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

Regulating Broadband Networks: Assessing the Global Data for Evidence-Based Policy

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September 2012

Paper prepared for the Tullock Lecture on Big Ideas About Information, presented at the Information Economy Project, George Mason University, Arlington Virginia, September 25 2012

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Acknowledgement

I would like to acknowledge and thank the Information Economy Project at George Mason University, and in particular Professor Thomas Hazlett, for honouring me with the invitation to present the prestigious Tullock Lecture on 'Big Ideas about Information', and for generously funding my trip from Wellington, New Zealand to Washington, DC. It is a humbling experience for an academic from one of world's smallest and most isolated developed economies (New Zealand, located in the South Pacific, with a population of only 4.4 million people) to deliver a lecture on telecommunications regulation policy to an audience of policy, practitioner and academic stakeholders in the capital city of the country that is not just the world's largest economy, but also gave birth to the internet, and nearly thirty years on, still stands at the international forefront of its adaptation and development.

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September 18, 2012

Context[1]

My academic research for the past fourteen years (following a career of similar length as an IT professional) has been grounded predominantly upon comparative analysis of the performance of the New Zealand telecommunications sector under a variety of policy regimens. At first glance, one might wonder what insights such a body of research could possibly offer United States practitioners and policy makers as the industry sits at the cusp of a new age of ubiquitous ultra-fast broadband availability. However, an examination of the historical context suggests that comparative analysis of the development of the New Zealand and United States industries over the past thirty years, and the more recent experiences of the past thirteen years as New Zealand has pursued industry policies more consistent with those firstly of Europe and latterly Korea and Japan, is informative for policy makers and practitioners in both countries.

Whilst unlike the United States, New Zealand has not been at the forefront of technological development of the internet, in the 1980s and 90s[2] it stood in the vanguard of telecommunications sector deregulation and privatisation. In 1987, it became the first country in the OECD to rely predominantly upon competition law rather than industry-specific regulation to govern sector activity. The ensuing 'light-handed' regulatory regime provided fertile ground for foreign (and notably American) interests. This took the form of substantial investment (by both telcos and media companies, and as both incumbent operators and new entrants) and 'live market experimentation' with the implementation of both new technologies and alternative business models. It has been argued that in this regard, New Zealand provided an excellent 'natural experiment' against which the American industry (and notably the effects of 1996 Telecommunications Act reforms) could be compared. Thus, for a period in the 1990s, New Zealand could lay claim to being at the centre of a substantial international telecommunications analytical and research endeavour. A search of the contemporaneous literature confirms that a substantial number of American law, economics and public policy scholars and practitioners were both prolific and significant contributors to this endeavour.

The new millennium, however, brought with it a sea-change in New Zealand telecommunications policy. From being the most lightly-regulated telecommunications market in the OECD in 1999 (and one of the first with a fully privatised incumbent operator[3]) New Zealand

[1] For further detail, see Howell (2003), Howell (2007), Howell & Sangekar (2009), Howell (2010) and Howell (2012).
[2] Albeit that it has held an early and strong strong leadership position in the availability, uptake and use of the internet - Boles de Boer, Evans & Howell (2000); Howell & Marriott (2001); Howell, Mishra & Ryan, (2004).
[3] Telecom New Zealand was fully privatised in 1990 (Howell, 2007), unlike Telstra in Australia, which was not fully privatised until 2006 (Howell, 2012).

has now become in 2012 one of the most tightly regulated, with a fixed-line industry structure mandated to embody full structural separation and cost-based access pricing across all networks. Moreover, government has re-entered the industry as a primary stakeholder in the funding (specifically subsidising) and controlling the strategic direction of the firms providing the nationwide ultrafast broadband network infrastructure. To understand this policy u-turn, it is necessary to consider the context in which this change has occurred.

Innovative change – be it of technological or policy origin – creates turbulence[4]. Turbulence is by its very nature unsettling for all who are caught up in its effects. First, because it is extremely difficult to anticipate exactly how the effects of change will play out in highly complex and adaptive systemic environments, turbulence generates uncertainty. Second, it inevitably results in the emergence of winners and losers. The New Zealand telecommunications policy changes took place in the context of wide-sweeping economy-wide reforms creating maelstroms of turbulence that left very few citizens unmarked (albeit that when measured against a counterfactual of the pre-reform policy status quo, even the 'harmed' individuals were most likely (absolutely, though not necessarily relatively to the winners) better off at the end of the period)[5]. The political consequences were both constitutional[6] and policy[7] changes adopted with the espoused intention of militating against the future ability of policy-makers to generate turbulence of the forms and magnitude experienced in the 1980s and 1990s.

In telecommunications, the 'sea-change' was manifested predominantly in an explicit retreat from the regulatory frontier towards increasing conformity to various forms of international 'policy orthodoxy'. As 'light-handed' regulation was abandoned for (successively) access regulation overseen by an industry-specific regulator (2001), bitstream unbundling (2004), local loop unbundling (2006) and functional separation of the incumbent operator (2007), international interest in New Zealand as a locus for policy and business model innovation, and the attendant analytical research endeavour, has receded. Even recent government funding of the nationwide fast fibre network has drawn only muted international research interest[8], in large part

[4] I wish to especially acknowledge the contributions of Mark Obren and Lew Evans towards my learning and thinking on this matter.
[5] See Evans, Grimes, Wilkinson & Teece (1996) for a discussion.
[6] The adoption of proportional representation as the means of electing representatives for the national Parliament.
[7] The Labour-led government won the 1999 general election promising a series of policy reforms in the telecommunications, electricity, health, education, labour, transport and state services portfolio areas. These reforms were widely promulgated as "reversing the failed policies of the 1980s and 1990s". However, few changes were made to the financial and monetary policies introduced in the earlier reforms.
[8] Three notable exceptions are Stanford Levin (University of Southern Illinois Edwardsville, USA), Catherine Middleton (Ryerson University, Toronto, Canada) and Bert Sadowski (Eindhoven University of Technology, The Netherlands).

because these policies have already been extensively applied (and researched) in other jurisdictions[9].

It is this context that leads, both directly and indirectly, to today's lecture. First, the unfortunate demise of international research interest in the 'New Zealand experiment' has left me with some degree of market power as one of the few academics to have extensively studied, both theoretically and empirically, the transition from industry governance under competition law (the espoused ulterior objective of thirty years of international industry deregulation and privatisation) to an increasingly interventionist industry-specific regulation. I also have few rivals analysing the interplay of the concomitant disruptions of increasingly intrusive re-regulation and the rapid diffusion of internet adoption and use (arguably the most significant technological disruption in the telecommunications industry's long history[10]). My research therefore is likely especially relevant for United States policy-makers who so far have eschewed explicit regulatory intervention in internet markets. New Zealand offers a viable set of 'factual' experiences to inform United States policy-makers of what might occur if access regulation policies are applied part way through the diffusion of internet technologies, as opposed to being in place in advance of that widespread diffusion occurring (as has been the case in most other OECD countries). Indeed, the application of some of my research arising from the New Zealand experience to the United States policy context in respect of the National Broadband Plan (Howell, 2009) has played some part in the invitation to present this lecture today.

Second, but perhaps more important for the theme of this lecture are the insights that my research has given me into the role of empirical evidence in the policy-making process per se. At the forefront of policy innovation, theory (in its normative role) alone must provide the inspiration[11]. There is scant empirical evidence to act as a guide, aside from what one observes contemporaneously with the implementation. To expand the military metaphor, for those in the van the role of empirical research is predominantly to fine-tune current tactics in order to achieve the current objective, and to assist in making a call to abandon the thrust if that is indicated. For the rest, however, empirical research of the vanguard's endeavours provides evidence to support a case for either joining the thrust (i.e. adopting the same policy) or rejecting it. The actions of the initiators have themselves created information from which followers can learn. 'Evidence-based

[9] Not just Japan and Korea, but also a number of non-OECD countries such as Hong Kong, Singapore and Malaysia.
[10] Obren (2006).
[11] The New Zealand reforms of the 1980s and 1990s were in large part based upon the theories of neoclassical micro and macroeconomics emanating from the 'Chicago School' – see Evans, *et al.*, (1996) and (more recently) Evans, Guthrie & Quigley (2012).

policy' is thus an information luxury afforded predominantly to second and subsequent movers[12]. Its primary purpose is to avoid (or at least minimise) many of the costs of policy-induced turbulence borne by the first mover(s) – including eschewing the policy if overall the benefits on offer do not appear compelling.

One might anticipate, therefore, that when contemplating a decision to follow the leaders in international policy, policy-makers in the 'following' jurisdiction have much greater scope than their predecessors to utilise sophisticated evidence based policy-making processes, simply because there will be more evidence available to be utilised. Yet paradoxically, New Zealand's policy position reversal has been characterised by increasingly less reliance upon empirical evidence as successively more of the 'internationally orthodox' policies have been adopted. Whilst the Ministerial Inquiry into the Telecommunications Sector in 2000 and the Telecommunications Commission Inquiry into Local Loop Unbundling in 2003 contained substantial empirical economic analysis of both the New Zealand industry and international comparators (albeit that the 2000 Inquiry, when recommending a change to industry-specific regulation, largely ignored the findings that the New Zealand industry performance under light-handed regulation was no worse than (and indeed in some cases outperformed) international comparators), the 2006 unbundling policy is notable for its explicit rejection of the need to revisit any of the economic analysis undertaken in 2003 when full unbundling was rejected. Neither was there any explicit analysis, theoretical or empirical, undertaken to support the functional separation mandates of 2007[13] or government re-entry as the sector's principal funder in 2008.

These observations have led me to conclude that in large part the primary objective of New Zealand telecommunications policy in recent years has become the pursuit of policy orthodoxy for its own sake. This appears to be the only plausible reason why policy-makers would eschew the need for reasoned analysis of the empirical evidence offered by the experience of the early adopters when advancing policies to achieve particular economic (or even social)

[12] For these insights, which draw extensively upon the theory of real options and its application in the policy and regulatory arena, I am indebted to the work of, and many discussions with, Lewis Evans, Graeme Guthrie and Neil Quigley.

[13] Separation was mooted in the 2006 LLU policy discussions as a possible further remedy available in the event that the desired broadband uptake objectives were not achieved using LLU mandates. However, there is no evidence in the policy papers of any literature review being undertaken, and discussion of the possible financial consequences is confined to a single sentence stating that any costs arising would be borne entirely by the incumbent operator (Howell, 2009a). This is consistent with the focus of New Zealand telecommunications regulation policy being the explicit restraint of a specific firm with an erstwhile historic position of dominance in a given (wholesale) product market, rather than a forward-looking consideration of the future evolution of interaction in regulated and other related product markets (Howell, 2012).

objectives[14]. The military analogy is one of blind loyalty in backing up comrades, regardless of the personal consequences[15]. When there is little choice in the matter of adopting a policy, and few options for resiling from that position even if it should prove to be harmful on some dimensions[16], there is little need for ex ante evidence to support the position taken and few incentives to invest in ex post analysis of the policy's ongoing over-arching merits. Rather, the research effort becomes focused on localised 'fine-tuning' of the parameters under which a pre-determined policy will be implemented. Thus, if early adoption has been governed predominantly by the pursuit of policy conformity, finding that there is a comparative shortage of 'evidence' readily available 'off the peg' to facilitate an evidence-based approach by potential later-adopting jurisdictions is quite plausible.

However, an absence of empirical analysis is not the same thing as an absence of evidence. And evidence-based policy-making is not simply the synthesis of a literature review and a 'consultation process' assembling the views of others who have travelled the path previously. Moreover, the critical analysis undertaken by the early adopters addresses a different set of strategic options from those on offer to potential later adopters. I suggest that later-adopting jurisdictions face not just the strongest, but arguably the only, incentives to conduct the necessary ex post empirical research on the efficacy of the policies of the early-adopting jurisdictions in order to inform subsequent adoption decisions. But the greater is the number of conforming early-adopting jurisdictions, the smaller is the number of later adopters facing the relevant incentives to undertake the requisite analysis, so the less of it there is likely to be available. For example, despite its strong advocacy of local loop unbundling policies from as early as 2001, it was not until 2007 that the OECD commissioned any econometric analysis of the policy's effects on broadband uptake. It is no coincidence that most of the empirical research generated over this same period (including my own) has been motivated (indeed commissioned?) in large part by the threat of the policy's introduction in the four OECD jurisdictions 'holding out' – the United States, Switzerland, Mexico and New Zealand (at least up until the 2003 Inquiry). The challenge for evidence-based policy-making in following jurisdictions is therefore not just one of finding

[14] Whilst economic imperatives have been cited as a justification for government fast fibre funding, these are almost always cited alongside observations of the need to 'keep up with' other countries. Korea has been explicitly cited as a key benchmark (Howell, 2012).

[15] Furthermore, pursuit of policy orthodoxy as a prevailing objective may not be a uniquely New Zealand phenomenon. In a report commissioned by the FCC to inform the United States National Broadband Plan (Berkman, 2009), the authors appear to confuse the popularity of access regulation amongst OECD member countries with its efficacy in their policy evaluation. Conformity to European Union access regulation policy is a mandatory obligation for nineteen of the thirty OECD countries at the time who were also EU members or candidates for membership.

[16] See Pursiainen (2003) for a discussion of the tensions faced by Finland when faced with the need to conform to EU telecommunications policy mandates.

the data, but constructing the evidence in a manner that is both plausible and informative in respect of a different question.

I will now turn to a consideration of the processes of evidence-based policy-making, which stand as a context to the substance of my own research to inform the broadband regulation policy-making process. In the 1990s, when New Zealand stood in the vanguard of telecommunications industry interaction governed by competition law, it was ultimately the courts that adjudicated on the quality and relevance of the evidence (often empirical in nature) offered in support of the various positions advocated by competing adversaries. Maybe it is not co-incidental that the 1990s also represented the apogee of international research interest in the New Zealand industry. Contestability of evidence in an uncertain environment where there were initially few guiding precedents likely spurred further research, even if it did not necessarily result directly in court action being taken. The mere potential for action likely incentivised research by both the incumbent and its competitors. The research endeavour enabled increasingly greater understanding of the complex network of interactions making up the industry. Such research also informed policy – notably the several occasions when the relevant ministers refrained from altering the 'light handed' regulatory settings because the empirical evidence proffered did not provide sufficiently compelling evidence that the proposed changes would lead to overall increases in sector efficiency relative to the status quo. By contrast, the introduction of industry-specific regulation altered all of the research focus, the incentives for sector participants to commission research and the nature and standard of evidence proffered.

This experience from New Zealand has led me to consider how the quality of evidence used in support of 'evidence-based policy-making' should be assessed and utilised. The judicial processes from competition law provide some guidance for policy-making. First, a decision must be made (even if that is to do nothing/accept the status quo). Second, it is made on the basis of the argument of the case both for and against a proposition. An important part of the process is the ability of the parties to assess the quality and applicability of the evidence offered by their adversaries. Third (and an important learning from competition law), empirical evidence plays a vital role. Fourth, adjudication is undertaken by an informed, but impartial judge. Finally, the process is transparent, observable, and almost always appealable on matters of the process, if not the substance, of the decision. A policy-making process that observes these conventions would appear to provide greater assurance that the ensuing policies adopted will be evidence-based than one which lacks even one of these characteristics. Deviations from these conventions invoke

risks that crucial evidence might be either overlooked or given inappropriate weight in the judgement[17].

So what does this mean for the practice of an applied economics and policy researcher? Whilst I may have had the privilege of being able to observe and comment upon the processes, ultimately my main academic contribution has been as a researcher with an especial interest in the development and assessment of broadband policies in a jurisdiction which is an openly declared follower. As an academic researcher, charged with the role of being a 'critic and conscience of society' in a jurisdiction where there have been few incentives to undertake empirical research and which has been governed by a policy-making process that has become increasingly less evidence-based, I have endeavoured to 'fill in some of the gaps' in the New Zealand policy evaluation process with research of both New Zealand and international data that would have supported an evidence-based approach. Today's presentation is a synthesis of some of the insights I have gained from my research 'journey'. They are my views, but I hope that, on the basis of the foundation provided by past theory and evidence from practice, they may help shed more light on the complex matter of broadband policy.

[17] By my estimation, the turning-point in the New Zealand policy-making experience came in 2006 when an explicit decision was made to remove responsibility for key sector policy evaluation from the quasi-judicial Telecommunications Commission and place it in the political domain. The minister at the time made it clear that the role of the Commission was the supervision of micro-regulation of the sector rather than the evaluation of policies such as local loop unbundling and structural separation. As the political policy making process in New Zealand contains none of the key checks and balances of a judicial process, and importantly are governed by a decision-maker who is in fact one of the parties to the 'action', there are few incentives for the commissioning and hearing of evidence against the proposed policy.

The Presentation

For an economist whose research focuses on broadband networks (and in particular, the role of competition and regulation policy governing their operation), an appropriate starting point for a lecture on 'the Global Data for Evidence-Based Public Policy' is a definition of what constitutes a (principled) policy-making process in the first place, and how 'evidence-based policy' fits into this schema. I propose to begin by exploring these concepts, and then proceed to illustrate various elements of them with applications to broadband policy-making. The illustrations are drawn principally from my research in the New Zealand and United States contexts, but also draw upon other OECD exemplars. A caveat upon my work is that it relates predominantly to developed economies, so may not necessarily apply globally.

1. The (Principled) Policy-Making Process

Few policy-makers would contest the proposition that a principled policy-making process should consist of eight distinct steps[18].

The object of interest must first be clearly defined. Next, a means of measuring it must be identified. It may not always be easy to identify appropriate measures, as the object of interest is quite likely intangible. Typically, the policy-maker will have to rely upon a number of proxies to capture the full extent of the relevant object. An important part of this step is identifying how closely the proxy measurements (either individually or collectively) will reflect actual states of the object of interest. This leads to the need to identify how much weight to give to each of the proxies in the subsequent evaluation processes.

Having identified the object of interest and how to measure it, the third step is to determine if there is actually a 'problem' that warrants attention in the first place. This step is critical, as it requires the policy-maker to identify the owner(s) of any potential 'problem' and the objective(s) that the 'owner(s)' might wish to pursue. It usually requires, in combination with the first two steps, quantification of the magnitude of any potential 'problem' (in relative if not absolute terms), and identification of interested parties and their stakeholding in the 'problem'. An important consideration at this point is that one party's 'problems' seldom exist in isolation from another party's 'opportunities'. Understanding how a purported 'problem' may have come to exist in the first place forms a crucial part of identifying both its existence and materiality. I will contend that in respect of many broadband policy-making exercises, it is quite difficult to ascertain how these steps have been addressed. Consequently, determining the relevance of 'evidence' collected from these exemplars for subsequent policy making is problematic.

[18] These principles are outlined and discussed further in Howell (2012a), in respect of digital divide policies.

Only after it has been ascertained that there is a real and material problem that warrants addressing is it feasible to begin identifying and evaluating alternative policy interventions. As a general rule, providing the first three stages have been satisfactorily addressed, the subsequent parts of the policy-making process are comparatively straightforward. The alternatives must be evaluated over the projected lifetime of the policies against each other and the status quo – bearing in mind that that the status quo is itself dynamic, and not simply currently-observed parameters fixed into the future. Notwithstanding debates about some of the technical requirements for undertaking cost-benefit analyses, use of this tool stands as a fundamental requirement of principled policy-making processes[19]. It is only once such empirical evaluation has been undertaken that it is possible to decide upon and implement a chosen course of action.

Furthermore, implementation plans must necessarily include ongoing (periodic and repeated) evaluation of the effectiveness of the chosen action against not just the measurement proxies, but the underlying objectives that gave rise to the identification of the 'problem' in the first place. For completeness, evaluation of the implementation should include address not just criteria for determining 'success', but also those which indicate both the absence of evidence of the policy delivering the desired outcome and any potential harms induced. This includes at a minimum some triggers to indicate when consideration should be given to aborting the chosen course of action.

2. Evidence-Based Policy-Making

A current theme in the New Zealand public policy discourse (in part befitting the emphasis given currently to policies tending to 'follow' rather than 'lead' international trends – see Context) is the role of 'evidence-based' policy. Whilst many definitions for this concept exist, the broad parameters are based upon implementing policies where there exists some (typically empirical) evidence that they will in fact increase the likelihood that the desired objectives will be delivered more efficiently than if they had not been adopted. An implied (but rarely stated) corollary is that the implemented policy will also do no harm (or at least will include as part of its provisions the means of mitigating known harms that will likely arise from its adoption).

This concept is neither novel nor controversial to economists schooled in the application of the Kaldor-Hicks criterion in the evaluation of policy interventions (that is, a policy intervention is economically justified when it results in an increase in total welfare sufficiently large that the gains of the winners are sufficiently large that they could in theory compensate the losers and still leave society better off in the aggregate than without its implementation).

[19] Ergas & Robson (2009).

However, the more recent popular credence given to evidence-based policy-making derives principally from its application in medicine, and notably public health policy[20].

In essence, 'evidence-based policy' is motivated by the process of conducting clinical trials. Ultimately, therefore, it derives from the application of the scientific method, where the relevant 'evidence' is drawn from comparisons based upon objective (measurable) criteria and replicable 'experiments'. This necessarily implies a considerable degree of understanding of the scientific methods in the processes of selecting, creating and assembling the evidence used to support specific policies. An important consideration is how to determine the extent to which a specific item of 'evidence' will actually contribute to informing the specific question being addressed. It begs the question of who will make such an assessment, and how the criteria for their application will be determined.

A criticism frequently levelled at 'evidence-based' policy-making is that although it is well-suited to addressing issues derived directly from 'laboratory science', it is less helpful for matters whose origins derive from social sciences. When one's laboratory is the highly complex adaptive system known as society, how can one reliably assess the nature and applicability of the evidence?

It is in some ways appropriate that this lecture is being delivered in a Law School. Law is a social science, with one of its disciplines being the study of processes that enable the weighing of evidence under the conditions of uncertainty. Furthermore, legal processes anticipate and deal with evidence offered both for and against highly contestable propositions. Moreover, these same processes bias against enabling irreversible actions occurring in the absence of sufficiently compelling evidence in their support. This suggests that evidence-based policy-making processes might benefit from processes similar to those on a legal context for determining both the eligibility of evidence to the matter in hand, and the requirement that in order to be implemented, the case for the policy (supported by its evidence) should at least meet a pre-specified 'burden of proof'.

For example, this could be operationalized in a principled policy-making process by subjecting a preferred policy to an (implicit or explicit) quasi-judicial process whereby the case for its adoption is argued before an informed but independent adjudicator against the case that it not be adopted. The more complicated and technical the evidence presented, the more important it is that the evidence be assessed by specialist rather than generalist adjudicators. Arguably, this is the process observed in specialist commissions charged explicitly with the assessment of policy

[20] Hansen & Rieper (2010).

proposals (such as the FCC)[21]. Yet in many jurisdictions (including New Zealand), highly complex, technical telecommunications policy issues have been adjudicated by parties with few claims to the specialist skills and lack of bias that such decisions warrant – namely politicians. This would appear to be the antithesis of a principled, evidence-based policy process.

3. Application: Principled, Evidence-Based Broadband Policy

Having established the theoretical parameters, we can now turn to applying them to both a normative and positive evaluation of broadband policy development.

The application of an evidence base to principled policy-making processes suggests an agenda of 6 items for consideration. The first three are somewhat interdependent, but cover the first three steps of principled policy-making:

1. What is broadband?

   which will include a discussion of how it might be measured/quantified;

2. What is the 'broadband problem'?

   including identification of the objective(s) that are perceived as not being achieved and the consequential 'owners' of the ensuing 'problem(s)';

3. What is the evidence?

   including a critical assessment of the nature and quality of evidence adopted in support of the identification of 'problems'.

The second three address specific policies – mostly associated with access regulation – as a means of elaborating upon:

4. What policies have been proposed to ameliorate the 'problem'?
5. What evidence supports these policies?

   with discussion on adherence to the expectations of principled, evidence-based policy-making, including an assessment of whether the benefits outweigh the costs; and

6. What evidence is there that policy-makers are continuously evaluating the policies that they have adopted, and are willing to abandon ineffective or counter-productive ones?

3.1 What is Broadband?

As the first step in the policy-making process requires the identification of the object of interest, a definition of 'broadband' must be agreed. A quick reference to most of the usual sources of

[21] For these insights, I am indebted to Tim Hazeldine, by way of his consideration of issues of environmental policy in the New Zealand context-

definitions used by policy-makers (such as Wikipedia, the OECD, the ITU and the first five national broadband policies that fell out of my file box) would suggest that the definition of broadband is 'settled' (i.e. widely agreed). It is almost always defined, even in policy documents, in its technical capacity as a communication bandwidth of at least 256kbps.

Whilst this definition may be of some use as an overarching artefact of network engineering, its purpose for policy-making is rather more limited. It is, I will contend, not a definition of the object of policy interest, but instead more correctly one of the proxies used to assist in its measurement. The distinction is far from trivial in a critique of evidence-based policy-making processes. A policy focused upon a solitary measurement proxy of something that might be of greater ultimate importance will result in the delivery of the underlying objective only to the extent that the (single) proxy is closely aligned to that objective. Furthermore, it begs the question of why, of an array of possible measurement proxies, one in particular should be elevated above the others to become an object of policy interest in its own right. Yet in the broadband policies of most countries, the metric is subsumed into the object. By way of illustration, to the extent that New Zealand's current broadband policy has articulated a definition of 'broadband', it refers almost exclusively to the deployment of physical networks of a defined technical capacity. Similar observations have also been made in respect of Korean policy[22].

Instead, I would like to propose that a more policy-relevant definition of broadband is that it is a digital data transportation mechanism. In respect of the ever-changing technical characteristics of speed and capacity, 'broadband' can be considered as the current access frontier to the internet General Purpose Technology (GPT), relative to the legacy dial-up internet access[23]. This definition enables the consideration of 'broadband policies' independent of any specific network technology or operator, at the same time as invoking the need to take account of the intertwining threads of technological dynamism and policy formulation. It thus facilitates consideration in the much broader context of data digitalisation (the convergence of many different forms of historic media (e.g. audio, video) onto a common digital format) which is occurring at the same time as the proliferation of new range of technologies capable of transporting and storing digital data. The closest any of the 'generally accepted' definitions come

[22] Shin & Jung (2012).

[23] For a discussion, see Howell & Obren (2002). This paper frames dial-up and broadband internet access using the concepts of General Purpose Technologies as espoused by Grossman and Helpman in the context of the economic considerations governing decisions made by producers in technologically dynamic as to if, and when, they will choose to invest in the frontier, given that they have already invested in the legacy.

to recognising this concept is Wikipedia's final point (almost an aside): "However, the term became popularized through the 1990s as a vague marketing term for Internet access"[24].

The practical manifestation is that whilst broadband policy discourse to date has focused on network technologies transmitting data (fixed/mobile; copper, HFC, optical fibre, cellular, wireless, satellite, etc.), this should not be to the detriment of the consideration that data transportation is but only one component of the digital data and internet phenomena[25]. Using an analogy from transportation, a shipping policy developed in isolation from policies governing procurement and distribution activities is likely to be of limited value.

It is also apposite at this point to address the question of what broadband is not. A risk exists that a definition based upon specific network configurations may result in potentially confounding characteristics being introduced into the policy-making process, especially if given networks and/or their operators have been the object of other policy interventions. I will come back to this point subsequently, but suggest at this stage that 'Broadband' is not '(Fixed Line) Voice Telephony Mark II', even though there may be some common technological characteristics that could lead some policy-makers treat it as if it is. As a consequence of past policies in most countries to privatise and liberalise the telecommunications industry, unlike fixed line telephony from which we can draw some historic parallels, broadband is diffusing into a 'contestable' (or in some cases even an 'effectively competitive') marketplace where consumers have the option of connecting to the internet via multiple network technologies. Furthermore, whereas the original telephone networks supported a single application (person to person voice communication), the application and user base supported by the internet is vast, volatile, and heterogeneous across multiple different dimensions. Moreover, the proliferation of internet technologies means that unlike fixed line voice telephony, applications need not be tied to specific networks, locations or even individuals. In the assessment of the relevance of evidence from past policies for future policy-making, these distinctions are potentially significant.

3.2 What is the 'Broadband Problem'?

Having agreed upon a definition of the object of interest, we can now turn to the question of whether there is in fact a 'problem' warranting policy intervention. The first point to establish is,

[24] http://en.wikipedia.org/wiki/Broadband

[25] As a personal anecdote, I note a former colleague's redefinition of the phenomenon of 'sneakerware' (in a continuum spanning hardware and software, the term assigned to the actions of the computer operator in the service bureau in which I worked in the early 1980s running between buildings with a tape of data extracted from a system operating on one computer to an adjacent building to load up a second computer operation) as elementary broadband. Given the tape capacity, the speed at which the operator ran, and the distance between buildings, there was no doubt that this digital data transfer activity met the current generally accepted technical definition of 'broadband' in that it exceeded 256kbps.

if there is a 'problem' to be addressed, whose 'problem' is it? This leads directly to the identification of both the desired objective(s) of the 'problem owner' and the metrics used to assess the case for intervention.

In order to ensure that this discussion remains tractable, I acknowledge that this is a lecture on public policy, and the reasons why policy-makers might care about broadband are almost as numerous as the applications available on the internet. The following list is but a small sample: economic aspirations; capturing external social benefits (in the economic sense distinct from private benefits); social inclusion objectives; a motivation to address real or perceived needs or inequities; regional development; economic stimulus from infrastructure investment; it offers a reason to regulate (or continue to regulate) telecommunications firms; vote-farming; subsidy-gathering; etc. As an economist, I am qualified to comment only on those objectives with an economic component. So a further caveat is that the subsequent discussion presumes the relevant objective is that of a benign social planner seeking to maximise the economic benefits of broadband for the relevant economy[26].

3.2.1 An Economic Growth Objective

This leads to the question of how one might go about assessing the economic impact of broadband – a necessary precursor to the determining if there is a 'broadband problem' to address in the first place. In the initial definition, it was agreed that broadband is the current frontier technology enabling access to the internet. So the economic effects of broadband are a subset of those associated with the internet. The economic value of the internet arises not as a function of the underlying network technologies, but from the use of applications. That is the market for internet connections derives from the market for applications. End users select applications in the context of their preferences and budget constraints (in a world where competition exists for those budgets and users may have many partial or close substitutes in their choice set).

Demand for internet access connections is thus derived from the value end users accrue from the use of applications which, it has been established in the current technological environment are, in large part, independent of the nature of the 'last mile connection via which that access is achieved. Broadband (frontier) benefits are distinguished from those available from the use of dial up internet access (the legacy)

[26]And at this point I acknowledge that I could not possibly dare to proffer a view of the political economy of broadband policy development in a lecture endowed by such an eminent practitioner of that discipline as Professor Tullock.

insofar as broadband enables accrual of the economic benefits of the use of new applications not possible with dialup (an absolute benefit) and the marginal gains (net of cost differences) from using dial-up capable applications on a broadband network. A similar calculus attends the appraisal of the benefits of pushing the broadband frontier out further (e.g. ultra-fast broadband compared to standard broadband).

By way of illustration, the majority of the benefit I derive from reading a book (and even a digital copy) is independent of the transport mechanism by which it is delivered to me (standard post or express courier delivery of a disc containing the electronic copy; or an e-book delivered digitally by Amazon). This is not to say that there are not some marginal benefits (and costs) associated with the chosen delivery mechanism under certain circumstances (e.g. timeliness in receipt; absolute cost differentials) which may influence my choices. Rather, the point is to demonstrate that broadband is not an economic end in itself, but a means to achieving some economic ends. Broadband is only a subset of the internet, which itself is only a subject of the digital world. The demand for internet connections (and hence ultimately the economic benefit attributable to broadband) does not exist in isolation, but must be considered against alternative scenarios. If I don't want to read the book in the first place, then the delivery mechanism is irrelevant (albeit that a connection grants an option to use that method in the future, for which I may be prepared to pay a positive price conditional upon the availability of and the prices I face for the alternatives).

3.2.2 A Cautionary Tale

I have raised the matter of the understanding of how economic benefits are derived at this stage because it directly manifests in determining the relevant measurement proxies to use when assessing if there is actually a problem in the first place. There are undoubtedly positive economic benefits to be had from the technology. However, it is important that policy-makers are clear about how they are derived, and where the locus of 'problems' impeding their accrual might ultimately lie.

Many academic (including peer-reviewed) and policy papers take it as given that there is a significant causal relationship between various measurements of 'broadband' and economic growth, and that this is sufficient to justify policy intervention. One of the most cited papers (and most methodologically sound, insofar as determining an answer to

the authors' question) is Roller & Waverman (2001). This paper ha 121 citations recorded in the IDEAS website on September 23[27]. An examination of ten randomly selected papers from the last five years that cite the paper reveals 8 claiming it as evidence that either ICTs or broadband positively influence economic growth (one references the paper, but does not cite it in the text)[28]. Yet the paper offers no evidence at all for a relationship between any of ICTs, internet or broadband and economic growth. Rather, the authors find, in a longitudinal (20 year) multi-country (21 OECD nations) study, a significant positive causal link between telecommunications infrastructure investment and economic growth. The data cover the 20 years between 1970 and 1990, before broadband was even 'invented'. Furthermore, commercial implementation of internet applications is likely only captured in the last year or two of the data, when the magnitude of its effect was likely extremely small[29]. This suggests that there is considerable confusion amongst researchers not just about what broadband is defined, but also scant understanding of literature cited.

Whilst many subsequent studies[30] have endeavoured to establish empirical linkages, they mostly find correlations rather than causative effects. They are also problematic in that they focus mostly on independent variables capturing broadband measures alone, so therefore may be omitting other elements of the telecommunications and internet environment that may appear superficially to be independent of, but are potentially correlated with, the broadband metrics chosen (e.g. mobile network connection diffusion – which in the spirit of Roller & Waverman, as a component of telecommunications investment, may also be contributing separately to economic growth).

3.2.3 And How To Measure It?

If one assumes that the policy-makers' objective is to maximise the economic benefits from broadband, and (despite the caveats voiced above) there is a broadly positive relationship between some broadband metrics and economic growth, then which metrics

[27] http://ideas.repec.org/f/c/pwa233.html
[28] The one that cites it appropriately is endeavouring to assess the economic effect of mobile telephony.
[29] In a similar vein, BERL (2011) uses productivity multipliers based on the entire contribution to economic growth from ICT investments (which includes all hardware, software and communications elements) observed in the late 1990s to estimate the economic contribution of broadband to the Auckland and Bay of Plenty regions in New Zealand
[30] See Howell & Grimes (2010) for a literature review. More recent papers include Czernich, et al., (2009) and Rohman & Bohlin (2012).

should be examined to first assess the extent of a relationship and second, determine if there is a problem to address?

The preceding discussion suggests that, at the very least, a range of metrics might be needed to gain an insight into the object of interest. A rudimentary first cut would suggest measures relating to both legacy and frontier technologies, applications capable of being used upon each, the extent to which they are being used (or in the case of some yet-to-be defined problems, could be used but are not), and substitute and complementary activities. But for each of these variables of interest, there are many competing metrics. Should the network technologies be measured by connections possible or connections purchased? What about investment in each? How should applications be addressed? By potential to use them or actual use? How can these metrics be converted into an assessment of economic effects? And what weight should be given to each in the assessment?

It is clearly a far from simple task to assemble the evidence necessary to ascertain whether there is in fact a problem warranting intervention. Yet it is surprising how seldom these questions are addressed in broadband policy formulation. Most policies and the studies supporting them invariably place nearly 100% weight in the analysis on a single metric - broadband uptake per capita (or its close variant, potential broadband uptake - measured by the proportion of the population able to connect to broadband if they so desired). The amount invested in supplying those connections is at best and only sometimes a secondary consideration.

As to the relationship between broadband investment and uptake and economic growth, one would presume from an examination of most policies that the prevailing dominant policy logic is that 'Broadband is (Unequivocally) Good', so (a) more broadband is (unconditionally) better than less (however it is measured, but almost always uptake per capita is cited); (b) faster broadband is (unconditionally) better than slower broadband; and (c) having more faster broadband sooner is (unconditionally) better than having it later. The ensuing international competitiveness that has emerged can be likened to a horse race[31] or an Olympic sport – that is, the outcome is a game of 'winner takes all' where one country 'wins' and all others 'lose' (or save face only by

[31] Thank you, Glenn Boyle.

ranking higher in the OECD league tables than their closest rivals). Observed differences in uptake are offered as 'evidence' not just of 'winning' and 'losing', but also as endorsements of the effectiveness of policies that may or may not have influenced the place achieved. Once again, it appears as though a metric has supplanted the economic objective to the point where it is now the subject of broadband policy intervention. This is amply illustrated by examples from both United States and New Zealand policies. George W Bush stated in 2004 that, in respect of broadband uptake per capita, the United States' OECD ranking performance of "tenth is ten places too low as far as I'm concerned"[32], whilst in 2005 Helen Clark announced policies to "ensure targets for broadband uptake … are met"[33].

3.2.4 Which Variables, And What Weighting?

A simple exercise using OECD descriptive statistics illustrates at this point the dangers of relying on solitary rankings statistics to drive policy decisions. Whilst much emphasis has been placed upon the broadband uptake per capita race in the OECD Olympics because for a variety of reasons it is perceived as the 'glamour event', it is not the only medal on offer (and indeed, the OECD continues to caution against the use of their data in this manner). The OECD broadband statistics portal contains a large and growing number of tables containing data that shed light on elements of the economic benefits associated with broadband. A consistent performance across many events (for example, winning a decathlon) may be a better indication than winning a single event but performing poorly in others.

Few will doubt that Korea has, over an extended period, been a stellar performer in the broadband uptake per capita race (albeit that recent performance has fallen off a little). But if the ultimate objective is one of economic merit, one might expect that the race for secure servers per capita (economically significant internet trading activity usually necessitates some level of data security) or domain names per capita (as a measure of business, rather than residential use of the internet) might be informative. Whilst Korea has never left the top quartile of the OECD in broadband uptake per capita since 2001, it has never in this time strayed out of the bottom quartile in secure servers

[32] The USA ranked 15th in December 2011.
[33] The target was for New Zealand, ranking 19th in the OECD at the time, to enter the top quartile by the turn of the decade.

and domain names per capita. By contrast, whilst New Zealand and the United States have been mid-pack broadband uptake performers, they have never left the top third of the OECD in the other two metrics. Connections purchased do not necessarily provide a good indication of the economic gains on offer if they support predominantly non-economic activities. Shin et al (2012) have recently questioned whether the primary economic benefits so far from Korea's broadband policies arise from creating a showcase for exportable Korean manufactures associated with broadband network use (such as network components, handsets and computers, and to a lesser extent, gaming software) rather than the generation of economic benefits from high levels of national connectivity. In a similar vein, the prevailing assumption that faster cheaper broadband connections will unequivocally lead to higher levels of broadband uptake per capita is also called into question by OECD data. Japan does indeed have the largest percentage of connections to fibre broadband networks in the OECD at December 2011 (63%), and some of the lowest pricing. Yet its broadband uptake per capita sits at only 16th – one place behind the United States and one ahead of New Zealand.

3.2.5 So What DOES Broadband Uptake Per Capita Tell Us?

Even if one does ascribe to the view that there is some validity in using broadband uptake per capita as the predominant metric to assess performance towards an economic objective, it is implausible that the relevant objective should be to maximise broadband's economic contribution by maximising broadband uptake. Rather, I would suggest that, if broadband uptake per capita is to be an object of policy interest, the relevant question is what constitutes the 'correct' (economically most efficient) rate of broadband deployment, uptake and utilisation for a given economy, not just at the current point in time, but over the lifecycle of the technology. Whilst the answer to this question may be informed by comparative analysis of uptake in other countries, it must be considered in light of a range of other economic, social and demographic characteristics that offer a much richer understanding about not just why observed uptake rates differ between countries, but potentially other aspects of the nexus between internet technologies and economic growth. Importantly, it suggests that an understanding of the differences between countries is an important part of the determination of whether there is a 'problem' in a given country in the first place.

I will now return to my earlier point that broadband is not 'Fixed Line Voice Telephony Mark II'. Fixed line voice telephony is an extremely mature technology, in that it has reached – and has indeed passed – its diffusion apogee. The number of fixed line connections is declining. In terms of the classic diffusion curve, the 'ascendant S' has turned into the 'descendent 2'. In contrast, broadband diffusion is still, in most countries, in the ascendant. Furthermore, the pool of data available for empirical analysis (since it became commercially available in 1998), relates to a particular point in time in this natural process. This is important for the consideration of econometric modelling – notably because economic performance is typically measured as a growth rate. Whilst higher economic growth is unequivocally better than lower economic growth, growth rates in diffusion processes tell different things, depending upon where in the diffusion process the data pertains.

A typical technology will diffuse through an economy over time (see Figure 1). In the early stages of the lifecycle, it is comparatively immature. There will typically be only a small number of providers, and prices will be high (especially for network technologies where economic scale is significant). There are also substantial risks (on both the supply and demand sides), as the technology is largely unproven (both technically and commercially). Given these factors, there will initially be only a small number of early adopters. High prices and significant risks mean these initial customers must derive very large benefits from their use, in order to offset the higher costs. As a cautionary note, case studies assessing the benefits to these early adopters will do not generalise easily into those in mass markets as early adopters are not representative. This provides a plausible explanation why the promises from many studies suggesting very high benefits on the basis of user case studies in the early stages of a technology's diffusion may fail to be realised when re-examined ex post.

However, as the technology moves into its mid-stage of diffusion, prices tend to decrease as further technical innovation lowers costs, production efficiencies accrue and the market becomes more competitive as more suppliers enter. As usage prices fall, high-valuing early adopters experience a wealth transfer in respect of their existing usage (but this is not a net economic gain in itself). Welfare gains come as the threshold of benefit at which new users will purchase is now lower. The number of connections sold rises as

the price falls, but (holding applications constant) the average net benefit for each successive new user will be lower than the ones before. That is, the net economic gain per user decreases as connection numbers increase, in the classic case of diminishing returns. This illustrates the importance of applications in understanding the economic effects of internet (and broadband) connectivity. At any given point in time, new applications valued positively by users raise all of the price threshold at which new users will adopt and the number of actual adopters and the aggregate net economic benefits generated. Indeed, the cycle of decreasing returns from higher adoption levels can be avoided only if this cycle of application innovation also occurs.

In the late or mature stage of the technology, however, saturation is approached. As most of the possible potential purchasers have already connected, only 'laggards' with very low potential benefits from purchase are left unserviced. On the supply side, competitive pressures have also likely substantially played out. Prices stabilise and the connection growth rate slows to a near-standstill as the costs of acquiring very low-valuing new customers likely exceed the returns on offer. Only if there is a step-change in supply-side factors (e.g. a new lower-cost technology enters or, as occurred in the case of fixed line voice telephony when competition and regulatory policy changes eased some market frictions) could significant economic gains be expected. Typically, in most markets not subject to policy interest, it is the stasis associated the mature phase that leads to the incentives for the creation of new products more highly valued by customers than the existing one, in order to induce them to switch from the old product to the new, usually at a higher price than that paid for the old one. Unless the benefits of the new product are real and valued more highly by users than the 'old' one, switching will not occur even at the same price for each product.

3.3. Does the 'Evidence' Even Confirm the Existence of a Broadband Uptake per Capita 'Problem'?

The diffusion model discussion confirms the earlier assertion that identification of a 'problem' will require a lot more information than the raw differences in broadband uptake per capita (or other related metrics) between countries or other geographic entities at a given point in time. The economic effects arise from a complex interaction of factors, many of which are impervious to policy intervention, and almost all of which are hard to measure. Many proxies for factors affecting both the supply and demand sides have been suggested as explanators of inter-country

differences at a specific point in time (such as at the release of the OECD comparative statistics). They include (but are not restricted to) factors such as user endowments (wealth, education, age, time and gender), costs of supply (population density, degree of urbanisation) and social and geographic factors affecting the range of alternatives available on which users can spend discretionary resources of both time and money (such as weather and diurnal patterns)[34].

Arguably, much of the empirical econometric modelling undertaken (as opposed to the use of simple descriptive statistics) in order to provide an 'evidence base' for a 'broadband uptake problem' does take account of most of these location-specific factors in coming to a view of whether the uptake rate at a given point in time is sufficiently well explained by the factors included or excluded from consideration. Some even endeavour to take account of the fact that as different countries started the broadband diffusion process at different times, data must be adjusted so that comparisons are made on the basis of months from the start of the diffusion proves rather than as a ross-section of data collected at a given date (including Howell, Boyle & Zhang (2008) – which will be discussed subsequently). There are many different models, coming to various conclusions of whether or not a given country's diffusion at a given time is sufficiently well explained by non-policy variables. This would appear to be the sort of evidence that would be useful for policy-makers trying to determine if there is a broadband problem to address. But is it being used in this manner?

In respect of New Zealand policy-making, I have examined in excess of twenty different models (excluding my own), of which three quarters have predicted uptake rates in excess of what was actually observed at the date of data collection[35]. If one was to apply a legal test to the evidence, on the balance of probabilities (if not beyond reasonable doubt) it would be difficult to support the contention of a 'problem' warranting intervention. In 2003, evidence presented to a Telecommunications Commission Inquiry into local loop unbundling from four relatively unsophisticated models in my sample with the same 75% 'hit rate' appeared to play some role in the recommendation not to mandate LLU[36]. Yet in 2006, essentially the same conclusion, derived from a sample of 14 models presented in evidence to a Parliamentary Select Committee had no effect on the decision to unbundle. In the official papers supporting this decision, there was no econometric analysis of the sort I had undertaken. Rather, the empirical analysis commissioned was predominantly descriptive and speculative in nature. A broadband uptake 'problem' was

[34] See de Ridder (2007) for a discussion.
[35] The most important factor contributing to this outcome is New Zealand's low GDP per capita – one of the most significant factors in most models (its rank in this statistic has never exceeded its OECD broadband per capita rank). At December 2011 it ranked 17th in broadband uptake per capita and 23rd in GDP per capita. Low population density also biases the expected uptake downwards in most models.
[36] Commerce Commission (2003).

deemed to exist because of New Zealand's low OECD ranking and, across a range of factors generally accepted to explain broadband uptake (price, GDP per capita, population density, age, education etc and a single competition variable – the share of broadband accounts sold by competitors to the incumbent), when compared to the rank in each of these statistics for the countries at that time forming the top 8 of the OECD in broadband uptake per capita, the only one where New Zealand ranked at the extreme (i.e. a rank of either 1 or 9) was the share of broadband accounts sold by competitors to the incumbent[37].

I note also that in the in the United States context, Berkman (2009) relies in this regard almost exclusively on descriptive statistics and bivariate correlations, as well as constructing an index based upon weighted rankings of only price, speed and penetration in its assessment of an 'uptake problem'. Only one multivariate statistical model predicting broadband uptake levels is offered, and the purpose of its inclusion is not to indicate actual performance compared to that predicted by the model, but to demonstrate the relative influence of each of poverty, urbanicity, price, education and median income on predicted broadband uptake per capita.

3.4 What Policies Have Been Proposed to Ameliorate the 'Problem'?

In my opening remarks, I alluded to this presentation containing both normative and positive thinking. So far, the emphasis has been largely normative – what one might expect to see in the definitional stages of 'good' principled evidence-based policymaking process concerning broadband – albeit illustrated with some examples from my research. The balance of the presentation will now focus on predominantly positive analysis and the evidence supporting the selection, efficacy and evaluation of broadband policies. There is necessarily a strong emphasis in this discussion on access regulation and in particular local loop unbundling, as these stand as the most commonly applied regulatory policy 'solutions' applied. However, I will contend that, possibly as a consequence of less attention having been given in policy-making practice to the definitional elements, it is not always clear whether the primary objective in implementing specific policies is actually the 'broadband problem' and even if it is, what is the relevance of the 'evidence' gleaned from analyses of policies implemented in other jurisdictions for a policy-maker considering their likely effects in a different context.

3.4.1 Why Access Regulation (and Local Loop Unbundling)?

Having identified that a problem that warrants attention actually exists, the next step in a principled, evidence-based policy-making process is to identify some policies which may ameliorate the problem, and on the basis of an empirical assessment, determine whether (relative

[37] Network Strategies (2006), critiqued in Howell (2006).

to the counterfactual of the status quo), the benefits of its implementation will materially exceed the likely consequential harms. It does not take a new observer of the telecommunications industry long to identify that one set of policies – access regulation, including various forms of unbundling and its' even more intrusive variants functional and structural separation – has dominated the policy debate in the last decade. However, from the perspective of principled, evidence-based policy-making, the question is begged of why this policy has been a first recourse when addressing options that address the 'broadband problem'.

To answer this question, and to gain an understanding of the role to be played by evidence from the evaluation of instances of this policy where it has been implemented, it is imperative that the context in which it has been introduced in various jurisdictions is considered. Crucial to this is the recognition that policies are never introduced into a vacuum, and that policy-makers are addressing multiple objective simultaneously. They are also (if undertaking principled policy-making) also continuously revising the continuing efficacy of past policies in regard to both the achievement of their original objectives, and the identification of possible new threats and opportunities that may necessitate either alteration to some of the policy settings or even its discontinuation.

I return once again to the point that 'Broadband' is not 'Fixed Line Voice Telephony Mark II'.

In almost all jurisdictions where it has been adopted, access regulation was implemented during the 1990s, in the context of sector-wide policies of market liberalisation (and in some cases privatisation), with the specific objective of increasing the competitive (and quasi-competitive) pressures facing former (government-owned) monopoly incumbents. It was introduced into the fixed line voice telephony market at a time where the technology was (in the OECD countries at least) in an extremely mature stage of its life-cycle. The problem it was addressing was not the need for a more rapid diffusion of a new technology (albeit that increasing connection numbers did provide some information about the efficacy of the remedy – discussed subsequently). Its primary objective was reducing the market power of specific firms. This was underpinned, at the time, in some jurisdictions at least[38], by analyses of the extent of dominance, its exertion and cost-benefit analyses indicating net positive economic gains from its implementation[39].

[38] As noted in the Context to this presentation, in many European Union countries, policy orthodoxy rather than principled consideration of the individual costs and benefits in each country led to the implementation of access regulation.

[39] In New Zealand, the cost-benefit analyses underpinning the decision not to implement the policy were influenced in large part by New Zealand's very small scale and the high fixed costs of industry-specific

The currently-available evidence base for the applicability of access regulation as a 'solution' to the 'broadband problem' comes from the consequences of technological dynamism in the telecommunications industry. The combined forces of digitalisation, network technology proliferation, the internet and hence, by extension, the emergence of 'broadband' as an element of consideration – have undermined many of the core assumptions that underpinned the original decisions made to implement access regulation. The policy settings from the 'old world' have been 'grandfathered' into the new one. For policy-makers in those jurisdictions where it has already been applied, the relevant question is whether, in the face of these combined 'shocks' to the industry, the economic benefits presumed to arise from the presence of access regulation in its former context are still relevant and achievable in the current context. An important part of this consideration is whether access regulation is helping or harming the accrual of net economic benefits in the new context. The purpose of such inquiry is, I contend, to inform fine-tuning of the extant policies, including consideration of the option of abandoning them. This is in essence a very different question to that addressed in jurisdictions where access regulation has never been applied (or in the case of the United States, strict limitations have been placed upon the extent to which extant policies can be 'grandfathered' into the new world).

The currently available body of econometric evidence informs a contemporary assessment of the costs and benefits of applying access regulation as a 'remedy' to the 'broadband problem' (as opposed to the 'competition problem' as defined in the 1990s) on two dimensions. First, as to the specific inquiry into the extent to which the rate of broadband connection uptake might be an indicator of the accrual of economic benefits from broadband, does access regulation (in any or all of its manifestations) increase, decrease or have no material effect on the rate at which consumers choose to purchase broadband connections (relative to the counterfactual of no access regulation)? Or, as it is often cast, does access regulation drive broadband uptake?[40] Second, does access regulation assist, impede or have no effect upon the transition of the industry moves from one based upon single network type and a single application to one with multiple networks and applications. Or as it is more commonly cast, does access regulation of copper networks disincentivise investment in, and thereby the development and deployment of, alternative (newer) network infrastructures[41].

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regulation. As the three-firm concentration ratio in almost all of New Zealand's significant industries exceeds 85% (Arnold, Boles de Boer & Evans, 2001), 'competition' is widespread concern. At the time, it was considered that the applicability of jurisprudence arising from competition law cases across all industries would be more cost-effective than (many) industry-specific regulators (Howell, 2007). .

[40] Papers in this vein include

[41] Papers in this vein include Gans & Williams, 1999; Jorde, Sidak & Teece, 2000; Laffont & Tirole, 2000; Valletti, 2003; Crandall, Ingraham & Singer, 2004; Gans & King, 2004; Hausman & Sidak, 2005[41];

It is important at this stage to be quite clear as to whether the primary purpose for which access regulation is proposed as a remedy is to address a competition problem (which historically has pertained almost exclusively to its use in market liberalisation and privatisation policies) or a broadband uptake problem. I suggest that the following quote (Ferguson, 2004) indicates some confusion as to the primary consideration:

> "*Broadband service and affordability, however, have consistently lagged well behind demand and progress in information technology, with damaging results. The Internet revolution remains incomplete and threatens to stagnate if the situation continues ..... The continuing dominance of ILECs (incumbent local exchange carriers) in that market impedes the healthy, and much-needed, development of an efficient broadband market. The result of these policy and market failures is inadequate technological progress, innovation, and productivity in advanced Internet services and telecommunication services generally."*

This sort of confusion is not unique to analysis of United States policy. As identified earlier, New Zealand's Telecommunications Amendment Act 2006 states that the explicit purpose of introducing local loop unbundling was to increase broadband uptake. Indeed, it is the only OECD jurisdiction to have this primary purpose. Yet the policy's introduction was based upon evidence of 'competition problem'. Evidence that the policy might have had minimal effect on broadband uptake rates was rejected. It begs the question as to whether policy-makers proposing this remedy are looking backwards and 'refighting' historic battles to justify the introduction of problems rather than looking forward to meet new challenges posed by new problems in a new context.

The 'learning' is that if a policy-maker is to invoke the application of a set of remedies applied to a legacy policy problem as a potential solution to the resolution of a frontier (i.e. different) policy problem, then it must be quite clear that the remedy has the desired effect on both problems. Whilst it is highly likely that there will be overlaps between the two policy objectives, close attention must be paid to what is different about the contexts in which the same policy will be applied. It may well be that there is both a competition problem and a broadband problem to be addressed. It may well be that historic policies addressing the competition problem have been successful in past contexts. But that does not mean that they will continue to be successful in addressing either competition or broadband problems in current or future contexts. Each problem, context and remedy must be examined on its own merits, with its own objectives and metrics. This does not mean that policy-makers do not have to make some decisions about tradeoffs. But it does mean that a principled, evidence-based policy-making process will be

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Crandall & Waverman, 2006; Guthrie, 2006; Bourreau & Dogan, 2006; Pindyck, 2007; Aron & Crandall, 2008; Grajek & Roller, 2009; Waverman, Meschi, Reiller & Dasgupta, 2007

explicit about what these tradeoffs are, how they arise and why the trade-offs decided upon are beneficial overall, across all relevant criteria.

Once again, it must be stressed, the broadband context ***is*** different to fixed line voice telephony. In many cases, real fixed line infrastructure competition (albeit oligopolistic) already exists in many markets. Technological innovation means that, for many market segments, given current application bases and utilisation, for many consumers mobile and wireless technologies offer partial or close connectivity and utilisation substitutes. Other distribution options exist for many applications (e.g. CDs and DVDs for music and video) which constrain network operators' market power. The mere existence of these alternatives provides market disciplines in a manner not possible in the voice telephony context. And, importantly, due to differences in the life-cycle of the technology, the nature of competitive interaction presumed optimal in the late stages of a mature technology is not necessarily what will be optimal at the outset. A critical question for competition policy in the broadband context is whether the sort of competition envisaged when access regulation was first utilised will be consistent with resolution (or even the identification of) a broadband uptake problem.

3.4.2 A 'Competition' 'Problem' or a 'Broadband' 'Problem'?

As the preceding discussion has elucidated, competitive forces play an important part in the rate at which a technology diffuses. However, the role they play is not consistent across the entire technological life-cycle. High costs and risks in the early stages (especially when there are substantial scale economies on offer) naturally tend towards lower competitive intensity. As the technology matures, however, competitive intensity will naturally increase (unless impediments preventing its development exist). At the end stage of the life-cycle, competitive intensity in the legacy market naturally falls off as the frontier is pursued. This suggests that it would be naïve for policy-makers to presume that a single set of competition (or regulation) policy settings should apply unaltered across a technology's entire life cycle, if their overriding objective is to ensure that the maximum economic benefit is to be gained from that technology's adoption and utilisation[42]. The skill is in determining when the benefits of policies enhancing competitive intensity will outweigh the costs.

Arguably, when access regulation was introduced to voice telephony markets in the 1990s, it was in response to a real, demonstrable competition problem. As mobile telephony was in its infancy, fixed line operators had considerable market power. The purpose of the policy was to stimulate competition in those parts of the fixed line industry where it was possible to do so.

[42] See Heatley & Howell (2010) for a discussion.

The extent to which the policies were successful was measured using metrics which are now very familiar – notably the number of connections per capita, minutes of use and the prices charged for connections and services. When the technology is mature, and competitive intensity is low (for natural or unnatural reasons), a step-change in uptake per capita is a signal that either costs have reduced sufficiently or highly-valued new 'applications' have been added to the product bundle such that low-valuing laggards previously holding out will now adopt. The same applies to the extent of use (e.g. minutes per connection per month). Observed price reductions offer partial evidence of the competition objective being achieved, to the extent that they address static efficiency considerations. However, the dynamic effects of product and service innovation are less easily measured. Nonetheless, increased uptake per capita even in the absence of observed price reductions provides circumstantial evidence that dynamic efficiency gains from additional innovation have been engendered.

By comparison, the initial diffusion of a new (frontier) technology begins precisely because of the presence of innovation. In many cases such innovation arises from either competitive stasis in the market for a relatively mature legacy product (for example, as has been observed in mobile telephony with the successive implementation of successive 'generations'). Alternatively, it may emerge in the form of product differentiation in oligopolistically competitive markets, whereby rival firms compete contemporaneously with different variants, one of which may gain some form of dominance in a given market if its features are more highly valued by potential users (for example, competition between CDMA and GSM technologies in some mobile markets[43]). In the absence of substantive barriers to the development of these competitive forces, then so long as the benefits of the frontier/differentiated product are sufficiently highly valued by consumers, its diffusion will emerge as a natural consequence of innovative activity.

[43] In New Zealand, Vodafone (GSM) and Telecom (CDMA) competed in this manner until Telecom closed down its CDMA network in July 2012. Whilst in terms of market share, Vodafone enjoyed a slight edge from around 2003, the market seldom deviated outside a 60/40 split by connections. However, there were significant variations in the market segmentation of the two operators. Over this period, Vodafone enjoyed significant dominance in the business voice market, whereas Telecom dominated the residential and texting (SMS markets). Vodafone also had a disproportionate share of the more populous urban (and notably Auckland) markets (where its infrastructure investment was concentrated), whereas Telecom's market share has tended to increase the further away from Auckland the customers are typically located. Telecom has also been dominant in the rural market. However, this may be subject to change following the recent awarding of funding under contracts for the new Rural Broadband Initiative (with a substantive investment in mobile initiatives) on the basis of a joint bid by Telecom and Vodafone.

3.4.3 What Constitutes 'Evidence'? And How to Assess It?

In the context of fixed line telephony, arguably, DSL could be considered as a new application on a legacy (copper) network (as compared to connections to the frontier of fibre). If there was negligible evidence of competitive pressure applied from cable networks, the purchase of DSL broadband connections could have, in part, derived from lower prices arising as a direct consequence of access regulation. But as DSL is in this context a 'new application' offering new benefits to consumers, for there to be a clear nexus between the access regulation policy and a higher level of DSL connection purchase, evidence would be required that controlled for the purchases of this new 'application' that would have occurred even at the higher (non-regulated, counterfactual) price by higher-valuing consumers. The net welfare generated by the policy (compared to the counterfactual of no regulation) is not total consumer surplus from DSL connection purchase, but only that attributable to the additional purchases arising as a consequence of the regulated price differential.

Of course if access regulation is applied in the presence of genuine infrastructure competition, it becomes more difficult to ascertain whether observed price differences arise from regulatory intervention or natural competitive forces. It would appear to be potentially quite misleading in this complex milieu to put over-much emphasis on any single indicator when assessing any 'evidence'. As indicated in the earlier discussion about broadband uptake in Korea and fibre uptake in Japan, mapping many different pieces of evidence onto alternative scenarios may be a useful means of dealing with some of the complexity inherent in such dynamic situations. As is the case in the application of circumstantial evidence in court processes, where a range of alternative plausible scenarios and multiple pieces of circumstantial evidence exist, the greater the number of pieces of circumstantial evidence that are inconsistent with the scenario offered, the less likely it is to be the most credible explanation.

At this point, I will offer a possible scenario as to why so much emphasis in broadband policy-making has come to be placed upon a handful of metrics such as broadband uptake per capita and the market share of competitors. In the context of market liberalisation policies and a relatively mature fixed line voice telephony market, fixed line uptake per capita and the market shares (especially of competitors to the incumbent) were indicators that were useful in measuring the success of policies pursuing increased competition. This led to their systematic collection in the first place. In order to facilitate the comparative evaluation of different policies in different jurisdictions, agencies such as the OECD and ITU endeavoured to collate databases of consistent and therefore comparable data across countries. The processes of their collection were relatively straightforward initially, given that in most cases the industry was governed by industry-specific

regulators imbued with considerable powers of compulsion in the collection of such information (especially from the solitary incumbent). As competitive entry occurred only very gradually, it was (relatively) simple to start adding collection of similar data from the new entrants. Thus, when the fixed line industry underwent the strategic shock of DSL's invention, as it was exclusively the incumbent copper operators deploying it, it was very simple to extend the data collection to include the gathering of similar statistics relating to DSL.

However, as the DSL (broadband) market is underpinned by very different competitive dynamics to those in fixed line voice telephony, it is far from clear that the DSL data can be used in the same manner as fixed line voice telephony data even to assess the effect of market liberalisation policies, let alone inform broadband uptake policies. At the very least, the presence of competing provider networks (initially cable and satellite, but now also wireless and cellular) meant the scope of relevant data collection needed to be very much broader – and often going outside regulators' powers of data collection. It also became very much more difficult for the international agencies to standardise cross-country data collection. This is evidenced in the considerable lag in, and the quality of, the OECD's collection of initially cable and satellite, and subsequently wireless and cellular, data relative to the collection of data pertaining to DSL.

It is crucially important in the practice of principled evidence-based policy-making that both policymakers and academics are aware of both the limitations of the data and the different contexts which underpin the generation of the relevant data. The science of decision-making (as per Kahneman and Tversky) cautions against falling victim to classic traps such as the 'availability bias' and the 'sunk cost fallacy'. This is equally relevant to both policy formulation and empirical analysis. Simply because similar data used for the analysis of past policies are available does not mean they can be used in the same manner to inform on either a new context or a new policy. Just because some data are already available it does not mean that they either must be used, or that they are the only data that are necessary to inform decision-making in the new context. Or even that policies themselves can be recycled (e.g. access regulation applied to fibre as opposed to copper networks) in order to address different policies. Furthermore, care must be taken to guard against the risk that that simply because specific policies were in place when the context changed, and the 'target performance metrics' subsequently behaved in the manner anticipated for the policy, it can necessarily be presumed that it was the policy and not the context change that led to the observed outcomes.

By way of illustration, there is general agreement in the literature that evidence of the effects of access regulation on competition prior to the implementation of DSL was at best

inconclusive [44] . However, competitive intensity undeniably increased following the implementation of DSL[45]. But how much of this was due to policies and how much to technological innovation? Without doubt, market liberalisation did enable the deployment of competing networks, and at the margins access regulation may have led to some options for the deployment of DSL broadband not available in jurisdictions where it was not implemented. The level of complexity even in the evaluation of competition policies is clear. This would suggest that it would be quite a lot more difficult to create a credible argument using data and models which may not even be fit for purpose in a new context to evaluate the effect of competition on the second policy objective of broadband uptake. However, the availability bias and sunk cost fallacy appear to play a part in much of the evidence collected in relation to the linkages between access regulation and broadband uptake. To paraphrase, simply because some data and models are available, we can (and indeed must) use them. And equally, in respect of the policy itself, just because it was in place initially does not mean that it cannot be abandoned.

3.5 Evaluating the Evidence of Broadband Policy Efficacy

I will now finally turn to my evaluations of some of the evidence that has been created and offered in support of the efficacy of access regulation on broadband uptake. In my research, I have consistently sought to take account of the underlying dynamic context when positing my own models and critiquing those of others. I acknowledge that I am exposed to my own biases (the exposition of which is quite rightly the subject of peer critique) and my inquiry has been influenced by specific factors in the New Zealand context in particular. My request is that my 'testimonies' are evaluated in the spirit of the metaphor of legal tests for the admissibility and consideration of evidence around which this discussion has been framed and which I have proposed as being valuable in the practice of principled, evidence-based policy making.

3.5.1 Boyle, Howell & Zhang (2008)

This paper stands as probably the most influential application of my thinking about the nexus between policy and broadband uptake in a dynamic context. It was prepared as a critique of evidence offered in support of the contention that local loop unbundling increases broadband uptake per capita. In work commissioned by the OECD, de Ridder (2007) produced a mixed effects model that found econometrically significant evidence that there was a positive effect. Specifically, the longer that local loop unbundling had been in place, the greater was the effect on

[44] See Hausman & Sidak (2005) for a discussion.
[45] Distasio, et. al., (2006); Grajek & Roller (2009)

broadband uptake per capita. This model subsequently became the focus of United States inquiry when it was used in Berkman (2009).

This analysis provides two salient lessons for the credibility and admissibility of evidence. As econometrics is not my academic forte, this paper relies upon Glenn Boyle's more expert contribution (and John de Ridder's data – Wei Zhang did some of our number crunching). Analysing the identical data and model using statistical techniques taking account of robust standard errors, the significance de Ridder attributed to local loop unbundling ceases to be statistically significant (although the coefficient is still positive).

However, we did not stop our analysis there. My contribution was in examining the context in which the data in the model had been collected. One of the 'problems' of ready availability of all of data, statistical analysis packages and a bevy of keen, low-cost students looking for the chance to test their newfound mastery of the software packages and statistical theories is the apparent precedence of models 'tweaked' to justify the specification of the model given the data chosen, at the expense of checking the consistency of the initial model with the real-world context. Arguably, mastery of empirical application of statistical techniques is quicker and cheaper to learn, and much easier to assess objectively, than understanding of the ways in which complex dynamics play out in real world markets.

Returning to the earlier discussion of how access regulation might affect diffusion, the finding that the effect is greater the longer the tool has been in place seems not to fit the dynamic model presented. A single regulation imposed in isolation would most likely have a single, stepwise effect on diffusion rates, especially it, as is the most usual explanation, access regulation alters the price at which a technology is offered in the market. The most likely effect would be a single upward shift in the diffusion curve at the point of implementation. The de Ridder model, however, finds an effect that increases over time. This appears more consistent with the 'natural diffusion effects' scenario, especially in the early stages of a technology's diffusion (the data cover 2004 to 2007, so this is fits the context of early to mid-stage diffusion in most jurisdictions). This suggests that an investigation of how de Ridder's model specification might be confounding the effects of natural diffusion and regulation is warranted.

As a first step, it is useful to examine the magnitude of the coefficient of the unbundling variable in relation to in relation to others in the model. Even if it was plausible that there was an effect, how big is it? This is important for subsequent analysis because the costs and risks of a policy might render it less plausible if the benefits are small and the costs large. Surprisingly, in

the analyses of such models, the extent of materiality is seldom discussed[46]. A finding of statistical significance in one variable alone is usually deemed sufficient to assert a beneficial effect from implementing the policy[47]. The effect of the time that LLU has been in place in de Ridder's model is very small indeed. For example, it suggested that in 2007 in New Zealand, implementation of the policy would generate an additional 20,000 connections (at the time, there were in excess of 700,000 live connections). Furthermore, as the model used longitudinal panel data, there was a variable taking account of the year to which the data pertained. This variable was also positive and statistically significant – and its coefficient was nine times that of the unbundling coefficient. As diffusion is time-dependent, this is not surprising. It confirms that de Ridder's model finds the overwhelmingly most significant effect driving broadband uptake (at the time the data were collected) is the passing of time. But de Ridder's unbundling variable is also time-dependent. This suggests that correlation between the variables could be confounding the analysis.

To assess the extent of this model specification issue, we first separated the data into two groups by the year of collection (2004 and 2007) and re-ran the model. The coefficient for LLU was larger in the model run on the 2004 data than the 2007 data. This appears to contradict de Ridder's conclusion from the full panel model that the effect of unbundling on broadband uptake increases over time. Rather, it suggests that it is in fact ***decreasing*** over time. Next, we recast the model to separate out the effects of the length of time that broadband (proxied by DSL) had been available and the length of time that LLU had been in place (the year dummy was no longer necessary). Under this specification, LLU ceased to be significant at all and its coefficient was several orders of magnitude smaller than the coefficient for the length of time that broadband was available, which was (coincidentally) very highly significant indeed. And finally, just to check that there for any potential stepwise effect from the presence or absence of unbundling, we replaced the time-dependent LLU variable with a 0/1 dummy. It was not significant in any of the individual years or full panel data.

As a 'witness for the defence' in the prosecution of the case that LLU drives broadband uptake, I can only submit this evidence for consideration by policy-makers. However, my contention is that in the context of the dynamic scenario I have postulated, the 'circumstantial evidence' appears to fit much better with my explanation than the de Ridder conclusions.

[46] One exception is Distasio, Lupi & Manenti (2006). Their paper provided my inspiration for this line of inquiry.
[47] Berkman (2009) is but one of many examples.

3.5.2 The Berkman (2009) Application

In the United States context, the solitary empirical model supporting the Berkman (2009) recommendation that LLU be adopted as a means of increasing broadband uptake was the original de Ridder model, modified only for the shortcomings in the choice of statistical methodologies relating to robust standard errors identified in Boyle, Howell & Zhang (2009). There was no mention in this analysis of any of the concerns regarding model specification. I cite this not as a criticism of the paper per se (although in Howell (2009) I do address this matter) but to make a point about the admissability and use of econometric evidence in policy evaluation. This relates to the question of 'blind' data manipulation to meet theoretical statistical objectives without giving due attention to contextual factors.

Berkman's (2009) application of the de Ridder model is notable for the nature of the selection of data in creating the 'evidence'. The authors note that the effect of LLU on broadband uptake is both larger and more significant when the data for Switzerland are omitted. Indeed, it would appear that all of the evidence in the paper is based on data omitting Switzerland. But no reason is offered as to why this approach is taken, except that it appears to better support the contention that unbundling drives broadband uptake. By analogy, if we ignore this potentially important piece of evidence, we may have a better chance of a 'guilty' verdict. However, the suppression of evidence in a judicial process usually requires some cogent justification.

The 'problem' of ignoring Switzerland from the data is that it is one of only four of the 30 OECD jurisdictions (at the time of analysis) where local loop unbundling had not been implemented. It was also the one with the highest absolute level of broadband uptake. Omitting Swiss data from consideration is analogous to concluding that there is plenty of space in the room so long as one ignores the presence of a rather large elephant.

However, in the history of analysis of the potential influences on broadband uptake per se, there has been a particular outlier – Korea – which has often been omitted from the analysis because of its potentially confounding data effects. However, that is because, in the quest of an explanation for an understanding of factors influencing broadband uptake, there were significant contextual factors that made it likely that including Korea would distort the analysis. The reason was that the exceptionally early and rapid uptake of broadband in Korea was almost certainly as a consequence of government policies that subsidised both its deployment and uptake[48]. This characteristic was not present (at the time that most of these analyses were undertaken) in any of the other 29 OECD countries. Omitting the distortion caused by Korea allowed more informed analysis of what the influential factors in the other 29 most likely were. Korea was omitted not

[48] Hausman & Sidak (2005); Shin & Jung (2012).

because it messed up the empirical results, but because of factors inconsistent with the conceptual modelling necessary to inform the object of interest in the first place. By analogy, in the quest to identify how we might induce more and different elephants into the room we could ignore one of the elephants already there because we had a pretty good idea that the reason for its presence was irrelevant to what would motivate movement of the elephants we were really interested in.

Indeed, in a 'reality check' of the evidence offered in the Berkman inquiry (of the form outlined in the discussion on BHZ), one might ask what in the model might actually be consistent with Switzerland's high level of uptake. Again, the materiality of the LLU coefficient comes into question. Its effect is very small indeed, in a model where other, also highly significant, factors are identified. If it's uptake was primarily attributable to other significant factors such as a head start in the diffusion process, low initial prices and competitive pressures from cable networks, then omitting it from the model because it complicates the desired LLU finding, then the model is less useful for assessing the relevance of these other factors in understanding the nature of the complex reality being modelled – including evidence also offered by the Berkman authors as to the influence of LLU on prices.

3.5.3 Access Regulation Unequivocally Increases Competition – Howell (2008).

I will now turn to an example illustrating how undetected contextual differences can lead to the same policy having different effects in different jurisdictions. The learning is that even if a policy has been demonstrated to have been effective in another jurisdiction, it cannot be taken for granted that it will be effective in the new context, as local characteristics may be different. This example also illustrates the need for detailed monitoring and evaluation of the policy against all of its espoused objectives, along with the consequences of a lack of clarity and prioritisation when there are multiple objectives for implementing a policy. Unlike de Ridder (2007), BHZ (2008) and Berkman (2009), this example relies upon case study and not econometric evidence. However, in the spirit of this inquiry it is informative.

In 2004, bitstream unbundling was introduced in New Zealand in large part as a political compromise when full local loop unbundling was rejected. At the time, there was some EU evidence that it might have been associated with higher levels of DSL uptake, without necessarily crowding out investment (although with more data this has subsequently been drawn into question). Its implementation took place in the context of the long-running objective to increase the competitive forces operating on the incumbent operator. However, there was an additional explicit objective that the policy should also stimulate an increase in broadband uptake, given New Zealand's low ranking in the OECD statistics. Thus, the policy was implemented in conjunction with two explicit provisions on the incumbent that unless specific uptake (250,000

broadband connections) and competition (33% sold by competitors to the incumbent) targets were met by December 2005, more stringent regulation would be imposed. Whilst the nature of the more stringent regulation was not articulated, given the recent context, it would almost certainly have been the imposition of full LLU. Progress towards the targets was monitored by the Telecommunications Commission.

Figure 2 shows the development of the market over the relevant period. Shortly after bitstream unbundling was introduced, New Zealand broadband uptake accelerated. Indeed, at December 2005, the uptake target had been exceeded by 11%. This was cited (in the political domain at least), as clear evidence that the bitstream unbundling policy was 'working' to increase broadband uptake. However, measurement of progress towards the competition objective uncovered a 'smoking gun'. The share of broadband connections sold by competitors to the incumbent at December 2005 was 25%. That is, a policy introduced to increase both broadband uptake and competition had succeeded (indeed exceeded expectations) in relation to the broadband objective, but failed in its competitive objectives. It is noted that this was the solitary competition metric used to assess performance in the relevant inquiry, which was led by the Ministry of Economic Development (in its role as policy-maker) rather than the Telecommunications Commission, which had undertaken the 2003 LLU inquiry, and given its location within the Commerce Commission which oversees competition policy in New Zealand, was both more independent and better placed to both analyse the relevant information and conduct a contestable process. However, the New Zealand Telecommunications Commission is not truly independent, as unless legislation is already in place, it can only advise the Minister. Any changes to the regulatory framework require political action.

The immediate response (politically) to the failure of Telecom to meet the market share target was that the (comparatively lighter-handed) bitstream regulation had failed to make the market more competitive, and consequently full LLU must be implemented. The industry 'Stocktake' prepared by the Ministry claimed (without any rigorous empirical analysis of either the international or New Zealand contexts – even the descriptive statistics provided were unconvincing) that LLU legislation would lead to even more competition and broadband uptake would rise to even greater levels such that New Zealand would once again enter the top quartile of the OECD rankings. This conclusion was bolstered mainly by the views of officials in other jurisdictions where LLU had already been introduced, and the OECD.

A cursory glance at Figure 3, however, shows a very different story about the role bitstream unbundling played in New Zealand. When bitstream unbundling was implemented it was on the assertion (from international 'evidence' that it would increase competition and thereby

increase broadband uptake. Regardless of what may have occurred elsewhere, Figure 3 shows that in New Zealand, bitstream unbundling has been associated with a ***decrease*** in competition, at least when measured by market share. The share of connections sold by competitors to the incumbent fell from 35% prior to the legislation to 25% at December 2005, at the same time as the number of connections sold increased exponentially. That is, ***decreasing competitveness*** is associated with ***increasing broadband uptake***. What makes this even more puzzling is that in the New Zealand ISP market, competitors to the incumbent had a dial-up internet market share in excess of 50% in 2003 – that is, they already had acquired the customer relationships that unbundling is supposed to facilitate, in large part due to intense competition during the late 1990s when New Zealand exhibited world-leading dial-up internet connectivity and use[49]. Indeed, the incumbent was actually taking internet customers off the entrants in a more competitive market as they converted from dial-up to DSL connections. This is totally at odds with the classic arguments used to support the introduction of unbundling legislation.

It is unclear whether the policy decision-makers (politicians) were aware of the facts above, as they are not articulated in the material prepared by officials. However, the 33% broadband market share competition target appears to be exactly what the market shares were when the bitstream policy was agreed in December 2003, suggesting that they must have been able to deduce that increased regulatory intensity had the opposite effect to that postulated when bitstream unbundling was implemented. Indeed, there is no assessment at all in the Stocktake of the possibility that the regulation has failed in its primary competition objective – rather, it appears to have been assumed that any shortfall in the competition target is entirely a consequence of the incumbent exerting its dominant position. As I have argued elsewhere[50], it has been difficult not to conclude that the primary purpose of the 2006 Stocktake was largely immaterial to a political decisions made prior to the 2005 election to pursue greater New Zealand alignment with OECD policy orthodoxy.

Figure 3, however, invokes a very real challenge to the orthodox policies, and begs the question of what is different about the New Zealand context. That is, what alternative scenarios might explain why, despite the introduction of policies designed to increase competition, has the opposite occurred? In the absence of a contestable process and a fair trial for the evaluation of the proposed policy, there were few incentives for the development of alternative scenarios. However, I will now discuss the one I proposed, that analyses a dynamic game being played by three parties – the incumbent, the entrants and the policy makers. The incumbent wants to

[49] Howell (2003).
[50] Howell (2010).

maximise profits, but is subject to the constraint of not wanting to invoke more intrusive regulation – that is, full LLU. The entrants advocated strongly for LLU at the 2003 Inquiry. They too will seek to maximise profits, but will also likely want to increase the likelihood of getting full LLU in the future. They may be prepared to compromise profits in the short run in order to achieve the longer-run LLU objective. When the regulator announces the targets, the incumbent has strong incentives to work with entrants to meet them. However, the entrants can choose their strategy based upon what will most likely get them their long term objective of full LLU. In this respect, it is better for them if the incumbent fails in at least one of the targets. The entrants have strategic control over the incumbent's ability to achieve the competition target. As long as it is not too costly for them, they will avoid selling bitstream connections in order to get full LLU. As they already have a slight market share edge in dial-up internet connections, they can continue to sell these to their existing customers – who are presumably profitable. That is, they can 'hold out' on aggressively marketing or upselling selling bitstream connections to their existing customers (i.e. only selling bitstream connections to those customers who initiate the transition from dial-up to DSL themselves, or even not offering DSL at all, thereby forcing these customers to go the incumbent, further facilitating the 'failure' to meet the competition target). This scenario is a classic example of a 'fix that fails' because of the dynamic interaction of multiple parties in a systemic context[51].

Further investigation shows that it was not only strategically rational for entrants to not sell bitstream connections, but also more profitable, simply because there was not a 'competition problem' in the first place. Prior to bitstream being enacted, there was not a supply-side 'problem' – the incumbent's entry-level retail DSL connections were priced low by OECD standards and were very widely available[52]. When the bitstream wholesale prices were announced, they conferred a revenue margin of just over $2 per connection per month for entrants on the entry level product. However, the revenues derived from interconnection charges alone for dial-up access for the average internet customer were around $10 per month (and ISP entrants were almost all customers of the infrastructure entrant in order to maximise such revenues[53]). Thus, not only was it strategically rational for the entrants to eschew selling bitstream connections in order to increase the likelihood of getting full LLU, it was in fact more profitable for them to do so as they got higher revenues from keeping customers on dial-up connections for as long as possible.

[51] Davies, Howell & Mabin (2008) .
[52] Howell (2003).
[53] Karel (2003); Howell (2007).

This example illustrates the power of using both all available evidence and many different scenarios when assessing both evidence and policy options. It also illustrates the danger of using a single metric – connections sold by competitors – and a single model when assessing the efficacy of policies. Complex dynamic interactions do not lead to simple cause-effect outcomes. And it is insufficient to accept that a policy in one context will apply identically in others without empirical verification in the new context.

3.5.4 The Counterfactual is Dynamic Too

Full LLU was implemented in New Zealand in 2006, and functional separation in 2007. Even at the time, international theoretical evidence suggested that these policies would likely have chilling effects on the incentives for either the incumbent or entrants to invest in frontier technologies. Subsequent empirical evidence from the EU is beginning to bear this out. The New Zealand case study adds to this body.

The investment community responded very negatively to increased regulatory intensity on the incumbent. Telecom's share price fell dramatically, leading to the firm announcing in 2007 that it was prepared to invest only $500 million of the estimated $1500 million required to implement the nationwide FTTN network it had initially proposed to implement at the 2003 LLU inquiry. The initial target for this network was 2007, but various factors, not least of which was the need to comply with increased regulatory obligations, had led to this investment being delayed. That this threat was credible, and not just cheap talk, was signalled when the firm returned $1000 million of the proceeds from the sale of its directory business in April 2007 to shareholders. Subsequent negotiations between the Minister and the firm led to undertakings to implement the planned build by December 2011. The network was completed ahead of schedule, but at substantially greater financial cost in real terms than anticipated in 2003, in large part because the collapsing share price increased the company's cost of capital. Continued regulatory intervention also had dynamic efficiency consequences, as its implementation was delayed by four years relative to the 2003 scenario.

This serves to illustrate the need to assess the effects of policy interventions against dynamic counterfactuals, in the contest of an unbiased process. In neither 2003 nor 2006 was the relevant counterfactual the current status quo. The 2003 recommendation against full LLU was in large part a consequence of the effects it would have had on the FTTN network. Yet in 2006, this factor was barely mentioned. Rather, delays to the planned implementation (which had undoubtedly been affected by regulatory changes) were attributed entirely to the incumbent's exertion of its dominance. At the very least, in a contestable process, there are incentives for the scenario of a dynamic status quo to be fully explored. This is arguably what occurred in 2003,

when the Commission, with its quasi-judicial processes, oversaw the inquiry. However, in 2006, when the process was overseen by the Ministry, there was limited opportunity for the alternative scenario to be argued contestably, and the question was adjudicated by a biased panel (politicians) who had likely already decided what would occur.

3.5.5 Doing Nothing is Always an Option: Government-Funded Ultra-Fast Broadband

In a principled policy-making process as argued for in this presentation, the onus of proof for proceeding with a policy is that it has satisfied a net benefit test against a dynamic counterfactual. However, it is not always possible to support the case for the policy with sufficient empirical evidence if the status quo is so dynamic that even it cannot be predicted with much confidence. In these circumstances, in a quasi-judicial context, it would seem to be beyond the ability of any judge to be able to assert that the case for a policy has been proven to a sufficient standard to warrant proceeding. In the policy-theoretic context, this can be considered using theories of decision-making under uncertainty. This literature suggests that when uncertainty is very high, or the investment/policy is irreversible, the option of delaying making a decision until more information is available is very valuable[54]. The logic is that investing too early risks the assets becoming stranded. If it does become evident subsequently that an investment should have been made earlier, then unless it is a 'winner takes all' game, it is possible to retrieve much of the benefits by accelerating the pace of a later investment.

To illustrate this, I will use the example of government funding of fast fibre networks in Australia and New Zealand. These countries have invested very large sums to deploy nationwide FTTH networks, in large part predicated upon policies of 'nation-building' and 'not being left behind' competitor nations (notably Japan and Korea) in broadband technologies. Yet it is far from clear first why the Korean government has invested in its network, and second, what the benefits are for Japan, given that it has a broadband uptake rate very similar to New Zealand and Australia's. It is also far from clear what the disadvantages are from not having a FTTH network first (especially in New Zealand, given its nationwide FTTN network that has been available since 2011). If there was a 'winner takes all' advantage, then the value of pre-empting others has already been lost. If there are relative benefits, then that would be best revealed by first investing in research on the countries that have already employed the policy in relation to the implementing country's object of interest (and not just the metrics that are used to assess this). There is scant evidence of either New Zealand or Australian policy-makers engaging in this sort of inquiry[55].

[54] Guthrie (2006).
[55] Howell (2012).

If it is assumed that the primary objective is the pursuit of total economic welfare, then there are usually strong private incentives to deploy new networks, even in the presence of technological dynamism, if the value of the applications to users is sufficiently compelling. This has been demonstrated many times over in recent years in the mobile telecommunications markets, where several generations of technologies have been deployed, and transition of customers from one to the other engineered, on the basis of the value to consumers of new applications only able to be delivered on the new (frontier) networks. The role of applications in driving network investment even in rural areas has also been demonstrated in New Zealand, when in 2001 Fonterra (a large dairy farmer co-operative whose members produce over 90% of New Zealand milk) entered into contracts with multiple providers to ensure that all of its members had access to 256kbps services in order to utilise a range of internal applications that were of net benefit to the co-operative[56]. It begs the question therefore of what role policy should play in network – as opposed to application – implementation. If initial specification of the object of interest focuses on the wider economic objectives rather than network-specific ones – that is, a digital economy policy rather than a (fixed line) telecommunications policy – then it becomes less clear why intervention is necessary, except when there is clear evidence of the market failing to deliver when there is proven demand.

Once again, this example highlights the need for clear evidence of the existence of a problem before policy intervention is warranted. It is far from clear what applications exist currently that can be implemented only on ultrafast networks, but not on current ones. Even where ultrafast fixed networks exist, using Figure 1 their low levels of uptake in the presence of existing networks is strongly suggestive of either or both of a lack of applications or an absence of a compelling additional functionality that either users are willing to pay for or network operators are prepared to invest in[57]. That is, an absence of investment in a technologically dynamic environment is not necessarily an indication of investment intransigence by private sector operators (and notably incumbents with some residual market power). It may simply be that the investment case currently does not stack up. However, when it does, then there is every reason to believe that the incentives for both network operators and consumers will be strong and that in contestable markets, at least one operator will be motivated to invest. The evidence for this lies in the evidence for the diffusion of mobile broadband, which in fact is competing with ultrafast connections for constrained household spending.

[56] Corbett, *et al*., (2004).
[57] Heatley & Howell (2010).

This is not to say that there will not be benefits from ultrafast networks in the future, but that at present consumers appear to be valuing the ability to use many existing applications on mobile devices more highly overall than the ability to use other applications on faster networks. The benefits of speed may not be as highly valued by consumers as policy-makers (and arguably also some fixed line network operators) would like them to. And it is beholden on policy makers to take these factors into account when investing large sums of taxpayer's money. I would contend that if the object of policy interest is shifted from specific technologies towards the derivation of economic value from the use of digital data, then this will facilitate both the generation of more relevant research to inform policy, and better policy decisions, in line with the principles outlined in the earlier part of this presentation.

4. Conclusion: Lessons for Policy-Making

This presentation has taken a very broad sweep across both the normative and positive aspects of evidence-based broadband policy. If nothing else, it has highlighted that policy-making in this highly technologically volatile environment is not easy. It is a very complex environment, and has become more so with market liberalisation, the profusion of network technologies and types and the rapid growth of new applications from which users derive benefits. Nonetheless, the principles of good evidence-based policy-making should prevail, even if it leads to the (reasoned) decision to do nothing, but watch more closely to be able to implement better policies in the future.

To that end, I would like to suggest that the contestable model of evidence-based policy evaluation offers a principled way of proceeding even (and arguably especially) in the face of complexity. Any policy must pass a level of benefit to justify proceeding, and intervention is not costless. It is likely more costly when uncertainty is high, as it risks crowding out alternative paths of development of subsequent interaction. Thus incentives must be exist to ensure that the relevant evidence/research is collected/analysed in the first place. The process by which this is done is therefore extremely important. A monopoly for policy ideas and alternative scenarios for the way the future will unfold is still a monopoly, with all that entails. Competition – or at least contestability – in the development and processes for assessing the relevant evidence is, I suggest, unconditionally preferable to an alternative.

Figure 1: The Diffusion Curve

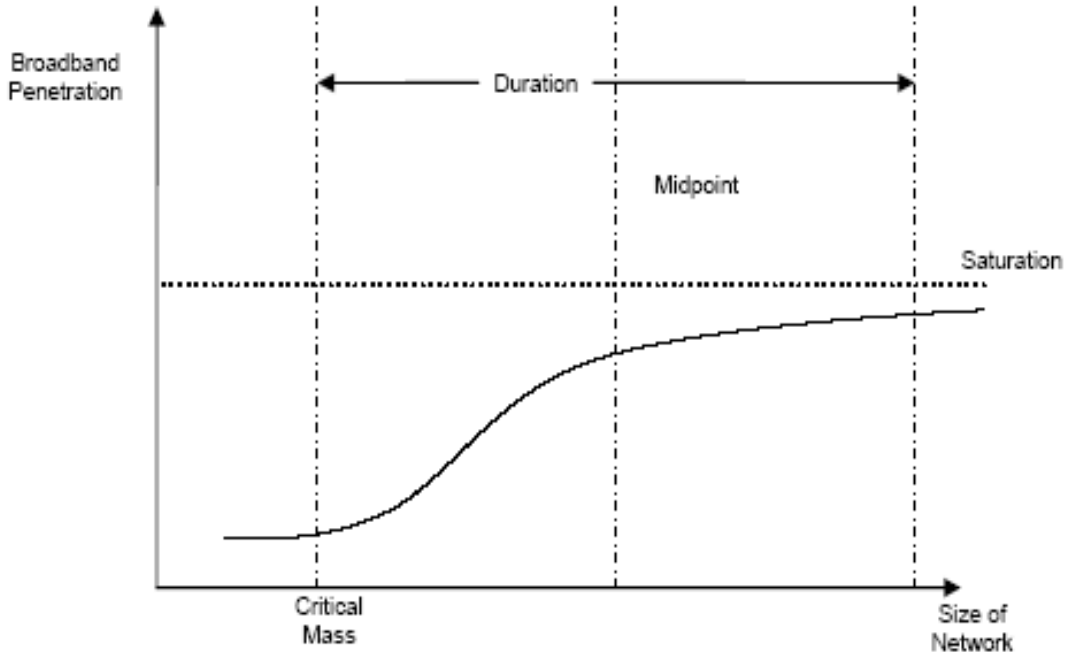


Figure 2: Broadband Diffusion in New Zealand

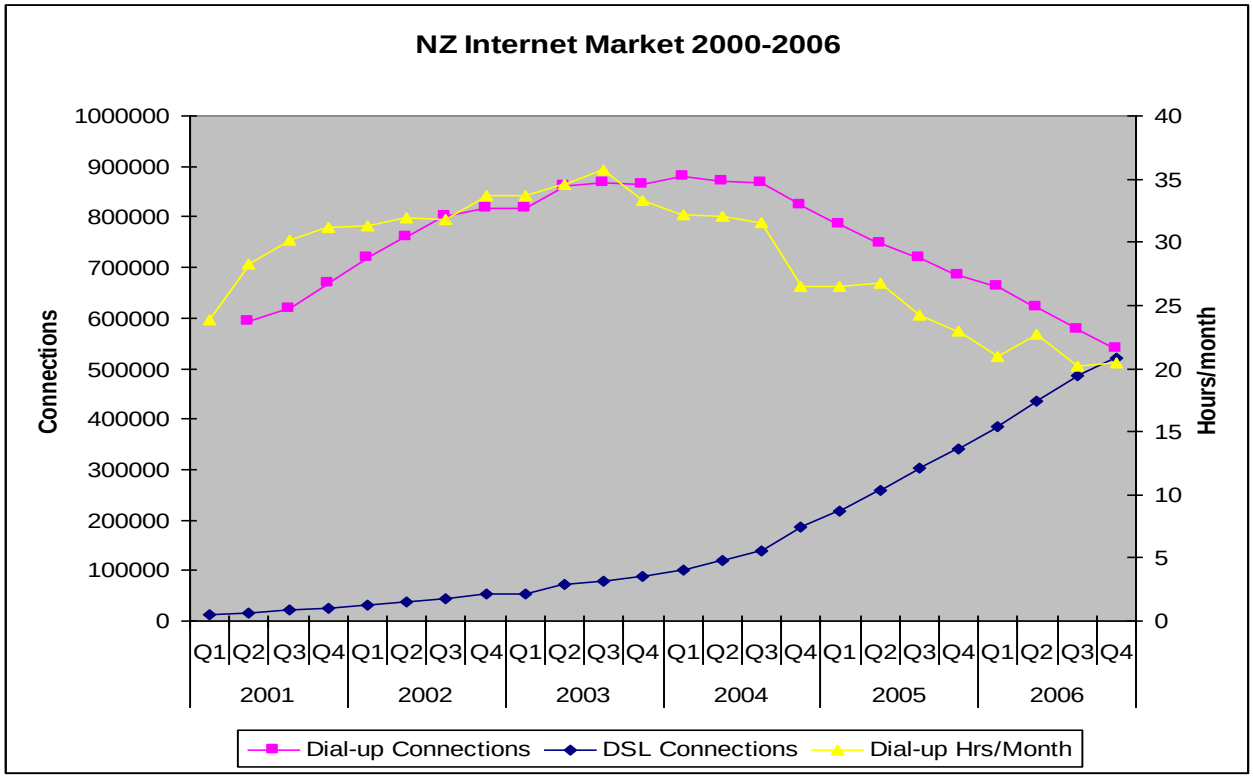
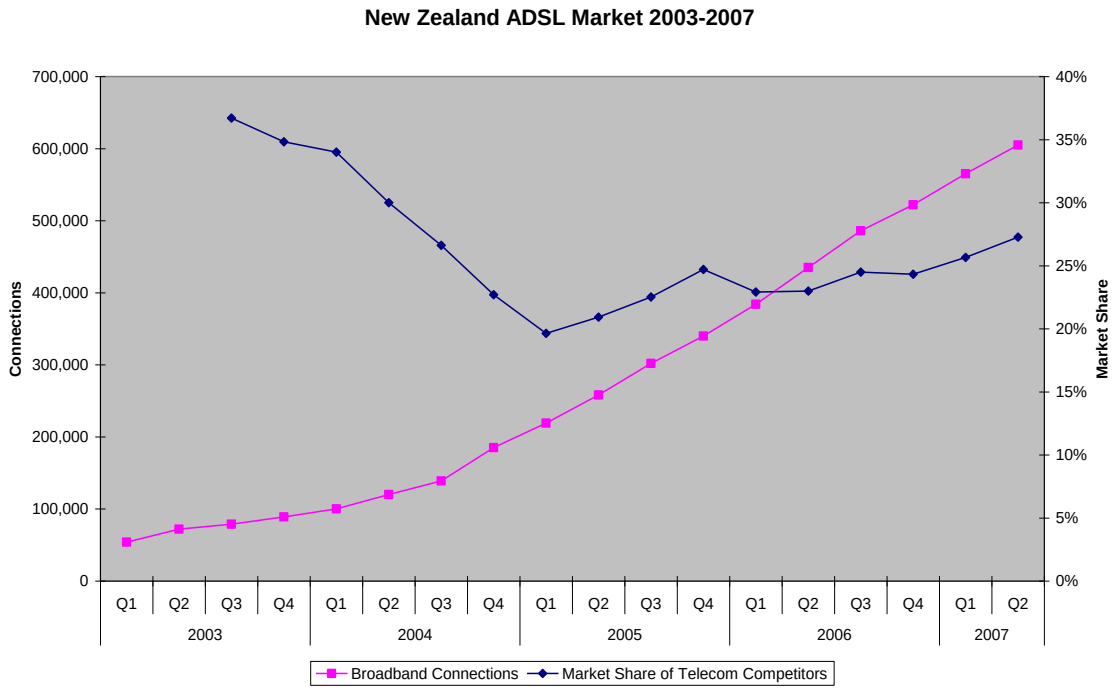


Figure 3: Bitstream Regulation, Competition and Broadband Diffusion



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