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

Competition, Regulation and Broadband Diffusion:

the Case of New Zealand

November 2006

Bronwyn Howell

New Zealand Institute for the Study of Competition and Regulation Inc. and Victoria Management School, Victoria University of Wellington, PO Box 600, Wellington, New Zealand. Email bronwyn.howell@vuw.ac.nz

This paper is a draft chapter prepared for Dwivendi, Yogesh K., Papazafeiropoulou, Anastasia and Choudrie, Jyoti (Eds.) ***Handbook of Research on Global Diffusion of Broadband and Data Transmission.*** *Idea Group (forthcoming, 2007). The author acknowledges the helpful comments of Professor William Melody and participants in the NordICT workshop on the Political Economy of ICTs, Skagen, Denmark August 27-31 on an earlier draft of this paper.*

Abstract

New Zealand offers a through-provoking case study of the effects of different competition and regulatory policies on broadband diffusion rates. Despite having one of the highest rates of Internet connection and usage in the OECD, widely available broadband infrastructure and low prices, broadband uptake per capita languishes in the bottom third of the OECD. Whilst low uptake has typically been attributed to competition and regulatory factors associated with New Zealand's 'light-handed' regulatory regime, this chapter proposes that the most likely reason is a combination of legacy demand-side regulations, in particular the tariff options for voice telephony, and limited value being derived by residential consumers from the small range of applications currently necessitating broadband connections. The New Zealand case illustrates the effect that legacy regulations can have on the diffusion of new technologies, and indicates a need for more research on the effect of telecommunications industry regulations on demand-side uptake factors.

Introduction

Despite being one of the leading countries in the adoption[1] and use of Internet access, and having (1) a sophisticated e-commerce infrastructure and internationally high numbers of e-commerce transactions per capita, (2) a population regarded as avid early adopters and users of applications such as electronic funds transfer and electronic commerce, (3) widespread and early deployment of a variety of high-speed broadband technologies and (4) internationally low prices for broadband products, New Zealand's broadband uptake per capita has been consistently in the lower third of the OECD[2] (Table 1). The simplistic explanation typically offered for low broadband uptake has been New Zealand's telecommunications competition and regulatory framework[3].

In an industry where sector-specific regulation, and local loop unbundling (LLU) in particular, have been strongly advocated and widely adopted internationally[4] with the specific objective of accelerating broadband uptake rates[5], New Zealand has stood apart from most of its OECD counterparts. Principal differences are its reliance upon competition law and minimal regulation to shape participants' actions[6] and its reluctance to impose competitive access obligations on its solitary privately-owned national fixed line network operator[7]. In the absence of detailed market analyses, 'competition problems' attributed to the different

---

[1] At September 2005, 76.3% of the New Zealand population had access to the Internet (ITU).

[2] Details of New Zealand's relative performance in Internet and e-commerce metrics across time are contained in Boles de Boer, Evans and Howell (2000), Howell and Marriott (2001) and Howell, Mishra and Ryan (2004). Broadband investment history, diffusion and utilisation is documented in Howell and Obren (2002, 2003), and Howell (2003, 2006). Comparative international pricing analyses are in Howell (2003) and Wear and Duncan (2005) and Network Strategies (2006). Table 1 provides a summary.

[3] Ministry of Economic Development (2006).

[4] The OECD has advocated since 2001 that, in the absence of competition between different technological platforms, local loop unbundling may play a significant role in facilitating the development of competition for former monopoly incumbent telecommunications providers (OECD, 2001). At October 2006, Mexico remained the only OECD nation not to have mandated some form of local loop unbundling.

[5] Local loop unbundling was mandated by the European Union in Regulation 2887/2000/EC in order to boost competition in the provision of broadband (Official Journal L 336, pp 4-8, 30.12.2000 as cited by Sutherland, 2006. New Zealand mandated bitstream unbundling in 2004 and legislation for full LLU is pending. Full LLU is proposed to address low levels of broadband uptake (MED, 2006).

[6] Between 1990 and 2001, the solitary industry-specific 'regulations' covering the NZ telecommunications sector related to the 'Kiwi Share' retained by the New Zealand government following the privatization of the formerly state-owned network operator, Telecom New Zealand Ltd. The 'Kiwi Share' capped residential line rentals at the price charged at the date of privatization (taking into account consumer price index (CPI) changes), a universal service obligation equalizing line rental charges for rural and urban users, and an obligation to make available a 'flat rate' tariff option to all residential consumers. Following reintroduction of sector-specific regulation in 2001, the costs of the universal service obligation became shared amongst all network operators. A Telecommunications Service Obligation (TSO) payment is levied annually (retrospectively) by the Telecommunications Commissioner. Despite the ability to raise residential line rental charges in accordance with the CPI, Telecom has very rarely altered prices, resulting in decreases in the real price of residential access across the 1990s that have been greater than the OECD average (Howell and Obren, 2003). The popularity of the flat rate residential tariff, which was the only tariff option offered under state ownership, is evidenced by the fact that fewer than 10% of residential consumers chose the two-part 'Economy' tariff offered by Telecom at any time when it was available between 1997 and 2004. This tariff option has now been withdrawn. Wear and Duncan (2005) show that, as a consequence of the popularity of the flat rate tariff, calling minutes per residential account in New Zealand are substantially higher than in comparator OECD countries where local calls are metered per minute.

[7] Boles de Boer and Evans (1996).

regulatory approach have become convenient scapegoats upon which to lay the blame[8] for the New Zealand broadband uptake 'problem'[9].

The credibility of the 'competition problem/regulatory differences' explanation for low broadband uptake begins to fail, however, when juxtaposed against New Zealand's OECD leadership in virtually every other indicator associated with uptake and utilisation of the Internet. The same competitive and regulatory framework applying during the rollout of broadband infrastructures appears not to have impeded investment in, or uptake and utilisation of, all other non-broadband Internet-related infrastructures and applications. Neither does it appear to have impeded investment in or internationally competitive pricing of, broadband services[10]. The primary characteristics that competitive markets are presumed to deliver, and are the primary objectives of regulatory intervention – low prices, timely introduction of new services and higher product qualities, and universal service/access[11] - have already been achieved. The additional benefits that are typically expected from increased competitive intensity - greater provider variety and consequent marginal improvements in service quality – do not appear to be sufficient to account for the substantial differences in broadband diffusion per capita between New Zealand and countries with smaller Internet-using populations, higher absolute prices for broadband access and less widely-available infrastructures.

The New Zealand case study begs the question of the role of specific regulatory interventions in determining the broadband diffusion rate. Firstly, how has New Zealand been able to achieve supply-side conditions in the provision of broadband access that have yet to be achieved by the majority of countries employing extensive regulatory intervention in fixed

---

[8] See, for example, Network Strategies (2006).

[9] Attribution of 'broadband uptake problems' to differences in competitive and regulatory regimes has also occurred in the United States – e.g. Hausman, Sidak and Singer (2001), Ferguson (2002), Hausman (2002), Shelanski (2002), Wallsten (2006) and Sacher and Wallsten (2006).

[10] New Zealand was amongst the first OECD nations to complete digitisation of the telephone network (1994). New Zealand was third in the OECD (after the United States and Canada) to offer a commercial ADSL product (January, 1999). By 2003, it was available to 85% of fixed line customers. In 2006, it is available to 94% of fixed line customers. The initial speed offered (2Mbps) was one of the highest in the OECD. In 2001 was the third lowest-priced product (megabyte per second downloaded) in the OECD (Howell, 2003). Whilst it has been suggested that data caps are depressing uptake (e.g. Network Strategies, 2006), caps arise as a consequence of the high volumes of data transmitted from offshore, which must pass through the monopoly Southern Cross trans-Pacific oceanic cable (Howell, 2006). For monthly usage packages of 10Gb and less, comparing products of comparable speed, New Zealand prices are still substantially lower than those of most other OECD countries. In 2004, New Zealand's incumbent 10Gb/month package (i.e. comparable in extent of coverage and availability) was between 9% and 30% lower than the equivalent products offered in all of the OECD top quartile uptake countries (Howell, 2006a, based upon data in Network Strategies, 2006). Iceland, despite the presence of much more severe data caps on international traffic (100Mb per month, compared to 10,000Mb per month in the most generous NZ capped package), has consistently been amongst the top OECD performers in broadband connections per capita.

[11] Although substantial choice of service provider and some aspects of service quality might not have been achieved, these must be assessed against the fact that New Zealand has a small population (4.1 million), low population density (14.6 persons per square kilometer), widely geographically-dispersed pattern of urbanization, with only one city having a population of more than 500,000 and is geographically isolated. New Zealand markets typically lack advantages from economies of scale, exhibit substantially higher concentration levels than comparator countries, and have relatively higher levels of capital intensity than comparator countries (Arnold, Boles de Boer and Evans, 2003).

line access markets (that is, various forms of local loop unbundling), despite its reliance upon a privately-owned network provider with substantial market power and only competition law and a handful of very light-handed regulations (and in particular, an absence of LLU) with which to shape participants' interactions? Secondly, even if regulatory intervention is necessary to ensure the provision of widely-available, low-priced broadband Internet access, does it necessarily follow that a population of high-using, widely experienced Internet users will automatically substitute away from their existing access technologies to broadband connections?

This chapter addresses these questions. Whilst supply side factors make the purchase of a technology possible, broadband diffusion rates measure the demand side response to its availability. The apparent absence of supply-side impediments in the New Zealand market suggests that an explanation for slower diffusion may lie in demand-side factors. The apparent reluctance of experienced Internet users to buy broadband connections suggests a demand-side reluctance to substitute from dial-up to broadband access, which regulators focused on supply-side factors are typically ill-equipped to identify. This information asymmetry leads to risks of over-attribution of the effect of regulatory intervention on uptake statistics of embryonic technologies. By holding supply-side factors constant, a demand-side model of broadband purchase and substitution can be developed, based on the utility derived by users from a defined set of Internet applications and differences in tariff structures, in order to provide a better understanding of the factors influencing the replacement of dial-up Internet access by broadband. With such understandings, regulators will be better equipped to analyse the need for regulatory intervention, thereby raising the quality of regulatory intervention.

When applied to the New Zealand case facts, the model suggests that demand-side tariff regulations pertaining to residential voice telephony (specifically flat-rate tariffs) have had a significant effect upon the development of the New Zealand market, leading to a bias towards purchase of dial-up Internet access. That so few New Zealand Internet users have substituted to broadband suggests that, at the current point in time, the applications used most frequently by the majority of users do not require the speed and data volume capabilities of broadband, and dial-up remains the most cost-effective Internet access method. This raises the question of whether it is appropriate for regulators to utilise any tools to influence embryonic technology diffusion patterns, given their sparse information about the demand-side characteristics, as well as raising the issue of the extent to which the effect that their regulations have already had on demand-side factors are being evidenced in existing broadband diffusion statistics.

Regulation, Diffusion and the Regulatory Use of Diffusion Statistics

As a starting point, it is presumed that the diffusion of any technology is the outcome of the interaction of supply-side and demand-side factors. The presumption is that, in the absence of any impediments to bargaining, total welfare is maximised as a consequence of such interactions. The quantity of units sold per capita (diffusion) under these circumstances is optimal. However, impediments may result in either more or fewer than the welfare-maximising quantity being sold. The impediments may affect either the supply or the demand side of the market. For example, supplier market power results in lower total welfare as the supplier constrains supply in order to sell units at higher prices. Likewise, subsidies to consumers may result in the quantity demanded being higher than optimal, with total welfare reduced as a consequence of the welfare forfeited in other markets in order to create the subsidy being greater than the welfare accruing from higher purchases of the subsidised good or activity.

Supply-Side Regulatory Intervention

The argument typically offered to justify the regulation of telecommunications markets, and incumbent telecommunications operators in particular, is to constrain operators' use of market power to maximise their profits by restricting the supply of services to consumers and charging prices above the point where welfare is maximised. Regulatory intervention principally seeks to reduce these supply-side constraints (including the use of price controls), resulting in a focus upon the use of metrics indicating changes in uptake per capita in order to assess the performance of regulatory intervention in constraining supplier market power.

Increases in uptake per capita are thus the principal demand-side indicators to regulators of increases in total welfare resulting from reductions in the exertion of supplier market power, inasmuch as it has been previously established that the supply side was in fact being constrained by suppliers' actions. The inference drawn is that regulatory intervention has been the driver of the ensuing welfare increase represented by increased uptake. This is distinct from the welfare inferences that can be drawn from increases in uptake (i.e. the natural diffusion pattern) of a completely new technology. An increase in uptake in this case signifies that the benefits of purchasing the technology exceed the costs for an increasing number of customers who are gradually choosing to purchase. This may occur as the price reduces (e.g. as more suppliers enter the market or as a growing market leads to economies of scale and improved production processes, resulting in lower costs passed on to consumers as lower prices), as new applications utilising the technology are developed, thereby increasing the size of the potential market, or as more potential customers become informed about the benefits that the technology offers them, relative to other calls on their budgets.

Risks From Demand-Side Information Asymmetries

Melody (2005) notes that the current body of regulatory knowledge has been accumulated principally from regulating suppliers whose exertion of market power is well-established, and where it is has been established that there is a pent-up demand for products and services that is not being met specifically because of supplier actions. Hence, in the conduct of regulatory activities focusing upon constraining these supply-side powers, "attention to demand is not a priority" (p 28). The consequence is an approach to market development "fostered by the fascination of many old and new operators with the technical capabilities of new technologies" and a prevailing view that "if we build it, they (consumers) will come", at the expense of understanding the role of the demand side factors in the diffusion of technologies supplied by the regulated providers.

Thus, when new technologies are diffusing in industries that have been regulated because of the presence of historic supply-side market power, a risk exists that uptake increases arising from the natural patterns of a new technology offered by the regulated providers diffusing may be inappropriately attributed to supply-side regulatory interventions, simply because there is insufficient understanding of the relevant demand-side factors that are simultaneously contributing to the observed diffusion pattern. Likewise, it may be inappropriately assumed that diffusion rates can be accelerated with supply-side interventions at very early stages of the new technology's diffusion, simply because the same interventions have been instrumental in raising uptake, and therefore welfare, in more mature product markets. Such approaches risk distorting the normal competitive interactions that occur in the early stages of any new technology, where there are substantial uncertainties for both suppliers and consumers about the short and long-term merits and uses of the technology.

The diffusion of Internet access in the historically highly-regulated telecommunications industry provides an example where the risks of distortions arising from regulatory intervention are significant. Existing regulatory measures will affect diffusion patterns, with differences in initial conditions and regulations necessarily contributing to differences in patterns between countries being observed. Melody (2005) further notes that "typically, both regulatory rules and tariff restrictions prevent experimentation and add to the risks of innovation, particularly by intermediaries and end-users on the demand side of market development" (p 33). In order to determine whether regulatory, supply- or demand-side factors are responsible for observed differences, to assess the likely efficacy of any regulatory intervention and to improve regulatory quality, an understanding of existing demand-side factors and their contribution to diffusion patterns is essential.

A Demand-Side Model of Broadband Uptake

In the case of Internet access technologies, demand is derived from the benefits that consumers accrue from the applications utilising Internet access (Crawford, 1997). As with all telecommunications technologies, Internet demand generates a requirement for both access and usage (data transmission) (Laffont and Tirole, 2002). Dial-up and broadband diffusion statistics measured as connections per capita are capturing only the component that relates to Internet access. When making a decision about whether to purchase a connection, and which connection type to purchase, a user must consider the effect of both access and usage charges required to derive benefits from a defined set of applications. Whilst all Internet users must pay an access charge, users of applications generating large amounts of data traffic will incur greater usage charges than users of applications generating lower amounts of data transfer. The user will purchase an Internet connection only if the benefits from the applications exceed the sum of access and usage charges (Wenders, 1990), plus other incidental costs.

If it is presumed that broadband technologies are the frontier of Internet access, and dial-up technologies the vintage, then users will substitute when the additional benefits of using the frontier technology exceed the additional costs for the defined set of applications. The frontier technology is said to be dominant when all new users purchase it, but only conditionally dominant when some new users choose to purchase the vintage technology, despite the frontier being available (Helpman and Trajtenberg, 1996). The specific benefits that broadband access confers are savings in time (due to faster data transfer) and the ability to use applications that are physically impossible to use on dial-up. Thus, the user will substitute if the benefits of broadband are greater than the additional costs to support use of the existing application base, or if the benefits from additional applications that can only be utilised with broadband access exceed any additional costs that their usage incurs (as per Boyan and Jovanovic, 2000) [12].

Purchase and Substitution

The purchase and substitution decision can be modelled thus[13]. Assume an Internet customer i uses a set of $j = \{1,2,3,...n\}$ applications each requiring υ_j megabytes of bandwidth to

[12] Network effects that accrue from having more individuals connected to the Internet network, irrespective of connection type) are included in this benefit.
[13] The form of the model derives from Wenders (1990).

generate a benefit (net of all costs other than those associated with information transfer) of $\Sigma_{j=1}^{n}\beta_{ij}$. The benefit can be generated using either a broadband or a dial-up Internet connection. Fixed costs are F_D for dial-up access and F_B for broadband, (e.g. equipment, telephone line, DSL line, cable subscription, ISP subscription). Assuming that dial-up access is metered per minute connected and broadband per megabyte transferred, variable costs are V_D per minute for dial-up access (including both telephone and ISP time-based charges), and V_B per megabyte transferred for broadband. The user's time taken to transfer information for application *j* is T_{Dj} minutes using dial-up and T_{Bj} minutes using broadband ($T_{Dj} > T_{Bj} > 0$). The user has a value of time γ_i per minute.

The user can choose to purchase no connection, a dial-up connection or a broadband connection, depending upon which option renders the highest utility Π_{Ki}, measured as benefits less costs. A connection will be purchased only if $\Pi_{Ki} > 0, K = D, B$. If all other user costs are independent of the information transfer method, then the user's net utility from Internet use will be:

$$\Pi_{Di} = \Sigma_{j=1}^{n}\left(\beta_{ij} - (\gamma_i + V_D)T_{Dj}\right) - F_D \qquad \text{using dial-up} \qquad (1)$$

and

$$\Pi_{Bi} = \Sigma_{j=1}^{n}(\beta_{ij} - \gamma_i T_{Bj} - V_B \upsilon_j) - F_B \qquad \text{using broadband.} \qquad (2)$$

Users will continue to add applications to their portfolios, and increase the usage of existing applications (incurring additional costs in minutes of time and data transfer consumption), as long as the additional benefits exceed the additional costs. Dial-up access will be purchased where $\Pi_{Di} > \Pi_{Bi} > 0$ and broadband where $\Pi_{Bi} > \Pi_{Di} > 0$. Substitution of dial-up with broadband will occur when $\Pi_{Bi} > \Pi_{Di}$. If one application *j=n* cannot physically operate using dial-up, then broadband will be purchased only if Π_{Bi} exceeds $\Pi_{Di} = \Sigma_{j=1}^{n-1}\left(\beta_{ij} - (\gamma_i + V_D)T_{Dj}\right) - F_D$.

Broadband will be preferred to dial-up when

$$(F_D - F_B) + \gamma_i \Sigma_{j=1}^{n}(T_{Dj} - T_{Bj}) + \Sigma_{j=1}^{n}\left(V_D T_{Dj} - V_B \upsilon_j\right) > 0. \qquad (3)$$

Equation (3) shows that broadband substitution will be more likely to occur if the fixed costs for dial-up are large relative to the fixed cost of broadband, the value of time for the user is high (and/or broadband is significantly faster than dial-up – connection speed is implicitly captured in the user value of time), or the volume of information transfers is large. It is less likely to occur if the per-megabyte charge is large relative to the per-minute charge, the value of user time is low, or the relative speed difference is small.

If broadband was truly a dominant technology, the applications predominantly used were feasible only on broadband, or if time is valued highly and the time savings from broadband use are large because data transfer volumes are large, then broadband would quickly dominate dial-up access. However, empirical data does not appear to support this contention. New dial-up connections continue to be sold to new Internet users in the United States (Horrigan, 2006), New Zealand (Howell, 2006) and Europe (EU, 2006). Different user time valuations, however, may lead to conditional dominance of broadband, at least for some user classes. Different time valuations plausibly account for observations of a greater likelihood of higher income users (presumed to have higher valuations of time) purchasing broadband connections than lower income users (Horrigan, 2006; Rappoport, Kridel and Taylor, 2002), even though in some surveys they appear to use the connection less frequently (Horrigan 2006 notes that higher income users spend less time per month on Internet activities than lower income users). Low valuations of time and/or low data volumes are also consistent with experimental (Varian, 2002) and survey (Horrigan, 2006; EU, 2006; Point Topic, 2006) data suggesting that the majority of consumers are not prepared to pay large premiums for faster connections, given the current application base and usage patterns[14].

Together, these data suggest that the applications currently available and routinely used to generate benefits (apart from those supporting audio and video streaming and gaming) may not, as yet, necessitate the purchase of broadband connections for the majority of Internet users. Rather, they suggest that broadband technology choice is largely determined by relative prices, especially at low usage volumes. Technology choice may also be strongly influenced by tariff structures. If historic regulatory intervention in the telecommunications market has resulted in pricing patterns that influence the relative connection and utilisation charges faced by customers, then in the absence of any other obvious supply-side distortions in the market, it cannot be discounted that these interventions are affecting the rate of diffusion of the broadband frontier access technology. Of particular interest in respect of Internet access is the use of two-part and flat-rate tariffs.

[14]EU data in January 2006 indicate that only 19% if surveyed broadband users would be prepared to pay 10% more for faster connections and only 10% of users 20% more. EU (2006) indicates 40% of EU dial up users, and Horrigan (2006) 50% of US dial-up users, are happy with existing dial-up speeds and have no plans to purchase broadband connections in the foreseeable future. Point Topic (2006) indicates 82% of UK Internet households (both broadband and dial-up) are satisfied with download times.

Flat-Rate Tariffs and the Demand-Side Substitution Model

Flat-rate pricing tariffs influence users' consumption levels by equalising the prices paid by both light and heavy users. Whereas, in order to minimise total costs, a heavy user will typically favour a high fixed, low usage tariff and a low user a low fixed, high usage tariff, under flat rate tariffs both pay the same fee, irrespective of the level of usage (Carlton and Perloff, 2000). Once a connection is purchased, the user faces no financial consequences of varying usage levels. Light users consuming less than the average quantity subsidise heavy users consuming more than the average. Flat rate tariffs enable heavy consumers, in particular, to use more of the product than they would had they faced a charge equal to the marginal cost of their usage. Welfare is reduced relative to marginal cost pricing, as the additional costs incurred must be recovered either from all users in the form of higher a fixed fee[15], or from another source.

Flat-rate pricing regimes for Internet access are prevalent across the OECD. Combined with an unmetered telephony component, they have been widely advocated as means of encouraging increases in both Internet access and use (OECD, 2000). On the one hand, it is claimed they offer budget 'insurance' by eliminating the risk of users receiving unexpectedly large bills when unaware of the quantity of data transfer their use is generating, especially when using new Internet technologies where megabytes transferred per application may be opaque (Anania and Solomon, 1997; Brownlie, 1997)[16]. On the other hand, as they facilitate 'costless' (to the consumer) increases in usage, they are attributed with engendering the higher levels of both dial-up Internet uptake and usage observed first in countries where unmetered local telephony calling was the norm (Australia, Canada, New Zealand and the United States – OECD, 2000; Howell, 2003). Miravete (2003) suggests that, in respect of voice telephony plans at least, whilst consumers facing two-part tariffs may lack sufficient information to select the optimal plan initially, learning is rapid and they substitute quickly to a more cost-effective plan if the initial choice is non-optimal.

Equations (1) to (3) can be modified to account for two types of flat rate tariffs. When local telephony calls are unmetered (i.e. $V_D = 0$), equation (1) becomes

[15] Fewer light users purchase a connection, and all users pay a higher fee, thereby lowering welfare relative to the counterfactual of the heaviest users consuming beyond the point where the benefits of their usage fall below marginal cost.

[16] Likewise, flat-rate plans obfuscate the fact that light users are consuming very small quantities of data transfer, thereby reducing the likelihood of light consumers transferring to a more cost-effective two-part tariff plan. Despite the early popularity of flat-rate broadband packages, introduction of competition in broadband supply is resulting in more two-part tariffs being offered ('product variety'), as predicted by Wenders (1990). As suppliers gain more information about differences in customer usage patterns, they differentiate their offerings in order to maximise their share of surplus (whilst simultaneously increasing total surplus by reducing inefficient cross-subsidies from flat-rate tariffs).

$$\Pi_{Di} = \Sigma_{j=1}^{n}\left(\beta_{ij} - \gamma_i T_{Dj}\right) - F_D . \quad (4)$$

When broadband usage is unmetered (i.e. $V_B = 0$), equation (2) becomes

$$\Pi_{Bi} = \Sigma_{j=1}^{n}(\beta_{ij} - \gamma_i T_{Bj}) - F_B \quad (5)$$

With no additional infrastructure usage charge incurred with increasing transaction volumes under flat-rate tariffs, uptake of new applications and additional use of existing applications incur only the cost of user time. If new applications and transactions accrue a net benefit over the additional user time costs incurred, they will be adopted and used increasingly, irrespective of the infrastructure access method chosen. The substitution choice becomes a simple trade-off between fixed costs, the value of user time, the number of applications used and the relative speed of the connections:

$$(F_D - F_B) + \gamma_i \Sigma_{j=1}^{n}(T_{Dj} - T_{Bj}) > 0 \quad (6)$$

Under flat-rate pricing of both access methods, broadband will be preferred if the fixed costs of dial-up are large relative to those of broadband, if broadband is significantly faster than dial-up, the value of time for the user is high, and the number of information exchanges is large. Once the fixed prices and infrastructure speeds have been set by infrastructure providers, assuming users initially purchase the optimal technology for their volumes of usage, growth in the number of broadband connections is dependent solely upon increases in users' valuation of time and/or the volume of information transfers.

However, truly flat rate dial-up telephony charges as per equation (6) are uncommon[17]. Even where unmetered calling has prevailed, connections to the Internet may incur a fixed charge per call (e.g. in Australia). New Zealand has been one of the few countries where the regulatory-mandated local residential telephony calling tariff has resulted in users incurring no charge for either dial-up Internet connection or utilisation, although such tariffs are commonly offered voluntarily by providers in the United States (Miravete, 2003). From equations (1), (4) and (5), it becomes clear why the substitution of broadband for dial-up connections has occurred at a substantially slower rate in New Zealand and the United States than in countries with metered dial-up telephony.

When dial-up access is metered, but broadband unmetered, broadband is preferred when

[17] With the exception of Australia, New Zealand, the United States and Canada, per minute charging has prevailed, although it is noted that some operators are now offering unmetered data calls on voice lines, even though voice calls are still metered (OECD, 2005).

$$\gamma_i \Sigma_{j=1}^{n} (T_{Dj} - T_{Bj}) + V_D \Sigma_{j=1}^{n} T_{Dj} > (F_B - F_D). \qquad (7)$$

The smaller the difference between the fixed components of each technology's access price, and the higher the usage price per metered dial-up minute, the greater the likelihood that broadband will be purchased for a given application base and transaction volume. Unlike in equation (6), an increase in the volume of usage contributes directly to the technology trade-off decision via an infrastructure usage charge for the vintage technology (dial-up) which is not incurred for the frontier (broadband).

Thus, all other factors being equal, where transaction volumes are increasing (that is, where new applications and uses are continuing to be developed and users are continuing to adopt them) substitution between the vintage and the frontier will occur more rapidly when there is a metered usage price for the vintage technology. Conversely, where there is no usage charge for the vintage, current and future usage expectations contribute to the technology purchase decision only inasmuch as they are influenced by the user's valuation of time. Increases in usage must be greater to justify the decision to substitute, simply because there is no infrastructure usage cost incurred as a result of increasing transaction activity. Thus, both initial purchases of, and substitution to, the frontier, will be less than if a vintage infrastructure usage charge is present.

Implications

The demand-side model illustrates the weakness of relying upon uptake statistics alone in isolation from utilisation statistics when assessing the effects of regulatory intervention on markets. Regulations influencing uptake and use of the vintage technology (in this case, dial-up telephony) must be considered when interpreting uptake statistics for the frontier technology. Whilst slow uptake of the frontier might indicate a market power abuse, it might equally be reflecting a regulatory distortion favouring continued use of the vintage technology. Conversely, rapid uptake of the frontier might just as easily reflect demand side responses to pricing structures of the vintage technology as the consequence of regulatory interventions in the frontier technology's supply side.

Application to New Zealand

As supply-side constraints appear unsatisfactory in explaining New Zealand's low broadband uptake, the demand-side model offers a potential explanation. Whilst multivariate regressions on countries suggest that low GDP per capita, low population density and uneven urbanisation patterns may contribute (Wallsten, 2006), regulatory factors contribute. The demand-side model suggests that the New Zealand data indicate that the benefits of broadband access for the vast majority of experienced Internet users do not, at present, justify the additional costs of substituting away from very low-priced dial-up access to very low-priced broadband access[18]. This may be because New Zealanders place very low valuations on their time, or do not, on the whole, place a high value on the applications that necessitate broadband connections (that is, audio and video streaming and gaming) relative to other calls on the residential budget (e.g. substitute applications)[19]. Consistent with other countries such as Australia and the United States, where bandwidth used per consumer has been measured, the average bandwidth consumed per customer is low[20], with a small proportion of consumers utilising a disproportionate share of available bandwidth.

As New Zealand's GDP per capita is relatively low (21st in the OECD), the individual valuation of time may play a role. However, Howell (2003) finds that business uptake of broadband connections relative to other OECD countries is high, and consistent with all of the other Internet access and usage statistic rankings in the upper quartile. This suggests that valuations of business time, at least, are not delaying broadband uptake noticeably compared to other countries. As the number of households exceeds the number of businesses by a factor of around 8.6:1, national uptake statistics are dominated by residential user patterns. The evidence suggests that residential primarily uptake is responsible for the differences from other countries. As flat-rate telephony tariffs have applied to residential telephony users, but not business users, the demand-side model of flat rate pricing of both infrastructures (equation 6) appears to offer the most plausible explanation for the low levels of broadband uptake despite high levels of Internet uptake. The differences between equation (6) and equation (7) appear to account for the lower levels of broadband uptake in New Zealand, as well as Australia and the United States[21], relative to other countries where metered telephony usage has prevailed.

---

[18] Table 2 shows the relative price of New Zealand broadband access to dial-up access, compared to a sample of other countries.

[19] Significantly, New Zealand currently has no IPTV services. The sole digital pay television product is provided via satellite. Fibre-based cable television is available only in two localities, and has a very small market share. 'Triple play' cable bundles offering video content simply resell wholesaled content from the satellite provider. The incumbent telecommunications provider offers a pseudo 'triple play' bundle whereby television content is provided by the satellite company over its infrastructure, but with billing aggregated with voice and data services by the telco (Howell, 2006).

[20] Australian data shows residential broadband usage was 1.3Gb/month in the September quarter, 2003 (compared with 1.5Gb/month in New Zealand in January 2003 – Howell, 2003) to 2.2 Gb/month in the March quarter, 2005. http://www.abs.gov.au/ausstats/abs@.nsf/e8ae5488b598839cca25682000131612/6445f12663006b83ca256a150079564d!OpenDocument

[21] Canada has a different set of local telephony characteristics, given the fact that access agreements were associated with geographic 'de-averaging' of prices, meaning the simple model cannot be applied directly to the Canadian market (OECD, 2003; Howell, 2006; Cave, 2006).

Strategic Interaction

It is apposite to consider at this point the extent to which the flat-rate residential telephony tariff might have contributed towards the development of the supply side of New Zealand's broadband market. When the incumbent telecommunications provider was corporatised in the late 1980s and privatised in 1990, all legislative barriers to entry in the New Zealand telecommunications market were removed. Whilst the incumbent faced no requirements to allow access to its infrastructures by other operators, it had no protections from competitive entry. Under competition law, it faced the risk of legal action by competitors from exerting its market power. As a former state-owned enterprise in a light-handed regulatory environment, it also faced a very real political risk that industry-specific regulation could be reintroduced at any time. Thus, competitors and customers had access to two powerful mechanisms in addition to normal competitive and regulatory forces via which to constrain Telecom from acting in the manner typically associated with unregulated monopolies (Evans and Quigley, 2000). The threat of such actions has undoubtedly shaped the strategic choices made by the company.

In the absence LLU, new technology providers had no option of using Telecom's infrastructure to offer broadband services. Stand-alone infrastructures were required. In the absence of specific entry barriers, these could be installed whenever commercially indicated. New Zealand's first broadband provider, CityLink (Ethernet LAN), entered in 1995, followed by iHug (satellite) and Saturn Communications (fibre-optic cable) in 1998. When Telecom offered ADSL in January 1999, it was the fourth entrant into the broadband market. Whilst each of the competitors (apart from iHug) was confined to regional operation, competition from these alternative technologies provided significant competitive pressure on Telecom. iHug was initially the price leader (Howell and Obren, 2003). As satellite broadband could potentially be offered nationwide, Telecom was required, right from the start, to offer its ADSL services throughout the country at one (universal) price. To have adopted any other pricing strategy would have risked political action in response to accusations of strategic pricing[22]. The risk of political and/or regulatory intervention was real and significant, given New Zealand's long history of geographically-averaged telephony charging, consumer expectations and the 'universal service' obligations on Telecom as a consequence of the 'Kiwi Share' (see footnote 6). Thus, early investment in, and low universal pricing of, broadband by Telecom are in part explained by competitive entry and threat of legal and regulatory action.

---

[22] When Saturn offered lower-priced telephony services over its fibre connections, and Telecom moved to match them in the region covered by Saturn, this is precisely what occurred.

However, competitive entry and legal and regulatory threats alone were not been the only forces acting on Telecom. These forces have interacted with another key factor – mandatory unmetered local residential telephony tariffs. Flat-rate residential tariffs have prevailed from the earliest days of state-owned telephony provision in New Zealand, and were included in the Kiwi Share as a point of political pragmatism in order to minimise consumer (and voter) dissent when Telecom was privatised in 1990. Whilst designed to address voice telephony pricing, unmetered local calling provided real benefits to residential consumers with the advent of Internet access. As illustrated in equation (4), unmetered tariffs place few restrictions on increases in consumer usage. Howell and Obren (2003) show that between 1996 and 2003, traffic minutes on the fixed network trebled as a consequence of new dial-up data traffic (by contrast, dial-up Internet traffic resulted in less than double the traffic passing over British Telecom's voice networks over the same period). Whilst the 'Kiwi Share' regulatory arrangements allowed for Telecom to increase residential line rentals annually in line with the CPI, partly because of the real risks of political intervention arising from consumer dissatisfaction, line rentals were adjusted only once between 1990 and 2003. Consequently, Telecom was forced to bear practically all of the costs of additional use of the network for residential dial-up Internet access. The costs to Telecom of this were substantial, given that New Zealand dial-up Internet users were on average amongst the heaviest in the OECD (35 hours per month on average for 850,000 residential users – Howell and Obren, 2003).

The substantial cost to Telecom of 'free' (to the user) residential dial-up usage most likely provided the strongest strategic justification for the firm to invest early, rapidly and widely in broadband infrastructure. The sooner high-consuming residential Internet users could be migrated from dial-up use, which could not be charged, to broadband, the use of which would generate additional income (in either or both of access and usage fees), the sooner the substantial losses arising from the huge volume of dial-up Internet usage could be stemmed. Thus, a high-quality ADSL product was introduced (2Mbps, when the entry level residential offering in most other OECD countries was 256kbps) early (January 1999, 3rd in the OECD), roll-out around the country was rapid (80% of telephony customers were connected to ADSL-capable exchanges by 2002, 94% by 2005) and prices were set low to encourage early substitution. A range of two-part tariffs were offered, providing incentives for light users to substitute to broadband without having to subsidise heavy users. Heavy users, however, paid a lower per megabyte usage charge. All users were required to pay usage charges (albeit via 'bundles' of downloading capacity), in part reflecting the fact that over 95% of data consumed came from offshore, via the monopoly Southern Cross cable. All providers, including those with their own infrastructures, were required to charge in this manner as all are required to utilise the monopoly Southern Cross cable[23].

Answers and Implications

The interaction of regulation in the form of flat-rate residential telephony charging, threat of regulation and legal action in a lightly-regulated market governed predominantly by competition law, and demand-side factors in the form of a rational user response to the costs and benefits of Internet use thus appear to provide the most plausible explanation for the New Zealand observations. In answer to the first question posed in the introduction, regulatory factors are implicated, but it is the combination and interaction of a set of factors, including retail tariff obligations and universal service obligations, that have led to New Zealand achieving supply-side conditions in the provision of broadband access that have yet to be achieved by the majority of countries employing extensive fixed line regulatory interventions. Importantly, the case study illustrates that competition is a dynamic, interactive process involving suppliers, consumers, regulators and legislators, and that there are many ways in which desired supply-side outcomes can be achieved without necessarily having many firms in a market, or without recourse to LLU.

Whilst some of the circumstances in the case study may be unique to New Zealand, a key finding is the significant effect that regulations relating to a legacy vintage technology can have on the supply conditions of a frontier technology. It is impossible to assess the efficacy of any regulatory intervention without taking into account both supply and demand factors as they relate to both technologies. Moreover, it is negligent to ignore the effect of regulations on the demand side of the market (as price caps, universal service obligations and retail tariff requirements are) upon the measures of regulatory performance, simply because they were not considered significant in the past. The risk this invokes is that new regulations may be imposed on the suppliers of the frontier technology that are both unjustified, and most likely impotent in addressing the factors associated with the vintage technology that are the real causes underlying the observed outcomes.

In answer to the second question, the demand-side model and the New Zealand case study illustrate that, in the absence of supply-side constraints, it is not at all clear that experienced Internet users will adopt broadband simply because it exists. There is no reason to presume that the decision to purchase broadband is any different from that governing any other product

[23] Most opted to charge different rates for national and international traffic, reflecting the cost differences.

or service with derived demand (e.g. physical transport). Consumer purchase is determined by increases in utility, relative to other options. If the benefits of the frontier are not large, then relative prices are pivotal. The New Zealand data suggest that the utility of broadband is possibly much lower relative to dial-up, than may have been presumed by regulators, possibly due to a shortage of applications for which broadband is necessary. It may be that the historical emphasis on technological capabilities and the focus on supplier factors have created an over-reliance upon assessments of user requirements by vested supplier interests, at the expense of genuinely consumer-determined assessments. With regulatory effort focused on infrastructure providers in markets where wholesale and access customers have become the primary 'users' of a regulated telecommunications company's services, the usage of residential consumers, in particular, may be more easily overlooked by regulators. The risk is that, in the spirit of 'build it and users will come', supply may outpace demand, especially in the case of new technologies where it may take time for consumers to develop applications using its capacity, with uninformed regulators incorrectly interpreting the lack of consumer uptake as evidence of supply-side 'problems' justifying further regulatory intervention.

A further danger emanating from the lack of demand-side understanding is that uninformed and unjustified regulatory intervention may determine the technology that 'wins' the majority of the market, thereby leading to increased pressure on legislators and regulators from incumbent and new entrant suppliers. As the New Zealand case study illustrates, flat-rate telephony pricing has resulted in dial-up Internet access 'winning' the market share battle, at least given current applications. The rate of substitution to broadband will be accelerated if this tariff option is replaced with metered dial-up tariffs. But is such a regulatory change warranted? As with all other regulatory interventions, the final arbiter must be total welfare. If it is cheaper for a network provider to carry the same traffic on broadband than dial-up networks, then welfare is higher if substitution occurs. Without tariff restrictions, network providers would voluntarily change the tariff structure in order to accelerate substitution. Mandatory tariff regulations preventing suppliers from making these adjustments may allow inefficient over-consumption on the vintage technology to continue for longer than would have been the case absent the regulations. It is possible that this is the welfare outcome in New Zealand, if broadband data transfer really is cheaper per megabyte than dial-up. The lesson from this chapter is that mandatory flat rate tariffs for current broadband technologies may in the future impede the rate of substitution to the frontier technology that supersedes the current frontier. Likewise, flat rate calling tariffs (occurring within usage 'bundles') may impede the substitution 3G mobile handsets for 2G handsets among some user groups.

Conclusion

The New Zealand case study illustrates that regulatory interventions have interacted with other factors to have significant effects on the supply-side market conditions and broadband diffusion rate. The New Zealand data call into question the extent to which supply side factors and regulatory intervention in other countries can explain differences in broadband uptake rates. Demand side factors, and in particular, regulations affecting demand-side behaviour, such as flat-rate tariffs, price caps and universal service obligations, may also be instrumental. Further analysis such as that undertaken in this chapter will likely reveal other demand-side factors affecting broadband diffusion. More research enabling regulators to understand the demand-side of telecommunications markets that has long been opaque, is indicated.

References

Anania, L., & R. Solomon. (1997). Flat – the minimalist price. In L. McKnight & J. Bailey (Eds.) *Internet economics* (pp 91-120). Cambridge, Massachusetts: The MIT Press.

Arnold, T., Boles de Boer, D., & Evans, L. (2003). The structure of New Zealand industry: its implications for competition law. In M. Berry and L. Evans (Eds.), *Competition law at the turn of the century: a New Zealand perspective.* Wellington, New Zealand: Victoria University Press.

Boles de Boer, D., & Evans, L. (1996). The economic efficiency of telecommunications in a deregulated marketL the case of New Zealand. *Economic Record* 72(216) 24-39.

Boles de Boer, D., Evans, L., & Howell, B. (2000). *The state of e-New Zealand*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Brownlee, N. (1997). Internet pricing in practice. In L. McKnight & J. Bailey (Eds.) *Internet economics* (pp 77-90). Cambridge, Massachusetts: The MIT Press.

Carlton, D., & Perloff, J. (1999). *Modern Industrial Organization.* New York: Addison Wesley.

Cave, Martin. 2006. Encouraging infrastructure competition via the ladder of investment. *Telecommunications Policy* 30, 223-237.

Crawford, D. Internet services: a market for bandwidth or communication? In L. McKnight & J. Bailey (Eds.) *Internet economics* (pp 379-.400). Cambridge, Massachusetts: The MIT Press.

European Union. (2006). E-communications household survey. Retrieved November 6, 2006 from http://ec.europa.eu/public_opinion/archives/ebs/ebs_249_en.pdf .

Evans, L., & Quigley, N. (2000). Contracting, incentives for breach, and competition law. *World Competition* 23(2).

Ferguson, C. (2002). *The United States broadband problem: analysis and policy recommendations* (Working paper 31). Washington, D.C.: Brookings Institution.

Hausman, J., Sidak, G., & Singer, H. (2001). Cable modems and DSL: broadband internet access for residential consumers. *American Economic Review* 91, 302-07.

Hausman, J. (2002). Internet-related services: the results of asymmetric regulation. In R. Crandall & J. Alleman (Eds.) *Broadband; should we regulate high-speed internet access?* (pp 129-156). Washington, D.C.:AEI-Brookings Joint Center for Regulatory Studies.

Helpman, E., & Trajtenberg, M. (1996). *Diffusion of general purpose technologies*. National Bureau of Economic Research Working paper 5773.

Horrigan, J. (2006). *Home broadband adoption 2006.* Pew Internet and American Life Project. Retrieved November 6, 2006, from http://www.pewinternet.org/pdfs/PIP_Broadband_trends2006.pdf

Howell, B., & Marriott, L. (2001). *The State of e-New Zealand: 12 months on.* Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Howell, B., Mishra, V., & Ryan, L. (2004). *The State of e-New Zealand: 2004.* Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Howell, B. (2003). *Building best practice broadband in New Zealand: bringing infrastructure supply and demand together.* Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Howell, B., & Obren, M. (2002). *Broadband diffusion: lags from vintage capital, learning by doing, information barriers and network effects.* Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Howell, B., & Obren, M. (2003). *Telecommunications usage in New Zealand: 1993-2003*. Wellington, New Zealand: New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Howell, B. (2006). *Submission: Telecommunications Amendment Bill.* Presented to the Finance and Expenditure Select Committee, New Zealand House of Representatives, 11 August 2006. Available from the New Zealand Institute for the Study of Competition and Regulation. http://www.iscr.org.nz

Howell, B. (2006a). *Broadband penetration: does it matter and does it require local loop unbundling.* Public lecture presented at the New Zealand Institute for the Study of Competition and Regulation, Victoria University of Wellington, October 16, 2006. Presentation available at http://www.iscr.org.nz .

Jovanovic, B., & Stolyarov, D. (2000). Optimal adoption of complementary technologies. *American Economic Review* 90(1), 15-29.

Laffont, J-J., & Tirole, J. (2002). Competition in Telecommunications. Cambridge, Massachusetts: The MIT Press.

Melody, W. (2005). Regulation and network investment: a framework for analysis. In A. Mahan & W. Melody (Eds.) *Stimulating investment in network development: roles for regulators* (pp 19-37). Lyngby, Denmark: The World Dialogue on Regulation for Network Economies.

Ministry of Economic Development. (2006). Telecommunications stocktake cabinet paper. Wellington, New Zealand: the New Zealand Government. Retrieved November 6, 2006, from http://www.beehive.govt.nz/Documents/Files/Cabinet%20paper%20and%20minute.pdf

Miravete, E. (2003). Choosing the wrong calling plan? Ignorance and learning. *American Economic Review* 93(1) 297-310.

Network Strategies. (2006). *The broadband divide: achieving a competitive international ranking.* Report prepared for the New Zealand Ministry of Economic Development. Retrieved November 6 2006, from http://www.med.govt.nz/templates/ContentTopicSummary____20541.aspx.

OECD. (2000). *Local access pricing and e-commerce* (Report DSTI/ICCP/TISP(2000)1/FINAL). Paris, France: Organisation for Economic Co-operation and Development.

OECD. (2001). *The development of broadband access in OECD countries* (Report DTSI/ICCP/TISP(2001)2/Final). Paris, France: Organisation for Economic Co-operation and Development.

OECD. (2003). *Developments in local loop unbundling* (Report DSTI/ICCP/TISP(2002)5/FINAL). Paris, France: Organisation for Economic Co-operation and Development.

OECD (2005). *Communications outlook 2005*. Paris, France: Organisation for Economic Co-operation and Development.

Point Topic. (2006). *91% happy with the quality of home internet services.* Retrieved October 30, 2006 from http://www.point-topic.com/content/dslanalysis/061017consats.htm

Rappoport, P., Kridel, D. & Taylor, L. (2002). The demand for broadband: access, content and the value of time. In R. Crandall & J. Alleman (Eds.) *Broadband; should we regulate high-speed internet access?* (pp 57-82). Washington, D.C.:AEI-Brookings Joint Center for Regulatory Studies.

Sacher, S., & Wallsten, S. (2006). What U.S. broadband problem? (Policy Matters 06-18). Washington, D.C.:AEI-Brookings Joint Center for Regulatory Studies.

Shelanski, H. (2002). Competition and regulation in broadband communications. In R. Crandall & J. Alleman (Eds.) *Broadband; should we regulate high-speed internet access?* (pp 157 -196). Washington, D.C.:AEI-Brookings Joint Center for Regulatory Studies.

Sutherland, E. (2006). *An exit from telecommunications regulation*. Available from http://3wan.net/

Varian, H. The demand for bandwidth: evidence from the INDEX project. In R. Crandall & J. Alleman (Eds.) *Broadband; should we regulate high-speed internet access?* (pp 39-56). Washington, D.C.:AEI-Brookings Joint Center for Regulatory Studies.

Wallsten, S. (2006). *Broadband and unbundling regulations in OECD countries* (Working paper 06-16). Washington, D.C: AEI-Brookings Joint Center for Regulatory Studies.

Wear, S., & Duncan, I. (2005). *Telecommunications pricing in New Zealand: a comparison with OECD countries.* Wellington, New Zealand: New Zealand Institute for Economic Research. Retrieved November 6, 2006, from http://www.nzier.org.nz/SITE_Default/SITE_Publications/x-files/12139.pdf

Wenders, J. (1990). Two views of applied welfare analysis: the case of local telephone pricing. *Southern Economic Journal* 57(2) 340-48.

Table 1. Relative OECD Internet Connectivity and Uptake Rankings, 2003

Internet Metric	New Zealand		Australia		USA		South Korea		UK		France	
	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank
Connectivity Statistics												
ISP Accounts/100	14	9th	12	10th	18	5th	23	1st =	11	12th	5	21st
Household %	48	5th	47	8th	50	3rd	-	-	38	10th	12	23rd
School Availability	22	4th	17	5th	27	2nd	5	19th	16	9th	6	18th
Internet Hosts/1000	105	8th	95	10th	272	1st	14	26th	63	13th	31	19th
Web Sites/1000	11	12th	9	13th	47	1st	6	17th	25	4th	4	20th
Domain Names/1000	22	11th	19	16th	38	5th	21	14th	51	1st	9	20th
Secure Servers/million	202	3rd	190	5th	301	2nd	11	28th	141	8th	38	21st
Broadband Statistics												
BB Subscr/1000[78]	7	19th	9	17th	47	4th	173	1st	6	20th	11	15th
DSL Subscr/1000[79]	14	15th	8	20th	15	14th	130	1st	7	21st	12	17th
DSL Coverage %	85		85			65		90		66		91
Uptake Statistics												
Hours/month/ISP	21	2nd	18	4th	26	1st	-	-	10	7th =	10	7th =
account	(Xtra)		(Telstra)		(AOL)				(All ISPs)		(All ISPs)	

Source: Howell (2003) p 39.

Table 2. Selected Broadband:Dial-Up Cost Ratios, 2003

	Residential			Business		
	Broadband	Dial-Up (150 hours)	Ratio	Broadband	Dial-Up (150 hours)	Ratio
France	367	793	0.46	850	1460	0.58
Germany	305	537	0.57	510	1110	0.46
Sweden	250	805	0.31	430	1281	0.34
UK	317	224	1.42	370	332	1.12
US	317	247	1.28	442	328	1.35
NZ (1)[85]	348	134	**2.59**	420	353	**1.19**
NZ (2)[86]	348	230	**1.51**	213	263	**0.81**

Source: Howell (2003) p 42.