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Dimensions of the Digital Divide:
Perspectives from New Zealand

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Principal Acknowledgement

I would like to especially acknowledge and thank the Keio University Global COE Programme Conference on Designing Governance for Civil Society, and in particular my colleague Professor Minoru Sugaya, for inviting me to present at this conference, and for funding my trip to Tokyo. In terms of physical transport costs, because of New Zealand's small physical scale and geographical isolation, academics with very tight budget constraints are on the 'losing side' of the conference attendance divide, making it very expensive for most of us to attend as many conferences, seminars and workshops as our colleagues in more populous regions are able to do. Distance also makes it very difficult to attract overseas participants to conferences hosted in New Zealand. This renders your generosity especially valuable.

I would also like to thank Professor Sugaya for providing the thought-provoking topic for the session on the Digital Divide in the Asia-Pacific region. This has necessitated a review and reassessment both of my work and that of others on the Digital Divides in New Zealand, relative to those in other countries and regions, as they stand in 2012. As my own work in this area dates principally from the early to mid 2000s, it has been necessary to reacquaint myself with the state of the current international literature – which serendipitously led me to the organising theme for this paper and associated presentation. In a longitudinal context, it appears that there is a large empirical literature identifying and measuring a range of 'digital divides' over many dimensions, and a large number of policy instruments designed to ameliorate them, but at first blush it appears that many of the divides persist, and are widening rather than narrowing. This suggests that either the policies used already are either ill-targeted or largely impotent, or even worse, despite their good intentions, have contrary effects on the indicators used to measure the existence of the divides. This paper addresses some of these issues.

I am very grateful to have the opportunity to participate in this conference, both as a presenter and a delegate, and trust that this opportunity will provide mutual benefits in academic and policy discussions in both Japan and New Zealand, and ultimately the wider world.

Thank you.

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Wellington, New Zealand
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Researcher Statement

This paper and the associated presentation have been prepared in response to a brief from Professor Minoru Sugaya to examine issues of the digital divide in each country, and discuss similarities and differences in the policies adopted to ameliorate it. The paper presented here is subtitled 'a perspective ***from*** New Zealand' because it documents my own conclusions resulting from my position as an academic applying an economic lens to the issues of the digital divide. Whilst it refers to elements of the New Zealand policy response, it is not intended to provide a full or comprehensive documentation of New Zealand government policy in this area. Rather, the paper seeks to take a critical view of both the benefits and costs of some of the perceptions of the digital divide and the policy interventions adopted to ameliorate them.

In keeping with the economics paradigm, it is taken as given that any policy will require trade-offs in the allocations of scarce resources in an economy, and that the metric used for assessing the effects of the policies is economic welfare (or efficiency) – in all of its dimensions (static, dynamic, allocative and productive). The paper also distinguishes between private costs and benefits borne by the individual participants in the economy, and social benefits and costs that accrue over and above the private benefits. Policy intervention will usually be necessary to enable external ('social') benefits to be generated and total welfare increased, it is recognised that these interventions will also likely alter the allocation of private benefits between different participants in the economy (transfers), which will inevitably create 'winners' and 'losers'. In the short term, transfers create a 'zero sum game', where the gains to the winners are directly offset by losses incurred by the losers. However in the longer-term they can also alter the incentives facing economic participants, and thereby alter the total amount of additional welfare generated by the policy (relative to the counterfactual of the policy not being implemented). The identity of winners and losers as a consequence of a policy thus matters, as it helps to explain the motivations of those advocating for or opposing its implementation, but long-term policy stewardship would seem to be best served by seeking to maximise long-term welfare outcomes, with very good reasons being needed to justify policies that militate against its pursuit. Policies seeking to optimise in respect of elements other than total welfare (e.g. technology uptake statistics) will support the pursuit of higher total welfare only if there is an unambiguous positive correlation between the two objectives at all times.

I note also that my insights have been derived from observations made principally on developed economies, so may not necessarily translate directly to economies in the developing world.

Introduction

Information and Communication Technologies (ICTs) are almost universally regarded as key potential factors for economic growth, social development and cohesion[1]. Consequently, the diffusion of ICTs such as computers, internet and broadband has attracted considerable academic and policy interest – in particular identifying levels of access to and uptake and usage of these technologies across different communities of economic and social activity[2]. This has drawn attention to apparently large differences between many groups (generally described as the 'digital divide') and manifest policies targeted at reducing the observed differences[3].

Notable features of the digital divide debate in the academic and policy literature are the long standing of the problem identification (it seems to emerge in the early 1990s, concurrent with the initial commercialisation of the internet), its apparent intransigence (the volume of empirical papers measuring divides is increasing over time, and their content appears to suggest that divides are, if not increasing, then at least persisting unabated, despite numerous policy interventions), and a strong bias towards inter-country comparisons (focused predominantly within the (developed) OECD countries and between developed and developing countries). Empirical analysis of geographical divides within countries is limited, and mostly United States-centric, in part due to an absence of data[4]. To the extent that other socio-economic statistics are examined in the context of the divide, it is largely in respect of how differences in factors such as income, population density, urbanisation, education and literacy contribute towards explaining relative differences in ICT uptake between countries[5], rather than how (or whether) directly altering the underlying indicators will close either absolute or relative gaps in economic and social outcomes. Conspicuous by its absence (with the exception of the extent to which access regulation policies such as local loop unbundling affect broadband uptake at a national level[6]) is a literature on critical analysis of the effect of specific policy interventions on ICT diffusion indicators[7].

Notwithstanding, a considerable amount of (scarce) research and policy resource continues to be expended identifying divides and developing policies to ameliorate them. New

[1] Billon, Marco & Lera-Lopez (2009); UNCTAD (2008); ITU & UNCTAD (2007); Pohjola (2003). For a critical review of these assumptions, see Kenny & Kenny (2011), Howell & Grimes (2010) and Fink & Kenny (2003).
[2] Hilbert (2011), OECD (2008), ITU & UNCTAD (2007), World Bank (2006).
[3] For recent literature reviews, see Vicente & Jesús-López (2011) and Hilbert (2011).
[4] Billon, Marco & Lera-Lopez (2009), Vicente & Jesús-López (2011).
[5] Hilbert (2011).
[6] See Boyle, Howell and Zhang (2008) for a discussion.
[7] Howell & Grimes (2010) discuss the absence of policy evaluation generally in respect of ultrafast broadband networks, but this pattern is repeated for most other ICTs. For example, it is still far from clear how computers contribute ultimately to economic growth (by construction or utilisation), how big any effect is, by how long the gains are lagged behind the investment and in which parts of the economy they are accruing.

Zealand is no exception in this endeavour, and the author has been active in undertaking research on ICT diffusion divides both within the country and between New Zealand and other comparator countries[8]. However, three very surprising patterns have emerged as a consequence of a recent reading of the economics and policy literature in the context of the research I have undertaken on the 'digital divide' in New Zealand. First is the dominance of the pursuit of policies equalising a very small number of indicators used to measure the divides as an end in itself – nearly exclusively broadband connections per capita and the nature and quality (i.e. speed) of the technologies available – in isolation from any attention to how the diffusion of different types of ICTs to different groups (including the diffusion and use of the applications that connectivity enables) facilitates the achievement of any net increase in economic wellbeing[9] (as an economist I am unable to comment on the dimensions of social wellbeing, but I note that there is no explication in any of the New Zealand policy literature justifying the pursuit of any indicators on the basis of a trade-off between the achievement of any broader economic and social ends).[10] Second is the fact that policies continue to be rolled out to address perceived divides, even though there is often negligible evidence that the policies will have any material effect on the divides they seek to address[11]. Third is the apparent reluctance to address the role of existing long-standing policies whose effects run contrary to the closing of some very clear divide indicators that are considered of direct policy relevance[12].

These observations tend towards the conclusion that there are some fundamental gaps in the 'digital divide policy process' and the focus of the associated research endeavour on which it draws (much of which is commissioned to support it). These gaps warrant investigation. This is certainly true, in my (economics-based) assessment, of the New Zealand processes. By extension, given my recent reading of the international literature, it would appear that this is also an issue in the international context as well. The contribution of this paper to the conference agenda is therefore to use New Zealand research and exemplars to illustrate some of the 'problems' in the current state of 'digital divide' research and policies, and to suggest (to the best of my abilities as an economist) how insights from economic theory can assist in, if not directly addressing the gaps,

[8] For example, but not limited to Boles de Boer, Evans & Howell (2000), Howell & Marriott (2001), Howell and Obren (2003), Howell (2003), Howell, Mishra & Ryan (2004), Howell (2007), Howell, Boyle & Zhang (2008), Heatley & Howell (2010; 2010a), Howell (2010; 2010a), Howell (2012). Other papers can be found by searching on the author's name on the ISCR website Research page http://www.iscr.org.nz/research

[9] See, for example, Grimes & Howell (2010), Howell & Obren (2003), Howell and Obren (2002).

[10] I suspect that the body of other social science learning may similarly lack the clarity of a direct nexus. This appears to be supported by Hilbert (2011), who comments on the vast number of potential factors and models of digital divides in his wide multi-disciplinary survey.

[11] See, for example, Obren & Howell (2010) on Fast Fibre Broadband and New Zealand's international economic competitiveness; Boyle, Howell & Zhang (2008), Howell (2007), Howell (2006), Howell (2003) re local loop unbundling.

[12] See, for example, Heatley & Howell (2010), Howell (2001a) re universal service pricing and free local calling and national and regional broadband uptake rates; Howell (2012); Heatley & Howell (2010); Howell Meade & O'Connor (2010) on access regulation and fibre broadband uptake rates.

then at least fostering a greater understanding of some of the mechanisms by which the diffusion of ICTs and applications enabled by them amongst different populations enhances either or both of individual and societal economic and social wellbeing.

The paper proceeds as follows. Section One provides a brief overview of the 'digital divide' from a New Zealand perspective, including some illustrations of the disjunction between research and policy that give rise to my observations and concerns. Section Two then returns to first principles by posing fundamental questions of problem definition, measurement and policy development and effectiveness. This section seeks to explain, in part, the focus on infrastructure uptake statistics as the bellweather of the digital divide, and proposes some alternative metrics that provide different insights that lead to the question of the extent to which currently observed divides might contribute towards or militate against the achievement of broader social and economic objectives. Section Three takes three New Zealand examples to illustrate insights into the digital divide gained from the use of simple economic models. These examples also highlight some of the ways that existing entrenched policies can militate against the achievement of intermediate ICT uptake goals as well as longer-term objectives. Section Four concludes.

1. The Digital Divide in New Zealand

New Zealand is a small (population 4.4 million), geographically isolated country (it is the world's most isolated developed economy, with its closest neighbour Australia – also relatively small with 22 million people – 2000 km and 3.5 hours flying time away). It is characterised by low population density (15 people per square km – comparable to Finland and Norway) – with even its most densely-populated area – Auckland – having a comparatively low density by international urban standards (316 per square km, compared to Sydney – its nearest Australian neighbour at 362 and Tokyo at 6703). It is comprised of two main long narrow islands, both bisected longitudinally by large mountain ranges. As such, it constitutes one of the most expensive countries (both per connection and per capita) in which to deploy telecommunications infrastructure[13]. International terrestrial electronic communication is via a single submarine cable to the West Coast of the United States (return trip time – RTT - for a standard web page averages 220ms) and Sydney, Australia (RTT 120ms). RTTs to Europe (the traditional focus of trade connectivity) exceed 350ms, whilst RTTs to Asia (except Singapore) are around 300ms due to the need for traffic to travel first to the United States and then to Asia. This compares to a worldwide average RTT of around 100ms for a user to connect to a Google server (RTT within the United States of less than 80ms[14].

Although classified as developed[15], New Zealand's economy is relatively undiversified, with a strong export focus on primary production and tourism, which has endured for the past thirty years despite considerable policy efforts to promote increased diversification. Whilst large reductions in international transport costs have assisted, the high costs of shipping physical goods to foreign markets mean its competitive international advantages lie predominantly in its benign climate, enabling relatively low-cost animal protein-based production and its unique landscape and culture[16]. Its biggest export partner is currently Australia, but the share of trade to the Asian region is growing commensurate with economic expansion in that region. Whereas in the 1960s its GDP per capita was one of the highest in the world and comparable to Australia's[17], it now lags Australia by 30%, and has fallen to 23rd out of the 32 OECD countries[18].

Despite its physical isolation and high infrastructure costs, New Zealand has a long history of early adoption of new technologies. Telegraph lines were laid in 1856, the first

[13] Alger & Leung (1999).
[14] Obren & Howell (2010).
[15] New Zealand is a member of the Organisation for Economic Co-operation and Development.
[16] Obren & Howell (2010), Porter (1990), Blainey (1966).
[17] Malpass (2011). The Decade-Long Binge: How Government Squandered Ten Years of economic Prosperity. Sydney: Centre for Independent Studies.
[18] OECD statistics using PPPs held constant at 2005 levels.

telephones were connected in 1879, and in 1995 New Zealand was one of the first countries in the OECD to have a nationwide fully digital telephone network[19]. It has also exhibited OECD leadership in the deployment of broadband. The first fibre broadband services were retailed to Wellington businesses in 1996[20], CATV broadband has been available since 1998, and in January 1999 New Zealand became the second OECD country outside of North America (after South Korea) to retail ADSL services to residential consumers[21]. Nationwide deployment of high-quality (2Mbps was the original service quality installed) ADSL was rapid, with 85% of telephone lines being ADSL-capable by 2002 (95% by 2005 – Howell (2006) concluded it was unlikely this will be exceeded, this is due to geographic terrain and population density). Furthermore, on the basis of a quality- and volume- adjusted price per megabyte per second downloaded, prices for New Zealand's ADSL have been consistently in the lower half of the OECD[22] (2nd after Korea in 2001). Moreover, in line with the longstanding regulatory obligation to charge equalised residential tariffs across the country, ADSL services were offered under the same pricing policy even though this was not initially a regulatory requirement. There has also been considerable investment in mobile telecommunications infrastructure in New Zealand – also with no evidence of any lag in the quality of the networks provided[23]. Howell (2003) and Howell and Obren (2003) concluded there was no evidence to suggest the presence of supply-side impediments to the market-led development of effective broadband and other telecommunications markets in New Zealand (taking note of existing policies to subsidise rural connections).

1.1 Digital Divide Policy History

Official policy concern about the potential that New Zealand might be a digital backwater was first raised in 2000, in advance of a government-sponsored Digital Summit where the country's first Digital Strategy was launched. However, research commissioned for the Summit found that that, contrary to initial concerns, New Zealand was in fact a world leader in dial-up internet uptake and usage as well as in a number of other indicators of the potential for internet-enabled activities to contribute positively to economic performance[24]. Nonetheless, concerns continued to be expressed in the media and the political domain regarding the quality of infrastructure in rural areas (possibly a legitimate concern given that, since the incumbent provider had been subject to competition whilst still required to meet universal service prices, it may have been unable to

[19] Howell (2003), Howell (2007).
[20] Howell (2010b).
[21] Howell and Obren (2003).
[22] Howell (2006).
[23] Albeit with some concerns regarding the price of services – Commerce Commission (2011).
[24] Boles de Boer, Evans and Howell (2000). Indeed, it was much better placed when examined over a range of metrics than some countries with very much higher per-capita broadband internet uptake (e.g. Korea – Howell, 2003).

afford to keep maintaining very expensive rural facilities[25]) and descriptive statistics from survey data indicated that internet uptake per capita was lower in rural areas than urban ones. Thus the rural-urban digital divide entered into the New Zealand policy lexicon.

The emergence internationally over the early 2000s of broadband as the successor frontier technology for internet access led to it rapidly becoming the focus of the rural-urban digital divide in New Zealand. Initially, this was addressed as a supply-side 'problem' emanating from (perceived) neglected spending on rural infrastructure[26], leading to a number of policies directed specifically at the subsidisation of rural broadband infrastructure (e.g. Project Probe, Rural Broadband Challenge). The farmer-owned dairy co-operative Fonterra (which processes over 95% of the milk produced in New Zealand) also got involved subsidising the connection of all of its (then 13,000) farmer-members via the technologies best suited to the location (ADSL, wireless, radio and satellite)[27].

Despite the lack of evidence of supply-side impediments, New Zealand's broadband uptake per capita remained persistently in the lower half of the OECD league tables throughout the 2000s – a fact that has come to dominate New Zealand's digital divide and telecommunications regulatory policy agenda. Despite considerable evidence that New Zealand's broadband uptake per capita has consistently ranked several places above its rank for GDP per capita (currently 18th vs 23rd), by most models taking account of all of income, age, education, population density and urbanisation has recorded absolute uptake rates in excess of what is theoretically predicted[28], and that the 'divide' is confined to the residential sector[29] (business uptake levels are high by OECD standards, especially given the small average size of businesses in New Zealand)[30], the persistently low rank is seen as evidence of a 'digital divide' with the rest of the OECD that 'must be addressed'.

The matter became a political imperative at the 2005 General Election, when the (governing and ultimately victorious) Labour Party announced that if elected it would introduce policies targeted specifically at increasing New Zealand's broadband uptake per capita[31]. When a Stocktake of the sector was undertaken in 2006, the benchmarks for comparative international performance that guided subsequent policy interventions were a range of statistics reported for

[25] Armstrong (2001), Howell (2007), Heatley & Howell (2010).
[26] Howell (2006) found that, relative to other countries with similar geographic and demographic characteristics where the conversion to digitalisation had similarly been completed early, there was no significant difference in investment patterns (digitalisation being the key enabling investment for ADSL broadband infrastructure to be applied – there being no other evidence of an ADSL investment lag).
[27] Corbett, Howell, Mishra & Ryan (2004).
[28] Boyle, Howell & Zhang (2008).
[29] Most likely a consequence of dial-up internet charging patterns and strategic arbitrage by entrants on the differences between low retail broadband prices and the costs of access to the regulated alternatives – Howell (2007).
[30] Howell and Obren (2003); Howell (2003).
[31] Howell (2007).

the countries occupying the top quartile of the OECD broadband uptake per capita rankings at the end of 2005. The policy settled upon was local loop unbundling, on the basis of New Zealand's telecommunications markets not being sufficiently competitive. This conclusion was not reached on the basis of any principled economic[32] or competition law-based assessment[33]. Rather, the conclusion of a 'competition problem' was arrived at because, of the range of possible factors identified in the literature as having a bearing on broadband uptake per capita, the only criterion where New Zealand ranked either 1 or 9 relative to the 8 top-ranked OECD countries in broadband uptake per capita at the time was the share of connections sold by competitors to the incumbent[34].

Academic research and evidence presented in the debate at the time and to the Parliamentary Select Committee considering the issue that there may have been a number of other equally plausible reasons for New Zealand's comparative position appears to have had little effect upon the policy formation process. Alternative explanations included: that subsidised access to dial-up internet access under 'free local calling' regulations had reduced the rate at which broadband would be substituted for dial-up in New Zealand relative to countries where dial-up internet calls were charged; strategic behaviour by market participants seeking access to the incumbent's infrastructure; and that the empirical evidence that unbundling drives broadband uptake is at best equivocal and of very small material effect compared to doing nothing, even if there is a positive effect[35]. These alternative explanations may have been given little weight in the decision if politicians had already decided prior to the election to implement their preferred policy intervention. If this was the case, then they were less likely to take account of subsequent independent policy analysis if it suggested that their electoral commitment to act as promised (for which the voters would assess their performance) was contrary to wider economic and social outcomes which take time to accrue, and are not always easy to observe or quantify[36].

Consequently, New Zealand stands unique in the OECD as the only country where one of the statutory purposes of local loop unbundling regulation is to increase broadband uptake, even though there is negligible evidence to suggest that the policy will be able to materially alter the outcome[37].

[32] As undertaken by the Telecommunications Commissioner in assessing the likely returns from LLU in 2003.
[33] As must be undertaken in the European Union.
[34] New Zealand's absolute percentage at 25% was unlikely to be statistically significantly different to that of the next-best OECD country (Finland) at 29%, but no tests of statistical significance were undertaken. Howell (2006).
[35] As per the testimony of the author to the Select Committee – Howell (2006), Howell (2007).
[36] Howell (2010).
[37] It is notable also that there was no cost-benefit analysis undertaken of the policy as had occurred in the 2003 analysis by the Commissioner– which would have necessitated quantifying the likely effect – something the Commissioner noted was problematic given the equivocal status of the literature on the point. By 2006, the state of the literature had, if anything increased the uncertainty regarding the veracity of the assumption that unbundling drives broadband uptake.

1.2 Current policies

The pattern of a policy focus on broadband uptake relative to competitor countries as the overriding objective of broadband policy interventions generally has persisted, through to the current flagship Ultrafast Broadband (UFB) policy. This policy provides government subsidisation to the extent of $1.35 billion via public-private partnerships to build a Fibre-to-the-Home (FTTH) network offering 100Mbps downloading capability covering 70% of the population by 2018 (under the aegis of the now National Party-led government). The objectives articulated for this policy are to address poor broadband uptake performance – albeit that there is an economic imperative couched in the ability of the network to facilitate a step-change in economic performance "in line with our competitors" – namely Australia and Korea, which also have national broadband networks facilitated substantially by government financing[38]. That rapid infrastructure uptake is the benchmark for success is confirmed by the undertakings between the government entity Crown Fibre Holdings and PPP partners. To the extent that there is any attention given in the policy to addressing internal digital divides, this is confined largely to the requirement that universal non-discriminatory prices agreed ex ante with the Crown are charged by the (structurally separate) firms to their commercial retailer partners in an endeavour to equalise retail prices across the country regardless of local differences in underlying costs.

It is noted that UFB rollout agreements have prioritised access for schools, hospitals, health facilities and business customers over residential ones. However, there is scant evidence of a comparative business broadband uptake with international comparators[39]. Moreover, almost all schools and hospitals in New Zealand are government-owned. Given government controls most school and hospital funding and hence broadband purchase ability, it is not clear how the prioritisation of schools and hospitals in the UFB rollout addresses any pressing digital divide imperatives, except as a second-order consequence of government securing connectivity first for its own purposes. To this end, the UFB Public-Private Partnership is not very different in effect to the rollout of telephony in the 1880s, when the government of the day used taxpayer funds to prioritise connecting its own facilities, with private sector funding being relied upon to connect the remaining businesses and residences[40].

This leaves the $400 million Rural Broadband Initiative (RBI) as the main supply-side policy to address local digital uptake divides. This policy is targeted at providing a minimum of

[38] Howell (2012) and Howell and Grimes (2010) suggest that this policy may be predicated upon an 'arms race' scenario – if competitors have such networks, then New Zealand must have one too. It may not actually be well-used or necessarily generate any additional benefits, but having one may militate against the loss of key human and corporate capital from New Zealand on the off-chance that there may be benefits arising at some time in the future.

[39] Including the almost exclusively privately owned primary health care sector - indeed, the evidence suggests that New Zealand is, again, a world leader in this metric – Cullen, Howell & Martin (2011).

[40] Wilson (1989).

5Mbps technology-agnostic broadband connections to schools and 252,000 households in the most rural parts of New Zealand. Whilst it addresses the issue of infrastructure availability in the most rural parts of the country, it leads to the creation of a new 'gap' of around 10% of households in provincial areas covered by neither the UFB nor the RBI.[41] Whilst they have access to 'best efforts' ADSL, it is not clear what will happen to them if, as appears inevitable from policy directions, fibre replaces copper in the UFB areas and the remaining (nationwide, at least in respect of backhaul, etc) copper network in a long, thin country must now necessarily become very much more expensive per customer to maintain to serve remaining customers in 'non-fibre' areas.[42] So far there has been no clear policy articulated as to the existence of this new divide that results from policy rather than market activity.

1.3 Other Policies

Whilst this section has so far focused on supply-side policies in the infrastructure arena, it is noted that there have been a number of other very much smaller policy initiatives focusing on either the demand side of the infrastructure equation, and at the application level. Ultimately, the demand for infrastructure – measured in the uptake of internet and broadband connections per capita – is a derived demand, dependent on the underlying demand for applications that make use of the infrastructure. To this end, government can play a role by either subsidising the development of applications or by using its role as a participant to foster the use of applications that require a broadband or internet connection. If the applications are sufficiently valuable to end users, then they will buy an internet/broadband connection in order to use the applications, thereby stimulating internet/broadband uptake.

New Zealand has a Whole-of-Government policy designed to ensure co-ordination of policy initiatives across the various arms of government. In respect of digitalisation, this has been manifested in the creation of some fully digital applications which cross different government policy and service delivery arms, such as Companies, Charities and Land Registers[43]. Initiatives have also been introduced in the (government-funded parts of) the health sector to digitise patient records[44]. However, these applications are utilised predominantly by commercial entities, almost certainly already having internet access, so their objectives are principally efficiency-related rather than addressing any digital divides. Many other government functions targeted at individual citizens are not yet digitised (e.g. voting in the General Election) or if available in digital form, offer digital access as an option whilst still maintaining the traditional

[41] Heatley & Howell (2010a).
[42] Heatley & Howell (2010).
[43] Karp (2010).
[44] Digital records have long been the norm in the privately funded part of the health sector.

forms of engagement, lest the digitalisation creates new disadvantages for citizens unable to get access to the internet (e.g. Census returns, Inland Revenue interactions, and motor vehicle registrations).

Whilst the digital option may be convenient for those with internet access already, the ongoing availability of a non-digital option reduces the incentives for non-purchasers to connect – in effect enabling the persistence of divides such as those observed in relation to elderly and income-poor individuals. This creates a tautological inconsistency, as once the diffusion rate passes 50% of the addressable population[45], the only potential subsequent purchasers are the 'laggards' who, perceive there to be less benefit from the purchase than the average benefits perceived by those who have already adopted. If the uptake rate is to be increased in such a 'maturing' market, it is precisely these reluctant consumers who must be persuaded to purchase[46]. To have a policy on the one hand to increase uptake, yet on the other to have policies that make it easier for these 'laggards' to avoid having to make the purchase seems guaranteed to thwart the uptake objective and impose additional costs (i.e. the costs of maintaining two systems in parallel) – that is, doubling the costs (reducing welfare) whilst achieving no meaningful change from the status quo in the uptake metric.

These sorts of contradictory policies likely explain in part why so much effort is expended, but observed divides remain. In the New Zealand context, policies to support the digitalisation of government activities frequently cite increased incentives for internet uptake as one of the benefits, yet the same policy-makers also articulate the 'rights' of individuals to choose the means by which they engage with government to support the need for extra resources to create multiple interaction options. A greater incentive for connection would occur if the non-digital option was removed (as is currently occurring in relation to broadcast television), yet this is seldom applied in policies where government (either central or local) is the application provider. That these apparently contradictory effects are so rarely identified in supporting policy material suggests both weaknesses in 'whole of government' oversight of digital policy cohesion and some possible explanations for why some divides – notably those associated with elderly and income-constrained populations, who are the largest group of 'laggards' in internet uptake – persist despite large sums being applied to the supply side to reduce the cost of infrastructure access.

[45] New Zealand had already passed this point in terms of internet connections per household at the time of the first analysis undertaken by this author (Boles de Boer, Evans & Howell (2000).
[46] Howell (2009b).

2. *Critiquing the Policy Process*

The discussion on New Zealand digital divide policies highlights some real disjunctions between understanding of the nature of digital divides and the efficacy of policies applied to ameliorate them. If the same disjunctions prevail in other countries, then it begs the question of whether there are more fundamental flaws in what have become the commonly-accepted 'solutions' to the divide 'problem' as a consequence of limitations in the formulation of digital divide policies. This section seeks to identify what should be looked for in 'good' digital divide amelioration policy – if, indeed, such a straightforward response is possible to the question.

2.1 Typical Policy Processes

A typical policy process would involve first defining the object of interest, identifying how to measure it (including identifying whether it actually exists), and identifying, if it does actually exist, whether it is indeed either feasible or desirable to do anything to ameliorate it. Having devised a policy intervention, it is then appropriate to design means of determining how to assess the extent to which the policy is likely to be (or to verify if it has been) effective relative to the counterfactual of not implementing the policy. It is not sufficient to introduce a policy and then simply assume that any change in the identified measures observed subsequently has occurred as a consequence of the policy, because the measures of interest may have altered regardless of any intervention.

The relevant costs and benefits are not the absolute changes observed, but the changes that have occurred relative to what would have occurred under the counterfactual of no policy[47]. This leads to the need to undertake a principled cost-benefit analysis, regardless of whether or not the overarching objective is economic in nature. Furthermore, it is prudent to consider that the policy may have negative consequences. It is also important in the assessment that transfers between individuals are recognised as zero sum reallocations and not counted as gains simply because the interests of only one set of market participants is being considered. Counting the gains to 'winners', but not the losses to 'losers', leads to misleading overestimations of the size of the problem being addressed and the extent to which policies can address them[48]. Only after such a process has been undertaken, can a fair assessment be made of whether the policy is worth pursuing. Moreover, good policy processes will have provision for regular reviews to assess whether the anticipated gains are being realised, and to identify whether there have been any

[47] See, for example, Boyle, Howell and Zhang (2008) and Howell (2010) Berkman response on broadband diffusion. These papers show that the failure to take account of the fact that broadband uptake rates are altering over time for a whole range of reasons other than LLU policy risks over-attributing all unaccounted but correlated changes in the model to the policy instrument.
[48] Crampton (2011); Harrison & Robson (2011).

unexpected side-effects that alter the gains achieved. Such reviews should also include assessment against criteria that would indicate that the policy should be abandoned[49].

2.2 Which Divide: Infrastructure or Applications?

In respect of 'digital divide' policies, the first step is to define the object of interest. However, this throws up the first hurdle. Exactly what is the 'digital divide'? Hilbert (2011:715) finds "a vast collection of theoretically justifiable definitions exist" relative to "the question of how the digital divide is defined in practice by policy-makers". The New Zealand policy history illustrates the way in which it is possible for pursuit of closing one divide in isolation from consideration of others can lead to both perverse outcomes and inconsistent policies. Whilst history can provide some explanations for why this might be the case, good policy not only should be able to, but indeed must, take account of such complexities in the trading-off the case for allocation of resources relative to other calls on budgets (both time and money).

2.2.1 Infrastructure measures: a "Data Availability Bias"?

Telecommunications sector observers – and notably regulators – have long used measures of infrastructure uptake as bellweathers of industry performance against policy objectives of privatisation, liberalisation and increased competition. In a mature, stable and widely-diffused market (as telephony was in the 1980s and early 1990s), increases in telephone lines per capita and minutes of use were a reasonably good indicator that the policies were removing barriers to uptake – e.g. by reducing costs and offering new ways of charging for the delivery of a very narrow range of applications, namely voice and other calls (e.g. fax, other data). Consequently, these data became part of the mandatory information requested by regulators. As long as the effect of competition in the markets was small[50], the data supplied by incumbent (regulated) operators was a very close approximation to the population for most countries. Thus, such regulator-collected data became the basis of data aggregated by international policy agencies such as the OECD and the ITU, and was used to prepare analyses of the comparative progress made by different countries towards market liberalisation. This analysis was assisted by the fact that, as the data had been collected for reasonably common purposes, it was largely standardised, increasing the accuracy of international comparisons.

The advent of the internet and the ability for a whole new range of applications to be offered over telecommunications infrastructure changed the ways in which end users derived

[49] Policy-makers are not exempt from falling victim to the 'sunk cost fallacy' whereby costly but failed policies are persisted with on the basis of the size of usually very large irrecoverable amounts already invested (Gans, 2005). The appropriate approach is to reassess the project in light only of future anticipated costs and benefits given the new knowledge about likely programme outcomes.

[50] And in respect of voice telephony, it was – competitive entry has been largely a feature of the post-internet era of telecommunications provision.

benefits from the networks (see discussion in section 1 above on derived demand). Regulatory interest, however, continued to be focused on the infrastructure owned by regulated firms – leading to the addition of broadband connections to the data already collected for regulatory purposes[51]. It is noted that in the absence of regulation, there was a considerable lag in the establishment of the collection of official statistics on the use of non-telco provision of internet connectivity. For example, in the days of dial-up internet connection being the only means of internet access, it was unregulated Internet Service Providers (ISPs) who mediated access to the internet. As the data collected for national statistics was in support of very diverse policy activities, it has tended to be much less standardised and therefore makes international comparisons harder. In part as a consequence of standardisation problems, the OECD has been at pains to caution users of their statistics of these limitations, and by extension the limitations of analyses undertaken using them. Boles de Boer, Evans & Howell (2000) noted that the statistics are only indicators, and often the conclusions require the analysis of several indicators together in order to form a comprehensive understanding of the underlying competition or economic growth outcomes that the policies are seeking to pursue.

Availability of data on the provision of internet connections by regulated firms and the nature of the analysis undertaken by international organisations explains why, since the early stages of internet diffusion, the uptake of internet infrastructures – and especially broadband – connections has dominated the discussion of international digital divides. However, limited data availability should not restrict the quest for better understanding, lest the pursuit of the statistic becomes the focus of policy to the exclusion of the pursuit of the outcomes for which the statistics are only imperfect proxies. Moreover, it is not necessarily the case that a metric used for measuring performance in a market for a mature, fully-diffused technology will be communicating the same information in a nascent market for a new technology. For example, differences in the time at which the new technology is made available will lead to very different uptake rates at a single point in time in two populations that are absolutely identical in every other dimension[52].

Nonetheless, infrastructure uptake rates have become the most popular statistic used to identify "digital divides". They are (to a large extent) available, and can be (relatively) easily parsed down to various sub-national bases in order to shed light on other divides (namely, geographical – urban vs rural, population densities – dense vs sparse areas, proximate vs distant). But the question remains whether they are a good proxy for assessing either the extent to which

[51] For an early example, see Hargiatti (1999).
[52] Howell (2009b).

individuals have access to the internet or the likely economic consequences arising from internet access (or divides in it). Such statistics fail to capture the extent to which single connections are shared – for example within a household or business[53] – or the extent to which some individuals are able to substitute access via a home internet connection with access at another location such as work, school or public facilities such as libraries.

2.2.2 Application Use Underpins Economic, Social Benefits

Furthermore, defining divides on the basis of infrastructure access fails to take account of the fact that ultimately, the economic and social benefits are derived not from owning the connection, but utilising the applications that run on it. A divide in access may not necessarily lead to a divide in the accrual of benefits. This suggests that a comprehensive analysis of the effects of divides, and policies to ameliorate them, should also include analysis of the extent to which the connections are used, and the applications that are used. Whilst on the one hand, an application cannot be used without a connection, if there are other means by which the similar benefits can be achieved, the absence of a connection may not have a very large net economic impact.

Unfortunately, statistics on application uptake and use are much harder to obtain, and are generally not available in a form that can be collected in simple, objective population-wide form. Typically, such analysis requires the extrapolation of survey sample responses in order to project population outcomes. Nonetheless, well-designed surveys should be able to obtain useful data for analysis.

Thus, it is surprising to find that very few of the papers in the 'digital divide' economic and policy literature use these types of surveys. Most, unsurprisingly given the location of the genesis of the commercial internet, relate to United States data, and a small number of researchers are disproportionately represented in the analysis based on them[54]. Surprisingly (perhaps) they generally find that although internet adoption is positively correlated with income and education levels, once an internet connection is purchased, the time spent on internet activities is negatively correlated with both of these indicators. This is contrary to the relationship found for the use of voice telephony, where minutes of use typically increase with both higher income and higher levels of education. The most likely explanation is that low income people and those with low academic qualifications most likely have a low opportunity cost of leisure time[55] (that is, the alternative options available to them for using their leisure time other than internet use have low values – often because these people have a large amount of leisure time (e.g. as they are

[53] Ford, Koutsky & Spiwak (2007).
[54] These academics include John Horrigan, Avi Goldfarb, Jeff Prince, Kenneth Flamm, Anindya Chaudhuri, Paul Rappoport, Lester Taylor, and Don Kridel.
[55] Goldfarb & Prince (2008).

unemployed) and their low levels of disposable income mean that they cannot access alternative higher-priced leisure time pursuits available to those with higher levels of disposable income). This effect is exacerbated by the use of 'flat rate' pricing, resulting in the consumption of all individuals to the point where marginal benefit of use is zero, rather than marginal cost[56].

These factors lead to the conclusion that, at least given the current range of applications, proportionately more of the internet's scarce resources are being consumed by those individuals whose value of consumption is, with current applications, likely relatively low. If digital divide policies increase the rate of connectivity in these groups via subsidies, then the net economic effect may be a reduction in total welfare as the low value of the welfare they gain from internet use may be less than the loss of welfare to the individuals whose taxes must increase to fund the subsidy. That is not to say that the individuals will not gain some social benefits from use, but good policy would demand some tradeoffs be considered between the social and economic consequences.

Consequently, much more attention needs to be given to the role of applications used in assessing the effect of policies on closing divides. As connections are necessary but not sufficient for the generation of benefits from internet connectivity, policies closing divides can only be of net benefit if they facilitate application use benefits in excess of the additional costs of both connection and application use (including the externalities that result from the use of negatively-valued applications – for example, low-valued 'spam' use that congests networks slows down the traffic associated with more highly-valued applications, and necessitates higher investment in facilities such as backhaul[57]). It is not immediately evident that current policies are taking due account of these types of trade-offs.

2.3 Whose Divide? And Why Does it Matter?

The previous section has alluded to the dimensions of infrastructure and applications as dimensions of divides. However, the data availability bias has led to the definition of many other divides, such as those based on individual characteristics such as age, gender, ethnicity, income and disability. However, as also already alluded to, it is not always clear that the entity of interest for policy will be an individual. Just as it is not necessarily clear that there is a direct nexus between connections and individuals, it is also not clear that there is a nexus between individuals and applications. Whilst some divides are defined on individual characteristics, others may be best defined along other dimensions, such as households or families. Others may be best defined

[56] Howell (2008b).
[57] Howell (2010a) and Howell and Grimes (2010) discuss the role of flat rate tariffs in inducing inefficiently early investment in additional infrastructure.

along business or residential dimensions. This is important, because applications are likely targeted to specific user groups (i.e. "markets"). Competition policy analysts are familiar with the use of these dimensions when defining markets in order to analyse the effects of mergers on welfare, but so far, this approach does not seem to have had much effect on the analysis of digital divide policies, despite (as shown in the New Zealand example), infrastructure rollout policies to address digital divides often have subgroup targets or priorities. More attention to these factors might assist in the assessment of the effects of policies.

2.4 How to Measure It?

Again, following on from the availability of data, most policies assess the effects of digital divides using 'per capita' type measures (including, for example, 'per business' or 'per household'). The rates are also most often reported in their absolute states. This leads to the identification of the most egregious divides – such as those separating the developed and developing economies- and has spurred the development of policies to address them, lest the 'divides' become self-reinforcing, and create even greater separations.

However, it is not always clear that divides measured in the absolute sense are indicative of widening divides. Indeed, when expressed as growth rates, these same statistics quite often reveal that, despite having lower absolute rates, the 'disadvantaged' groups may also exhibit higher growth rates, suggesting that even without any policy interventions, the disadvantaged countries could eventually converge with the advantaged ones. This may be as simple as a matter of technological diffusion – for example, the technology/application etc started diffusing later in the disadvantaged population. Whilst there may be some benefits to be had from accelerating the trend, it is acceleration in the growth rate relative to what it would have been otherwise, rather than increasing the absolute level of the statistic that the policy must achieve. Yet most policies remain focused on closing absolute divides rather than accelerating relative growth rates[58].

In a similar vein, the question is begged of why 'per capita' rates dominate the measurement of divides. Developing countries will almost invariably always lag developed ones in these statistics simply because they have lower incomes, so have other priorities for scarce resources. A more policy-relevant question might be, given the economic growth imperatives of most digital divide policies, at least between countries, the proportionate effects of the smaller investments in low-income countries. The results from such an analysis can be surprising. Fink & Kenny (2003) show that when comparing the number of fixed and mobile phone lines per dollar of GDP, low and middle income countries 'leapfrog' high income ones. That is, their

[58] Howell (2009b).

investment in a smaller number of phones seems to have had a greater relative effect on GDP than in developed countries. Likewise, middle income countries lead high income ones in internet users per dollar of GDP. Once again, this is consistent with inter-country research on the link between various measures such as ICT spending, telephones and internet connections and GDP growth. Whilst there is a positive effect in most cases, the analyses are near-unanimous in their findings that the effects are greater in lower-income countries. Once again, this is consistent with a scenario of convergence rather than increasing divergence, and even simple economic reasoning. In developed countries, additional investment is usually on projects with very low marginal benefits, as the 'low hanging fruit' has already been plucked. However, in developing countries, the investment is directed towards fruit that in other countries would have been plucked long ago that is ones with very high marginal benefits, that flow through to the greater proportionate effects on GDP per capita.

The consequence of this discussion is that many of the perceived 'digital divides' which attract so much policy attention may be simply artefacts of a world that is inherently unequal, but even without policy intervention, is exhibiting patterns of convergence, as would be expected from the natural forces of activity in a global economy where factors such as trade barriers and impediments to the flow of information in any form (e.g. censorship) are breaking down. Better understanding of what the measures are indicating will result in better targeted policies in disadvantaged markets, and avoid large expenditure on policies that may have ultimately little material effect, or potentially negative consequences, on the broader economic goals in advantaged ones.

2.5 Who Cares, and Why?

The preceding discussion has critiqued the policy formation process from some simple first principles citing models and literature that have, predominantly, been in the public domain for a long period. It begs the question, then of why digital divide policies seem (by the New Zealand example at least) to be at such variance with the current states of academic understanding. The Public Choice school of economics would suggest that all actors, including governments, are using their part in the policy process to maximise their individual positions. Whilst it might be expected that disadvantaged groups will favour policies that deliver benefits to them for little or no additional cost, and that infrastructure and applications provider firms have an incentive to advocate for policies that grow their market size and/or share, or reduce risk by providing subsidies for deployment, it cannot be discounted that governments use digital divide policies for their own purposes. In democratic countries, that is usually because the policies will attract votes amongst the communities that stand to benefit. This reinforces the need for robust policy analysis

as independent of the self-interested agendas as possible. This is a challenge for researchers at forums such as this one. Whilst not perfect, the academic peer review process does allow for the critique of policies from different perspectives. It is in this spirit that I have offered my thoughts.

3. New Zealand Examples

The previous section has provided some broad theoretical points to consider when developing, implementing and evaluating digital divide policies. In this section, by way of modelling a critical approach based on my own economics paradigm, I wish to share some examples of policy critiques that I have undertaken on digital divide policies in New Zealand. None of these examples required the development of any new theory, but rather illustrate how simple theory applied to actual policies draws out some of the inherent tensions between apparent policy objectives and likely outcomes.

3.1 A Quick Economics Tutorial:

(a) Supply and Demand

As a basic principle, economists start with the premise that competitive (or well-regulated, in the case of monopolies) markets do a reasonably good job of supplying infrastructure and applications to consumers who value them above some cost of production[59]. Consumers have individual values that they place on the good, and as long as the good is offered at or below that value, they will buy. The aggregate of all individual demands becomes the market demand (Panel 1). Likewise, individual suppliers will sell at any price above their production, which aggregated across all suppliers leads to the market supply curve (Panel 2). The aggregate of the difference between what consumers pay and what they value the good at is 'Consumer Surplus'; likewise the difference between what it costs suppliers and what they receive is their profit or 'Producer Surplus'. Markets arise from the interaction of consumers wanting to maximise consumer surplus and producers wanting to maximise producer surplus. The market 'clears' at the price and quantity at which supply and demand intersect. The sum of the two surpluses created at this price and quantity is the 'welfare' created by the market (Panel 2). The market mechanism ensures that the goods produced are those with the lowest production costs, and that they are allocated to those consumers valuing them most highly, thereby maximising total surplus. For the given market price, all consumers valuing the good above market price buy, and are supplied by all producers with costs below the price.

'Divides in availability' of the good (in this case, an infrastructure such as broadband) will arise when the cost of supplying in a given market lies above the willingness to pay of all consumers in the market. Panel 3 illustrates such a case. In this instance due to economies of scale, the infrastructure has a lower average cost of production per unit the more units are

[59] Albeit, that the definition of this cost is hotly contested between regulated firms and regulators and those seeking access to the regulated firm's infrastructure and services.

produced (as is common in telecommunications). The good will not be produced in this market – in any quantity or at any price – because the producer cannot recover the costs incurred in producing it. This could be the case in, for example, rural areas. However, if a subsidy is provided to allow Q units to be supplied at price P (which has the effect of lowering the producers effective cost per unit of production – the red average cost curve), then the good will be produced. The Q connections are supplied to those customers valuing the connection at P or above, yielding the green surplus. The subsidised producer breaks even, so is no worse off than not producing (noting that economic costs include a fair return on capital employed, meaning the producer receives at least his opportunity cost of using the capital in its next best use – this is what induces the production of the subsidised good rather than others that the producer could choose to supply).

However, consumers valuing the good below P will not purchase connections, even at the subsidised price, because they do not value it sufficiently highly. Thus, 'divides in uptake' of infrastructures arise as a natural consequence of differences in the valuations of consumers in the market. This leads to infrastructure 'haves' and 'have nots' as a natural state of the nature of markets. Uptake divides therefore are not, of themselves, necessarily 'bad', as it is a given that consumers are heterogeneous in both their personal preferences for the subject good and all other goods on offer to them. Individuals make their purchase choices as a consequence of the relative values they place on the entire range of goods and services available to them in light of their own budget constraints (i.e. their purchase comes as a consequence of trade-offs). If the chance to purchase broadband is foregone, it is because the consumer is left better off by buying something other than broadband with the money that they might otherwise have spent on the connection.

Whilst supply-side interventions (such as subsidised connections) can resolve 'availability divides' by inducing a product to be made available when otherwise it would not be, they are 'blunt instruments' for resolving 'uptake divides', as they subsidise the price paid by all consumers, even those who would willingly have paid a higher price for the connection. This explains why high-valuing consumers (e.g. wealthy farmers and the telecommuting 'managerial classes') are often the most ardent advocates for subsidies enabling rural connections, as they individually stand to gain most surplus from the policy, even though they may use the case of low-income individuals in the area (who most likely are not high valuers, given the other more pressing priorities on their tight budgets) as examples of great benefits being bestowed[60].

Nonetheless, such subsidies are worth pursuing in the aggregate if the total surplus gained is less than the sum of the subsidy required and the negative effects arising from the welfare

[60] The lesson here is that it is not appropriate to use the perceived benefits of these high valuers as the benchmark for the welfare effects of the policy on the 'average' beneficiaries, as this will lead to a substantial overstatement of the benefits and an increased likelihood that the policy will fail to deliver the returns claimed.

foregone in other markets in order to apply the subsidy funds to broadband provision. In my observations, digital divide policies rarely take the foregone welfare into account in the policy assessment. Most policies use the additional anticipated consumer surplus compared to the cost of the subsidy alone.

(b) Demand Elasticity

Market demand curves summarise the willingness-to-pay of a large number of individuals in effect because they aggregate information regarding each individual's willingness to pay for an additional item, given one item has already been purchased (i.e. the 'marginal benefit' of purchasing another one). Alternatively, this can be expressed as the effect that a change in price of the item will have on the propensity of that individual to buy the good in the first place. Economists call this property 'demand elasticity' and it is reflected in the 'steepness' of the demand curve. At the level of the market, this is the aggregate curve as shown in Panels 2 and 3, but as illustrated in Panel 1, individuals will have very different individual demand elasticities. Some will be steep, and some will be shallow.

The effect of demand elasticities is illustrated in Panel 4. For a given rise in price (P to P1), the quantity sold to customers with the steeper blue demand curve falls from Q to Q1. However, for the shallower red curve, the same price rise results in a much bigger reduction in quantity – from Q to Q2. The red customers are more price-sensitive than the blue customers. This is because they have many other things that they would get more surplus from buying if the price for the good rises (for example, cheaper dial-up internet access may be a satisfactory substitute for broadband, even though this method may take more time to achieve the same welfare, especially if the consumer has a low valuation of leisure time). On the other hand, steep curves indicate that there are fewer other goods that would offer similar benefits, so the customers are said to be less price-sensitive – the subject good is not easily substitutable in their choice set. Goods that consumers consider to be essential (i.e. they would continue to buy them, even in the face of big price rises) have steep demand curves, because they cannot easily substitute other goods to get similar benefits (for example, if dial-up is not a satisfactory substitute as the connection is needed to support some very valuable application not capable of being delivered on dial-up, such as interactive video gaming against distant players on a game that has high definition graphics)[61].

[61] However, there will be some price at which even this consumer will not purchase broadband - when the price paid exceeds all benefits accrued from playing relative to the next best alternative, such as playing a high definition non-internet game locally with a local competitor on an X-box or Playstation, or watching a high-definition movie on a DVD. This example highlights the fact that, whilst it is often claimed that connections are 'essential' to individuals using such interactive gaming applications, in practice when faced with price rises (or as evidenced in NZ, data caps) they often prove to be very price sensitive as they have access to a plethora of other activities from which to spend their (actually low-valued) leisure time.

3.2 Case Study 1: Rural Email

The two simple concepts of supply and demand and price elasticity provide a cogent explanation for the findings in our first case study on the use of email by businesses in New Zealand (Howell, 2001).

Building on the discussion in section 2, it is now evident that the demand for internet connections is a derived demand, based on the benefits derived from the use of applications. Whilst there may be connectivity divides between rural and urban groups, are there also application divides? It was a commonly-held presumption in New Zealand in the early 2000s that rural New Zealand lagged urban New Zealand in the use of internet-enabled applications. Surveys appeared to confirm that this was the case. However, it might be that rural New Zealanders face higher costs for some of the communication activities that internet access enables, so would have both higher initial willingness-to-pay for internet access than their urban counterparts, and be less price-sensitive. New Zealand's long-standing universal service pricing makes it difficult to assess this by uptake statistics. However, if true, we might expect to see (given similar prices) greater use of the applications for which the substitutes were more expensive – for example, by users in rural New Zealand.

Fortunately, we had access to a business registry database that covered all businesses in New Zealand with a telephone (the Yellow Pages registry). This register also recorded email and website addresses for some businesses (these businesses paid an additional fee to have these contacts included). As this database was (at the time - 2000) the monopoly registry of telephone-enabled (i.e. digital) connectivity in New Zealand, the listing of email and website information was presumed to indicate that these methods of communication were valued by the business. If a business had such addresses, but chose not to advertise them, then (at the time) this suggested that they were not as highly valued. As the database was a population-based one, and disaggregated at geographical levels, this enabled us to test whether there really was a lag in the uptake of email and website applications in rural New Zealand, at least in respect of businesses, by examining the listing rates of email and website listings to total listings in each location.

The results are shown in Panels 5-7. At the aggregate level, a divide indicating overall lower rural use was found (Panel 5). However, when disaggregated, some interesting patterns were found. Auckland, the only city of international scale and the major commercial centre in New Zealand, sits at the top of the North Island. If proximity to the major urban centre renders internet connectivity more valuable, as is frequently used to support the claim that density creates its own network effect that leads to more purchase and use of internet technologies in urban areas, then the listing rate of businesses should increase the nearer they are to Auckland. Yet for email,

the listing rates in the more distant South Island were higher than the more Auckland-proximate North Island (Panel 6). The likely reason is that the communications for which email is a substitute (long-distance phone calls, faxes, longer trips to less numerous postal centres to mail physical communications) are much more expensive the further away the businesses are from the people they need to communicate with (and the less densely populated are the regions). This is carried through to the finer disaggregation shown in Panel 7. The areas with the highest 4 email listing rates were South Island provincial areas. The first main centre is Wellington (very bottom of the North Island) at 5th. Auckland is mid-ranked, with only two thirds the listing rate of the leading provincial centres. However, email is not valued evenly in all provincial areas. This suggests that there are likely some other factors that make email more valuable in some of these regions than others. One possibility is that the high-ranking regions are major tourist regions, where communication with individuals (and hence the value of a listing in a contact registry) is especially valuable. However, this does not detract from the key finding that application value rather than connectivity is required to assess the underlying economic effect of digital divides.

It is noted that whilst we found a 'reverse divide' for email, there was no discernable divide in respect to website listing (but neither was there a 'lag' suggesting a need for a policy intervention). We hypothesised that the business value of websites is different to that of email, as websites (at the time) substituted for many applications that were already independent of location (e.g. mail order). This would be consistent with the absence of any discernable difference – and the finding that there was no evidence to suggest that non-urban businesses were 'lagging' their urban counterparts. We repeated the analysis two years later (Howell and Marriott, 2002), and found the results largely unchanged. Whilst the North-South email divide was closing (i.e. Auckland was 'catching up' with the rest of the country as the technology became more widely diffused), the number of provincial areas with higher email listing rates than the highest urban area had increased, suggesting the real differences in costs of substitutes persisted.

3.3 Case Study 2: Universal Service Pricing

As identified in Section 1, New Zealand has a long history of equalised prices across the country for communications services (dating from 'postalised' mail tariffs in the 1850s and carried through to telegraph, telephone and now broadband services. These prices persist (and indeed are enshrined in legislation), despite the very different costs of service delivery in different regions, due to the very wide differences in population densities (Auckland had 316 per square km, Wellington 59, and the rest of the country averaging 14), and despite subsidies being provided to reduce the costs to producers. It is notable that communications is the only 'essential service' in New Zealand subject to such national price equalisation policies. Other goods such as food,

housing, electricity and other fuels are all allowed to vary in price according to regional cost differences, despite the fact that all most likely exhibit steep demand curves, so will continue to be purchased in similar quantities even in the face of big price changes.

From a 'digital divide' perspective, the policy justification for equalised tariffs is based on the presumption that 'equality' means everyone pays the same price. Equalised prices might mean that rural people face no price disadvantage relative to their urban counterparts when it comes to 'going digital'. However, 'equal price' does not necessarily mean 'equal surplus'. If everyone pays the same price, then high-valuers get more surplus than low-valuers. There is a plausible case to be made (on the basis of the first case study) that in fact rural people may actually value internet access more highly than their urban counterparts, as the cost of alternative means of accessing information and information-based resources (travelling to meet friends, going to the library to look up information, watching movies at the cinema or collecting and returning DVDs to the video library) are higher. Thus, they may be prepared to pay more in order to be able to access these information-rich media in their own homes than urban individuals for whom the cost of accessing non-internet variants is lower.

In this case study, the supply and demand model will be used to show that if rural people do value internet connections more highly, then equalised pricing leaves them very much better off than their urban counterparts, who some of whom are now unable to afford to purchase connections. Panel 8 sets up the model. For simplicity, we assume two customer groups of equal size with demands that are equally elastic (i.e. same slope) but that the higher costs mean the rural customers (purple demand) sits above the urban one (red demand). We also assume that there are two different prices reflecting costs (PR for rural; PU for urban) that renders each group with identical surplus (Q connections sold in each market at the respective prices, yielding the two (red and blue) identically-sized surplus triangles). In effect, every urban consumer is paired with a rural customer with identical characteristics except for the absolute valuation difference. The surplus outcomes for each member of the pair are identical. On many dimensions, this would appear to be a 'fair' outcome.

Panel 9 shows the effect of a universal service requirement. If a single price PK is charged, then the number of connections sold to the rural market increases from Q to Q1. But the number of urban consumers falls from Q to Q2. In effect, some urban customers will 'give up' connections that they would have purchased at the urban cost in order to enable rural customers who wouldn't have purchased at the rural price to now become connected. However, rural consumers now enjoy collectively a very much larger surplus than before (the large blue triangle in Panel 10). Urban surplus shrinks dramatically (the aqua triangle). Furthermore, the lower-

valuing urban customers – for example, poor, price-sensitive urban dwellers – are the ones who lose out. Yet rural customers who in all other dimensions are equal and got the same surplus as these urban consumers under the different prices now get a 'bonus' welfare gift (are better off) as they pay a lower price for the connection they would have still bought at the higher price. The change is expressed in relative terms as well. Rural customers not purchasing at all under the two-price paired scenario now get to purchase, even though their urban 'pairs' with identical demand elasticity cannot expect to purchase in either the single or two-price scenario. This actually creates an 'inverse rural urban divide' effect, as, unlike my simple example that assumed equal market sizes, in reality the urban market is very much larger than the rural one. The price change will cause proportionately more urban losers than it creates rural winners, at the same time as it exacerbates the divide between predominantly low-income urban individuals and all other internet users.

On the level of consumer surplus, the outcome of this case study raises the question of what is more 'fair' – equal prices or equal surpluses. However, in respect of 'digital divides' it illustrates how policies promoting equal prices may actually work counter to the objective of increasing uptake amongst some targeted groups (low income urban) by 'picking winners' in others (all rural, regardless of willingness to pay and demand elasticities). Again, it highlights the need to take account of both winners and losers from policy interventions. Increasing rural uptake is not a net gain if it occurs at the cost of urban subscribers who could have purchased without the policy but do not purchase when it is place.

3.4 Case Study 3: Access Regulation and Non-discrimination – The Single Price Curse

An important lesson from the last case study is that there may be circumstances where charging different customers different prices is ultimately both 'fairer' in terms of the allocation of surplus across all customers and more efficient, at the same time as it addresses discrepancies in uptake rates across different customer groups. Price discrimination is one such case.

Price discrimination is when two different customer groups are charged different prices for the same good – that is it costs the same to produce the good regardless of which customer buys it. Price discrimination may be used strategically to increase profits when the supplier (with some market power) can identify which consumers have higher valuations and charges them higher prices whilst charging lower-valuers lower prices (e.g. at cost) (this is possible assuming the low-valuer cannot buy at the low price and resell to the higher one and appropriate the margin). Relative to the counterfactual of selling to all customers at cost price, this strategy has the effect of transferring surplus from the higher-valuing consumers to the producer, but has no effect on the number of connections sold. It is a zero sum game.

However, in some circumstances, price discrimination can lead to increases in all of the number of connections sold, total welfare and producer profits. It can also lead to the market-led provision of services (i.e. without a distorting subsidy) in the case where demand lies below the cost of production. The 'classic case' where this occurs is when there are economies of scale in production – a downward-sloping average cost curve, as in Panel 3. If these circumstances exist, then selling more connections means that the average cost of producing them is lower than if fewer are produced. Producers in these circumstances may actually want to sell at two prices – one high and one low, in order to sell more items. The cost reductions can be appropriated as profits, but equally, the gains can be shared with customers (for example, by using 'profits' from the sale at the 'high' price to subsidise losses incurred on ones sold at the 'low' price[62]. Indeed, this is precisely the method used initially to accelerate the diffusion of fixed line telephony, where business connections were charged at higher prices than residential ones, and even within residential users, different tariffs were applied to standard residential and beneficiary (e.g. elderly pensioners) consumers. The reasoning is not substantially different from that used in the 'universal price' scenario above, where profits made on connections sold above cost (i.e. to urban customers) subsidise connections supplied below cost (i.e. to rural ones). Price discrimination is also the principal reason why government-owned telephone companies offered price discounts to pensioners – not because they inherently 'cared' about the elderly customers (although for political purposes the strategy could be marketed as such), but because if they could induce pensioners who would not have bought at a higher single price to purchase at a lower discriminatory price, then more connections were sold, average costs per connection were lower, and efficiency was increased and total surplus was higher relative to the counterfactual of a single price.

Mandatory single prices, therefore, militate against more efficient markets where economies of scale exist. Yet these are precisely the pricing policies that prevail in telecommunications access regulation across most of the OECD. 'Non-discrimination' clauses actually militate against both increasing total infrastructure uptake and addressing the divides between low-valuing customers who will not purchase at a single price, but will in the two-price scenario. To this end, I will now argue that non-discrimination policies arising from infrastructure regulatory policy run counter in their effects to digital divide strategies seeking to both increase absolute uptake and provide opportunities for low-income people to become connected.

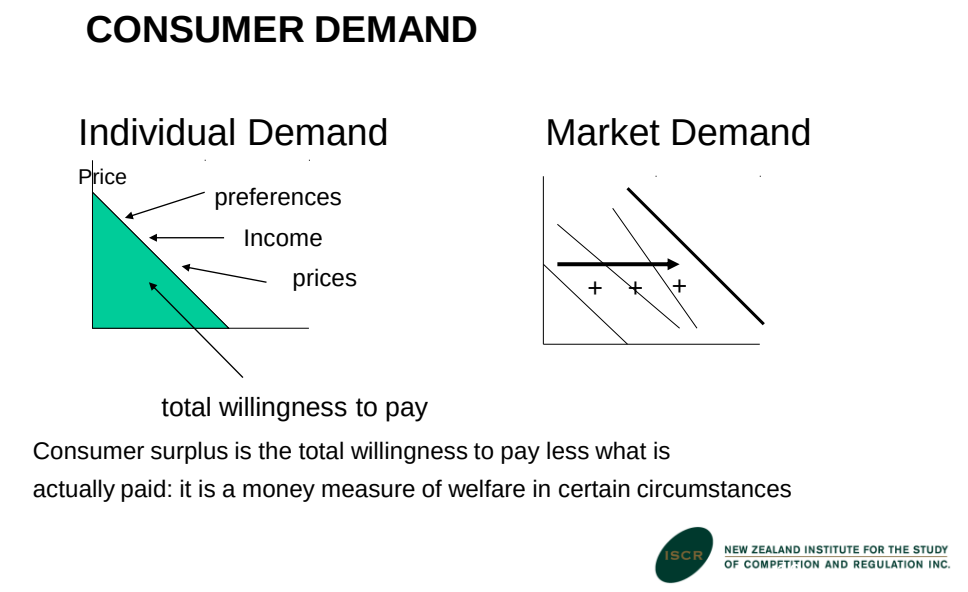
The scenario is depicted in Panel 13. There is no single price at which the connection will be provided. However, as the average cost curve is downward sloping, the average cost of producing more units is less than the average cost per unit of producing fewer units. If the good is to be produced, then it is most efficient for the largest possible quantity to be produced. Assuming that high-valuing and low-valuing consumers can be identified and resale is not possible, then, from the cost and demand curves, Q units can be made at cost per unit P. From the demand curve, these units can be sold to low-valuing customers at price P Low, at a loss of P – P Low per unit. However, if QH of the units can be sold to customers with willingness to pay P High and above, then a profit of P High – P is made on each of these QH units. Losses will be made on the remaining Q – QH units sold at P Low. If the profits made on the high price units are greater than the losses made on the low-price units (trading off the sizes of the two grey rectangles), then the producer will willingly produce the good unsubsidised. Both high-price and low-price customers get surpluses that they would not get under a single price scenario (when there would be no production). But the most telling effect is that (rather than in case 2, where high-valuing rural customers get more surplus whilst low-valuing urban ones exit the market) the subsidy effect is from high-valuers to low-valuers, thereby increasing uptake specifically amongst a group of customers that is often disadvantaged (e.g. low income individuals) and targeted by other digital divide policies, without (as in the subsidy case) conferring 'windfall gains' on high-valuing groups.

It is important to note that non-discrimination provisions in telecommunication regulation were predicated upon the desire to increase competitive entry in telecommunications markets. They pertain to the sale of services from the incumbent to its competitors and militate against the incumbent favouring its own firm (discriminating against its competitors). The intention was to introduce competition into the parts of the market that were not subject to economies of scale. For a mature technology, this might not be a big problem, as production is likely already at quantities on the flat part of the average cost curve. However, for a new technology (for example Fibre to the Home - FTTH) which is at the early stages of its diffusion, with small customer numbers, or in a small market (e.g. rural) the ability to engage in price discrimination may be the difference between a technology being available or not. That is, price discrimination addresses divides in availability, and arguably with fewer distortions than subsidies. Furthermore, digital divides relate to final purchase by end consumers, whose demands are inherently different. They are served by retailers who, by regulatory contrivance, have limited market power and do not, as a rule, face downward sloping cost curves. If by dint of customer knowledge they do charge high-valuing customers higher prices, there is no obligation for them to use these to subsidise

low-price low-valuing customers, who may not even be their customers. The upstream infrastructure company, who supplies all the downstream customers and could effect transfers between customers to increase welfare and uptake, is precluded from doing so. Technology rollout and uptake is delayed relative to the case of a single operator and the ability to charge discriminatory prices direct to customers. It is noted that in unregulated mobile markets, the rollout of new technologies is rapid, and price discrimination is rife.

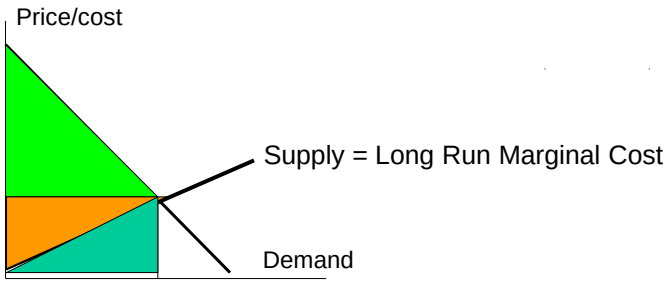
Thus the evidence suggests that conflicts exist between the pursuit of digital divide policy objectives and established policies in other areas of telecommunications and social policy. Ironically, the presumption that competition policy will assist in addressing digital divides by lowering prices and enabling more people to purchase, and ultimately lowering barriers to closing digital divides may not be borne out in practice.

Panel 1



Panel 2

MARKET DEMAND AND SUPPLY



Consumer's surplus (rent)

Producers' surplus (rent)

Resource cost of producing q*

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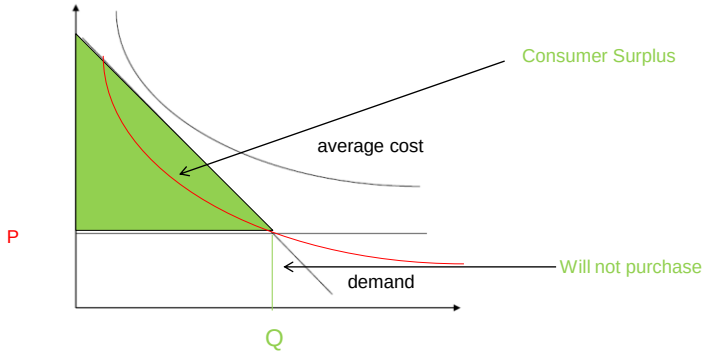
Panel 3



Demand below Average Cost
Good not provided or consumed at any price

Subsidy lowers effective cost
Good now provided and consumed at price P

By the Q consumers valuing it at P or above
Consumers valuing it below P will not purchase

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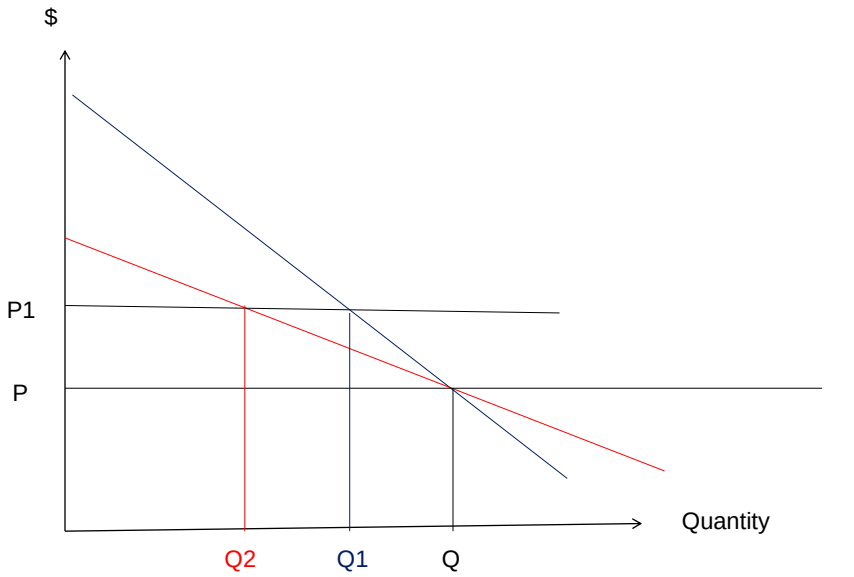
Panel 4



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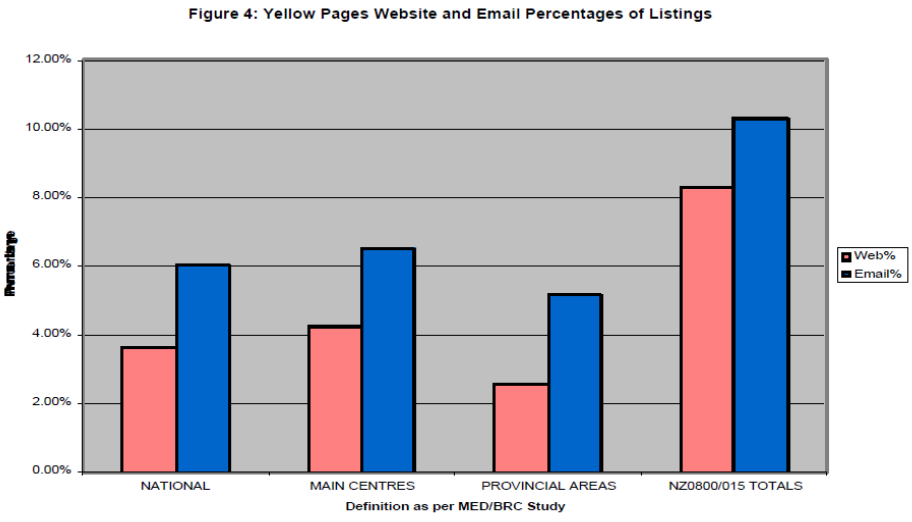
Panel 5



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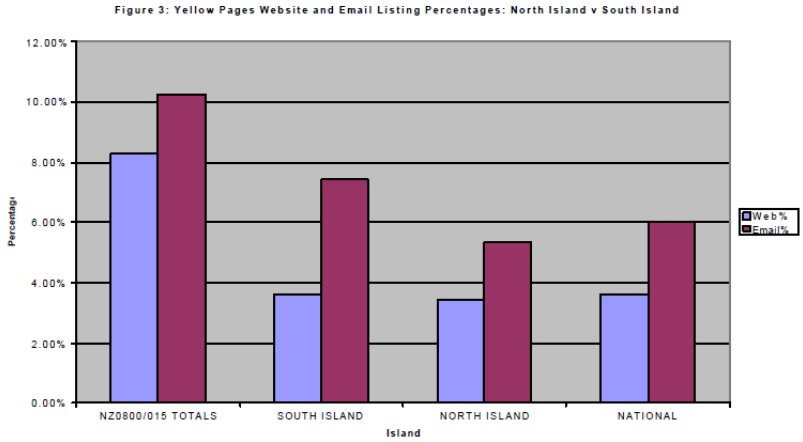
Panel 6



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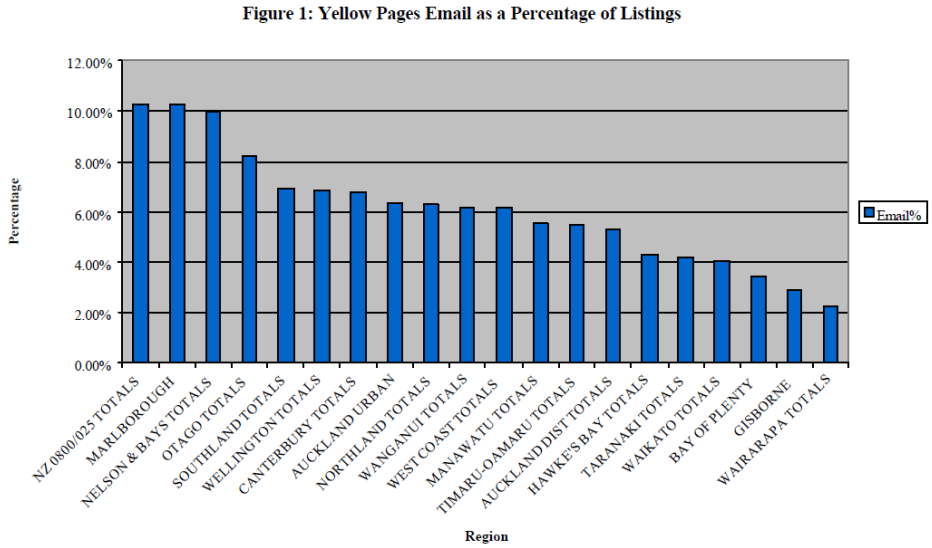
Panel 7



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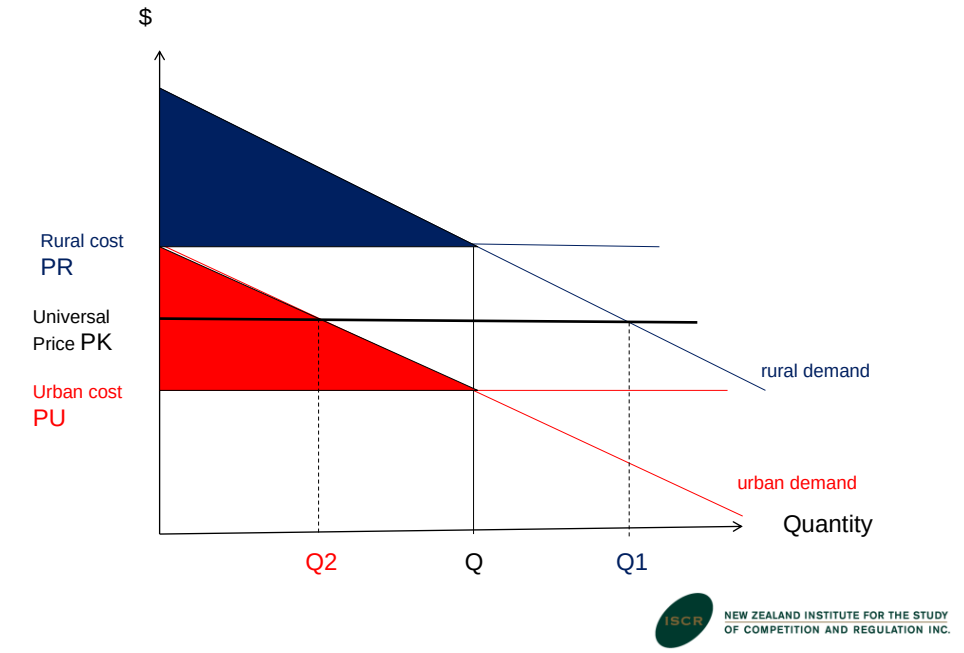
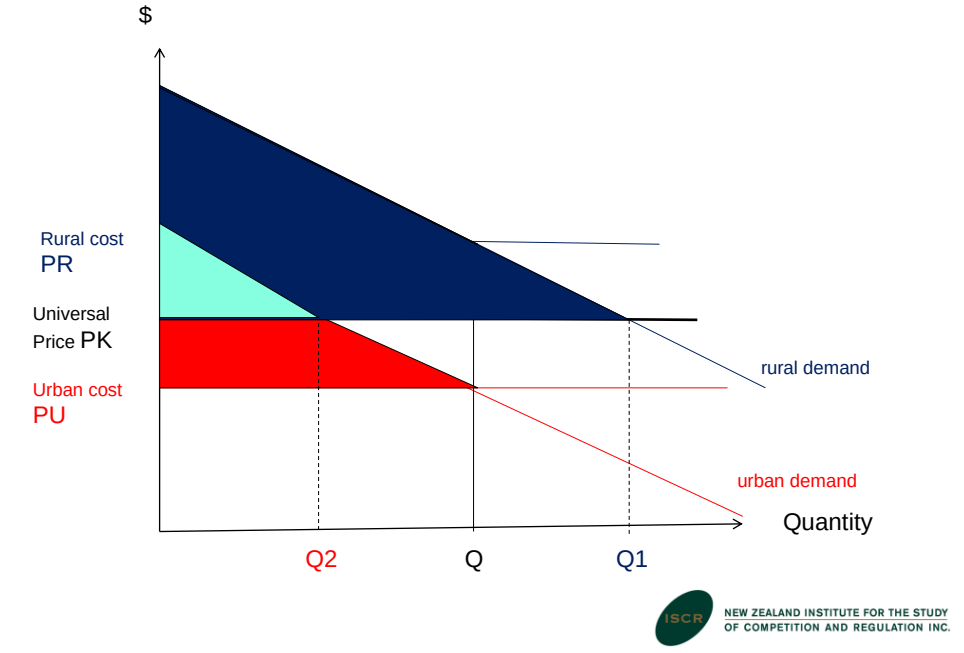
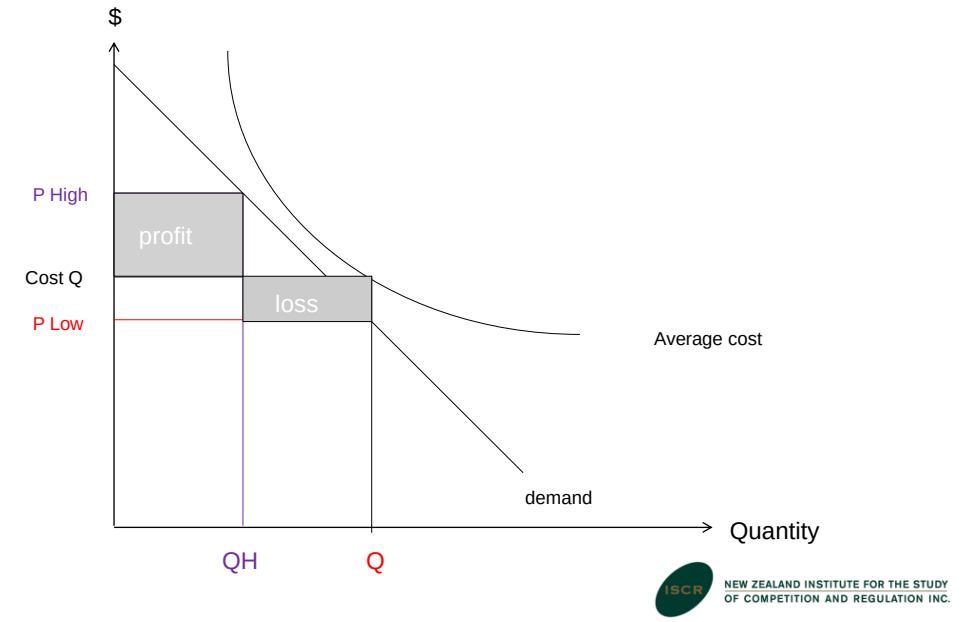
Panel 8



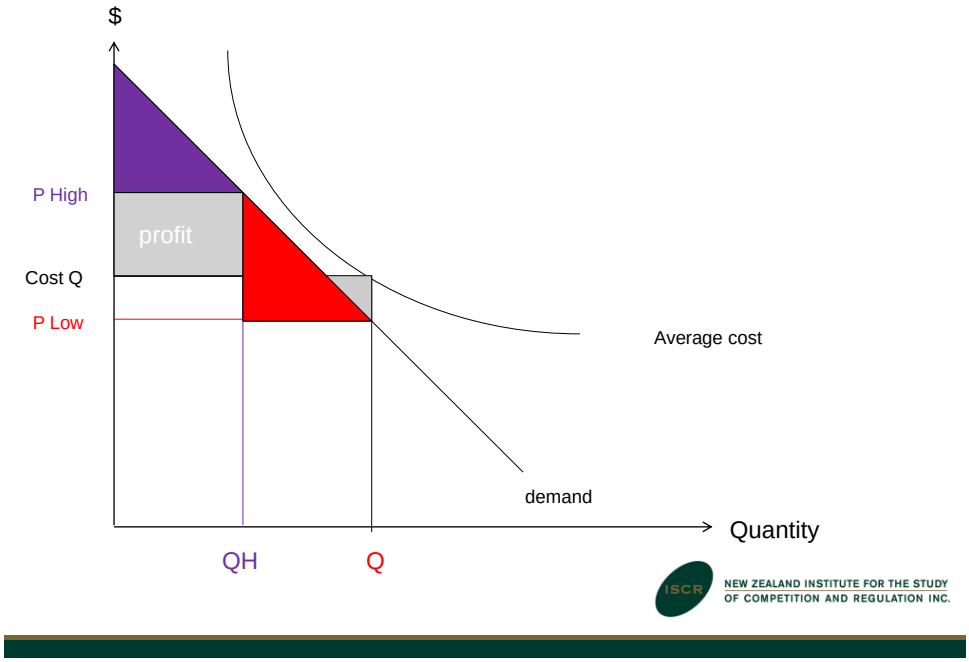
Panel 9



Panel 10



Panel 11



4. Conclusion

There are a large number of 'digital divides' over many dimensions and a large number of policies targeted at ameliorating them. They have been a feature of telecommunications policy debate for a long time. Furthermore, they do not appear to be diminishing in either magnitude or number, despite the large amount of resources directed towards 'closing' them. This suggests a 'failure' of many of the policies adopted to date. This paper has used a policy analysis critique to highlight a number of reasons why the divides persist.

Principal among these is that most policies focus on closing differences in measures such as infrastructure uptake, despite the fact that it is not clear how pursuit of closing indicator statistics is realising the ability to achieve the overarching goal of increased economic and social wellbeing. First, it is not immediately apparent that differences in uptake amongst different groups are always economically significant. Indeed, trying to correct differences that arise simply from the heterogeneity of individuals in the guise of redressing one uptake divide (e.g. urban-rural) runs the risk of making other divides worse (e.g. rich vs poor). Second, divides in infrastructure uptake do not take account of the consequences of the economic and social effects that arise from the use of the applications enabled by internet access. These economic consequences may push in very different divide directions.

Furthermore, existing policies may have substantial effects on the ability to close divides. Implementing new policies to address the divides, without also reconsidering how the extant policies contribute towards their creation, means the new policies may be doomed to fail, and potentially cause substantial additional costs to be wasted in the process. If the negative divide effects of the extant policies are high, then it is imperative that they be reassessed. No policy should be beyond reassessment, it also signals a need to evaluate digital divide policies in their wider context, not just narrowly in relation to individual metrics in alocalised context.

This paper suggests that improvements of this sort in the digital divide policy-making process may lead towards both resolving persistent divides and enabling the economic and social benefits that their resolution is anticipated to generate.

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