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Broadband Uptake and Infrastructure Regulation: Evidence from the OECD Countries

By

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Abstract

Policy organizations such as the OECD and the EU have placed much emphasis on the role of local loop unbundling as a regulatory tool in stimulating the rollout and uptake of broadband technologies, and consequently promoting the accrual of economic benefits from electronic commerce. However, there is mounting evidence that local loop unbundling has been less successful in promoting broadband rollout and uptake than competition both between duplicate networks of the same technology, and between competing technology platforms. OECD evidence of cross-country broadband rollout and uptake supports this contention. Cable modem access and uptake generally exceed that of DSL, even in countries practicing local loop unbundling, and in countries where no such policy is in force, DSL uptake significantly exceeds cable modem uptake.

This paper argues that content availability, and a cost-benefit trade-off supported by bundled products combining access and content, has stimulated demand for the cable product, thereby creating competitive pressure on DSL offerings. While local loop unbundling posits faster response to this competitive pressure, the OECD data provide little evidence to suggest that the primary driver is infrastructure availability. Rather, the evidence implies that application cost-benefit tradeoffs are the primary drivers of broadband uptake.

The paper further argues that overall low levels of broadband uptake reflect a fundamental lack of current applications utilising the high speed and high capacity of broadband to meet functional substitution requirements of users in such a way that the benefits of adopting broadband technologies to support information exchange exceed the increased costs. Unless such cost-effective functional substitution user applications are available, then the optimal time to invest in broadband for both users and infrastructure providers will be delayed in order to exploit lower costs, better technology and the holding cost of interest. Policies that promote infrastructure availability in isolation from the demand-driven applications that utilise this capacity run the risk of encouraging inefficient investment decisions.

Local Loop Unbundling and Broadband Uptake: Theory

Much emphasis has been given in recent years in policy-making to the role of regulatory tools such as price designation and local loop unbundling as means of countering the effects of monopoly pricing and delays in implementation of new technologies in the provision of local loop telecommunications services. The rationale supporting regulatory intervention is:

> *"to reduce bypass where it inefficiently duplicates infrastructure, and to promote entry into downstream markets"*[1]

Local loop unbundling policies require incumbent network operators to provide access to their infrastructure network to competing firms, usually at prices and conditions specified by regulatory intervention. Such conditions often require the incumbent to physically incorporate technology owned by the newcomer into the existing network in order to increase the range of basic services offered by the network. This policy is distinct from wholesaling, which generally utilises regulatory intervention to require the incumbent to provide 'bundles' of guaranteed access to services provided by the existing network to incoming firms, often at designated prices, in order for the newcomers to 'rebundle' access to retail customers in the form of value-added products and services. The key differences between the policies centre upon control and management of the core infrastructure. With wholesaling, the incumbent retains ownership and management control of the infrastructure, but regulation specifies the terms and conditions upon which the incumbent must make some of its products and services available. Local loop unbundling, on the other hand, gives newcomers some ownership and control rights to existing and new infrastructure.

Local loop unbundling has dominated recent regulatory policy-making in telecommunications. For example, the European Union has required compulsory unbundling of local loops in all of its 15 member states from January 2001[2]. Since 1997, emphasis on local loop unbundling has resulted in an increase to 26 of the 30 OECD members having either introduced actual unbundling of local loops (22 nations), or having policy plans to proceed, but not yet implementing, the practice (Czech Republic, Hungary, Korea and Poland)[3]. Only New Zealand, Mexico, Switzerland and Turkey have not introduced such policies: Turkey because it retains

[1] Boles de Boer, Enright and Evans (2000): 487.
[2] OECD (2001a): 15.

100% state ownership of the local loop, and therefore does not require regulatory intervention[4]; Switzerland because the Swiss Federal Court ruled in March 2001 against the telecommunications regulator's (ComCom) recommendation that local loop unbundling proceed; Mexico because it is not government policy; and New Zealand because the government has refrained from making a decision on the policy until the production of the Telecommunications Commissioner's Review, due within 24 months of the passing of the Telecommunications Bill late in 2001[5].

While it is recognized that local loop unbundling does enable the replication of some features of competitive markets within a monopoly network, unbundling also poses a range of contractual and incentive issues that can be expected to affect investment. Although unbundling reduces the risk of inefficient duplication arising from multiple identical networks, there is growing evidence that reduction in infrastructure costs and technological innovation are rendering competition between networks not only feasible, but actually efficient in many circumstances. That is:

> "*some duplication bypass is efficient to establish competition between potential and actual facilities that flows through to increased usage and lower prices.*"[6]

Boles de Boer, Enright and Evans (2000), in their comparison of the Internet Service Provider markets of Australia and New Zealand, show this is particularly important in downstream industries, especially where these downstream providers (in this example, Internet Service Providers - ISPs), pose competitive threats to telecommunications companies. They argue that New Zealand's open competition regime relative to Australia's policies of price designation and local loop unbundling predispose New Zealand to more efficient facilities competition. Specifically, New Zealand has lower prices and higher uptake of ISP services, despite Australia having three times as many downstream ISP entrants per head of population.

While general acceptance is given to the role of infrastructure competition in promoting the development of efficient telecommunications markets[7], local loop unbundling remains the regulatory method of first choice within the OECD, not only for the purpose of promoting efficient telecommunications markets, but also for stimulating the introduction and uptake of the

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3 *Ibid.*
4 OECD (2001): 37.
5 OECD (2001a): 15.
6 Boles de Boer, Enright and Evans (2000): 487.
7 "*all OECD countries have accepted the principle of open competition for telecommunications markets*". OECD (2001): 25.

technologies required for participation in, and accumulating the benefits of, the Internet and Electronic Commerce:

> *"Now the economic stakes and the importance of creating competitive markets are much higher than in the past, because of the expected positive economic impact of electronic commerce on OECD economies."*[8]

Specifically, local loop unbundling is seen as:

> "*fundamental to promoting a fast roll-out of broadband services"*[9],

despite evidence such as that of Boles de Boer, Enright and Evans (2000), showing that even in the markets for fundamental dial-up Internet access, actual patterns of downstream service uptake differ from those predicted from this espoused regulatory theory.

Key to the regulatory argument appears to be an assumption that local loop unbundling will promote the *availability* of new technologies based upon telecommunications networks (such as broadband services) – a supply-side argument based upon the premise that competing providers will put pressure upon incumbent operators to incorporate new technologies into their networks, thereby making the new technologies available to consumers. Once services are available, it is presumed that consumer demand for the new services will develop, raising uptake and generating the ensuing (anticipated) benefits. As long as consumer demand is present (demand side), unbundling is predicted to result in implementation of the new technology sooner, and/or at lower prices, than if the implementation decision was made by the monopoly incumbent alone.

The principal argument against unbundling is that such policies may actually delay and discourage investment in new infrastructure. A new entrant is guaranteed access to the incumbent's infrastructure at sure (designated) prices and the incumbent stands to receive sure (fixed) revenues for making that infrastructure available, reducing the risks for both the incumbent and the newcomer in gaining an income from the existing infrastructure. Combined with the setting of infrastructure prices by a regulator, this provides a disincentive to investing in new, riskier competitive technology. Risk management predicts industry participants will favour pursuing certain income over risking future revenues on an as yet unproven technology (Milgrom and Roberts (1992): 211). The new entrant may actually prefer the incumbent to bear the financial risks associated with implementing new technologies[10]. As the incumbent does not

[8] Ibid.
[9] OECD (2001a): 15.
[10] It is noted that in submissions to the recent Telecommunications Inquiry in New Zealand, the strongest support for local loop unbundling came from new entrants without a local loop infrastructure.

control all use of the new technology, this technology may display some of the properties of a specific asset. Under access regulation, implementation may thus require contractual risk-sharing between the two parties – a scenario that has the potential to include collusive setting of prices to the ultimate service consumer. The technology may become available to the consumer, but not necessarily at an average price (Carlton and Perloff (2000): 123). In addition, if regulated prices fail to adequately account for the sunk costs of the incumbent's infrastructure, then access regulation may encourage 'hit and run' usage of the incumbent's infrastructure by the new entrant, lowering prices to end consumers in the short run, but restricting long-run investment. An incumbent facing such a scenario is incentivised to manage this risk by limiting both new technology investment and reducing maintenance on the existing infrastructure (Dixit and Pindyck (1994)). The net effect of all of these consequences is that ultimate consumer uptake will be lower than the efficient level, and it will take longer for new technologies to be implemented – a scenario that Goolsbee (2001) shows has potentially huge welfare consequences from delayed accrual of benefits.

While it is acknowledged that there is no clear-cut theoretical trade-off between the pros and cons of local loop unbundling on broadband uptake (a table summarising the key issues, prepared by the ITU[11] and reproduced by OECD (2001a) is contained in Appendix 1), the OECD continues to promulgate local loop unbundling as fundamental to fast roll-out of broadband services. The justification is that:

> "*no evidence has been forwarded to substantiate the claim of delayed investment*"[12]

while:

> "*huge investments (are) being made by new entrants in local access markets, where unbundled elements are available, to provide broadband access.*"[13]

Indeed, the OECD goes so far as to suggest that open competition is untenable as a medium for promoting broadband access:

> "*Very few countries have even two competing providers using different infrastructures on a widespread basis, for broadband access. Even in those countries with two leading providers, experience shows that duopolies have not proved very efficient in providing telecommunications services.*"[14]

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[11] ITU (2001), cited in OECD (2001a): 18.
[12] OECD (2001a): 15.
[13] Ibid.
[14] Ibid, 16.

implying that merely increasing the number of providers is a sufficient and justifiable end for the regulatory means.

Yet the success measures of telecommunications market regulatory policies on competitiveness in downstream markets are not necessarily to be found in measures such as investment in the telecommunications sector, or even in the numbers of provider participants in that market[15]. Rather, the measures of success of such policies (if they exist) will be evidenced in the availability, prices and uptake of services in those downstream markets. Specifically, if local loop unbundling policies have been instrumental in increasing both the speed of rollout and the extent of uptake of broadband in the OECD countries that have adopted such policies, then it would be expected that countries that have implemented such policies will have:

- higher uptake of such services per head of population;
- higher proportions of the population to whom such services are available;
- services made available earlier; and
- lower prices for such services

than countries where such policies have not been implemented.

Further, the assumption that broadband uptake will, ipso facto, ensue merely because infrastructure is available presupposes that there is end-user demand for the services offered. This demand is dependent upon application demand and availability as much as upon technology infrastructure demand and availability. To assume that the patterns of rollout and uptake of domestic and small business data-transmitting broadband infrastructure will parallel those of domestic and small business voice-transmitting telephony infrastructure, assumes both that applications exist, and that the uptake patterns for those end-usage applications will follow the same patterns. It is by no means certain that the development and uptake patterns for domestic data applications will replicate those of domestic voice telephony applications, despite these applications initially utilising the same infrastructure (Greenwood and Yorukoglu (1997), Jovanovic and Nyarko (1996)). Therefore, it is premature to ascribe to a regulatory regime designed to promote rollout predicated upon access to one set of applications either the responsibility for facilitating rollout of a technology supporting a different set of applications, or the credit for achieving such rollout, without a more detailed understanding of how the applications and the infrastructure interact and influence end-user demand.

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[15] Boles de Boer, Enright and Evans (2001).

Local Loop Unbundling and Broadband Uptake: OECD Evidence

The evidence furnished by the OECD[16] on investment and uptake in broadband services amongst its members neither conclusively supports nor justifies the faith placed in local loop unbundling as the key policy in promoting broadband service uptake. Indeed, there are strong indications among the figures presented that, in certain circumstances, the counter-theory of depressed investment cannot be discounted as the stronger force in the presence of local loop policies. At the very least, the figures provide some reason to question the importance given to local loop unbundling as the key strategy to promote generation of the benefits promised by electronic commerce.

Broadband Uptake

Korea has the highest level of Broadband Uptake in the OECD

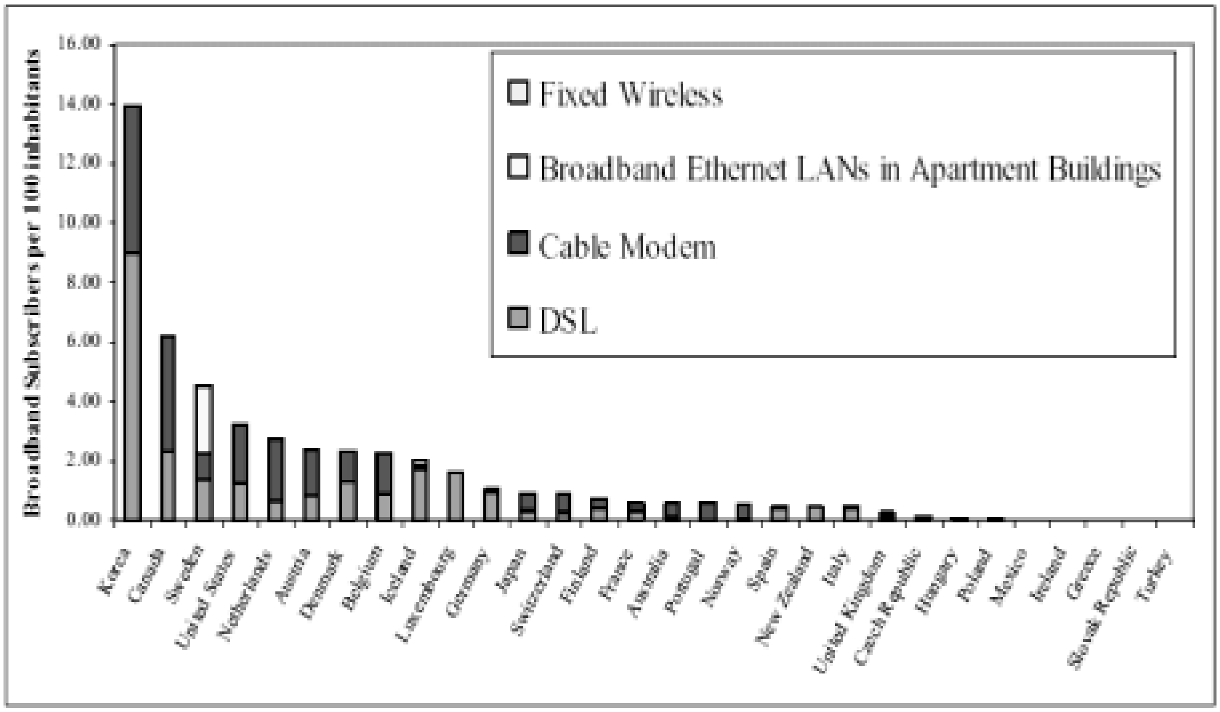
In June 2001, Korea, a country with no practice of local loop unbundling[17], led the OECD with 13.91 Broadband Subscribers per 100 (Figure 1). Two thirds of Korea's broadband subscribers have DSL connections (dependent upon local loops) whilst a third have cable modems. Korea's uptake of this technology is more than twice that of its nearest rival, Canada (practising unbundling), with 6.22 per 100 (of which only one third is DSL, two thirds cable modem). Of the next four highest uptakers, Sweden, the United States, the Netherlands and Austria (all of which practice local loop unbundling), DSL, the product based upon telephony infrastructure, comprises only between one fifth and one third of the number of broadband connections per 100 inhabitants.

Denmark at 7th (2.33 per 100) is the first unbundling practitioner to exhibit a higher proportion of DSL connections than cable modems, although Iceland (9th), Luxembourg (10th) and Germany (11th) also share this characteristic. Cable modem services are not offered in Luxembourg and Iceland, and although 86% of German households are passed by cable television networks, cable modem services have only recently become commercially available[18]. The relative uptake levels of DSL and cable modem services in Denmark have most likely been significantly influenced by the strategic positioning and pricing policies of telecommunications incumbent TDC (formerly

[16] OECD (2001a).
[17] Although it has proposed such a policy.
[18] OECD (2001a):27.

TeleDanmark), which in addition to owning the local loop, owns cable market leader Kabel TV (61% market share)[19]. The remaining OECD countries have very low levels of broadband uptake, with less than 1 connection per 100 inhabitants.

Figure 1. Broadband Penetration in OECD Countries, June 2001



Source: OECD

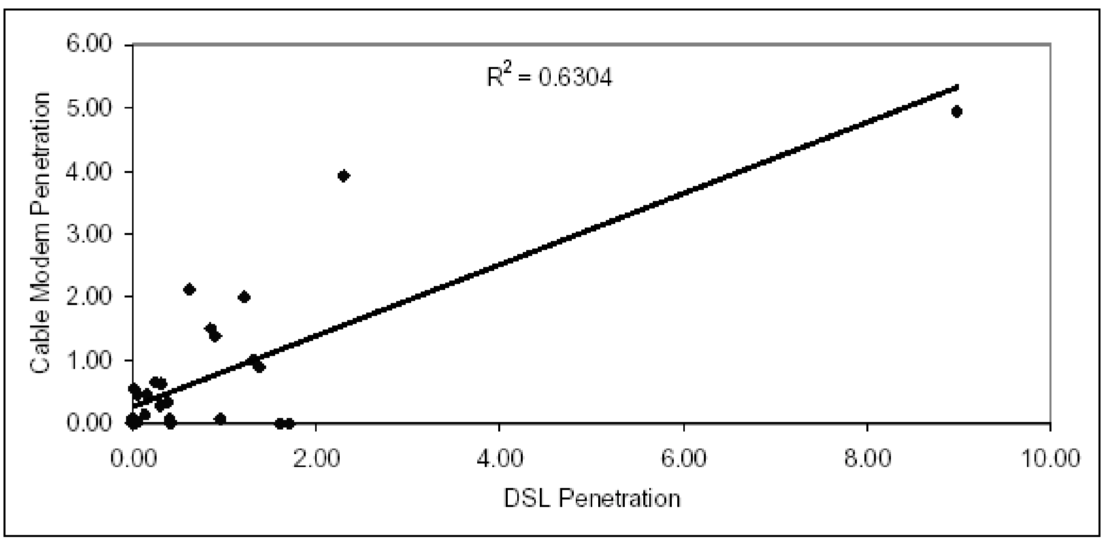
Thus, Denmark (7th) and Germany (11th) are the only broadband uptake country leaders (in the top half of the OECD) practising local loop unbundling in which DSL has achieved the highest market share in the presence of competition from other infrastructures, but this dominance has almost certainly resulted from restrictions to competition in the cable market, and between cable and DSL markets[20], rather than the success of policies within the telecommunications market. By contrast, two countries in which local loop unbundling is not practised (Korea and New Zealand) have broadband uptake market shares dominated by DSL technology (64% in Korea, 93% in New Zealand). While the dominance of DSL in New Zealand arises from the absence of a widespread cable network[21], New Zealand's DSL uptake at December 2000 (0.25 per 100), without unbundling intervention, marginally exceeded that of Germany (0.24 per 100), the reputed OECD

[19] Ibid, 25. Issues of common ownership of multiple technology platforms are discussed below.
[20] Limited options in Germany, common ownership of competing technology platforms in Denmark.

unbundling leader[22]. Absence of unbundling does not appear to have dampened penetration of the local loop-based technology in either Korea or New Zealand, so the policy appears to be quite inadequate as an explanator of OECD-wide broadband uptake patterns.

Indeed, the figures point to quite a different explanation. While the OECD finds that there is a significant correlation between high levels of cable modem and DSL uptake (Figure 2), competitive pressure in the provision of broadband services in countries with local loop unbundling appears to be coming primarily from technologies which by their very nature require second networks of infrastructure to be rolled out (fibre-optic cables and in the case of Sweden, Ethernet LANs)[23]. Further, Korea's DSL dominance is underpinned by independent duplicate network infrastructures provided by Hanaro and Korea Telecom[24].

Figure 2. Cable Modem and DSL Penetration, June 2001



Source: OECD.

Duplicate infrastructures (albeit of different technological bases, but performing the same function in some cases) appear to be having a much greater impact upon promoting the uptake of

[21] Ibid, 35
[22] OECD (2001a): 16. Gemany is promoted by the OECD as the leading exponent of local loop unbundling, with Deutsche Telecom investing USD 3 billion in 2000 on its fixed network alone.
[23] Using the OECD uptake figures but removing Korea and New Zealand from the analysis, a least-squares regression line of best fit with gradient 1.54 units of cable uptake per unit of DSL results. This compares to a gradient of 0.61 units of cable per unit of DSL in Figure 2, which includes Korea and New Zealand. This confirms the dominance of cable uptake over DSL in countries practising local loop unbundling. See Appendix 2 for graph.
[24] Ibid: 33.

broadband services than local loop unbundling. The mere existence of a single local loop provides competition in the broadband market for a single cable modem provider. Two monopoly providers of discrete and different technologies may provide a competitive market for the end product offered to the ultimate consumer (high speed Internet access) even though they face no competition in the provision of their intermediate networks (local copper loops and fibre-optic cables respectively). Together, their competition drives the increased rollout of discrete technology networks, but the extent of this competition is contingent upon, and is itself driven by, competition for the end product. This evidence tends to support the case that, increasingly, duplicate infrastructures yield the optimal investment rather than regulatory attempts to achieve efficiency via one network using local loop unbundling (OECD (2001a))[25]. However, the fundamental requirement for this inter-technology competition to be successful is that the competing technology platforms support a single end product market – in this case, high-speed Internet access – for which there is a proven demand.

New Zealand DSL Connections Exceed Australia's by Five to One

Further evidence of the inadequacy of the local loop unbundling explanation for broadband uptake is provided by a comparison of the number of DSL connections in Australia and New Zealand. Boles de Boer, Enright and Evans (2001) argue that regulatory differences are a significant explanator of higher numbers of dial-up Internet connections in New Zealand. This appears to also carry through to the relative levels of DSL uptake in the two countries. At December 2000, New Zealand had five times the number of DSL connections per head of population of Australia (0.25 per 100 compared to 0.05 per 100). This figure, while following a similar trend to the dial-up connections, is significantly more sizeable than the 10% New Zealand advantage over Australia in all Internet connections (both dial-up and broadband) found by Howell and Marriott (2001)[26].

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[25] It is noted that in some countries, notably the United States, there have been calls for 'unbundling' policies on cable networks, similar to the unbundling of local loops (Lehr and McKnight, 2000). This analysis implies that such policies may interfere with the competition between networks to the extent that rather than promoting efficiency, such a policy may actually reduce inter-network competition to the detriment of consumers.

[26] Although it is noted that New Zealand does not have a comprehensive cable modem offering, as only one city (Wellington – with less than 10% of the country's population) has a comprehensive fibre-optic cable service providing high-speed access in competition to Telecom New Zealand's DSL product. It is noted, however, that threat of new entry and/or expansion of the competing network have acted as competitive forces on the incumbent telecommunications operator.

As with the majority of other countries practising local loop unbundling, Australia's overall higher uptake of broadband due to high cable modem uptake (0.34 per 100 at December 2000, seven times the DSL uptake). Once again, high-speed Internet uptake is being driven not by telecommunications regulation, but by competition between networks, a competition which in Australia is (apparently) overwhelmingly being won by the non-telephony network.

Broadband Coverage and Rollout Timing

Whilst broadband uptake is one measure of the success of local loop unbundling policies, uptake must also be placed in the perspective of the timing of rollout, and the locations in which these services are offered. One of the claims made for local loop unbundling is that it will encourage investment sooner than if investment decisions are left to a monopoly provider (OECD 2001). Similarly, it is purported to enable services to be made available to a larger proportion of the population (ibid). The counter argument is that the policy will delay investment in upgraded technologies as incumbents and those having access to the single loop minimise risks to income from new, unproven technologies, co-ordinate to prevent prices falling to average cost, or reap the benefits of inappropriately-set designated prices.

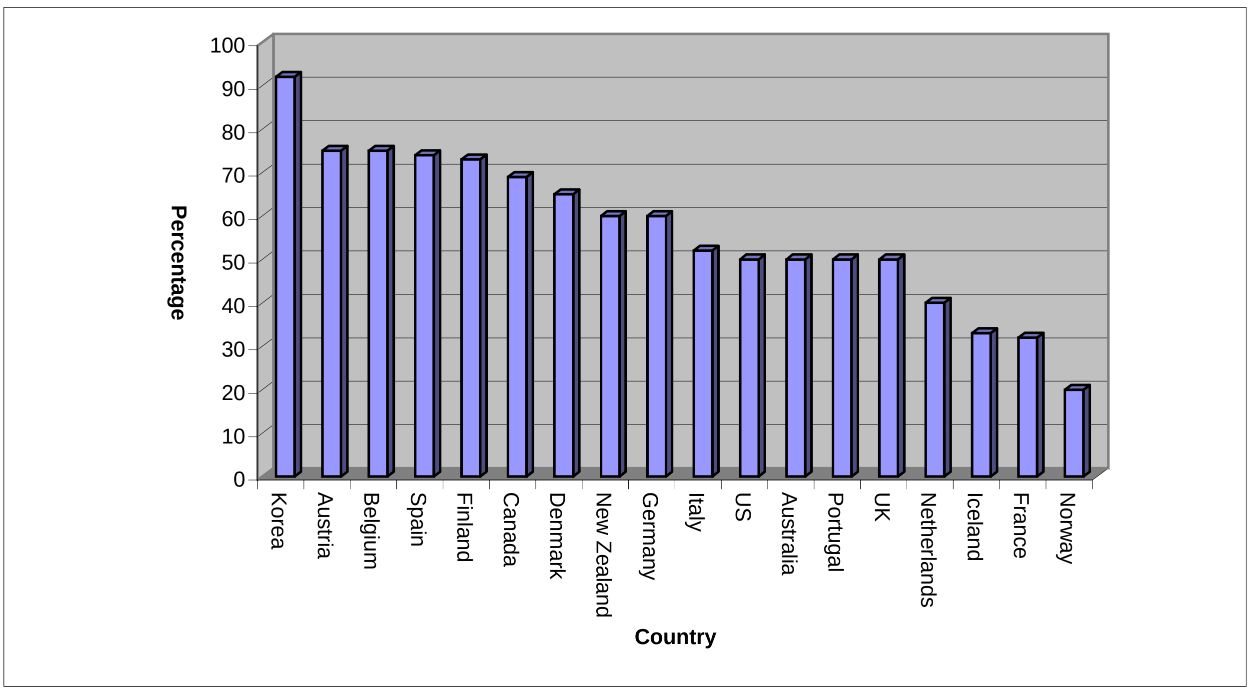
While it is recognised that differing population densities among countries have significant impacts upon the fixed and average costs of network infrastructures (Alger and Leung (1999)), if local loop unbundling is achieving its purported aims, in countries of similar population density, those practising unbundling should have both higher percentages of the population able to access the telephony-based product, and earlier rollout. Once more, the OECD evidence indicates a different story.

Unregulated Korea Leads Again

Korea again leads with 92% of its population capable of connecting to DSL (Figure 3). This is consistent with its high population density, but again not attributable to unbundling. Duplicate networks in this case are much more likely to be a function of high population density making it (relatively) cheaper to install duplicate networks in the first place. While the next 6 places are filled by countries practising unbundling, lending credence to the theory that unbundling increases investment in infrastructure, and hence the extent to which networks are rolled out, unregulated New Zealand has the 8th highest coverage, slightly ahead of unbundling leader

Germany at 9th. However, it is significant to note that high percentages of coverage do not necessarily translate into high levels of uptake. Spain, while 4th highest in terms of coverage is only 19th in total uptake, and 13th in DSL uptake. Similarly, Austria, Belguim and Finland rank significantly better in their DSL coverage ranking than their uptake rankings (Figure 4). High investment in infrastructure, such as that of Spain and Germany, may not necessarily be an efficient investment, if uptake to the service is low. Further, the United States has achieved a relatively high DSL uptake (0.89 per 100) with a coverage level (50%) the same as that of Australia, with very low DSL uptake (0.05 per 100). Thus, if coverage is the only metric in which unbundling offers a correlated and consistent advantage, it is not necessarily the primary one by which overall efficiency of the policy should be judged. Merely having the technology available is insufficient to motivate user uptake in many countries.

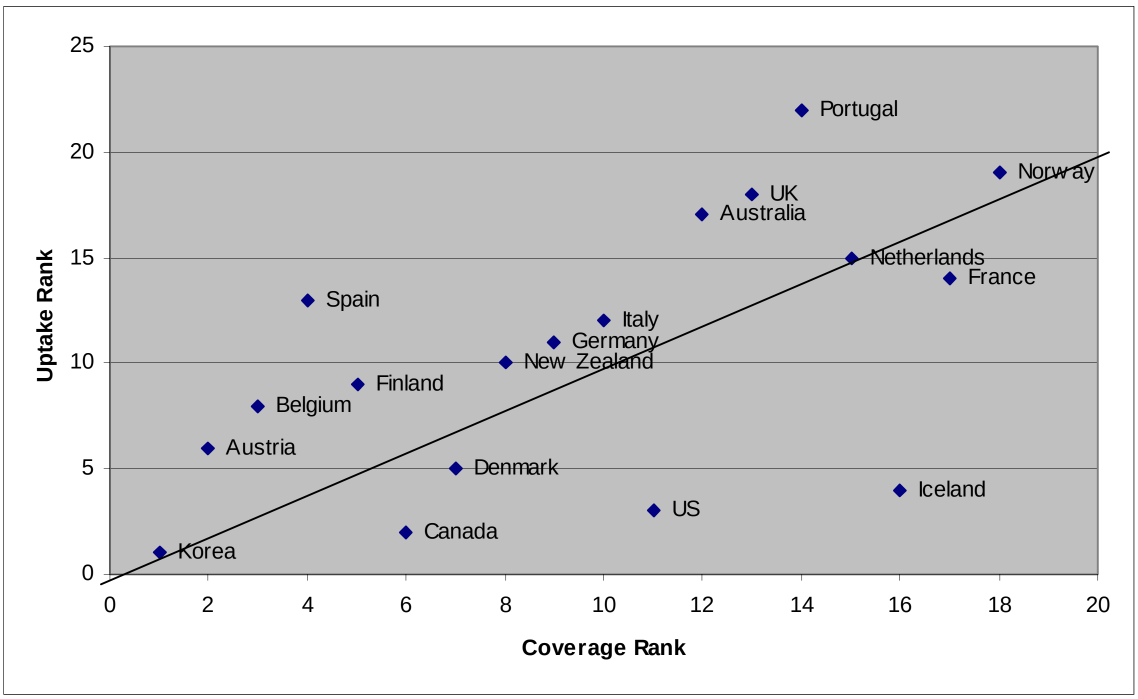
Figure 3. DSL Coverage in OECD Area 2000



New Zealand Outperforms Australia

Once again, the case of Australia and New Zealand is instructive. Despite having no unbundling policy, New Zealand's monopoly telecommunications provider, Telecom New Zealand, had commercial DSL offerings available some 18 months ahead of regulated Australia (Boles de Boer, Evans and Howell (2000)). This investment pattern is not confined to DSL. Digitalisation of Telecom's network was 95% complete in 1993 and 100% complete by 1997. Australia did not reach these targets until 1998 and 1999 respectively (OECD (2001): 89). By 2000, 60% of New Zealand households could connect to DSL, while only 50% of Australian households could achieve this (OECD (2001a: 11)), despite New Zealand facing a population density disadvantage vis-à-vis Australia which could be expected to equate to a 5% differential in fixed network costs[27]. Rather, these findings serve as further evidence that local loop unbundling is less effective than open, and inter-network, competition.

Figure 4. DSL Coverage and Uptake Rankings, 2000



Australia is (relatively) an OECD Underachiever

It is significant also that Australia was one of the first countries in the world to have two alternative broadband access networks in its three largest cities (OECD (2001a): 21). Consequently, on the basis of the experience in other OECD countries, high and early uptake of both variants of high-speed Internet access were predicted. Telstra and Optus both rolled out fibre-optic cable networks during the period 1992-97, while Telstra as the incumbent operator owned the local loop, but was obliged to share it with other operators. Rather than ensuring

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[27] Alger and Leung (1999) cited in Boles de Boer, Enright and Evans (2001).

competition between two network technologies, strategic positioning resulted in Telstra and Optus choosing to focus their competitive energies on their respective cable infrastructures, but prioritising content rather than Internet access. Whilst as a by-product of this competition, cable modem uptake in Australia has been significantly higher than DSL (December 2000 at 0.34 per 100), this is only 10% of the uptake of Korea, where cable services have been available only since July 1998, and only slightly higher than New Zealand's DSL uptake (which, with neither competitive pressure from cable network operators nor regulatory intervention, sits at 74% of Australia's cable uptake).

In summary, local loop unbundling appears to have had no significant effect in accelerating the rollout of DSL in Australia vis-à-vis New Zealand. The strategic positioning of the incumbent, and common ownership of cable and local loop networks by Telstra, may have muted the inter-network boosts to timing and extent of rollout of both cable and DSL offerings in Australia which have been enjoyed in other countries[28]. Consequently Australia ranked only 13th on DSL uptake in June 2001. This outcome is far removed from the promise of 1992, and leads to the tentative conclusion that competition law enabling common ownership of otherwise competing high speed Internet access network technologies, and high levels of concentration in this market increasing the potential of strategic co-operation (Evans, Quigley, Mathewson and Hughes (1999)), have had a significantly greater effect upon the market for high speed Internet services in Australia than any direct regulatory intervention in the telecommunications market alone.

Pricing

The third area where regulatory policy effectiveness can be compared is pricing of services. While Boles de Boer, Enright and Evans (2001) and Boles de Boer, Evans and Howell (2000) draw attention to the difficulties in comparing prices across countries, due to differences between posted prices and purchasing patterns, product bundling and usage habits, purchasing power parity figures give some ability to compare pricing, and hence regulatory differences between countries. Table 1 shows the DSL pricing in OECD member countries as at June 2001.

[28] As argued above, common ownership of the local loop and dominant cable operator may have also distorted the speed of rollout and uptake in Denmark.

Table 1. DSL Pricing in OECD Countries (USD, PPP)

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	Company	Initial charge (USD PPP)	Monthly charge (USD PPP)	Mbytes included	Additional cost per Mbyte (USD PPP)	Speed of connection downstream (Kbps)	Speed of connection upstream (Kbps)	Total Downstream/ Upstream Kbps per USD per month
Korea	Korea Telecom	43.32	57.76	Unlimited	0.00	1544-*8 000*	64-*640*	27.50 (*147.74*)
Japan	NTT (ACCA)	109.50	32.34	Unlimited	0.00	1 500	512	58.89
New Zealand (1)	Telecom NZ	367.53	47.93	400	0.13	4 000	740	*(87.68)*
New Zealand	Telecom NZ	367.53	61.83	600	0.13	4 000	740	*(69.76)*
Sweden	Telia	142.38	24.55	Unlimited	0.00	512	400	33.88
Canada	Bell Canada Sympatico	0.00	35.19	Unlimited	0.00	960	120	30.69
Finland	Elisa	114.57	37.43	Unlimited	0.00	512	256	19.52
Germany	Deutsche Telecom	53.23	46.91	Unlimited	0.00	768	128	18.75
United States	Verizon	0.00	49.95	Unlimited	0.00	768	128	17.94
Belgium	Belgacom	0.00	59.05	10 000	0.16	750	128	14.87
Iceland	Iceland Telecom	61.09	25.45	All domestic	0.12	256	128	*14.51*
Iceland	Iceland Telecom	61.09	50.91	All domestic	0.12	512	256	*14.79*
United Kingdom	British Telecom	208.97	55.66	Unlimited	0.00	500	250	12.68
France	France Telecom	159.40	47.98	Unlimited	0.00	500	128	12.40
Norway	Telenor	116.46	72.57	Unlimited	0.00	704	128	11.17
Switzerland	Swisscom	76.73	56.13	3 000	0.05	512	128	11.15
Denmark	TDC (TeleDanmark)	115.32	57.83	Unlimited	0.00	512	128	10.71
Australia	Telstra - Big Pond	182.70	62.78	3 000	0.00	512	128	9.72
Austria	Telekom Austria	7.43	59.93	1 000	0.08	512	64	9.59
Denmark	TDC (TeleDanmark)	115.32	40.45	Unlimited	0.00	256	128	9.06
Portugal	Portugal Telecom	151.45	103.56	Unlimited	0.03	768	128	8.45
Norway	Telenor	116.46	60.87	Unlimited	0.00	384	128	8.15
Luxembourg	P&T	159.18	72.00	Unlimited	0.00	512	64	7.72
Switzerland	Swisscom	76.73	40.68	1 500	0.05	256	64	7.63
Netherlands	KPN	277.94	75.31	Unlimited	0.00	512	64	7.21
Spain	Telefonica	167.72	57.17	Unlimited	0.00	256	128	6.40
Italy	Telecom Italia	0.00	62.38	Unlimited	0.00	256	128	6.16
Luxembourg	P&T	159.18	52.36	Unlimited	0.00	256	64	5.82
New Zealand	Telecom NZ	90.58	33.02	Unlimited	0.00	128	128	7.41
Australia	Telstra	182.70	55.02	3 000	NA	256	64	5.51
Portugal	Portugal Telecom	151.45	58.25	Unlimited	0.03	256	64	5.27
Spain	Telefonica	260.07	122.83	Unlimited	0.00	512	128	5.03
Hungary	Matav	269.50	215.60	Unlimited	0.00	768	128	4.07
Hungary	Matav	269.50	107.80	Unlimited	0.00	384	64	3.99
Turkey	Turk Telekom	13.50	137.42	Unlimited	0.00	256	64	2.32
Turkey	Turk Telekom	13.50	419.63	Unlimited	0.00	512	128	1.52

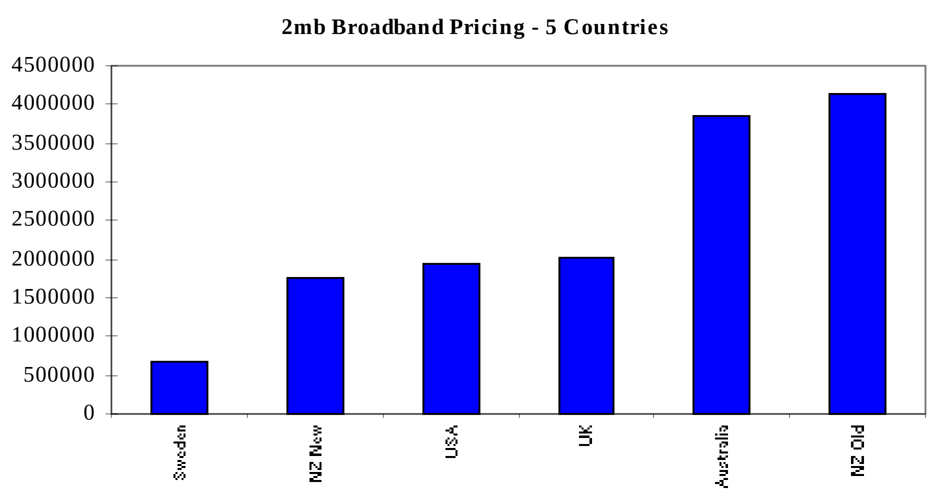
1. The minimum speed is used to calculate Korea's Kbps per USD data. The results using the maximum possible speed are in italics.
2. New Zealand Kbps per USD data, and other countries with caps on included Mbytes, are only comparable if users remain below the included allowance.
3. Services were not available in Czech Republic, Greece, Ireland, Mexico and the Slovak Republic at that time.
4. The data include tax.
5. The Kbps per USD use the initial cost (spread over five years) and the monthly cost.
6. Belgacom, Telecom Italia and Verizon were waiving connection fees at the time these data were collected.
7. AUP stands for acceptable usage policy.

Source: OECD.

Once again, Korea's leadership is evident (highest number of downstream/upstream Kilobytes per second per US dollar per month (PPP), reflecting both pricing and speed components), consistent with high levels of uptake, and reinforcing the strength of network competition over unbundling. While New Zealand figures highly in this comparison, it is noted that this advantage occurs only if usage is confined within the monthly megabytes allowed within the posted prices.

It is significant to note that the pricing advantages identified for New Zealand dial-up access vis-à-vis Australia are also present for DSL prices, reinforcing that the findings of Boles de Boer, Enright and Evans (2001) on dial-up access translate also into the broadband market. Further analysis by Boles de Boer and Evans (2002) of Teligen[29] data shows that this pricing advantage extends beyond residential broadband access into wholesale pricing. By their figures, changes to New Zealand's wholesale broadband prices in February 2000 resulted in New Zealand wholesale bandwidth prices falling below those of Australia, the USA and the UK (Figure 5).

Figure 5. Selective Pricing Comparison - 2000



Beyond the combined price, uptake and availability leadership of Korea, however, it is difficult to draw any firm conclusions that uptake and pricing of DSL in the OECD is being driven by infrastructure demand contingent upon end-user demand. Rather, there is evidence that prices influenced by regulatory intervention are having an inconsistent influence on the extent of DSL uptake. While Japan, Finland and Germany have comparatively low DSL prices (Table 1), these low prices do not appear to translate into correspondingly high levels of DSL uptake compared to the similar pricing, but higher uptake, of the United States. Likewise, Luxembourg, with some of the highest prices in Table 1 (only 7.72 Kbps per USD per month), has a DSL uptake rate higher than the total (broadband and cable modem combined) uptake of each of Finland, Germany and Japan. Clearly, price, coverage and uptake are not necessarily correlated among OECD countries, implying that factors other than end-user demand and normal competitive forces are influencing both pricing and uptake. Supplier-driven rollout, supported by regulatory intervention, is a possible explanation for these inconsistencies.

While it is extremely difficult to draw conclusions about the relative pricing of DSL and cable modem services across countries, due to the different speeds of data transfer, customer fixed set-up costs, and the influences of content bundling and cross-subsidy between television and high speed Internet access services in cable offerings, there is some evidence to suggest that low cable prices may be correlated to low DSL prices. Japan has both low cable (4th in Table 2) and DSL (2nd in Table 1) prices, along with fellow local loop unbundlers Canada (9th and 5th respectively) and Sweden (3rd and 4th respectively). Low-priced Japan, however, ranks only 12th in total broadband uptake. These findings support the argument that it is competition between the technology platforms that is influencing pricing, rather than unbundling policy per se, and that pricing alone is insufficient to explain uptake. Further, these findings, along with the dominance of cable in total broadband uptake, lead to the tentative conclusion that, where local loop unbundling exists, it is predominantly the combination of demand and pricing for cable modem services that is influencing DSL prices, rather than the other way around. If unbundling is having any effect, by this argument, it would only be as a secondary response to the primary competitive pressure applied by an unregulated cable infrastructure with the potential to offer an attractive pricing and service bundle encompassing cross-subsidisation between internet access and content provision.

These findings, linked with the evidence from unregulated Korea, would also appear to support the argument that intervention in the form of local loop unbundling may indeed delay investment. Korea has reached its high level of infrastructure rollout in a very short time (3 years), and unlike the local loop unbundling countries, this has been driven by DSL uptake. While Korea leads the OECD in low DSL pricing, cable prices in this country are in the higher half of the OECD for

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[29] Teligen Limited, formerly Eurodata Foundation, have prepared pricing comparisons for the OECD for more than 10 years. The figures used by Boles de Boer and Evans (2002) come from the May 2000 update and include input from industry and Government.

monthly rental. This is reflected in the 2:1 dominance of DSL over cable. Duplication of DSL infrastructure has led to lower pricing and very rapid network expansion (as for Australia – see above), leading to the fast accrual of flow-on benefits (Goolsbee (2001)). Further, the only other unregulated country with duplicate networks, New Zealand, is registering lower prices (over certain ranges of activity), higher uptake and greater coverage than that witnessed in many unbundling practitioners[30]. Had the option of unbundling been available in either of these countries, local loop duplication may not have occurred as rapidly, as unbundling offers a lower risk strategic option to new entrants. While duplication has not necessarily been prevented in other countries, unbundling has offered a strategic option that has become the method of first choice for new entrants in the countries where it has been available. The OECD evidence implies that those countries practising unbundling do not benefit from the additional stimulus of inter-network competition within the telecommunications infrastructure as Korea has, and as a result are dependent upon competitive pressure from cable networks on copper networks to drive the expansion of technology to support broadband Internet access and its subsequent economic flow-on benefits. Further, such countries are exposed to the dangers of common ownership of duplicate networks and collusive strategic positioning, and these further delay the effects of competition upon infrastructure rollout (e.g. Australia, Denmark), pricing and uptake.

It is also apposite to draw attention to the OECD's finding that the primary driver of dial-up Internet access uptake is unmetered telephony pricing, which enables effective 'always on' Internet access (OECD (2000)). Further, both uptake and usage are stimulated by the adoption of unmetered Internet connection time in addition to the unmetered telephony component (OECD (2001): 98). This implies that a similar uptake and usage effect may be evidenced with respect to unmetered volume usage of broadband connections, in addition to the benefits both DSL and cable modems offer by way of 'always on' access, and independence from PSTN connections.

[30] It is suggested that in New Zealand, threat of duplicate networks has acted as a competitive force upon the incumbent to act as if network duplication was widespread. The limited duplication provided by the rival network acts to give this threat credibility.

Table 2. Cable Modem Internet Access Prices (USD, PPP)

	Company	Plan	Connection charge (US$ PPP)	Monthly rental (US$ PPP)	Mbytes Included	Additional cost per Mbyte (US$ PPP)	Speed of connection down-stream (Kbit/s)	Speed of connection upstream (Kbit/s)
Denmark	TeleDanmark	Webspeed2	115.32	23.06	Unlimited	0.00	256	64
United Kingdom	NTL		34.83	27.85	Unlimited	0.00	512	
Sweden	ComHem	Internet Cable	132.56	28.97	Unlimited	0.00	512	128
Japan	J-Com	J-Com@home	0.00	31.34	Unlimited	0.00	2000	128
United States	Cablevision Systems Corp.	Optimum online*	108.90	32.95	Unlimited	0.00		
Switzerland	Cablecom	Hispeed: COMFORT	0.00	32.96	Unlimited	0.00	256	64
Portugal	Netvisao	128 Kbps	32.36	33.98	3 000	0.02	128	128
Norway	Chello	Chello	0.00	34.04	Unlimited		384	128
Canada	Shaw Communications	Shaw @ Home*	132.11	35.19	Unlimited	0.00		
Australia	Telstra Big Pond	Blast Off	133.32	38.76	250	0.13	256	64
Switzerland	Cablecom	Hispeed: Comfort	0.00	41.20	Unlimited	0.00	512	128
Portugal	Netvisao	256 Kbps	32.36	43.69	5 000	0.02	256	128
United States	Time Warner Cable	Roadrunner	110.00	43.95	Unlimited	0.00		
United States	Cablevision Systems Corp.	Optimum online	108.90	43.95	Unlimited	0.00		
Canada	Shaw Communications	Shaw @ Home	132.11	43.99	Unlimited	0.00		
Austria	UPC	Chello*	51.76	44.26	Unlimited	0.00		
France	France Telecom Cable (Wanadoo)	Prime@accès*	54.74	45.41	500	0.32	512	128
Finland	Helsinki Television	Welho	50.32	45.66	Unlimited	0.00	500 -1500	768
Norway	Chello	Chello Plus	0.00	45.75	Unlimited	0.00	768	128
Denmark	TeleDanmark	Webspeed2	115.32	46.24	Unlimited	0.00	512	128
New Zealand	Saturn Communications	Paradise Broadband 128	208.40	46.51	10 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	128	128
Australia	Telstra Big Pond	Freedom Standard	133.32	47.26	3 000	0.00	256	64
Spain	ONO	128 Kbps	87.95	48.33	750		128	
Belgium	Chello	Chello	0.00	50.19	Unlimited	0.00		
Netherlands	Casema (Wanadoo)	Wanadoo	76.33	50.63	4 000		256	96
Austria		Chello	51.76	50.63	Unlimited	0.00		
Australia	Telstra Big Pond	Freedom Delux	133.32	51.18	3 000	0.00	512	128
France	France Telecom Cable (Wanadoo)	Prime@accès	86.95	51.36	500	0.32	512	128
Mexico	InterCable	CableLink 500	66.79	53.43	500	0.19		
New Zealand	Saturn Communications	Paradise Broadband 256	208.40	53.46	5 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	256	128
Korea	Thrunet	Thrunet	47.26	54.87	Unlimited	0.00		
New Zealand	Saturn Communications	Paradise Broadband Max	208.40	55.54	1 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	512	128
Portugal	Netvisao	512 Kbps	32.36	58.25	8 000	0.02	512	128
Spain	ONO	256 Kbps	87.95	65.92	1 000		256	
Mexico	InterCable	CableLink 1000	66.79	80.14	1 000	0.16		
Hungary	UPC Chello	Chello	0.00	97.92	Unlimited	0.00	512	128
Spain	ONO	512 Kbps	87.95	101.10	1 500		512	

1. The prices for options marked with an asterisk are for users also taking cable television.
Source : OECD.

It is conceivable that, for example, New Zealand's extent of DSL uptake has been constrained vis-à-vis Korea due to the restrictions placed upon data exchange in New Zealand pricing packages, making it more costly for New Zealand users requiring high volume data exchange to use this method (Korea has unlimited DSL uploading and downloading packages, while New Zealand packages impose limits of 400 and 600 Megabytes per month before per megabyte additional charges begin accruing). Such pricing policies are most likely also a factor in the comparatively low DSL uptakes of Switzerland (3000 Mb/month – 16th in uptake), Australia (3000 Mb/month – 17th), and Portugal (5000 Mb/month – 21st). Austria (1000 Mb/month – 6th) and Belgium (10,000 Mb/month – 8th) are the apparent exceptions to this pattern. Belgium's 'anomalous' position is probably because its low prices and very high threshold for volume charging mean that the effect of the threshold on uptake is negligible. Austria's uptake is harder to explain, given its comparatively high DSL prices and low threshold for volume charging (second lowest, after Telecom New Zealand), except that there is strong competition between infrastructures in that country, the incumbent local loop operator Telekom Austria is not an active player in the cable television market (OECD (2001a): 23) and prices for both DSL and cable modem services sit consistently in the middle of the OECD rankings.

It is also noted that volume charges apply for cable modem services beyond specific monthly thresholds in Australia (250 Mb or 3000 Mb, depending upon provider), Portugal (3000Mb or 800 Mb), France (500 Mb), Spain (750 Mb or 3000Mb) and Mexico (1000 Mb). Significantly, all of these countries fall in the lower half of the OECD with in respect of total broadband uptake. Further, the high cable:DSL ratio of the Netherlands, the only high-uptake country (5th) with cable volume thresholds (4000 Mb/month) may be partially explained by the fact that its DSL prices are amongst the more expensive in the OECD, and that rollout of this infrastructure is comparatively recent (mid 2000 – OECD (2001a): 35). This evidence further supports the argument that pricing and availability of cable modem services are the principal drivers of overall broadband uptake and usage, assuming 'always on' and 'unlimited downloading' are necessary prerequisites for high uptake, irrespective of the nature of the infrastructure.

A Note about Substitution

An analysis of the broadband market is incomplete without a comparison to the role played by the traditional dial-up Internet access market. Internet functionality was provided first by the telephony-based dial-up market. Principally, the functionality provided by broadband is an enhancement to the basic services provided by the dial-up market – that is, faster Internet access, or the feasibility of downloading greater volumes of data. Inevitably, there will be substitution effects between the dial-up market, and the broadband market. Thus, dial-up Internet uptake, pricing and availability can be expected to influence uptake, pricing and availability in the broadband market.

The substitution effect is noticeable in the New Zealand market in particular. Dial-up Internet access prices in New Zealand are among the lowest in the OECD. Unmetered local telephony (there is not even a fixed local call charge for domestic PSTN calls in New Zealand) and almost universal unmetered Internet access charges have combined to result in an effective zero marginal cost for each extra unit of data exchanged via dial-up Internet connections in this country (Boles de Boer, Evans and Howell (2000)). This means that, over high volumes of usage, New Zealand dial-up prices are amongst the most cost-effective available, especially when calculated on a dollar per megabyte downloaded (indeed, on a marginal basis, each additional megabyte downloaded at a domestic telephone connection is, in effect, free with respect to the infrastructure cost faced by the customer, although it is noted that this does not include the opportunity cost of the time taken for the slower download). Consequently, New Zealand users are among the highest uptakers of dial-up Internet connections, and amongst the highest consumers in terms of the number of hours spent online per month, in the OECD (Howell and Marriott (2001)).

However, the especially low marginal prices for data access via dial-up effectively bias New Zealand users with a low opportunity cost of time against substituting expensive DSL connections. New Zealand DSL pricing strategies result in data use being charged per megabyte beyond a comparatively low downloading threshold (400 or 600 Mb/month). Beyond this threshold, the marginal cost of a megabyte of data downloaded via DSL is very significantly higher than the near zero marginal cost per megabyte of data downloaded via dial-up connections. Thus, it is in effect the trade-off between the marginal cost per megabyte of data access by DSL and the marginal opportunity cost of user time that will determine the point at which a New Zealand Internet user will substitute DSL for dial-up access for a given piece of data (ignoring any content value of that data to the user). If the opportunity cost of the user's time is very low, as it is for many domestic users, or the user is able to multi-task, and is therefore able to spread opportunity cost of a longer download time amongst multiple activities, then the cost-benefit trade-off will justify substitution by DSL only at very low prices or very high volumes of data transfer. Hence, the extremely attractive dial-up prices and pricing policies are depressing the uptake of DSL. The price of DSL would have to be very low indeed for users with a low opportunity cost of time to justify substituting the new technology for the old. Thus, broadband uptake in New Zealand is low by international standards, and the DSL uptake that does occur is dominated by small business users, for whom timeliness of data delivery is more critical (that is, with a higher opportunity cost of time), thereby raising the price point at which these users will substitute technologies. This explanation is consistent with the findings of Varaiya et al (1999) and Varian (2000) in the INDEX study at Berkeley, where willingness to pay for high speed Internet access was highest amongst clerical and administrative workers, with high time-dependence among tasks and limited ability to spread the opportunity cost of time amongst many tasks, than academics and students, who could multitask, even when the consumer of the time benefit was not the person paying for the high speed access.

Broadband Uptake Summary

A complete understanding of the broadband market is dependent not just upon the dynamics of high speed Internet access technologies and their pricing, but also upon the dynamics of the dial-up market, and even the values placed by end users upon the content of information transferred via these means and the time it takes to exchange data. To ascribe responsibility for promoting the wider economic benefits that are predicted to accrue from the use of such technologies to a limited number of regulatory policies surrounding just one of the infrastructures capable of delivering these end services is at once both too simple and incomplete. It is not surprising, therefore, that the evidence of the OECD uptake of broadband technologies cannot provide either conclusive or supporting evidence of the 'success' of local loop unbundling in stimulating broadband uptake. Neither is it surprising to find that an analysis of the broadband market cannot of itself explain the slower than expected uptake of this new technology, even in world-leading countries such as Korea.

Rather, this analysis shows that the interactions of this complex market cannot be understood merely from the statistics of the underlying infrastructure alone. For greater understanding, it is necessary to examine firstly the uses to which information transferred by these media are put, and the cost-benefit trade-offs associated with these uses. Once these are understood, then how they translate into infrastructure choices, and the prices and qualities of service at which specific users choose to either enter the market, or substitute one underlying technology for another, will become clearer. Thus, a better understanding of the dynamics of the broadband market may be gained from seeking content and user information-focused answers to why cable modem access dominates broadband access in most countries, and why total uptake is lower than expected, rather than relying upon infrastructure-based explanations.

Regulatory Policy, User Requirements and Broadband Diffusion

The preceding sections of this paper provide some empirical evidence from the OECD countries that the strong policy emphasis on local loop unbundling has had negligible effect in instigating the uptake of DSL services compared to countries where no such policy is active. Rather, the empirical evidence suggests that if there is an infrastructure-based explanation for the observed patterns, it is competition between technology platforms which is driving uptake of high-speed Internet access, and any increased DSL uptake in countries practicing local loop unbundling is in fact a secondary response to pressure from the existence of cable, rather than regulation being a primary driver of uptake. Further, there is some evidence to suggest that pricing policies to the consumer (specifically unlimited information volumes for fixed monthly fees) are, combined with unmetered pricing for dial-up access, more significant for both the uptake and volumes of usage, than local loop unbundling or regulatory price-setting for infrastructure access at the wholesale level.

If local loop unbundling is having any noticeable effect in the DSL market, this would appear to be in providing coverage. However, there is little evidence to suggest that high levels of coverage are translating into high levels of broadband uptake overall. Indeed, in some countries such as Germany and Spain, high investment is yielding a very poor uptake return. This implies that local loop unbundling runs the risk of promoting high levels of inefficient infrastructure investment, as the anticipated flow-on returns in projected electronic commerce returns cannot and will not ensue unless uptake follows.

None of these analyses, however, address the remaining critical question: why, despite the considerable emphasis given to infrastructure regulation in the OECD, and promotion of a competitive environment between technology platforms, is broadband uptake worldwide, both DSL and cable combined, with the possible exception of Korea, so low (OECD(2001a): 5)? Whilst similar patterns of rollout and uptake for ISDN are cited as a precedent supporting the development of infrastructure and high levels of coverage significantly in advance of actual uptake of the service (OECD (2001a): 10), another, more plausible, content-based explanation may underlie the uptake of high speed Internet connections than explanations predicated upon ‘build it and they will come’ philosophies.

In the absence of any regulatory intervention in the availability of technology-based network infrastructures, efficient investment is presumed to occur when demand for a service becomes evident. When the business case for a new application means that a new technology offers a more cost-effective way of providing the functionality of a specific application, then rollout will occur driven by the competitive effects of demand for this service. The optimal time to invest based upon the business case trading off the costs and benefits for each individual user, either producer and consumer, will determine the point at which any individual user will enter the market. This pattern is argued as the basis for the (unregulated) rollout of EFTPOS services in New Zealand in Boles de Boer, Evans and Howell (2000) and the higher proportional uptake of email by provincial New Zealand businesses than their metropolitan counterparts in Howell (2001). A producer will offer a new infrastructure technology when the benefits in the NPV of predicted future revenue streams exceed the NPV of projected current and future costs. When the costs and benefits relating to a specific application are such that the new technology platform offers a more attractive option for the consumer, then consumer uptake of that technology will follow, but based upon the bundle of benefits offered by the technology and the application combined. If the existing application benefits using the new technology platform do not exceed costs, then no matter how available that technology is, uptake (or substitution of the new technology for the old) will not occur. Application of the functional product transmitted via the network (e.g. the electricity that flows down the wires, the gas or water flowing down the pipes or the information flowing down the copper wires or cables) should drive the rollout of the network which delivers the product, rather than existence of the network being a basis for presuming that an application will be found by users that will justify its existence (Jovanovic and Nyarko (1996)).

It can be argued that infrastructure rollouts supporting domestic electricity and telephony fit the model of an infrastructure developing to meet a cost-effective application substitution process far better than the 'build it and uses will come' explanation. Electricity offered an immediately appealing domestic business case due to the ability of the new product to substitute for costly and dangerous heating and lighting fuels such as coal, wood, gas and candles, irrespective of any additional quality benefits that accrued (Greenwood and Yorukoglu (1997)). Domestic infrastructure rollout generated immediate returns for each new user connected, with uptake concurrently high (given the ability of those by whom the network passed to pay for the functionality in the first place). Similarly, telephony networks offered a substitute technology for an existing function – human to human communication – with the key application mail being substituted by telephony (Howell (2001a)). The ability to substitute real-time voice communication for delayed written communication meant that an immediately substitutable application was present. Those for whom written communication (over a distance) or timeliness of communication were important, substituted the new technology for the old, as long as the benefits of the new technology exceeded the additional costs. It is significant to note that for many domestic customers whom telephony networks passed, it took substantial reductions in the price of the product before their individual cost-benefit justification was met (e.g. people who knew no-one at a distance with whom they communicated, or had few time-sensitive communication needs). Further, investments in existing user-based infrastructures using the old technologies also had to be amortised before new user infrastructure investment could either be justified or occur (e.g. investment is plant utilising old power sources, human capital linked to maintaining and using that equipment). Hence, ubiquitous uptake took a significant time to occur (Atkeson and Kehoe (2001)). While new reasons for communication were developed around the new telephony technology to encourage a business case for domestic uptake to occur faster (e.g. emergency services (111, 911) and telephone goods ordering), these applications were picked up only when the benefits of the bundle of all available applications exceeded the costs.

This leads to the question of which applications are driving the uptake of firstly Internet services, and secondly, high-speed Internet access to utilise these applications. Arguably, high-speed Internet access offers only one sizeable advantage over Internet access generally: the speed of transmission (and hence the size of an information-based message that can be transmitted in a given time). The functionality is the same. Hence an analysis of the drivers of high-speed Internet access cannot be analysed in isolation from the drivers of Internet access in general.

The Internet essentially enables high-speed transfer of information between locations. These can be human to human, machine to machine, or human to machine transfers (Howell (2001a)). The Internet has enabled cost-effective substitution of a variety of information communication applications, for both business and domestic users. For example (but not exclusively), these include:

- email for transfer of information previously contained in letters, voice telephony calls, facsimiles, etc.
- websites for transfer of information previously contained in printed material (e.g. brochureware, product manuals, information manually transcribed onto order

forms contained on order forms and mailed/faxed) or verbal exchange (e.g. call centers)

- automatic exchange of data between networked computers (previously EDI applications
- new media formats for transmitting entertainment material (e.g. MP3s distributed electronically substituting for CDs, video clips via the Internet substituting for broadcast media)

Importantly, in all of these instances, the fundamental need for the functional application (transfer of information) existed prior to the arrival of the Internet. The arrival of the Internet enabled principally a more cost-effective substitution of the mechanism via which the information was transmitted. Internet applications have proliferated where the business case for their adoption has been substantiated over the previous method if information transfer. Indeed, where the business case overwhelmingly supports introduction of a technology platform that is not being provided by an existing operator, then competitive pressure will ensure that another provider will enter the market (as demand will exist and potential profits can be made – Boles de Boer, Evans and Howell (2000)). This is exemplified in New Zealand where pressure on incumbent telecommunications operator Telecom to provide high-speed Internet access to rural New Zealand consumers is coming from a consortium of farmers and application provider Fencepost.com (which has an application which provides information of value to farmers) via construction of a bypass network if that is required[31].

The question therefore has to be asked – what is the value-based argument supporting adoption of high-speed Internet access that will encourage users to migrate from dial-up connections to DSL and cable modems? Specifically, the business case requires that the benefits of higher speed (or greater quantity) of information transfer must exceed the additional costs. Mantell (2000) uses this argument of marginal benefit and marginal cost to explain slow uptake of electronic banking applications in the United States. The optimal time for the user to invest is determined by the balance of marginal additional costs and marginal additional benefits over those of the existing application and technology coupling, recognising that waiting time forms part of this assessment. Thus, as argued in the preceding section, if the user has a low opportunity cost of time, or limited need for the applications requiring the high download capacity of DSL and cable, then business case to support substituting the new technology for the old will require the price of the new technology to be lower than if time is important (and hence the opportunity cost of time is high) or high volume data transfer (necessitating broadband technology) is highly valued.

For domestic users, the applications that take advantage of the additional functionality of DSL and cable modems are few, and revolve predominantly around transmission of video-based information (video clips, entertainment, games etc.). While it is acknowledged that the dynamics of small business use are somewhat different (small businesses may benefit from 'always on email and timeliness of infrequent transfers of very large volumes of data), applications such as video conferencing are amongst the justifications given by users of high-speed services (Deloittes (2000)). The cost-benefit tradeoff supporting the migration of these users to DSL and cable modems thus hinges upon how much extra they are prepared to pay for the functionality of faster transmission or more video content.

For the domestic market in particular, the preparedness to pay for video content must be a significant factor. This is reflected in the dominance of cable in the broadband uptake of most countries, and the relative success of bundling cable modems (high-speed access to the Internet) with cable television access and content. Given domestic consumers are prepared to pay a given amount for cable TV content, and high speed Internet access substitutes customized video content for broadcast video content, it is not surprising to find that uptake of high speed Internet access in countries with high levels of cable television is also high, and that in the majority of these countries, cable broadband access exceeds DSL by a ratio of between 3:1 and 5:1. A market exists, and a technological substitution is occurring, driven by the availability of a market which is already 'attuned' to making the cost-benefit trade-off between cost, quality and availability of video-based entertainment material. Further, cable providers have been able to bundle their television and cable modem services, and benefit from cross-subsidisation, in order to increase uptake. The economics of this bundle of content and access medium has enabled significant competitive pressure to be placed upon rival DSL network providers to both reduce price and increase coverage to maintain a presence in the high-speed access market. While it is conceivable that local loop unbundling may have enabled faster response to this sort of pressure, it is debatable whether this has in fact been the case, as competitive pressure from any source would have offered the potential to achieve this goal. Indeed, the evidence from the OECD supports the

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[31] Infotech 4/2/02, noting that the co-operative is prepared to accept and consider a tender from Telecom in order to ensure that the infrastructure is provided to meet the information demands of farmers.

contention that the presence of local loop unbundling may have resulted in reduced competitive pressure through a reduction of competitive options in the form of duplicate infrastructures or the threat of their introduction. Where no such option has existed (New Zealand and Korea), DSL uptake has occurred faster and been proportionately greater.

Clearly, DSL-based products have been at a disadvantage in this scenario, as the ability to bundle content with access is not immediately present for this product. However, the case of Korea is significant. It would appear that a combination of high international call charges, combined with a high value placed upon the ability to communicate this manner, has resulted in the uptake of a substitute application – voice-over-IP for international PSTN telephony[32] – becoming part of the bundle. It would be interesting to know whether Korea's very high DSL uptake would have occurred if this net-benefit application were not available. It is conceivable also that in Korea other application-based drivers exist (e.g. limited availability of video content via other media such as broadcast free-to-air television and other competing entertainment products, and the relatively high proportion of Korean (and indeed, many other Asians, e.g. Japanese) people aged 18-30 years – the highest Internet-using demographic grouping in almost every country – opting to remain living with at home with parents due to high living costs, and therefore having high levels of disposable income available to spend on entertainment products[33]) which have further skewed the application cost-benefit trade-off in favour of high speed Internet access in general.

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[32] OECD (2001a): 33.
[33] Reference – must be an EIU piece on this somewhere

Conclusion

The tentative conclusion drawn from this analysis is that the market for high-speed Internet access is inextricably intertwined with the market for the specific applications this technology is enabling the substitution of, and the perceived and actual benefits the use of such applications will yield. Regulatory interventions that promote the rollout of infrastructures in isolation from the application-based justifications for doing so run the risk of wasting resources. Such infrastructure investment decisions cannot be made without first giving due weight to the optimal time for end users to invest. Building pipes without first taking cognisance of the business cases faced by the users (applications) consuming the water or gas that runs through those pipes is fraught with danger. Yet this is precisely the rationale that appears to be applied when promulgating local loop unbundling as the key to stimulating the benefits from electronic commerce. There is no doubt that, once the water pipe is built, a firm may find a use for the water conveyed in it, or at least a justification to locate a business at the end of that pipe, given that the investment in the pipe is by that time sunk. However, this may not have been the most efficient investment strategy, for both pipe-owner and water-user, had a joint proposal taking account of the needs of both, been developed from the start. Yet the presumptions of local loop unbundling, at least as they apply to high-speed Internet access, support the building of the 'pipe to nowhere'. By contrast, the unregulated development of cable networks, and the bundling of applications with infrastructure, have been (apparently) both more successful in terms of number of connections and in driving inter-network competition for the provision of high-speed Internet access, principally because of the integration of application and infrastructure. By either design or default, this integration appears to be the key element driving the current levels of uptake of domestic high speed Internet access.

The application analysis thus may also provide further insight into the lower than expected levels of high-speed Internet access uptake. It is likely that applications necessitating high internet transmission speeds, for which the majority of domestic and small business users are prepared to pay a premium for, do not yet exist, as the net benefits do not at the current point in time exceed the costs. There is a limit to the amount that domestic users are prepared to pay, and the time available to consume, entertainment products (content). The slow rise of high-speed uptake may be a reflection of the size, rates of increase and upper limits in these budgets, and the cost-benefit tradeoffs between content and individual time. This argument is consistent with Galbi's (2001) analysis that the real amount per person-hour spent on advertising in the past 75 years has not increased: merely the medium (technology platform: print, radio, television) on which it is spent has changed. Likewise, he argues that the available budget of time in person-hours spent on media activities has grown only by the same amount as the increase in total personal discretionary time. While people have substituted technologies (print, radio, television), the total spent has remained consistent per person-hour. This implies a limit to the amount of entertainment content that can be feasibly consumed using Internet technologies. Until a new application is developed which substitutes for another existing domestic user function (i.e. other than entertainment), requiring high-speed information transfer, for which there is a positive benefit for users in a cost-benefit trade-off, levels of domestic high speed uptake are unlikely to accelerate beyond those underpinned by the current entertainment-based spending budgets. Similar arguments apply to applications of business users, but with a different group of applications.

Thus, reaping the economic benefits of high speed Internet uptake and access may be constrained more by a shortage of applications meeting existing user cost-benefit criteria for substitution than limits to infrastructure availability. This analysis suggests a more detailed investigation of application-based drivers and user substitution behaviour must be undertaken before any assessment of the success of any regulatory policy for underlying infrastructures on ultimate economic benefits can be offered. Such an analysis must take cognisance of the different requirements of users, in particular the differences in information content demands of business and domestic users. In the meantime, promotion of any infrastructure regulation in ignorance of these user-driven effects is fraught with the danger that greater economic inefficiencies will be encouraged, in the form of unwise investment by both infrastructure owners and application users.

References

Alger, Dan, and Joanne Leung. 1999. *The Relative Costs of Local Telephony Across Five Countries*. ISCR Research Paper. http://www.iscr.org.nz/research/

Atkeson, Andrew; and Patrick Kehoe. 2001. *The Transition to a New Economy after the Second Industrial Revolution.* National Bureau of Economic Research Working Paper 8676 http://nber.org/papers/w8676

Boles de Boer, David; Christina Enright and Lewis Evans. 2000. The performance of Internet service provider (ISP) markets of Australia and New Zealand. *Info* 2(5): 487-495.

Boles de Boer, David; and Lewis Evans. 2002. *Broadband Pricing for Internet Services.* ISCR Working Paper, forthcoming.

Boles de Boer, David; Lewis Evans and Bronwyn Howell. 2000. *The State of E-New Zealand.* ISCR Research Paper. http://www.iscr.org.nz/research

Deloittes. 2000. *The New Economics of Transactions: the Evolution of Unique e-business Internet Market Spaces*. Atlanta, Georgia: Deloitte Consulting.

Dixit, Avanash; and Robert Pindyck. 1994. *Investment Under Uncertainty.* Princeton, New Jersey: Princeton University Press.

Evans; N Quigley, F Mathewson and P Hughes. 1999. *Thresholds for the Scrutiny of Mergers and the Problem of Joint Dominance.* ISCR Research Paper. http://www.iscr.org.nz/research

Galbi, Douglas. 2001. *Some Economics of Personal Activity and Implications for the Digital Economy*. Paper presented at the 19th ICFC Conference, Washington, DC.; June 26-29, 2001.

Goolsbee, Austan. 2000. *The Value of Broadband and the Deadweight Loss of Taxing New Technology*. University of Chicago Graduate School of Business Working Paper.

Greenwood, Jeremy and Mehmet Yorukoglu. 1997. *1974.* Carnegie-Rochester Conference Series on Public Policy 46: 49-95.

Howell, Bronwyn; and Lisa Marriott. 2002. *The State of E-New Zealand: 12 Months On.* ISCR Research Paper. http://www.iscr.org.nz/research

Howell, Bronwyn. 2001. The Rural-Urban Digital Divide in New Zealand: Fact or Fable? *Prometheus* 19(3): xx-xx.

Howell, Bronwyn. 2000a. Scoping Report: E-Commerce Performance Measurement Research for New Zealand. ISCR Research Paper. http://www.iscr.org.nz/research

ITU. 2001. *Regulatory Implications of Broadband.* Geneva, 2-4 May 2001. http://www.itu.int/itudoc

Jovanovic, Boyan; and Yaw Nyarko. 1996. Learning by Doing and the Choice of Technology. *Econometrica* 64(6): 1299-1310.

Lehr, William and Lee McKnight. 2000. *A Broadband Access Market Framework: Towards Consumer Level Agreements.* Paper presented at the 28th Annual Telecommunications Policy Research Conference, Alexandria, Virginia, September 2000.

Mantell, Brian. 2000. *Why Don't Consumers Use Electronic Banking Products? Towards a Theory of Obstacles, Incentives, and Opportunities.* Chicago: Federal Reserve Bank of Chicago Occasional Paper Series 2000-1.

Milgrom, Paul; and John Roberts. 1992. *Economics, Organisation and Management*. New York: Prentice Hall.

Ministerial Inquiry into Telecommunications. 2000. *Final Report*. Wellington: http://www.teleinquiry.govt.nz.

OECD. 2001. *Communications Outlook 2001*. Paris: Organisation for Economic Co-operation and Development.

OECD. 2001a. Working Party on Telecommunications and Information Services Policies. *The Development of Broadband Access in OECD Countries*. Paris: Organisation for Economic Co-operation and Development.

OECD. 2000. *Local Access Pricing and E-Commerce.* Paris: Organisation for Economic Co-operation and Development.

OECD. 1998. *A Borderless World – Realising the Potential for Global Electronic Commerce*. Paris: OECD.

OECD. 1998. *The Economic and Social Impacts of Electronic Commerce*. Paris: OECD.

Rood, Hendrik. 2000. Indicators for bandwidth demand. *Telecommunications Policy* 24: 263-270.

Varaiya, Pravin; Hal Varian, Richard Edell, Karyen Chu and Walter Beckert. 1999. *INDEX: a status report.* EECS, SIMS, Economics at UC Berkeley.

Varian, Hal. 2000. *Estimating the Demand for Bandwidth.* Berkeley: University of California, Berkeley mimeo.

Appendix 1.

Table 6. Unbundling considerations

Advantages	*Disadvantages*	OECD Comment
Encourages competition by reducing the economic barriers to entry by allowing new entrants to construct some components of their networks and obtain other components from the incumbent operator.	*Reduces incentive for construction of competitive network facilities.*	Unbundled local loops should be made available at cost-based prices. Thus, there should be no 'disincentive' for new entrants to invest in there own facilities. Rather it lets new entrants deploy infrastructure in response to demand and to market services to a wider base of customers from the commencement of service.
Encourages innovation, since new entrants can combine new technologies with components of existing networks.	*Undermines investment in alternative access networks (wireline and wireless).*	The purported disadvantage is the same as line 1. There is no evidence that unbundling has slowed investment in new infrastructures or innovation. In OECD countries that have introduced unbundling investment is proceeding apace.
Avoids unnecessary and inefficient duplication of components.	*Can enrich the new entrant at the expense of the incumbent operator.*	Experience shows that competition has increased the size of the telecommunication market to the benefit of all players. Duplication allows choice, creates competition and can improve efficiency and is not necessarily something to be avoided. The key question is the speed with which broadband services can be offered.
Facilitates access to rights of way, towers, etc, by new entrants, and avoids the disruption to streets and to the environment during a duplicate roll-out.	*Requires detailed regulatory intervention and technical co-ordination.*	Introducing unbundling may be challenging for regulators if incumbents have business models that are negative toward unbundling or new entrants do not have well co-ordinated and planned entry strategies. This does not mean that unbundling should not be implemented as the benefits outweigh the costs. Critical issues needing to be considered by regulators, in relation to unbundling, include collocation, provisioning timeframes, service quality and access to operator support systems.
Provides a new revenue stream to incumbent.	*Requires technical co-ordination between operators.*	All telecommunication services provided between networks require some level of technical co-ordination between operators. This is not an argument against implementing unbundling.

Source: Columns 1 and 2, in italics, are from the ITU Based on World Bank (2000), World Telecommunications Regulation Handbook, *Module 3. ITU, "Regulatory Implications of Broadband", Briefing Paper, Geneva, 2-4 May 2001.* They are not necessarily the views of the OECD or ITU.

Source: OECD (2001a): 18

Appendix 2. Uptake Analysis Excluding NZ and Korea

Using the OECD figures (OECD (2001a): 13) excluding those for Korea and New Zealand, the two significant DSL-using countries in which local loop unbundling is not practised, regression as used to produce Figure 2 can be repeated. The resulting graph, figure 6, shows a trend line with slope 1.66, compared to the slope of 0.56 in the OECD's analysis. R-squared for this line is 0.7952, compared to 0.6304, indicating a better fit than that achieved in the OECD model including Korea and New Zealand..

Figure 5. Cable Modem and DSL Penetration, Excluding NZ and Korea, June 2001