NEW ZEALAND INSTITUTE FOR THE STUDY OF COMPETITION AND REGULATION INC.

Comments to the Federal Communications Commission, Washington D.C. on Broadband Study Conducted by the Berkman Center for Internet and Society NPB Public Notice # 13; GN Docket Numbers 09-47; 09-51; 09-137

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Overview

This document has been prepared in response to the Commission's request for public comment on the report *Next Generation Connectivity: A review of broadband internet transitions and policy from around the world*, prepared by the Berkman Center for Internet and Society at Harvard University and released on October 13 2009[1].

The Berkman study was commissioned in order to provide "an independent expert review of existing literature and studies about broadband deployment and usage throughout the world to help inform the FCC's efforts in developing the National Broadband Plan"[2]. The Commission has requested comment on the following points:

1. Does the study accomplish its intended purposes?
2. Does the study provide a complete and objective survey of the subject matter?
3. How accurately and comprehensively does the study summarize the broadband experiences of other countries?
4. How much weight should the Commission give to this study as it develops a National Broadband Plan?
5. Are additional studies needed along the lines of the Berkman study?
6. Please provide any other comments on the Berkman study that you deem relevant.

The following comments are not intended to comprise a comprehensive review of the full content of the document. Rather, they focus specifically upon three aspects where I believe my research conducted over the past ten years qualifies me to critique the report: the theoretical and empirical linkages between access regulation and broadband market performance (including, but not limited to, the nexus between policy interventions and both the extent of broadband uptake and dynamic investment incentives leading to deployment of Next Generation networks) and the experience in and comparative performance of the New Zealand market under regulatory regimes based upon both light-handed competition law and increasingly intensive degrees of access regulation[3].

My critique specifically addresses:

[1] http://www.fcc.gov/stage/pdf/Berkman_Center_Broadband_Study_13Oct09.pdf

[2] "Harvard's Berkman Center to Conduct Independent Review of Broadband Studies to Assist FCC" news release. http://www.fcc.gov/Daily_Releases/Daily_Business/2009/db0714/DOC-291986A1.pdf

[3] My first published peer-reviewed article on this subject appeared in 2002 (Howell, B. 2002. Infrastructure Regulation and the demand for Broadband Services: Evidence from the OECD Countries. Communications and Strategies 47:33-61). I have subsequently produced more than 30 articles, conference papers and presentations published in a range of international peer-reviewed journals, edited volumes and international forums on these specific matters. I am a member of the International Telecommunications Society (ITS) and have regularly attended its international and regional conferences. I have been an invited speaker at a range of conferences and venues both internationally and within New Zealand, including the ITS, the Ecole Nationale Superior Telecommuniques (Paris, France), the OECD and the Australian Competition and Consumer Commission (ACCC). I have presented both written and oral submissions to the Finance and Expenditure Select Committee of the New Zealand Parliament on matters relating to New Zealand Telecommunications policy and legislation. Most of my publications and presentations are publicly available on http:///www.iscr.org.nz/research/ .

1. the comprehensiveness and objectivity of the Berkman report's review of existing theoretical and empirical literature documenting linkages between access regulation and broadband market performance (including country experiences);
2. the quality, credibility and reliability of the Berkman Center's review of the economic critique undertaken by myself and colleagues Glenn Boyle and Wei Zhang[4] on the OECD-published paper de Ridder (2007)[5], and the re-estimations then relied upon for Berkman's assertion that the relationship between the length of time local loop unbundling has applied and broadband uptake per capita is positive and significant; and
3. the integrity of the process by which the critique in 2. above was undertaken.

On these bases, I consider that the Berkman study fails to accomplish its intended purpose.

The literature surveyed is highly selective. Emphasis is given to historic measures of broadband uptake per capita, price, and speed of existing technologies as performance measures, without seeking to address either their relevance for sector performance evaluation or usefulness as meaningful policy targets. Negligible attention is given to the relative benefits of cross-platform competition versus access regulation on telecommunications platforms. The report does not canvass the very large literature of economic and econometric analyses published over the past ten years on the potentially very significant negative consequences of access regulation on dynamic incentives for future investment in next generation networks. The report does not accurately represent the balance of empirical evidence of the effect of access regulation policies on broadband uptake per capita. Analysis of the political economy of regulation is also absent, as is any reference to the substantial body of publicly available material on New Zealand's experiences – a crucial oversight given that New Zealand offers one of the few 'live' case studies of the effect of the introduction of access regulation at a relatively late stage in the process of the technology's diffusion and concomitant with the timing of investment in next-generation networks.

The empirical analysis undertaken by the Berkman authors comprises predominantly descriptive statistics, bi-variate correlations and weighted country rankings which of themselves offer little to support the primary recommendation that open access policies have been 'successful' in improving the performance of OECD countries in developing markets for next generation internet

[4] Boyle, G., Howell, B., & Zhang, W. 2008. *Catching Up in Broadband Regressions: does local loop unbundling realy lead to material increases in OECD broadband uptake?* Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation (Inc). Available on http://www.iscr.org.nz/f410,11598/11598_LLUBroadband01c_rev_300708.pdf .

[5] De Ridder, J. 2007. *Catching-up in Broadband – what will it take?* Paris, France: OECD Working Party on Communication. Infrastructure and Services Policy report DSTI/ICCP/CISP(2007)8/FINAL
Available on http://www.oecd.org/dataoecd/34/34/39360525.pdf

technologies, and that as a consequence the United States should adopt such policies. The solitary empirical evidence offered to support this conclusion is a mixed effects extension to an ordinary least squares model proposed by de Ridder (2007) as evidence of the statistically significant effect of local loop unbundling access regulation on broadband uptake per capita. The de Ridder model was critiqued by Boyle, Howell and Zhang (2008) in respect of both its selection of the estimation technique used and conceptual modelling. In respect of the former, re-estimation of the de Ridder model using robust standard errors led to unbundling no longer being significant. In respect of the latter, the critique noted that the specification of the unbundling variable as the length of time that unbundling had been present was highly correlated with the length of time that broadband had been available – a highly significant factor in determining broadband uptake per capita in the early stages of diffusion of a technology. Respecification of the de Ridder model to separate out the different time-based effects led to the conclusion that the finding of significance for unbundling policy in the de Ridder model specification occurred as a consequence of an omitted variable – namely the length of time the technology had been available.

The Berkman analysis cites the Boyle, Howell and Zhang (2008) critique of the de Ridder estimation technique, but proceeds to use the unaltered de Ridder specification in applying their alternative mixed effects estimation technique. No mention is made of the concerns expressed in Boyle, Howell and Zhang about de Ridder's conceptual modelling. Unsurprisingly, the Berkman analysis largely reproduces levels of significance for the unbundling variable similar to those found by de Ridder, which are therefore subject to the same concerns about modelling methodology as raised by Boyle, Howell and Zhang (2008). The failure to mention the substantive criticisms of the model upon which the Berkman authors rely so strongly for their empirical recommendation that access regulation will lead to improved performance in the United States broadband market (specifically, increased broadband uptake per capita) is surprising, given the degree of attention paid to the other aspects of the Boyle, Howell and Zhang (2008) paper. This omission, along with other errors in citation from this paper, raises questions about the standards of competence and integrity applied to this aspect of the Berkman analysis, and by extension to the entire project.

In summary, it is my view that the Commission should give very little weight to the findings of the Berkman study as it develops a National Broadband Plan. At the very least, a much more comprehensive review of the economic, econometric and political economy aspects of broadband markets and a range of alternative policy interventions is required to inform such policy-making.

1. Comprehensiveness and Objectivity of the Subject Matter Presented

The FCC has requested that the Berkman Center for Internet and Society conduct an "expert review of existing literature and studies about broadband deployment and usage throughout the world"[6]. The report contains a large amount of primary data sourced predominantly from the OECD, World Bank, United Nations and national regulatory authorities, and proceeds to apply some rudimentary statistical analysis to this data based principally upon those policies openly endorsed by agencies such as the OECD and the ITU and widely adopted by national regulatory authorities.

However, the report does not contain an explicit review of the large body of literature on policy and broadband market performance from academic and peer-reviewed sources[7]. This literature explores the very rich and complex nexus of relationships between a wide range of highly nuanced policy interventions and outcomes actually and potentially observed in the markets in question. As no such review is undertaken, the Berkman report fails to take account of the many alternative interpretations and explanations for their plethora of empirical observations. The absence of a literature review also means that the authors do not critically assess either the efficacy of or justification for existing policy preferences.

By way of illustration:

- National broadband uptake per capita, price and speed variables are selected as primary indicators of national 'performance', even though there has been considerable debate in the literature about their usefulness and relevance for cross-country policy comparisons (for example, but not restricted to, Wallsten, 2009; Boyle & Howell, 2008; Ford, Koutsky & Spiwak, 2007)[8], and despite cautions regarding their use being regularly provided by the organisations that furnish the data for international comparisons (e.g. the OECD[9]). Furthermore, Howell (2009)[10] shows that broadband uptake rankings in particular have very little meaning in isolation from a range of information relevant to the diffusion of the technology, such as the time it has been available, absolute and relative growth rates

[6] *Supra*, footnote 2.
[7] An examination of footnotes and reference lists indicates that fewer than ten of the more than four hundred referenced citations are derived from papers in this body of literature.
[8] Wallsten, 2009. *Understanding International Broadband Comparisons*: Washington, DC: Technology Policy Institute. http://www.techpolicyinstitute.org/files/understanding%20international%20broadband%20comparisons%202009%20update%207-9.pdf
Boyle, G, Howell, B. 2008. Ranking the Unrankable: How Useful are the OECD League Tables? *Competition and Regulation Times* 25:6-7. Available at http://www.iscr.org.nz/f407,11457/11457_March.pdf .
Ford, G, Koutsky, T, Spiwak, L. 2007. *The Broadband Performance Index: A Policy-Relevant Method of Assessing Broadband Adoption Amongst Countries*. Phoenix Center Policy Paper No. 29.
Available at http://papers.ssrn.com/ sol3/papers.cfm?abstract_id=1008283 .
[9] Personal communications with Taylor Reynolds, OECD economist and communications analyst responsible for collation of OECD broadband data
[10] Howell, B. (2009). Has local loop unbundling increased New Zealand's broadband uptake? *ISCR Current Comment* 2009(2). Available on http://www.iscr.org.nz/f539,15546/15546_LLU_and_Broadband_Uptake_2.pdf

and the size of the potential addressable market. These aspects attract very little attention in the Berkman analysis.

- There is negligible reference to the long-standing academic debate about the relative merits of policies encouraging inter-modal (facilities-based) versus intra-modal (services-based) competition (for example, but not restricted to, Grajek & Roller, 2009; Hellwig, 2008; Cave, 2006; Crandall & Waverman, 2006; Hausman & Sidak, 2005; Bourreau & Dogan, 2005; Howell, 2002)[11].
- The extensive literature on the likely negative effects of access regulation on investment incentives (dynamic efficiency), and hence the likelihood of delays occurring in investment in fibre-based technologies is not addressed (for example, but not restricted to, Gans & Williams, 1999; Jorde, Sidak & Teece, 2000; Laffont & Tirole, 2000; Valletti, 2003; Crandall, Ingraham & Singer, 2004; Gans & King, 2004; Hausman & Sidak, 2005[12]; Crandall & Waverman, 2006; Guthrie, 2006; Bourreau & Dogan, 2006; Pindyck, 2007; Aron & Crandall, 2008)[13]. Consequently there is no discussion of two recent empirical analyses demonstrating the significant negative effects of access regulation upon infrastructure investment in the European Union countries (Grajek & Roller, 2009; Waverman, Meschi, Reiller & Dasgupta, 2007)[14]. Yet the Berkman authors derive much of their support for access regulation from precisely the policies in place in EU countries.

[11] Grajek, M., & Roller, L-H., (2009), *Regulation and investment in network industries: evidence from European telecoms*, ESMT Working Paper 09-004, available from http://ssrn.com/abstract=1448666 .
Hellwig, M. (2008) Competition policy and Sector-specific regulation for Network industries, Max Planck Institute Collective Goods Preprint 2008/29;
Cave, M. (2006). Encouraging infrastructure competition via the ladder of investment. *Telecommunications Policy* 30 (3-4): 223-37.
Crandall, R., & Waverman, L., (2006), The failure of competitive entry into fixed-line telecommunications: who is at fault? *Journal of Competition Law and Economics* 2(1):113-48.
Hausman, J., & Sidak, H., (2005), Did mandatory unbundling achieve its purpose? Evidence from five countries. *Journal of Competition Law and Economics* 1(1):173-245.
Bourreau, M., & Dogan, P., (2005). Unbundling the local loop. *European Economic Review* 49(1):173-99.
Howell, B. (2002). Infrastructure Regulation and the demand for Broadband Services: Evidence from the OECD Countries. *Communications and Strategies* 47:33-61

[12] It is noted that whilst the Berkman authors do refer to this paper, it is in the context of individual country case study data, not for the principal research finding that local loop unbundling appeared to have negligible effect upon most indicators of broadband market performance examined.

[13] Gans, J., & Williams, (1999), Access regulation and the timing of infrastructure investment, *Economic Record* 75(29):127-38.
Jorde, T., Sidak, G., & Teece, D. (2000). Innovation, Investments and Unbundling. *Yale Journal of Regulation* 20:389-406.
Laffont, J-J., & Tirole, J., (2008), Creating competition through interconnection: theory and practice. *Developments in the Economics of Privatization and Regulation*, 2008: 451-80.
Valletti, T. (2003), The theory of access pricing and its linkage with investment incentives. *Telecommunications Policy* 27(10-11): 659-75.
Crandall, R., Ingraham, A., & Singer, H. (2004). Do unbundling policies discourage CLEC facilities-based investment? *Topics in Economic Analysis and Policy* 4(1):1-23.
Gans, J., & King, S., (2004), Access holidays and the timing of infrastructure investment, *Economic Record* 80(248): 89-100.
Hausman, J., & Sidak, H., (2005), Did mandatory unbundling achieve its purpose? Evidence from five countries. *Journal of Competition Law and Economics* 1(1):173-245.
Crandall, R., & Waverman, L., (2006), The failure of competitive entry into fixed-line telecommunications: who is at fault? *Journal of Competition Law and Economics* 2(1):113-48.
Guthire, G., (2006), Regulating infrastructure: the impact on risk and investment, *Journal of Economic Literature* 44(4): 925-72.
Bourreau, M. & Dogan, P. (2006). Build or buy strategies in the local loop. *American Economic Review* 49(1): 173-99.
Pindyck, R., (2007), Mandatory unbundling and irreversible investment in telecom networks, *Review of Network Economics* 6(3): 274-98.
Aron, D., & Crandall, R., (2008), *Investment in Next Generation Networks and Wholesale Telecommunications Regulation*, Available from: http://ssrn.com/abstract=1294910

[14] Grajek, M., & Roller, L-H., (2009), *Regulation and investment in network industries: evidence from European telecoms*. ESMT Working Paper 09-004, available from http://ssrn.com/abstract=1448666 .

- The Berkman report proposes and estimates an econometric model with broadband uptake per capita as the dependent variable and (*inter alia*) local loop unbundling (access regulation) as an independent variable. The model is proposed on the basis of reference to only two other models – de Ridder (2007) and Boyle, Howell and Zhang (2008), as these are deemed to be the most recent published papers using the most recent data. The rudimentary literature review on p 115 from which this conclusion is drawn is by no means comprehensive, as it contains reference to only four papers, three of which it is claimed provide full or partial support for local loop unbundling having a positive effect on broadband uptake. Furthermore, the incomplete review is misleading as it confuses models where there is a positive coefficient for the unbundling variable and those where there is a statistically significant effect. By contrast, Boyle, Howell and Zhang summarise (p2) "some studies find that unbundling has a positive, but very small and statistically insignificant, effect on broadband uptake (e.g. Distaso, Lupi & Manenti, 2006; Kim, Bauer & Wildman, 2003; Cava-Ferrruela & Alabau-Munoz, 2006); others that the effect is neither consistently positive nor statistically significant (Wallsten, 2006); and still others that it is small and transient (Denni & Gruber, 2005)".[15] De Ridder (p5) cites two further papers: one where no effect is found for unbundling (Garcia-Murillo & Gabel, 2003)[16] and one where a positive effect is found (Grosso, 2006)[17], albeit using a very different model to that of de Ridder, and which Howell and Zhang (unpublished) have been unable to replicate using the de Ridder data and which is itself subject to criticisms in its modelling and estimation technique selection[18]. There is at least one other empirical study frequently referred to in the literature (Aron & Burnstein, 2003)[19], which also finds no effect for unbundling. Appendix 1 below summarises the variables, methodology and results of all of these analyses. The notable findings are the paucity of

Waverman, L., Meschi, M., Reillier, B., & Dasgupta, K., (2007), *Access Regulation and Infrastructure Investment in the Telecommunications Sector: an Empirical Investigation*, London, United Kingdom: LECG.

[15] The papers cited are

Distaso, W., Lupi, P., & Manenti, F. (2006). Platform competition and broadband uptake: theory and empirical evidence from the European Union. Information Economics and Policy 18(1).

Kim, J., Bauer, J., & Wildman, S. (2003). Broadband uptake in OECD countries: policy lessons from comparative statistical analysis. Paper presented at the 31st Research Conference on Communication, Information and Internet Policy, September 19-21, Arlington, Virginia, USA.

Cava-Ferreruela, I., & Alabau-Munoz, A. (2006). Broadband policy assessment: a cross-national empirical analysis. Telecommunications Policy 30, 445-463.

Wallsten, S. (2006). Broadband and unbundling regulations in OECD countries. Working Paper 06-16, AEI-Brookings Joint Center for Regulatory Studies.

Denni, M., & Gruber, H. (2005). The diffusion of broadband telecommunications: the role of competition. Paper presented and the International Communications Society conference, Pontevedra, Spain.

[16] Garcia-Murillo, M., & Gabel, D. (2003). *International broadband deployment: the impact of unbundling*. Paper presented at the 31st Telecommunications Policy Research Conference, Arlington, Virginia, September 2003.

[17] Grosso, M. (2006), *Determinants of Broadband Penetration in OECD Nations*, paper presented to the Australian Communications Policy and Research Forum http://www.networkinsight.org/verve/_resources/GrossoM.pdf.

[18] Howell, B. & Zhang, W.. *LLU and Broadband Uptake Regressions: sensitivity to morel specifications.* ISCR working paper (unpublished).

[19] Aron, D., & Burnstein, D. (2003). *Broadband adoption in the United States: an empirical analysis*. Paper presented at the 31st Research Conference on Communication, Information and Internet Policy, September 19-21, Arlington, Virginia, USA.

empirical evidence across a wide range of studies and model specifications and estimation methodologies of a material and statistically significant effect of unbundling policy on broadband uptake, and that the de Ridder analysis departs markedly from the other analyses in its choice of a time-dependent unbundling variable specification (GUYRS is measured as the length of time unbundling has been in place, rather than the more usual specification of the policy variable as a 0/1 dummy and the number of unbundled lines sold). The latter point is explored more fully in section 2 below.

The extent to which the Berkman authors have searched to find information and analyses relevant to their country-specific case studies is also questionable. Whilst they observe whether or not access regulation is present in the subject countries, and the length of time that it has been in effect forms the primary criterion upon which they cluster the countries for case studies, there is little comment made about, or attempt to critique, the political economy issues that may explain their observations.

Although the presence of extensive government subsidies in Japan and Korea is noted, the authors do not identify that for the European countries who are also members of the European Union, telecommunications access regulation of the standardised form agreed in Brussels is a mandatory condition of membership as part of the aspiration to develop a common market in the provision of services (Howell, 2006)[20]. Neither is it noted that the exclusive objective of the EU policy is to increase competition to former incumbent telecommunications companies in the short term, regardless of the wider economic consequences of pursuing this objective (arguably the "means") rather than the more usual economic justification for regulatory intervention of increased total welfare, across the aggregated short- and long-term (the "end") (Howell, 2010; Howell, 2009)[21].

Combined with the strong advocacy for open access policies from the OECD and the ITU, the mandatory EU policy consequently leads to a significant upward bias in the number of countries adopting open access policies that is not necessarily reflecting the long-term economic efficacy of their adoption. Hence, the Berkman authors' "surprising" finding of near-universal adoption of open access policies (p12) is not surprising at all. Rather, it reflects pursuit of one specific,

[20] Howell, B (2006). *An institutional economics analysis of regulatory institutions in the telecommunications sector*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. Available on http://www.iscr.org.nz/f158,3455/3455_2006-12-14_Economic_Analysis_of_Regulatory_Institutions_in_the_Telecommunications_Sector_Bronwyn_Howell_.pdf

[21] Howell, B. (2010). From the pursuit of efficiency to the pursuit of competition in New Zealand's evolving telecommunications market. Chapter in Gentzoglanis, A. and A. Henten (Eds.) (forthcoming 2010). *Regulation and the Evolution of the Global Telecommunications Industry.* Cheltenham, UK and Northampton, MA: Edward Elgar Publishing
Howell, B., (2009), Politics and the pursuit of telecommunications sector efficiency in New Zealand, *Journal of Competition Law and Economics* 2009; doi: 10.1093/joclec/nhp016 .

narrow objective in a large number of countries. Furthermore, the benchmarks used for assessment of EU performance to a highly specific 'perfect competition' yardstick (number of new entrants, market share of new entrants) are neither the best proxies for long term economic welfare nor plausible expectations in an industry characterised by high fixed and sunk costs and more typically associated with competitive interaction of a form likely more consistent with models of oligopoly, monopolistic competition or dominant firm/competitive fringe, even in the presence of 'regulated competition' (Howell, 2009, Hausman & Sidak, 2007; Alleman & Rappoport, 2005)[22]. The Berkman authors thus confuse the popularity of access regulation with its efficacy. To justify its efficacy, much tighter empirical linkages than are present in the Berkman report must be demonstrated between access regulation and both clearly defined objectives and relevant performance indicators.

By omitting to review the political economy literature and data, the Berkman authors have overlooked the crucial detail that only one country – New Zealand – has mandated local loop unbundling with the specific policy objective of increasing broadband uptake per capita (Howell, 2007; Crandall & Sidak, 2007)[23]. Furthermore, the relevance of the very late stage in the broadband diffusion cycle at which New Zealand has introduced access regulation has also been overlooked. These factors take on significance, given that any introduction of access regulation in the United States as a consequence of the current review would be similarly into a market in which significant investments have already been made and consumer usage preferences and patterns are already well-established. The paucity of analysis and discussion of the New Zealand experience represents a significant omission and leads to a report that falls short of the level of comprehensiveness that would be informative for the FCC. Similarly, it is likely that the same oversight has led to negligible discussion of the United States' own experience with access regulation in the 1990s and the reasons for the rejection of such regulations (Crandall, Ingraham and Singer, 2004[24] provides a starting point for analysis of the United States experience).

Moreover, the Berkman authors' discussion and analysis of the New Zealand experience (p 108-9) is cursory and fails to take account of a large body of available data and commentary[25]. They claim (p 109) that they "do not have sufficient historical data to compare New Zealand's

[22] Hausman, J. & Sidak, G. (2007). Evaluating market power using competitive bemchmark prices rather than the Hirschman-Herfindahl index. *Antitrust Law Journal* 74(2):387-407.
Alleman, J. & Rappoport, P. (2005). Regulatory failure: time for a new paradigm. Communications and Strategies 60 pp105-121.
[23] Howell, B. (2007). *A Pendulous Progression: New Zealand's Telecommunications Regulation 1987-2007*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. Available on http://www.iscr.org.nz/f378,10548/10548_Pendulous_Progress_v_4_12_Nov.pdf
Crandall, R., & Sidak, G. (2007). *Is mandatory unbundling the key to increasing broadband penetration in Mexico? A survey of the international evidence*. Criterion Economics. Available on http://ssrn.com/abstract=996065 .
[24] Crandall, R., Ingraham, A., & Singer, H. (2004). Do unbundling policies discourage facilities-based investment? *The B.E. Journal in Economic Analysis and Policy*.
[25] Whilst I am the author with most papers addressing the New Zealand market, J Scott Marcus of WIK-Consult (Germany) has also taken an interest in the New Zealand case and authored several papers.

performance to our more balanced, multidimensional benchmarks", yet all of this data and very much more (including extensive analyses using efficiency as well as competition, price, uptake and availability data) for the period covering 2000 to 2009 is freely and publicly available on the ISCR website http://www.iscr.org.nz[26]. The papers and data are not difficult to find. A Google search on the term "New Zealand Broadband diffusion" on November 11 yielded thirteen direct references or links to ISCR work in the first twenty items. As one of ISCR's papers (Boyle, Howell & Zhang, 2008) has been cited, it cannot be that the authors were unaware of our Institute's existence or interest in access regulation and New Zealand broadband markets. Indeed, the website is the primary publication source for the paper cited by the Berkman authors (however, it is noted that although the paper is correctly referenced in the Annex to chapter 4 (p 151), in the text its authorship is attributed to "The New Zealand Institute" (p 139) – a completely separate organisation which has also published a very much smaller number of papers on New Zealand broadband policy).

The Berkman discussion of the New Zealand case fails to yield very relevant information that would inform the FCC's policy analysis for the Untied States. For example, New Zealand has been a world leader in the price of dial-up internet access and the number of people connected to the internet since the mid 1990s (Boles de Boer, Enright & Evans, 2000; Boles de Boer, Howell and Evans, 2000)[27], was third in the OECD to make commercial ADSL publicly available, from an early stage has had very wide availability of high-speed, low-priced ADSL (85% of residential consumers had access to 2 Mbps connections by 2002, priced very competitively (in OECD terms) taking speed and average usage into account - Howell, 2003)[28], but has experienced a much slower rate of residential (but not business) substitution from dial-up to ADSL almost certainly as a consequence of unmetered local residential calling raising the threshold of benefits required to justify users migrating from the legacy technology (dial-up) to the frontier (ADSL) (Howell, 2008)[29]. Access regulation has been impotent in addressing the rate of broadband uptake – indeed, the market share of entrants decreased following the mandating of bitstream unbundling in 2003 (Appendix 2) – and the best explanation for New Zealand's broadband uptake patterns remains demand-side factors that feed into the classic patterns of diffusion observed

[26] In the year to date, over 3000 unique downloads have been recorded of papers from the ISCR broadband project suite.

[27] Boles de Boer, D., Enright, C., & Evans, L. (2000). The performance of Internet Service Provider (ISP) markets of Australia and New Zealand. *Info* 2(5), 487-95.
Boles de Boer, D., Evans, L. & Howell, B. (2000). *The State of e-New Zealand*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. Available on http://www.iscr.org.nz/f234,4730/4730_e-new_zealand150900.pdf

[28] Howell, B. (2003). *Building best practice broadband: bringing infrastructure supply and demand together*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. Available on http://www.iscr.org.nz/f213,4379/4379_building_best_practice_060603.pdf

[29] Howell, B (2008). *The role of price structure in telecommunications technology diffusion*. Paper presented at the International Telecommunications Society European Regional Conference, Rome Italy, September 17-20, 2008. Available on http://www.iscr.org.nz/f460,13411/13411_ITS_Price_Structure_and_Technology_Diffusion.pdf

when any new technology begins to spread throughout the market (Howell, 2009)[30]. Indeed, each increase of the intensity of access regulation in the New Zealand telecommunications market has been directly linked to a measurable reduction in market efficiency (Howell, 2007)[31], most notably in substantial delays in the deployment of next-generation technologies, to the extent that a missing market for investment in fibre to the home has occurred, with the consequence that government has stepped in to subsidise its deployment (Howell, 2009)[32]. The dominant feature of the New Zealand market under access regulation has been three-way strategic gaming between the incumbent, entrants and the regulator (Howell, 2008)[33].

The paucity of critical analysis in the Berkman report is highlighted by the New Zealand case study. The inference "that the regulatory shift has had its intended effect" (p 109) based upon New Zealand's rise from 22nd to 18th in OECD rankings between 2006 and 2008 is overly-simplistic, flawed and internally inconsistent even with the study's own econometric analysis. The authors note that the rise in New Zealand's broadband uptake per capita occurred even though "prices on the other hand, dropped only slightly" (*ibid*) – a very puzzling finding given the assertions in their regression analysis (pp 116-7 and 138-51) that unbundling regulation acts on broadband uptake primarily because regulation lowers prices, with the effect being greater the longer unbundling has been in place.

It is also noted that the Berkman report, although claiming to synthesise experiences from around the world, focuses its empirical and theoretical analyses exclusively on OECD countries (presumably as a consequence of data availability and perceptions of comparability with U.S. experiences. Consequently there is little drawn from the experience of either mature non-OECD markets such as Hong Kong and Singapore or developing markets such as Brazil, Latin America, India, China, South-East Asia and Africa. The latter markets are notable for the extent to which mobile technologies are shaping market development, and warrant consideration in that they provide positive evidence to challenge the largely OECD-centric normative view that fixed-line technologies ought to dominate future broadband market developments. Whilst data and analysis on these markets is sparser, the LIRNE network (http://lirne.net) contributes significantly and positively to the international debate on telecommunications issues, and 'fills a gap' in analysis

[30] Howell, B. (2009). Has local loop unbundling increased New Zealand's broadband uptake? *ISCR Current Comment* 2009(2). Available on http://www.iscr.org.nz/f539,15546/15546_LLU_and_Broadband_Uptake_2.pdf

[31] Howell, B. (2007). *A Pendulous Progression: New Zealand's Telecommunications Regulation 1987-2007*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. Available on http://www.iscr.org.nz/f378,10548/10548_Pendulous_Progress_v_4_12_Nov.pdf

[32] Howell, B,. (2009). *Separating New Zealand's incumbent provider: a political economy analysis*. Paper presented at the International Telecommunications Society Africa-Asia-Australasia Regional Conference, Perth, Australia, August 2009. Available on http://www.iscr.org.nz/f503,14751/14751_Political_Economy_of_Separation_BHowell_April09.pdf

[33] Howell, B. (2008). *Strategic interaction under asymmetric regulation: the case of New Zealand.* Paper presented at the Telecommunications Policy research Conference, Arlington, VA September 2008. Available on http://www.iscr.org.nz/f467,13555/13555_ITS_Strategic_Interaction_Under_Asymmetric_Tariff_Regulation.pdf

and data relating to countries not part of the OECD network. Surprisingly, the Berkman report does not appear to make any reference to the research undertaken by this prominent network. The failure to consider such work impinges substantially on claims that the report is complete, comprehensive and derived from a worldwide study.

In summary therefore, I contend that the Berkman report does not provide a complete and objective survey of the subject matter as might be expected from an expert review. There are numerous omissions in respect of the body of both theoretical and empirical literature directly relevant to the FCC inquiry. The report is neither accurate nor comprehensive in its summary of the broadband experiences of New Zealand – rather, the very shallow analysis gives a very inaccurate picture and the conclusions drawn from it are unjustifiable and potentially misleading. It omits a substantial amount of relevant experience from non-OECD and developing world that challenges the OECD-centric paradigms of how broadband markets 'ought' to develop. The report therefore does not accomplish its intended purpose, and should be given very little weight in informing United States broadband policy.

2. Credibility of Econometric Analysis of LLU and Broadband Uptake

The Berkman report in large part relies upon reasonably simple descriptive statistics, bi-variate correlations, and weighted ordinal country rankings to inform its conclusions that access regulation is responsible for observed differences between the United States broadband market performance and that of the comparator countries. Such empirical analysis provides a very poor basis upon which to compare the efficacy of different policy approaches, due to the likelihood that individual factors interact with each other in complex ways, and that individual factors sampled at discrete points in time only partially reflect the extent of these interactions.

However, the report contains one multivariate analysis: a mixed effects regression model which the authors claim shows a positive and statistically significant relationship between access regulation (local loop unbundling, measured as the length of time that local loop unbundling policy has been in place) and national broadband uptake per capita (pp 115-7 and 138-51). In the context of the paper, this finding provides crucial evidence in support of the recommendation that the United States consider implementing access regulation.

The Berkman authors rely completely and uncritically for their econometric analysis upon a model specified in de Ridder (2007) subsequently critiqued and found by Boyle, Howell and Zhang (2008) to contain flaws in both the choice of estimation technique used and the model specification, both of which lead to de Ridder's model falsely attributing significance to local loop unbundling an effect that in alternative specifications is shown to be occurring as a consequence of an omitted variable – namely the length of time that broadband has been available. The Berkman authors justify their econometric modelling on the basis that de Ridder's paper "offers the most recent and extensive analysis, and because it was subject to recent direct methodological critique and reanalysis of the data" (p 115). They reject the Boyle, Howell and Zhang re-estimation of the de Ridder's equation using robust standard errors (Arellano, 1987; Petersen, 2007)[34] as "the Arellano method is not necessarily standard, considering the Peterson (sic) paper came out the same year as the de Ridder paper was published" (p 139) and the supposed superiority of their group effects estimation (pp 139-40) and the (possible) removal of Switzerland from the data sets estimated on the basis of its being an outlier that when eliminated "results in much more significant models than when it is included" (p 145).

[34] Arellano, M. (1987). Computing robust standard errors for within-groups estimators. *Oxford Bulletin of Economics and Statistics* 49, 431-433.
Peterson, M. (2007). Estimating standard errors in finance panel data sets: comparing approaches. *Review of Financial Studies*, forthcoming.

They re-estimate de Ridder's model (uncorrected for any of the criticisms of the modelling raised in Howell, Boyle and Zhang) using:

(a) an alternative mixed effects specification for the full panel (Table 4.3, p 145);

(b) an alternative data set for the length of time unbundling has been available, for both the full panel (Table 4.5, p 146) and the 2005 data alone (Table 4.4, p 146),; and

(c) an alternative 0/1 specification for the unbundling policy variable, for both the full panel (Table 4.7, p 148) and the 2005 data (Table 4.7).

It is unclear whether the Tables 4.4 to 4.9 report regressions using the full data sets including Switzerland, as unlike the description of Table 4.3, the number of data points has not been stated.

They find unbundling has both a positive effect and is statistically significant in all of these analyses, and thereby reject the criticisms contained in the first third of Boyle, Howell and Zhang that de Ridder's choice of estimation technique results in over-attribution of significance to the unbundling variable (GUYRS)[35]. This leads them to claim "our conclusion is that unbundling has a positive and significant effect on levels of penetration; that this effect is somewhat larger, more statistically significant and more robust than previously thought; and that some of the ambiguity in prior studies can be attributed to the large influence that Switzerland's experience had in dampening the effect of unbundling"(p 115).

However, the Berkman econometric analysis is notable for its failure to mention the Boyle Howell and Zhang (BHZ) criticisms of the conceptual construction of the de Ridder model, or to apply its theoretical concerns to test the plausibility of the Berkman models estimated. As identified in Section 1 above, the choice of estimation technique was only one of two substantive criticisms made by BHZ of the de Ridder model. Arguably, as two thirds of the BHZ paper is given to identifying a potentially serious modelling omission in the de Ridder paper, and re-estimating an alternative set of models that appear to substantially confirm this omission, the Berkman authors' failure to even mention this substantive concern is perplexing.

BHZ propose that the choice of 'years since unbundling was introduced' as the unbundling variable GUYRS in de Ridder leads to the finding of significance attributed to unbundling policy in the model, as GUYRS is highly correlated with the length of time broadband has been available. In a standard diffusion model (the classic 'S' curve), broadband penetration at any given point in time will be determined by the length of time it has been diffusing (Howell, 2009). Whilst in the de Ridder specification the dummy variable accounting for the year the data represents (2002 or 2005) picks up some of the effect of the time the technology has been

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available, there will still be a residual effect arising from the different levels of broadband diffusion achieved in each country by the time the 2002 data is sampled, given that in each country the technology was introduced at a different time. The cross-country difference arising from different adoption times is likely to be largest in the early stages of a technology's diffusion.

To test the hypothesis that there is an omitted, time-dependent variable in the de Ridder specification, BHZ added AVAILABLE, the length of time DSL had been available, to the model. Not surprisingly, AVAILABLE and GUYRS are highly correlated (Pearson coefficient in excess of 0.5. regardless of various specifications of GUYRS and AVAILABLE from various data sets). They then re-estimated the modified equations, firstly replacing GUYRS alone with a 0/1 LLU_YES as the unbundling policy variable, both with and without robust standard errors. LLU_YES was not statistically significant, but the year dummy increased in significance in both instances. The model was then re-specified and re-estimated using both AVAILABLE and GUYRS (but not the year DUMMY, as the time effect is clearly accounted for in the differences in the length of time the technology has been available), both with and without standard errors. The coefficient for GUYRS reduced by approximately one third, and it ceased to be statistically significant in both cases. Not surprisingly, AVAILABLE was statistically significant (Table 2, BHZ p 9). BHZ thus concluded that the significance found for GUYRS in the de Ridder specification occurred as a consequence of an omitted and significant variable – the length of time the technology had been available. This explanation is both conceptually and empirically justifiable.

As the Berkman econometric specification does not take account of the omitted variable identified in BHZ, it is also highly likely that it too is over-attributing the omitted time-dependent variable to other variables in the specification – specifically GUYRS when it is specified as a time-dependent variable. Indeed, analysis of the Berkman tables appears to support this contention.

The Berkman authors apply one set of models where GUYRS is replaced with a 0/1 variable (as per BHZ's LLU_YES variable). These models are reported in tables 4.6 and 4.7 p 148. The Berkman authors' tables indicate that GUYRS has considerably less explanatory power when expressed as a 0/1 variable (Tables 4.6 and 4.7) than in the equivalent regressions where it is modelled as a time-specific variable starting from 0 (Tables 4.4 and 4.5). There is no discussion of this finding, despite it being strongly suggestive of the time-dependence of GUYRS in the de Ridder/Berkman specification potentially detecting an effect due to an omitted time-dependent variable.

Further confirmation of this suspicion is provided by the Berkman finding that GUYRS as a time-dependent variable has greater explanatory power in the panel data than the 2005 data alone. Whilst the Berkman authors note that DUMMY picks up one time effect - namely the extent of diffusion that occurs between the 2002 and 2005 dates when data was sampled - the difference in significance of GUYRS is present even in the regressions done using only the single year 2005 data (Table 4.6 vs 4.4) where DUMMY is not present. Of course, an alternative explanation of the Berkman observation (warranting discussion in light of the empirical literature on LLU and broadband uptake summarised in section 1 above) is that LLU may have a more significant effect on broadband uptake levels earlier in the diffusion process (i.e. in 2002) than later (2005) - that is, the transient effect found for it by Denni & Gruber (2005) in their analysis of US data. This possibility draws into question the presumption implicit in their modelling that the effect of unbundling on broadband uptake is greater the longer unbundling has been in place. The absence of any such discussion places a further significant caveat upon the usefulness of the Berkman analysis and conclusions for future policy-making without further investigation - e.g. running the analysis on the 2002 data alone and comparing significance.

As an interesting aside, the Berkman 2005 tables and discussion tend towards the hypothesis that a further time-dependent factor not discussed in BHZ is also biasing the de Ridder /Berkman findings. The Berkman authors have demonstrated that GUYRS is correlated with the price variable LNPDSL. They ascribe this to the effects of regulation lowering prices - that is, all else being equal, the longer regulation has been in place, the lower the price of DSL will be. However, this does not flow logically from the presence of regulation per se (unless of course, the regulation in question is rpi-x incentive regulation - which access regulation is certainly not).

Regulation introducing cost-based prices when prices have previously reflected market power will most likely have a single, immediate stepwise effect on penetration as pent-up demand is satisfied from the one-off reduction in price. Once all consumers who value the good at the new price have purchased, there should be no further effect from the regulation itself affecting prices unless there is some other factor also acting to reduce the underlying cost of providing the regulated good - thus, a 0/1 LLU variable should be adequate to detect such a stepwise effect if it is present. Whilst regulation may ensure that any cost decrease that arises is more likely to be passed on, it does not automatically follow that there would be no such passing on if regulation was not present. For example, dominant firm-competitive fringe competition between two platform competitors would also ensure that some of the cost reductions shared by both networks was passed on. As reductions in regulated prices are simply passing on reductions in the underlying cost of the technology, a linear reduction in LNPDSL may not be signalling more effective regulation due to the length of time that the regulation has been in place.

Indeed, these effects, along with the demand-side diffusion effects noted in BHZ, may plausibly explain the 'anomaly' of Switzerland's low price and high penetration despite the absence of LLU which leads the Berkman authors to (we would content mistakenly) argue for the removal of Switzerland from consideration in the analysis. Removing Switzerland from the data sets analysed removes one quarter of the observations relating to countries where LLU was operational at that time (Mexico, New Zealand and the United States were the countries left in the sample). The authors cite Switzerland as a data anomaly, but provide no other credible explanation as to why it might be exhibiting the 'anomalous' observations. Yet the BHZ explanation of the significance of the length of time the technology has been available would imply that Switzerland, as one of the earliest countries to have DSL available, is not an anomaly. Arguably the Berkman authors may see Switzerland as anomalous simply because they are seeking to find a positive and statistically significant effect for LLU. If the primary reason why it is suggested Switzerland should be removed from the data was because it caused GUYRS to become less significant in their modelling (as is suggested in Figure 4.18 on p 145), it would be difficult to support the Berkman authors' contention that their econometric analysis is "independent" (as they claim on p 115).

Rather, an equally (or arguably even more) plausible explanation is that the actual cost of providing the technology is decreasing as a function of time. This phenomenon is a characteristic of any new technology, as more experience is gained, scale effects come into play and, importantly, new manufacturers are able to make the components more cheaply, allowing service providers (i.e. telecommunications network providers) buying the components as inputs for their services (i.e. construct networks and sell services) to do so at a lower cost. Indeed, this is precisely what has been happening in telecommunications markets - regulators have been able to reduce cost-based regulated (eg. TSLRIC) access prices over time simply because the underlying componentry now costs less to procure and install (and TSLRIC pricing ensures that even if services are provided on the same network, the regulated access price will go down because the current frontier technology cost has decreased, regardless of the cost of the technology actually deployed). The evidence of the effect is contained in the relevant price indexes in most OECD countries.

Thus, it cannot be discounted that it is industry effects (reducing real prices of DSL supply) and not regulation that is driving the GUYRS/LNPDSL effect that the Berkman authors identify. In the BHZ specification, AVAILABLE will pick up this effect, along with the increasing demand due to demand-side diffusion effects. However, the Berkman/de Ridder specification will not. When the BHZ authors model GUYRS as a time-dependent variable along with AVAILABLE

and LNPDSL (Models C and D Table 2), the significance of price decreases and GUYRS is no longer significant. Thus AVAILABLE is proxying for both the natural diffusion effects on the demand side of the model and the reducing cost of provision of the technology that has been evidenced in the industry. It is a significant explanator of the level of broadband uptake in this specification, and GUYRS specified as the length of time regulation has been in place is (as suggested in the pure regulation model) is not. (Of course, it also cannot be discounted that prices are lower in countries that have had the technology longer (correlated to time-dependent GUYRS) simply because it was deployed first in the lower-cost markets - something else that a more comprehensive analysis might seek to take into account).

In summary, the Berkman regressions do not conclusively support the finding of LLU being a significant driver of broadband uptake in the OECD, as they do not satisfactorily address the plausible alternative explanations of BHZ that natural technological diffusion processes that are resulting in a time-based GUYRS variable picking up other time-based factors associated with broadband diffusion. Consequently, both the de Ridder and Berkman regressions have over-stated the significance of LLU in broadband uptake. Whilst the Berkman authors claim that the BHZ estimation technique is used at unnecessary expense of power in the data, and that their estimation technique is satisfactory on the basis of the correlation structure of the data, such arguments are of little merit in the face of fundamental omissions in the modelling. When the time-dependent diffusion effects are separated out, BHZ find that the time-bound LLU proxy GUYRS is not significant, but the alternative time-bound variable reflecting both supply- and demand-side diffusion effects is statistically significant, both with and without accounting for robust standard errors. It would therefore be quite inappropriate fro the FCC to rely upon the Berkman empirical analysis to support United States policy-making[36].

[36] It it was never the intention of the BHZ authors to suggest that their model provided a 'the definitive answer' to the relationship between LLU and broadband uptake - it was simply intended to demonstrate that the de Ridder model (and now also the Berkman model using the same conceptual modelling and variables) cannot be used to support the efficacy of the intervention in the manner claimed without first addressing the points about the role of time-based diffusion factors in the model specification. Of course, it is always possible that there is a significant effect from regulation that might come to light at another point in time when the technology is more (or less) mature. However, at least to the point of the 2005 sample, any effect from LLU appears to be crowded out by the overwhelming effect of a new technology diffusing rapidly simply because of its own inherent characteristics - both on the demand and supply sides. Furthermore, as BHZ identified, even if it is significant, the coefficient of the LLU variable in all of the models suggests that its effect is materially small relative to the coefficients of all of the other significant variables at the present point in time.

3. Research Process Integrity

In the course of my examination of a limited number of elements of the Berkman report, I have become aware of a number of shortcomings in the Berkman research processes that I wish to draw to the attention of the FCC report commissioners. These may be the result of genuine oversights, lack of suitable expertise within the Berkman team to undertake the tasks with which they were charged, or at worst, a deliberate intention to mislead. I am in no position to suggest which (or any) of these explanations might best explain my observations. However, I feel that I cannot leave these shortcomings undocumented.

The most serious concern I have is the very substantial omission of the modelling criticisms identified in BHZ. It is difficult to imagine anyone who had read the paper not being aware of its substantive findings, or the importance of the conceptual modelling impacts upon the debate regarding the efficacy of access regulation as a means of increasing broadband uptake.

Furthermore, I am aware that the Berkman authors have been in contact with John de Ridder, who has openly conceded that the BHZ criticisms of his modelling are valid. He provided them with his data and, he has informed me, urged them to get in contact with me to discuss the implications of BHZ on the usefulness of the de Ridder model. John and I have been regular correspondents since first meeting in 2002, and routinely share our research with each other. Indeed, John was the first person I asked to review BHZ, and he freely admitted that we had raised some valid criticisms that impinged upon the usefulness of his regression analysis. John has been very generous in making his data set available to a number of researchers, and since the publication of BHZ, he has indicated to me that he has urged all such requesters to contact me, and has provided my contact details so they can discuss further with me the implications of our modelling. I can confirm that two other researchers have contacted me directly as a consequence of John's recommendation. However, I have had no contact from anyone associated with the Berkman project.

These two factors raise questions about the integrity of the Berkman research processes that I would suggest it behoves the FCC to further investigate.

There are also two other minor issues I have identified that, on their own, may be rather trivial but in light of the concerns expressed above I believe warrant highlighting.

Firstly, the eliminating Switzerland in the econometric analysis, given the large effect it has as one of the few countries without LLU, without offering a plausible explanation as to why it

exhibits such apparently 'anomalous' data may be statistically helpful, but any model explaining the nexus between LLU and broadband uptake has to be able to explain why Switzerland has negligible unbundling but a high broadband uptake. This is not addressed. Rather, the authors contend "much of the ambiguity in prior analyses is explained to a large extent by Switzerland's experience. While we too agree that Switzerland's experience is an example, that it is possible under certain circumstances to do well without unbundling, we see here that econometric analysis has been reflecting that qualitative caution, rather than a broader ambiguity in the results across many countries" (p 117). By omitting Switzerland (one of only four countries without LLU in place) from analysis,:the Berkman authors conclude there is even stronger "econometric analysis (that) lends support to the proposition that the experience of other countries in the OECD is that unbundling rules, effectively enforced, increase penetration" (p 139). It might be equally easily argued that omitting Switzerland enables the model to meet the theory, rather than confronting the more challenging question of looking for alternative explanations as to why Switzerland has high levels of broadband uptake without unbundling in place. Yet finding such an alternative explanation is not such a difficult task if the modelling in BHZ is introduced into the discussion.

Secondly, the level of referencing in the Berkman report is very poor. The misattribution of the aegis under which the BHZ authors undertook their research, and the mis-spelling of Petersen's name have already been identified. However, other papers and authors are also loosely referenced. De Ridder is referred to as "de Ritter" on p 116. Only one of the papers referred to in the (limited) literature review of econometric literature on p 115 is fully and correctly referenced (Wallsten, 2006 – footnote 85). Of the others, "Garcia-Murillo (2003)" is referenced in footnote 86 with only a title and no publication affiliation (from the title, I suspect it might be referring to Garcia-Murillo & Gabel (2003) as cited (with full attribution) in de Ridder and BHZ), whilst no details are provided for "Bauer et al (2003)", "Cava-Ferreruela and Alabau-Munoz (2006)" or "Grosso (2006)". Given the level of literature search in other areas of the paper has been so cursory (see section 1 above), that all of these papers are cited in both de Ridder and BHZ, and the discussion of the econometric analyses and country discussions shows very little understanding of the very wide range of debate on the subject of access regulation, it begs the question of whether the authors have actually acquired and read the papers concerned.

Unless the Berkman authors can provide plausible and credible explanations for these observations in respect of only those parts of the report that I have analysed in detail, then there must be considerable doubt about the integrity of the research process under which the Berkman report was produced.

Appendix 1 : Literature Survey – Broadband Uptake Drivers

Study	Data	Dates	Model	Variables	Specification	Signif
A&B 2003	US	2000-1 N=46	OLS	intra-platform	%popn 1 platform-capable	no
				inter-platform	%popn >1 platform-capable	yes
				education		yes
				internet accs		yes
				teledensity		yes
				loop length		no
				loop price		no
KBM 2003	OECD	2001 N=30	OLS	price	broadband – weighted monthly	no
				substitute price	30 hours peak + offpeak	no
				income	GDP per capita	no
				preparedness	own index of technology attitudes	yes
				competition	not specified	no
				popn density	not specified	yes
				policy cluster 1	dummy	no
				policy cluster 2	dummy	no
				policy cluster 3	dummy	no
G-M&G 2003	135 country	2001 N=135	Logit regression	LLU	dummy	no
				privatized	dummy	yes
				semi-private	dummy	no
				state-owned	dummy	no
				monopoly	dummy	no
				duopoly	dummy	no
				partial comp	dummy	no
				full comp	dummy	no
				popn density	people/sq km	yes
				price	monthly per MB	yes
				income	GDP/capita	yes
				education	illiteracy/avge years in education	no
				content	no. domain name servers	no
				internet access	dial-up internet accounts	yes
C-F&A-M 2006	OECD	2000-2 N=90	OLS demand	internet	accounts per capita	yes
					web sites per capita	no
				computers	PCs per capita	no
				education	% population tertiary qualified	no
		N=36	supply & demand	price	DSL, cable	no
				availability	lagged availability	yes
					cable passes home	yes
				internet	accounts per capita	yes
					web sites per capita	no
				computers	PCs per capita	no
				education	% population tertiary qualified	no
				LLU	unbundled lines	no
Wallsten 2005	OECD	1999-2003 N=179	OLS country & year fixed effects	full LLU	dummy	some
				sub-loop	dummy	yes
				bitstream	dummy	no
				co-mingling	dummy	some
				remote	dummy	no
				virtual	dummy	yes
				reg line price	dummy	some
				reg co-lo price	dummy	some
				income	GDP per capita	yes
				teledensity	fixed lines per capita	yes

Study	Data	Dates	Model	Variables	Specification	Signif
D&G 2005	US	1999-2004 N=39	logistic time-based	intra-platform	HHI number of firms on platform	no
				inter-platform	HHI sumsquare(platform share%)	yes
				competition	comp lines/total lines	no
				potential comp	% exchanges offering access	no
				teledensity	lines/exchanges	no
DLM* 2006	EU14	2002-4 N=158	OLS	intra-platform	HHI number of firms on platform	no
				inter-platform	HHI sumsquare(platform share%)	yes
				rights-of-way	dummy	no
				LLU price		yes
				leaseline price		yes
				call price		no
				income	GDP/capita	no
Grosso 2006	OECD	2001-4 N=179	double log GLS time-based	concentration	HHI platform market shares	yes
				income	GDP per capita	yes
				internet	fixed internet accounts last period	yes
				unbundling	dummy	yes
de Ridder 2007	OECD	2005 N=30 2003/5 N=54	OLS	income	GDP per capita	no
				age	share of population aged 35-44	yes
				education	popn % tertiary-educated	no
				price	weighted price DSL & cable	yes
					DSL price	yes
					relative price DSL/dial-up (20hrs)	yes
				weather	daily average sunlight hours	no
				saturation	internet subscribers/population	yes
				urbanisation	% of population urbanised	yes
				competition	market share of non-DSL lines	no
				LLU	years LLU in operation	yes

* DLM use number of all access lines upgraded for high-speed access as the dependent variable; customer purchase choices are reflected in HHI figures

Source: Howell and Zhang (unpublished)

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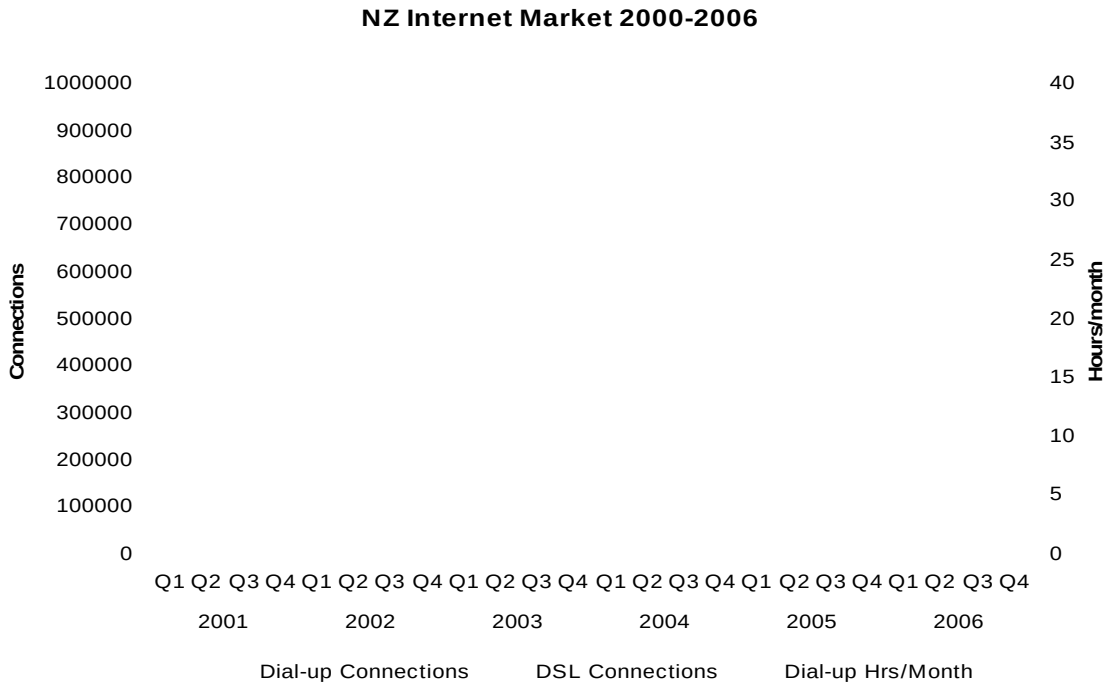
Appendix 2: Bitstream Unbundling and NZ Broadband Uptake (Howell, 2007 p 126)

Bitstream unbundling was mandated in December 2003; competitive intensity decreases – likely as consequence of strategic gaming by entrants seeking more intrusive regulation (Howell, 2008)



Substitution from dial-up due to increasing individual internet usage drives NZ broadband uptake

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