbits/s in total advertised BB
AUS	5,133,000	21,823	112,019,205
CAN	9,980,000	19,567	195,282,937
USA	81,146,225	14,619	1,186,256,081
UK	18,213,290	19,681	358,451,762
FRA	19,582,000	54,551	1,068,223,023
NED	6,131,000	33,679	206,487,092
ITA	12,338,502	14,336	176,884,765

111.   The OECD number of broadband subscribers is well correlated with the Akamai numbers of unique IP addresses. The OECD statistic average advertised broadband download speed is systematically higher than the Akamai statistic average connection speed. Given Akamai's reliance on actual connection data (and the high correlation between Akamai's average connection speed statistic and its other statistics concerning the percentage of users with connection speeds above 5 mbps, above 2 mbps, or below 256 kbps), it appears to be a more relevant measure than OECD's average of advertised rates, which would represent an upper limit.

112.   The ITU data is shown in the table below.

Data from ITU 2008 and 2007

| country	pop (CIA Jul 2010 est millions)	year	Internet users / 100 inhabitants			Internet users	International internet bandwidth Bits/s per internet user			B = Intnl MBits/s in total
			in year	CAGR	@ 2008		in year	CAGR	@ 2008	
AUS	21.516	2007	69	0.035	71.415	15,365,651	8,035	0.54	12,374	190,128
CAN	33.76	2008	72.4		72.4	24,442,240	22,250		22,250	543,840
USA	310.233	2008	71.2		71.2	220,885,896	15,461		15,461	3,415,117
UK	61.285	2008	76.24		76.24	46,723,684	55,259		55,259	2,581,904
FRA	64.058	2008	68.21		68.21	43,693,962	46,351		46,351	2,025,259
NED	16.783	2008	86.55		86.55	14,525,687	92,184		92,184	1,339,036
ITA	58.091	2008	41.93		41.93	24,357,556	26,940		26,940	656,193

113.   ITU data for Australia was only available for 2007, making it necessary to employ the given compound annual growth rates ("CAGR") to extrapolate to 2008 values, which can be compared directly to the

other ITU observations. The ITU statistic number of internet users is systematically higher than, but correlated with the Akamai unique IP addresses and OECD number of broadband subscriber statistics.

114.   The ITU data reports international internet bandwidth, expressed in bits/s per internet user. This statistic is somewhat less satisfactory than the Akamai average connection speed statistic because it reflects only international transmission capacity. For EU countries, the cost of constructing international links is low because they are clustered and largely on the same continent. The North American countries are adjacent to each other, but must cross the Atlantic Ocean to connect to Europe. Australia is relatively more isolated.

115.   The bar chart below presents a range of estimates of utilisation = usage / MST length, normalised to Australia = 1.

Comparison of normalised utilisation, based on different usage measurements and MSTs
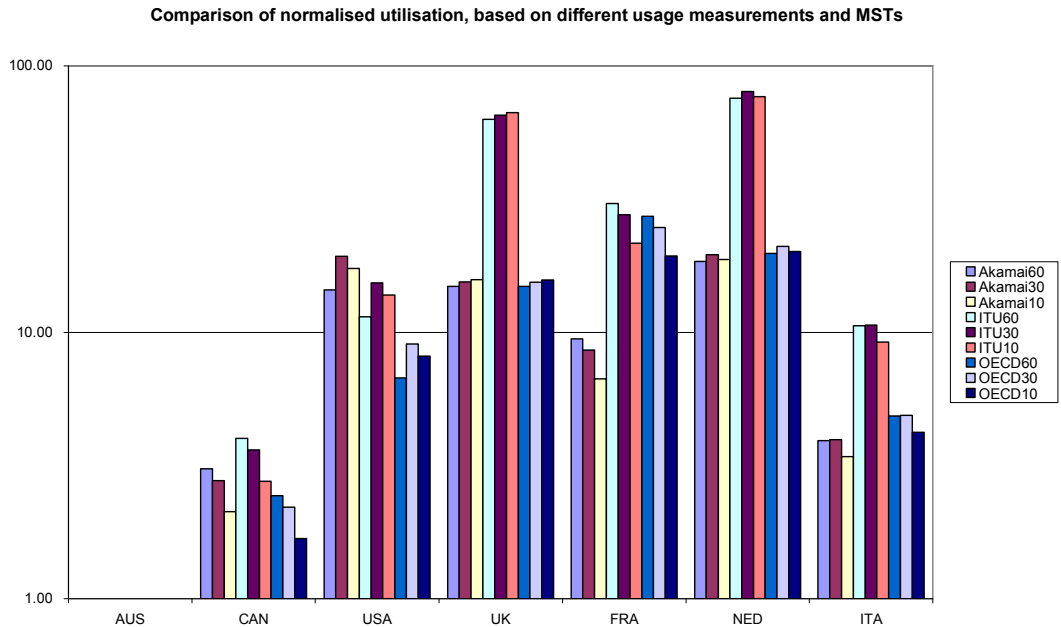
116.   The vertical axis is on a logarithmic scale. The labels for each data set consist of the data source for the usage information (either Akamai,

ITU, or OECD) and the number of cities used to construct the MST (either 60, 30 or 10). This chart clearly shows that on any of these nine possible measures of normalised utilisation, Australia is significantly lower than the other countries. Canada and Italy are the countries with the closest utilisation values to Australia, but even these countries have utilisation that is higher than Australia's by a factor of approximately 3 (Canada) and between 3 and 9 (Italy).

117. The Akamai 60-city utilisation measure is the preferable alternative in my opinion because it combines the more empirically grounded Akamai usage indicators with the most detailed 60-city MST.

Appendix 3: Transmission prices in USA

118. The prices outlined in this Appendix were obtained from standard schedules for unbundled network element prices for AT&T and BellSouth CLEC agreements. AT&T prices were valid at May 2007. BellSouth prices were valid at September 2006.

119. Unbundled prices (in USD) for AT&T and BellSouth ("BS") for DS-3 (45 Mbps) that were valid at November 2007 are tabulated below. Non-recurring prices are not included.

Unbundled DS-3 Transport Prices		
	Per Termination	Per Mile
AT&T - Arkansas	$348.50	$118.00
AT&T - California	$184.58	$35.72
AT&T - Illinois	$146.93	$29.81
AT&T - Indiana	$106.79	$28.62
AT&T - Michigan	$129.82	$6.20
AT&T - Ohio	$127.75	$21.61
AT&T - Wisconsin	$191.33	$33.29
BS - Alabama	$351.76	$4.09
BS - Florida	$535.50	$3.87
BS - Georgia	$174.71	$2.63

120.   The state-to-state variation in the level and structure of prices is notable. The prices shown in this table were converted to prices for 45 Mbps services at various distances (ignoring the cross connect component) by converting the distance-dependent price component to units of kilometres, multiplying by the distance in km, and adding twice the per termination charge. An end-to-end service requires two terminations.

121.   Since 2003, the Federal Communications Commission ("FCC") has not required unbundling of backhaul services at speeds of 155 Mbps or higher.

122.   As of November 2007, AT&T offered a point-to-point fibre-based Ethernet service at a 1 gigabit per second rate, called "GigaMAN", in the following six states: California, Illinois, Indiana, Michigan, Ohio, and Wisconsin. Monthly pricing for this service for a 12 month contract was USD3,925 per termination, plus USD125 per mile. Reduced pricing was offered for longer-term contracts, but I used the 12 month (minimum contract length) prices in the comparisons presented in this report.

123.   As with the DS-3 prices, these GigaMAN prices were converted to per-kilometre units then multiplied by the number of kilometres for services at each of the standard distances: 17.5km, 80km, and 250km. Three additional distances were used for the GigaMAN service: 500km, 750km, and 1000km. There is an additional cost component for repeaters, which would be needed for longer distances, but I have ignored this cost element.

124.   Finally, prices were converted to AUD units, based on exchange rates calculated as a 50-50 blend of OECD Purchasing Power Parity rates for 2006, and 10 year average exchange rates to 30 June 2007.

Annexure 1: Assumptions

Assumption	Reason for making it
Efficient transmission prices should approximately equal average cost, as long as total costs are prudent and provisioning of capacity reflects reasonably anticipated usage levels.	Prices higher than average cost may include monopoly rent. Prices lower than average cost would be unsustainable, even for an efficient operator.
Telstra's transmission yields on the exempt routes reflect strongly competitive conditions.	Exemption was granted on these routes only after the ACCC was satisfied that the level of competition was sufficient to make continued declaration not in the LTIE.
National average utilisation can be estimated adequately for the purpose of benchmarking as the ratio of total download speed to the route length of the minimum spanning tree for a group of the largest cities in each country.	Total download speed reflects usage of the national transmission network. The route length of the minimum spanning tree proxies network costs in an unbiased manner that captures relevant demographic features of each country.
The choice of a 60-city minimum spanning tree yields a representative estimate of national average utilisation.	Investigation of utilisation based on 10 and 30-city minimum spanning trees showed that the normalised utilisation is relatively insensitive to the number of cities chosen.
Each country's 101 year average market risk premium (or equity risk premium) is a satisfactory indicator for benchmarking purposes of the cost of capital faced by transmission service providers in the 2007 time period when prices were sampled.	MRP is linearly related to vanilla WACC when the risk-free rate, cost of debt and gearing are held equal across countries.
Power law functional form adopted for cost and usage in regression model.	Precedent for this approach found in the NZ study. Log-log regressions exhibit strong linearity.

Annexure 2: List of documents reviewed

- Akamai Technologies, Inc. "The State of the Internet," Vol.2 No.2, Q2 2009. Sourced from http://www.akamai.com/stateoftheinternet/ 3 June 2010.

- Dimson, E., P. Marsh and M. Staunton, "Global Evidence on the Equity Risk Premium," Journal of Applied Corporate Finance, Volume 15 Number 4, Summer 2003, 8-19. Accessed from http://wehner.tamu.edu/finc.www/FINC-Cuny/equity%20premium.pdf on 31 May 2010.

- International Telecommunications Union, "Information Society Statistical Profiles 2009—Asia and the Pacific."

- International Telecommunications Union, "Information Society Statistical Profiles 2009—Americas."

- International Telecommunications Union, "Information Society Statistical Profiles 2009—Europe v1.01."

- J. B. Kruskal, "On the Shortest Spanning Subtree of a Graph and the Traveling Salesman Problem," Proc. Amer. Math. Soc., 7, 1956 pp. 48–50.

- OECD broadband portal, accessed from http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html on 18 June 2010.

- Re Optus Mobile Pty Limited & Optus Networks Pty Limited [2006] ACompT 8 (22 November 2006).

- Review of Eircom's Cost of Capital, ComReg 07/88, November 2007.

- Shepherd, S. and D. Nutsford, "PRICE BENCHMARKING OF UCLL and UBA BACKHAUL SERVICES", LECG, 14 March 2008.

- Smart, M. "Assessment of Analysys Mason benchmarking." Expert report submitted to ACCC by Telstra, 6 October 2009. http://www.accc.gov.au/content/item.phtml?itemId=897196&nodeId=50d9a23a6258d81d2acc696a4a78cc98&fn=LECG%20Report%20Public.pdf

Annexure 3: Instructions

I have been asked to prepare a written report, which could potentially be relied on by Telstra in making submissions to the ACCC which expresses an opinion on the suitability of international benchmarking of Australian DTCS prices. In doing so, I am asked to:

- review comparable countries where pricing of wholesale transmission services has been regulated;

- identify the key factors that should be considered (and potentially adjusted for) when conducting a comprehensive international benchmarking exercise (eg utilisation, WACC, exchanges rates, regulatory environment) including those factors referred to by the Australian Competition Tribunal in Re Optus Mobile Pty Limited & Optus Networks Pty Limited (2006) ACompT 8;

- indicate how these factors could be practically applied in a DTCS international benchmarking context, including the nature of any adjustments that would be required; and

- identify any unique features of Australia which may affect suitability of international benchmarking of DTCS prices.

In the preparation of my expert report, I am asked to observe the following instructions:

(a) given the scope for the report to be used in the Federal Court in any judicial review proceedings, have regard to the Guidelines to Expert Witnesses for Proceedings in the Federal Court of Australia (Expert Guidelines) and expressly confirm in the report that I have read those guidelines and that I agree to be bound by them;

(b) include a detailed curriculum vitae setting out full details of all relevant qualifications, expertise and experience;

(c) include a statement of the questions that I have been asked to address;

(d) set out a list of all documents you have relied on in the preparation of the report, including any documents we have provided to you;

(e) expressly state all assumptions made in preparing your report and the reasons for making those assumptions; and

(f) set out the reasons for each opinion expressed in the report.

Annexure 4: Curriculum Vitae

Mike Smart, Consulting Director, LECG

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Sydney NSW 2001
Phone: +61 (0) 2 9234 0210
Email: msmart@lecg.com

BIO/SUMMARY

Mike Smart, based in Sydney, works primarily in the fields of competition, pricing and valuation, focusing on infrastructure and other networked businesses. He applies empirical economics to costing, demand estimation, corporate strategy, regulatory and competition policy issues. He has advised the Australian industry leaders in rail, telecommunications, ports, logistics, gas, mining, electricity and aviation, among other private and public sector organisations. Mike's advice includes the preparation of financial models, expert reports, board papers, regulatory submissions, and testimony. Mike has given evidence in the Federal Court of Australia and the Australian Competition Tribunal.

Prior to joining LECG in April 2008, Mike was a Vice President of CRA International and an executive director of the Network Economics Consulting Group (NECG). Before joining NECG, Mike was the Manager of Corporate Strategy for the Rail Access Corporation of NSW during its corporatisation and first three years of operation. That role encompassed commercial and regulatory challenges including development of an access pricing strategy and negotiating access contracts, as well as a significant contribution to the development of the NSW Rail Access Regime.

Prior to that role, Mike advised the Public Accounts Committee of the NSW Parliament, worked as engineering manager in a data acquisition and machine vision firm, and consulted, in California, to the airline and electric power industries.

Mike is a member of the Trade Practices Committee of the Business Law Section of the Law Council of Australia.

EDUCATION

BA Magna Cum Laude (Astrophysics), Harvard University 1979

PRESENT POSITION

LECG Limited, Consulting Director, since 2008

PROFESSIONAL EXPERIENCE

Litigation

- Briefed counsel for the Australian Pipeline Trust in a High Court challenge to the ACCC's Final Decision on the access arrangements for the Moomba – Sydney Pipeline. Decision handed down Sept. 2007.

- Assisted in the preparation of expert testimony in a Federal Court case concerning disputed management and occupancy of the Acacia Ridge rail terminal *Pacific National (ACT) Limited v Queensland Rail* [2006] FCA 91.

- Testified before the Australian Competition Tribunal in the matter of an Application by Virgin Blue to have the airside services at Sydney Airport declared: *Virgin Blue Airlines Pty Limited* [2005] ACompT 5.

- Conducted a series of imputation tests used in expert testimony in the Federal Court case *Australian Competition and Consumer Commission v Baxter Healthcare Pty Ltd* [2005] FCA 581, Sydney.

- Authored an expert report in the matter of an application by East Australian Pipeline Limited [2004] ACompT 8, heard by the Australian Competition Tribunal, Sydney.

- Testified before the Federal Court of Australia in the matter of *Australian Gas Light Company v. Australian Competition & Consumer Commission (No 3)* [2003] FCA 1525, Melbourne.

- Assisted in the preparation of expert testimony with respect to a disputed compensation claim in the Coal Compensation Tribunal (2002).

- Assisted in the preparation of expert testimony in an application before the Australian Competition Tribunal to have the Eastern Gas Pipeline unregulated *Re Duke Eastern Gas Pipeline Pty Ltd* [2001] ACompT 2 (4 May 2001).

Consulting

- Advised the Surat Basin Rail Joint Venture on regulatory risks surrounding a privately-owned coal railway line in Queensland (2008-10).

- Prepared two expert reports evaluating international benchmarking studies for fixed-line telecommunications service prices (2009).

- Undertook a quantitative assessment of the external benefits generated by Sydney bus services and the socially optimal level of Government subsidy (2008-09).

- Prepared expert advice on air cargo market definition issues (2008-09).

- Performed an empirical estimate of CityRail's marginal costs (Nov 2008) used in IPART's review of Sydney urban rail fares for 2009 – 2012.

- Prepared sections of an application by the Australian Pipeline Trust to have light handed regulation applied to the Moomba-Sydney Pipeline. Approved in Nov. 2008, this application was the first of its kind under the new National Gas Law.

- Authored a series of expert reports concerning Telstra's applications for exemption from declaration of various Domestic Transmission Capacity Services (December 2007 – October 2008). The sought exemptions were partially granted.

- Prepared an expert report concerning economic effects of alleged cartel behaviour by a motor vehicle dealership (2008).

- Prepared a quantitative assessment of the external benefits generated by urban rail transport in Sydney and the socially optimal level of Government subsidy (June 2008).

- Assisted NSW competition regulator IPART in its inquiry into the Port Botany land transport interface (Final report published March 2008).

- Co-authored, with Professor George Hay, an expert report concerning competition impacts of a merger in the plastic bottle industry (2007).

- Assisted FOXTEL in obtaining ACCC approval (granted March 2007) for its special access undertaking for its digital set top units.

- Advised IPART on its ongoing review process for actual coal rail access revenues against the statutory ceiling.

- Led a team analysing the regulatory test hurdles for a proposed reinforcement investment in the electricity transmission network for WesternPower (2007).

- Provided economic reports in support of the asset valuation for the Roma-Brisbane Pipeline in the 2006-2007 Access Arrangement round.

- Assisted AGL to obtain regulatory approval for the acquisition of certain Queensland retail energy business assets (2006-07).

- Advised a New Zealand firm on potential damages arising from alleged collusive pricing (2006-07).

- Worked in a team modelling the competition impacts of the (now approved) merger between Toll Limited and Patrick Corporation (2006).

- Prepared reports submitted to the National Competition Council on behalf of BHP Billiton Iron Ore concerning the Part IIIA application by Fortescue Metals Group to have the Mt Newman railway line declared (2005).

- Worked closely with the Australian Stock Exchange to develop and test options for the strategic review of trading, clearing and settlement prices, culminating in the December 2005 announcement of significant restructuring of prices.

- Prepared a pricing strategy for Airservices Australia concerning the intellectual property embedded in its published aeronautical data (2004-05).

- Assisted the Australian Pipeline Trust by preparing numerous submissions in regard to its campaign to have regulatory coverage of the Moomba-Sydney Pipeline revoked (2000 – 2003). Regulation was eventually revoked for the Western portion of the pipeline.

- Provided a detailed avoidable cost analysis for an Australian firm responding to allegations of predatory pricing. The ACCC ultimately did not proceed with the case.

- Helped the Australian Stock Exchange to design and establish pricing for a new data service (2002).

- Prepared due diligence report on regulatory risk for one of the underbidders for Sydney Airport in 2002.

- Prepared revenue forecasts and other due diligence reports for Toll Holdings and Patrick Corporation on access prices in their successful bid to acquire Pacific National (2001-02).

- Advised the ACCC on a method for valuing the land under Sydney Airport. The recommendations were adopted by the ACCC in the 2000 Sydney Airport decision on aeronautical charges.

- Additionally, Mike has prepared a number of economic reports regarding merger authorisations, declarations under Part IIIA of the Trade Practices Act, matters involving misuse of market power, commercial pricing strategies, and regulatory pricing decisions.

OTHER POSITIONS HELD

2005 – 2008   Vice President, CRA International
2000 – 2005   Executive Director, NECG, Australia
1996 – 2000   Manager, Corporate Strategy and Manager of Systems,
                  Rail Access Corporation of NSW, Australia
1993 – 1996   Director, Smart & Kay Pty Ltd, Australia
1989 – 1993   Independent Consultant, Australia
1986 – 1989   Engineering Manager, Science & Computing Applications P/L, Australia
1984 – 1985   Associate, Decision Focus Inc, Los Altos, CA (USA)
1980 – 1983   Professional Officer, University of NSW, Australia

PUBLICATIONS

"*Natural Resource Diversity and Democracy*," Mike Smart, **Economic Papers, Volume 28, No. 4**, December 2009, 366-375.

"*Value of Sydney bus externalities and optimal Government subsidy*," Mike Smart, Final report commissioned by the Independent Pricing and Regulatory Tribunal of NSW, October 2009.
http://www.ipart.nsw.gov.au/files/Consultant%20report%20-
%20LECG%20Final%20Report%20bus%20externalities%20-
%2013%20October%202009%20-%20WEBSITE%20DOCUMENT.PDF

"*Port Botany's Landside: Market Pricing to Address Congestion*", James Cox, Dennis Mahoney and Mike Smart, **Economic Papers, Volume 28, No. 1**, March 2009, 49-55.

"*An empirical estimate of CityRail's marginal costs and externalities*", Mike Smart, Report commissioned by the Independent Pricing and Regulatory Tribunal of NSW, November 2008.
http://www.ipart.nsw.gov.au/files/Consultancy%20Report%20-
%20LECG%20Report%20CityRail%20externalities%20and%20marginal%20costs%20
final%20-%2020%20November%202008%20-%20WEBSITE%20DOCUMENT.PDF

"*Value of CityRail externalities and optimal Government subsidy*", Mike Smart, Report commissioned by the Independent Pricing and Regulatory Tribunal of NSW, June 2008.
http://www.ipart.nsw.gov.au/files/CRAI%20report%20-
%20CityRail%20Externalities%20-%206%20June%202008.PDF

"*Transport demand and spatial equilibria*", Mike Smart, **Journal of Transport Economics and Policy, Volume 42, Part 2**, May 2008, pp. 323-343.

"*The Prime Minister's Export Infrastructure Task Force: Two years on—has anything changed?*", AusIntermodal conference, Sydney, 28 November 2007.

"*The role of economic regulation in reducing bottlenecks*", conference on economic regulation in transport and logistics, Lloyds List DCN, Melbourne, 6 June 2007.

"*The economic value created by the emergence of a national gas pipeline network*", paper presented at the Australian Pipeline Industry Association's Annual Pipeline Convention 2006, Alice Springs, 16 October 2006.

"*Track access and regulation*", presented to a course organised by the Australasian Railway Association in Melbourne, August 30-31, 2006.

"*The relative competitiveness of road and rail haulage*", presentation to a conference at the National Library on challenges in achieving efficient pricing in freight infrastructure, Canberra, April 28, 2006.

 "*Two case studies on road vs rail freight costs*", Mike Smart and Simon Game, submission to the Productivity Commission inquiry into freight infrastructure pricing, May 25, 2006.

"*Safety fears could derail years of reform,*" Sydney Morning Herald, 23 April 2003, p. 13.

Sydney Airport Revised Draft Aeronautical Pricing Proposal. Final report prepared for the ACCC, December 2000.

"*Land and Easement Valuation in Pricing for Networked Businesses – A Critical Appraisal.*" Henry Ergas and Mike Smart, Conference on Asset Valuation, ACCC, Melbourne, 16 June 2000.

"*Practical Aspects of Rail Access Implementation.*" Published in the Proceedings: Current Issues in Access. Business Law Education Centre, Sydney, 29 October 1999.

"*Solving the Riddle of Combinatorial Logic.*" Published in the Proceedings 23rd Australian Transport Research Forum, Perth, 30 September 1999. pp. 789-803.

"*Understanding Life Cycle Costing and Applying Life Cycle Analysis.*" Published in the Proceedings: Advanced Asset Management. IIR Conference, Sydney, 28 September 1998.

"*Application of Valuation Policies for Infrastructure Assets*". Published in the Proceedings: Strategic Asset Management in the Public Sector. IIR Conference, Sydney, 24 November 1997.

(Consultant responsible for drafting Parliamentary committee report) Inquiry into Financing of Urban Infrastructure -- Report on European Inspection Tour. Public Accounts Committee, Parliament of New South Wales. Report No. 67. December, 1992. ISBN 0 7240 9554 3.

(Consultant responsible for drafting Parliamentary committee report) Report on the National Parks and Wildlife Service. Public Accounts Committee, Parliament of New South Wales. Report No. 59. December, 1991. ISBN 0 7240 8806 7.

(Consultant responsible for drafting Parliamentary committee report) Report on Payment Performance. Public Accounts Committee, Parliament of New South Wales. Report No. 55. April, 1991. ISBN 0 7240 8797 4.

(Consultant responsible for drafting Parliamentary committee report) Report on the Forestry Commission. Public Accounts Committee, Parliament of New South Wales. Report No. 52. December, 1990. ISBN 0 7240 8786 9.

"*ASYST Applications*." The First Australian Forth Symposium: University of Technology, Sydney, May 1988.

"*Measuring Solar and Electric Heating Contributions in Occupied Houses*." Smart and Ballinger. **Energy and Buildings 9**. 213-219 (1986).

"*Fourier-synthesized Weather Data for Building Energy Use Estima*tion." Smart and Ballinger. **Building and Environment Vol.19 No.1**. 41-48 (1984).

"*An Economic View of Passive Solar Design in an Australian Context*." Ballinger and Smart. Published in the Proceedings: Solar World Congress, Perth, August 1983.

"*Tracking Mirror Beam Sunlighting for Deep Interior Spaces*." Smart and Ballinger. **Solar Energy Vol.30 No.6**. 527-536 (1983).

"*An Empirical Study of Problem Heat Flow Paths in Simulation Models*." Smart and Ballinger. Chapter 6 in **Predictive Methods for the Energy-Conserving Design of Buildings**. H.J. Cowan Ed. Pergammon, Sydney (1983).

"*Propagation of Magnetically Guided Acoustic Shocks in the Solar Chromosphere*." Foukal and Smart. **Solar Physics 69**. 15-25 (1981).