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Madden, Gary G and Coble-Neal, Grant

Curtin University of Technology, Perth, Australia

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Internet Economics and Policy: An Australian Perspective

GARY MADDEN* and GRANT COBLE-NEAL†
Communication Economics and Electronic Markets Research Centre,
School of Economics and Finance,
Curtin University of Technology

Publicly available information indicates that the demand and supply of Internet and Internet-related services are continuing to expand at a rapid pace. Since 1997 the number of Internet service providers (facilities-based and resellers) has increased by nearly 40 per cent; the number of points-of-presence per Internet service provider has increased by five times; the number of hosts connected to the Internet has more than quadrupled; and Internet traffic has increased from six to 10 times. The emergence of electronic commerce (e-commerce), driven by this rapid adoption of Internet services and continual technological innovation, is likely to have profound economic and social impacts on Australian society. This paper provides a detailed analysis of the impact of the Internet and e-commerce, ranging from the changes in the market structure of the telecommunications industry, its role in changing the organisation of traditional markets, the emergence of new markets, and the structural shifts to employment, productivity and trade. The paper also analyses contemporary Australian regulatory responses.

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* Correspondence: Gary Madden, Communication Economics and Electronic Markets Research Centre, Curtin University of Technology GPO Box U1987, Perth, Western Australia 6845, Australia. Tel.: +61 8 9266 4258, Fax: +61 8 9266 2391. Email: maddeng@cbs.curtin.edu.au

I Introduction

The growth potential of e-commerce has recently captured much attention and is high on the policy agenda of many OECD (Organisation for Economic Cooperation and Development) member countries. Developments in global network technology and Internet applications make the transmission of digitised data fast, inexpensive and simple at a time when consumption of computer technology is increasing. As a result, electronic commerce (e-commerce) has expanded from business-to-business (B-to-B) transactions between known parties to a complex web of commercial activity between individuals who may never meet. This environment offers low barriers to entry for e-commerce. (Goldstein & O'Connor 2000). E-commerce provides an alternative means of transacting and has the potential to modify traditional intermediation, lead to the creation of

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product markets, and forge more direct relationships between business, government and consumers (OECD 1997a; Performance and Innovation Unit, PIU 1999).

The Internet and related technology has caused the cost of many kinds of market interactions to fall. Nobel laureate Douglas C. North argues costs of transacting business, and defining, protecting and enforcing the property rights to goods and assets amounts to 45 per cent of developed country national income. Core transaction costs include accumulating, storing and transmitting information. The e-commerce innovation has the potential for the United States (US) economy to produce, 'a total annual cost saving of about 1–2 per cent, which over 5 years translates into an annual contribution to productivity growth of 0.2–0.4 per cent' (Litan & Rivlin 2001, p. 316). Accordingly, a substantial efficiency dividend to the economy, particularly in the information-rich sectors of banking, insurance, finance, software, wholesale and retail trade, legal and accounting services, education and health is anticipated. Potential large efficiency gains can result in increased uncertainty as incumbent producers face challenges from entrants. As with any technology innovation the earliest observed effects are incremental, that is, easier and less costly ways are found to perform established tasks. Subsequent shifts are more fundamental with entirely new applications discovered, and related business activity completely restructured. In the 'land rush' to secure Internet real estate, to gain first-mover market advantages, many firms are pursuing strategies that are properly interpreted as the payment of one-time, largely sunk entry costs (Borenstein & Saloner 2001).

Understanding Internet technology and its operation is critical to developing an appreciation of its likely contemporary and future impact. In particular e-commerce is important because of potential to enhance economic growth, reduce barriers to market entry, improve efficiency and effectiveness within existing business models, and transform existing business models (PIU 1999). The purpose of this paper is to review and assess the potential linkages between e-commerce and the industrial organisation of backbone infrastructure, transmission and service markets. To do so, a detailed analysis of the impact of the Internet and e-commerce, from changes to the market structure of the telecommunications industry, its role in changing the organisation of traditional markets, the emergence of new markets, and the structural shifts to employment, productivity and trade. In this context the role of contemporary Australian regulatory activity is also considered. The paper proceeds as follows. Section II describes the development of Internet technology and the history of its early deployment in Australia. This task is undertaken to provide a base for attempting to understand recent investment and merger activity that has affected the organisation of the Australian telecommunication market. Section III relates the nature of scale and scope economies derived from Internet backbone infrastructure. To capture these economies firms have entered into mergers and alliances globally. A description of Australian participation suggests concentration is also a feature of the domestic market. The network infrastructure push to greater concentration is reinforced by supply side network externalities. Current interconnection arrangements and their implications are considered in the context of carrier incentives and a recent Productivity Commission report. Section IV provides anecdotal evidence of web site visitation and the nature of e-commerce transactions. While these data describe present Australian e-commerce activity they are not helpful in indicating possible growth, its composition and potential impact. Toward this end a discussion of transaction costs (in particular search costs) is developed. Non-search transaction costs are also considered. Further the effect of e-commerce on intermediation is examined. Likely impacts of e-commerce on economic growth are also analysed. The discussion closes with an overview of the impact of information technology (IT) infrastructure on trade. Section V concludes and provides a vision as to the future.

II Internet Technology and Network Growth

The Internet is an interconnected network of networks that carries bits of information between computers or smaller networks of computers. This network connects independent computers, communications entities and information systems, without any hierarchy or rigid controls limiting the paths that users set up to communicate. The Transmission Control Protocol/Internet Protocol (TCP/IP) allows communication to occur along with a layering of user-defined applications. The earliest incarnation of the Internet evolved with the US Defense Advanced Research Projects Agency (ARPA). ARPANET, as the Internet was then known, used packet switching for communication to send small bundles (or packets)

of information from one computer to another (Pelcovits & Cerf 2002). Unlike circuit switching, where a dedicated communication path is established between the computers for the duration of a communication, information packets are sent independently, even by separate routes to their destination. The communications paths are shared by all flows of packets rather than dedicated to any one flow.[1]

Berners-Lee proposed Hypertext to share information among dispersed nodes by linking documents. This information system proposal also incorporated Hypertext Transfer Protocol (HTTP) as the means of transporting linked documents to nodes. The data management system, the World-Wide Web (WWW), included HTML, HTTP and the client machine software (or browser) and was released to the High Energy Particle Research community and the public in the summer of 1991. In February 1993, the National Center for Supercomputing and the University of Illinois released MOSAIC. MOSAIC was based on a graphical user interface that allowed persons without computer expertise to point and click to navigate the WWW.

Internet traffic initially traverses a link between the customer and an Internet Service Provider (ISP). The types of connection between a customer and an ISP are dedicated and dial-up. Dedicated access connects a customer to the Internet via a point-to-point transmission link to the ISP network. Dedicated access is offered both on a wholesale and retail basis over digital subscriber loop (DSL). Access methods range from DSL to cable modems to shared-radio links. Wholesale dedicated Internet access service is purchased by ISP that have either limited or no network facilities and resell Internet connectivity to retail end-users.[2]

Connection among ISP can be made using owned or leased facilities. Facilities-based ISP or Internet backbone providers (IBP) supply routers connected by high-speed data lines. Routers send packets to their destination. Inter-city high-speed data lines are mostly provisioned over fibre-optic facilities available from long-distance carriers. Most ISP are not long-distance carriers and lease long-distance capacity from carriers to sell value-added services such as Web hosting, email, co-location and security. Web hosting allows a user to place content, for example, a Web page, on a server operated by an ISP. Co-location enables large customers to place their server in space operated by an ISP. Security services include the provision of firewalls that permit Internet traffic flows between customer's computers and other sites but prevent unauthorised user access. ISP exchange traffic under peering arrangements where an ISP agrees to deliver Internet traffic in exchange for another ISP's delivery of traffic to its network. Traffic may be exchanged at a public network access point (NAP) or by private arrangement.

Publicly available information indicates the demand for and supply of Internet and Internet-related services are continuing to expand at a rapid pace (Kende 2000). For example, the US, since 1997 the number of ISP (facilities-based and resellers) has increased by nearly 40 per cent, points of presence per ISP five fold, Internet hosts quadrupled and Internet traffic six to 10 times. In addition, there were an estimated 7463 ISP in the spring of 2000, 20 per cent of which operated nationally. Similarly, suppliers of Internet connectivity (IBP) have expanded their physical presence.

Australian Internet involvement began in the early 1970s with small and isolated networks of agency connections to ARPANET via an international dial-up service offered by the Australian Overseas Telecommunications Commission (OTC).

[1] IP supplies globally unique addresses for packets transmitted among networks. It also specifies the digital equivalents of shape, size and format. Gateways (switches or routers) are able to read the destination address on a packet, and based on the information and intelligence in the gateway send a packet on the next leg of its journey. TCP is an agreed set of procedures that give a correct sequence to the packets and resends them if lost, discards any duplicates and assures the sender gets a confirmation of receipt. TCP also controls the data flow between hosts to prevent network congestion. The Internet's success is due to the robustness of its protocols that adapt networking and transmission media into a coherent global architecture.

[2] Dial-up access customers connect through a telephone call to an ISP modem bank that is the portal to the Internet and converts analog telephone signals into digital streams of packets. Dial-up access is provided on both a wholesale and retail basis. Wholesale dial-up access service is provided by larger to smaller ISP for resale to end-users and involves the provision of both access to modem banks and a link between the modem bank and ISP wholesaler network.

The University of Melbourne and the University of Wollongong exchanged files between their Unix-based computers using a dial-up line and the Unix-to-Unix Copy Protocol (UUCP). The mid-1970s saw the establishment of the Australian Computer Science Network (ACSNet) by the University of Melbourne and the University of Sydney (Clarke 2001). The Commonwealth Scientific and Industrial Research Organisation (CSIRO) provided an interstate link via their X.25-based CSIROnet until 1984.[3] The Carrs Report, commissioned by the Australian Vice-Chancellors' Committee (AVCC) in 1987–88, proposed an integrated network that ultimately the University of Melbourne and NASA developed to create the Australian Academic and Research Network (AARNet), that is, a 56 Kbps Internet satellite circuit between Australia and the US. This international link was later supplemented with links to the Australian National University, the University of Sydney and the University of Adelaide (Clarke 2001).

Early nonacademic use included software development, electronics firms and computing consultants attempting to establish links to US computer companies, and university graduates familiar with IT (Sinclair 1999). Other users included the Bureau of Meteorology, BHP and Telstra Research laboratories (Clarke 2001). The Australian library community was another early user. At this time commercial users were DIALix and Pegasus. DIALix provided Internet, email and Usenet access through periodic STD dial-up. Pegasus linked into the AARNET backbone for overseas Internet feeds and established a base of several thousand subscribers. Pegasus was subsumed into OptusNet via Microplex in 1998. From 1992, the Campus-Wide Information Systems group, driven by university librarians, provided a working model for Intranets and information sharing. The simultaneous introduction of the WWW, HTTP and the removal of ARPANET's research-orientated 'acceptable use' principle in favour of a decentralised user-pays system sparked an explosion in subscription. At mid-1995, the AVCC transferred its customers, assets and management of interstate and international links to Telstra.

In response to growing international traffic congestion during 1994 through to 1997, Telstra and Optus, and several large ISP expanded the backbone network. By mid-1997, AARNet2, via the Optus network, was deployed, integrating regional networks with high-capacity dedicated bandwidth, able to simultaneously support voice, video and data traffic. Among AARNet2 innovations is the implementation of voice over IP (VoIP) between universities and the CSIRO. Resultant growth in adoption underpinned the development of a multilayered network providing wholesale-retail network services. Commercial use of the Internet grew rapidly from the late 1990s, with 600 independent companies offering Internet Access Provider or ISP services (Clarke 2001).

III Backbone Infrastructure and Transmission Markets

The Internet innovation is reshaping the industrial organisation of telecommunications backbone infrastructure and transmission markets as incumbents and entrants pursue new sources of scale and scope economies through investment and merger activity. This shift in industry technology orientation has required substantial (private and public) investment in intelligent technology such as digital switching, fibre optics, satellite, cellular transmission and Internet equipment. Network construction costs range from US$4000 to US$3 million per kilometre, depending on the upgrade of wavelength-division multiplexing (TeleGeography 2001a). Similarly, submarine cable installation costs range from US$0.5 billion (10 000 kilometre cable) to US$2 billion (30 000 kilometre cable). Resultant global expenditure on telecommunications services is currently US$trillion annually (Noam 2002). High network construction costs and low operating costs imply cost advantages in terms of network size, reach and capacity (Noam 2002). Milgrom *et al.* (2000) claim economies of scale in IBP packet-switched operations are so substantial that ISP routing may be subadditive.[4]

Economies of scale and scope are leading to cross-industry vertical integration and global alliances in pursuit of service bundling and joint production. These outcomes imply cost subadditivity and ultimately few global dominant

[3] Both the UUCP, ACSNet delivered core file transfer protocol, email and news services using asynchronous store-and-forward networking technology.

[4] That is, reducing the number of IBP would reduce industry costs more than proportionately.

firms.[5,6] In pursuing such economies of scale 2200 companies have expanded internationally since 1999, and 300 of those are packet-switched operators (TeleGeography 2000). In the process, the telecommunications industry has tended to restructure itself from national monopolies to wholesale (IBP) and retail carriers. The global packet-switched market, however, is highly concentrated in 20, mostly US, carriers with AT & T/IBM, Global One/Sprint, GTE/BBN, MCI WorldCom/UUNet and PSINet responsible for 60 per cent of global traffic. Regionally, former national incumbents are seeking to leverage national infrastructure by providing regional services, for example, Level 3, Telstra and SingNet (TeleGeography 2000).

The main global alliances of Concert Communications, Global One and AT & T-Unisource are joint ventures. Concert Communications is jointly owned by BT (75.1 per cent) and MCI (24.9 per cent), and is supported by smaller joint ventures with Albacom (Italy), Telenordia (Sweden), Cégétel (France), Telfort (the Netherlands), Viag Interkom (Germany) and Sunrise (Switzerland) to market services (Curwen 2002). The Concert alliance intends to develop the largest global IP network to support e-commerce, global centres and Intranets. The alliance also has internal advantages of specialisation, for example, AT & T acquired the global IBM data network to facilitate rapid deployment of Concert services. Conversely, BT's specialisation is in the deployment of a 32 000 km pan-European fibre network with points-of-presence in over 200 cities. Launched in March 1996, Global One is a joint venture between Atlas Telecommunications and Sprint to focus on global voice, data and video service for corporate clients and international consumer services (Curwen 2002).[7]

[5] A network externality implies subscribers are attracted to the largest network, that is, an entrant with a small subscriber base is unlikely to be able to establish a sustainable critical mass (Economides & Himmelberg 1995).

[6] Nellist and Gilbert (1999) show the engineering configuration of networks also impacts on market structure. For instance, when the Internet backbone is comprised of a tree structured local access network, servers within the network can only be accessed from inside the network, which partly explains why an Australian portal (Looksmart) recently relocated to the US.

[7] Atlas Telecommunications was created (in December 1993) by Deutsche Telekom and France Télécom.

In the Australian backbone infrastructure market Telstra is a key IBP along with Optus, Connect.com/AAPT/TCNZ and UUNet/OzEmail/AccessOne. New entrant ihug became a wholesaler of satellite Internet access in 1999–2000. ihug also provides capacity to wholesale and retail ISP (resellers) such as Chariot/NetConnect and Pacific Internet. As a result, ihug is the largest satellite bandwidth reseller in Australasia and a leading ISP, supplying bandwidth to 120 ISP and has 120 000 Internet subscribers (ihug 2002). Table 1 reports Australian authorised telecommunications firms by type. The Telecommunications Industry Ombudsman (TIO) classifies firms as carriers, ISP, telecommunications service providers (TSP) or both Internet and telecommunications service providers (I & TSP).[8] These data indicate 80 per cent of telecommunications firms are ISP. Of particular interest is the growing number of I & TSP as technology increasingly permits convergence of telecommunications service and the Internet.

Market concentration among Australian ISP is indicated in Table 2 and Table 3. Table 2 shows that the six largest ISP provide services to 66 per cent of Internet subscribers while 70 per cent of ISP service less than four per cent of the subscriber market.

In terms of revenue, Table 3 indicates at 2001 that Internet services industry revenues are approaching $3–4 billion per annum. According to the Australian Communications Authority (ACA) *Customer Satisfaction 2000–01* survey, Telstra Big Pond is the largest ISP with 28 per cent of residential and 29 per cent of non-residential respondents, respectively. For urban household respondents the second and third most widely used ISP are Optus (13 per cent) and Primus (10 per cent), respectively. OzEmail (UUNet) and Optus rank second (six per cent) and third (four per cent) most widely used ISP among urban small business respondents (ACA 2001a, p. 201). Market share data contained in Table 3 confirm Telstra Big Pond as market leader. The 10 largest ISP represent 19 per cent of geographical coverage, service 70 per cent of residential subscribers and receive the bulk of industry revenues.

The degree of concentration among the dominant ISP is indicative of a recent trend toward

[8] The ACA and TIO carrier classifications are essentially the same. Differences in carrier numbers between the ACA and TIO are due to registration/licensing delays.

TABLE 1
Australian Telecommunications Industry Statistics

	1997	1998	1999	2000	2001
ACA licensed carriers	3	21	29	43	81
TIO registered carriers	n.a.	15	24	35	59
TIO registered ISP	n.a.	460	751	851	889
TIO registered TSP	n.a.	60	76	68	90
TIO registered Internet & TSP	n.a.	0	15	37	51
Total	n.a.	535	866	991	1089

Source: ACA (1998, 1999, 2000) and ACA (2001b) and TIO (1998, 1999, 2000 and 2001).
Note: n.a. indicates that the data was not available from the respective source in that year.

TABLE 2
ISP Classification by Subscriber Base

Subscriber base	ISP (number)	Provider category	Subscribers (thousand)	Market share (per cent)
Subscribers > 100 001	6	Very large	2800	66.0
10,001–100 000	30	Large	900	21.2
1,001–10, 000	150	Medium	400	9.4
101–1000	303	Small	140	3.3
< 101	114	Very small	5	0.1
Total	603		4245	100.0

Source: Australian Bureau of Statistics (2002).

TABLE 3
Australian ISP Market Shares

ISP	Points of Presence	Residential Subscribers (thousand)	Residential Subscribers (per cent)	Total Revenue (AUD$ million)
Telstra Big Pond	58	800	22.9	2669
OzEmail (UUNet)	79	450	12.9	n.a.
Optus/DingoBlue	76	300	8.6	139
HotKey (iPrimus)	31	250	7.1	518
TPG Internet	83	200	5.7	n.a.
One.Net	n.a.	170	4.9	40
AOL	72	150	4.3	n.a.
Austar/eisa	21	80	2.3	< 103
Chariot Internet	4	60	1.7	16
Connect.Com (AAPT)	72	53	1.5	44
Sample Total	447	2513	71.8	n.a.
National Total	2310	3500	100.0	n.a.

Source: Residential subscriber numbers are from ACA (2001a Table 13.3, p. 204). Point of presence data is obtained from the Australian ISP list http://www.cynosure.com.au/isp. Total point of presence and residential subscriber data are from ABS (2001). Telstra (2001), p. 81 provides total data and Internet services revenue (retail) in 2001. Optus (2001) gives total Internet and e-commerce revenue. Primus (2000) lists only gross annual revenue. Austar (www.austar.com.au) report 2001 total revenue of AUD $385 million. AUD $282 million is from pay TV. The remainder is due to mobile and Internet service, that is, Internet revenue must be less than AUD $103 million. AAPT revenue is from AAPT (2000). Point of presence refers to the number of geographic locations that subscribers can access the Internet by dial-up means.
Note: n.a. indicate these data are not available.

TABLE 4
Retail and Wholesale Rates of PSTN and VoIP

	PSTN Price		VoIP Price	
Country	Retail	Wholesale	Retail	Wholesale
Australia	0.52	0.23	0.25	0.14
Finland	0.17	0.11	0.08	0.05
Japan	0.26	0.09	0.04	0.04
Singapore	0.35	0.13	0.15	0.04
UK	0.10	0.07	0.08	0.02

Source: TeleGeorgraphy (2000).
Note: Rates are in USD$.

industry consolidation. Internet Service Providers such as Chariot/NetConnect, Austar, iiNet, Asia online and Pacific Internet have increased their subscriber base through mergers and acquisitions (ACA 2001a). For larger players, such as Telstra and Optus, mergers are likely to be resisted by regulators. Accordingly, both Telstra and Optus appear to have adopted broadband as the means to expand the subscriber base. In the financial year 2000–2001, Telstra achieved 169 per cent growth in broadband subscription, primarily corporate clients (Telstra 2001). During this period, Optus expanded its broadband customer base from 85 000 to 500 000 subscribers (Optus 2001, p. 63).[9]

Pursuit of sharply declining unit cost has encouraged market entry, and placed downward pressure on price-cost margins transforming transmission services into a near-commodity market. Table 4 indicates Australian retail and wholesale VoIP prices are 48 per cent and 61 per cent lower than corresponding Public Switched Telephone Network (PSTN) prices, respectively. Consequently, a bandwidth trading market emerged to ensure revenues. This market uses standard contracts and financial derivatives to offer the delivery of bandwidth capacity. Current global exchanges include Band-X, Enron, Tradingcom Europe and RateXchange. Regional exchanges include the Asia Capacity Exchange and London Satellite Exchange (TeleGeography 2001b).

Non-facilities-based (virtual) carriers are ISP that purchase flat-rate access from incumbent upstream IBP. With interconnection compatibility, telecommunications firms can outsource operations and consist solely of senior management. An advantage of this arrangement is that a firm can reduce and transform its fixed into variable cost. Noam (2002) argues this strategy works well for incumbent carriers because they are a nationally recognised brand. Alternatively, carriers are seeking economies of scope via 'one-stop-shop' arrangements, that is, to provide access to a full complement of telecommunications services, including international calling, Internet and multimedia capacity via an alliance using a common technical standard. Current US trends, for example, indicate an expansion of activity into related operations such as mobile communications, Internet access, cable TV and network operation software.

The network infrastructure push to greater concentration is reinforced by supply-side network externalities. In transmission markets, Shapiro and Varian (1998) show that a network externality provides incumbents with an incentive to avoid interconnection with entrants so as to preserve market power.[10] That is, under an assumption of linearity in value, an incumbent is better off acquiring an entrant rather than interconnecting. Further, Milgrom *et al.* (2000) show that smaller networks impose relatively high transaction costs on larger networks. A large number of competitors can unnecessarily delay interconnection agreements and reduce value to individual subscribers. Further, quality can also suffer. The presence of many competitors is likely to lead to a multiplicity of low bandwidth routes rather than a few high bandwidth routes, which given the high cost of building networks, can substantially raise industry fixed costs. On this basis, Milgrom *et al.* argue that it may be desirable to limit the number of competitors. Clearly, policy makers must consider whether price reductions and low cost usually attributed to competition are likely to be realised, and that perhaps some concentration should be tolerated.

Traditionally, market entry by facilities-based competitors is perceived an effective mechanism to deliver desired economic welfare gains.

[9] On the 7 March 2002, DingoBlue announced its closure due to its inability to trade profitably (ABC News, 2002).

[10] Katz and Shapiro (1985) propose the existence of a demand-side network externality in related to network size. To gauge the magnitude of the externality for Internet services Madden and Coble-Neal (2002) adapt a model suggested by Economides and Himmelberg (1995). The model when estimated on OECD data implies a one per cent increase in network size induces a 0.67 per cent increase in subscriber base.

However, Woroch (1998) argues that investment, rather than competition, is the appropriate means to achieve price reductions and enhance service quality. Greenstein and Spiller's (1997) highly elastic estimates of consumer surplus to digital telecommunications investment support Woroch's argument. Clearly, since investment provides a means to reduce price and enhance service quality, policy targeted directly at investment maximisation, rather than indirectly via competition, is more reliable. Recognition of these factors is reflected in the recent Productivity Commission *Review of Telecommunications Competition Regulation* (2001). Recommendations include softening aspects of the rules relating to anticompetitive conduct, increasing the stringency of the declaration criteria, and the addition of a new section of the Trade Practices Act (TPA), with the effect of mandating economic cost-benefit analysis of reductions in access prices. In effect, the Commission recommendations switch policy focus from exclusively that of competition to one that considers the impact on investment.[11]

The Commission report also addresses current access arrangements to incumbent networks. At present, the Australian Competition and Consumer Commission (ACCC) sets network interconnection rates, and arbitrates on disputes. Rates are set on the basis of total service long run incremental cost. Hausman (1999) considers that such arrangements are not entirely desirable. Mandated rival access on a short-term basis to incumbent networks means the incumbent bears the full investment risk. Unless access price reflects the full risk inherent in sunk investment (and under Australian regulation it does not), such as establishing a contract over the economic life of the investment, regulation amounts to provision of an option to entrants.[12] Accordingly, network investment by incumbents and entrants is reduced. To avoid potential regulatory failure associated with setting an access rate too low, Commission Recommendation 9.3 suggests a market power test be applied by the ACCC in deciding whether to arbitrate. The thrust of the test is to limit potential arbitration by the ACCC to cases where the test demonstrates an incumbent exercises enduring market power in a specific service (Productivity Commission 2001, p. 280).[13]

A payment system that encourages the free movement of network traffic is crucial for the proliferation of a seamless Internet. Payment arrangements are generally classified as peering or transit. Peering refers to connection between network carriers of similar size (normally IBP) while transit is typically established between relatively small retail ISP for connectivity to upstream IBP. Bill-and-keep peering is the most common form of peering arrangement, and means an ISP keeps all its customer payments and does not pay for interconnection to the terminating network (ACCC 2000, p. 45). However, free access to rival networks can lead to free-riding and market power. For example, ISP must police their network traffic to ensure rivals are not surreptitiously overloading their network.[14] Free-riding can also occur when small IBP, with substantially higher unit costs than those of large ISP, attempt to reduce costs by operating with insufficient numbers of network management personnel, equipment and peak-load route capacity, imposing a negative externality on rivals. Scope for anticompetitive behaviour exists when a large incumbent uses its larger size and associated network effects to peer with smaller rivals. The objective here is to raise rival costs, forcing the smaller rival to pass on the increased costs to its customers (Milgrom *et al.* 2000). However, even in the absence of deliberate gaming by rivals,

[11] This principle is reflected in Recommendation, 9.1 of Productivity Commission (2001, p. 260), which states '…The objects clause in s.152AB (1) of Part XIC of the TPA be changed from the long-term interests of end-user to "The objective of this Part is to promote economically efficient use of, and investment in, telecommunications services"…'.

[12] A counter argument is that an incumbent might deliberately overbuild to deter construction of rival networks. However, as Hausman (1999) points out, the telecommunications industry is characterised by high obsolescence rates. Incumbents who deliberately overbuild are, as time passes, increasingly locked into a higher unit cost relative to new entrants using newer technology.

[13] An incumbent is deemed to possess market power in a service when there are high sunk costs, the incumbent has the ability to exercise market power by refusing access, no availability of close substitutes, and no potential for new technology to erode market power.

[14] Routers, the computers that dynamically manage traffic flow, contain information about congestion on specific routes. These routers exchange signals as traffic conditions change and so optimise the whole network. However, these data can be manipulated to signal that own routes are full and so block free transit by rivals, while avoiding charges for transiting own traffic through rival networks.

Milgrom *et al.* argue that the Internet's traditional flat interconnection structure is susceptible to traffic bottle-necks, imposing substantial delays on end-users.

By contrast, transit arrangements are intended to enhance efficiency by channelling Internet traffic through a small core of IBP, and so optimise traffic flow. While traffic exchange by IBP and ISP provides mutual benefit reciprocity is contentious when IBP, as wholesale intermediators, demand payment for supplying traffic downstream that was received upstream for free. Moreover, the ACCC's first competition notice serves to highlight the tension between peering and transit arrangements, particularly when transit payment asymmetry exists.[15] The Productivity Commission (2001) discuss the possibility of two-way pricing, implying a net payments system for transit interconnection. While, this would substantially resolve the reciprocity issue, it does not establish the principles required to determine the form of interconnection, that is, peering or transit.

IV E-Commerce Markets

The Australian Bureau of Statistics (2002) *Internet Activity* survey estimates that as of September, 2001 (the latest date for which data are available) there were 603 Australian ISP providing Internet access services to 3.7 million household (residential) and 544 000 business and government (non-residential) subscribers. Collectively, these ISP host a total of 88 722 non-residential web sites, of which four per cent provide a secure environment for e-commerce (ABS 2002). In terms of traffic volumes, the ABS (2002) report that residential subscribers download an average 175 Mbs per subscriber compared with 1011 Mbs per non-residential subscriber. Table 5 lists the most visited web sites by Australian Internet users, as compiled by Digital Media. According to these data, half of these sites are Australian, while a further three sites are almost exclusively dedicated to search activities. Two sites, Microsoft and AOL Time Warner, contain generic content and have wide appeal.

TABLE 5
Web Site Visit Frequency

Web Site	Rank	Unique visitors (thousand)
NineMSN/Microsoft Sites	1	6221
Yahoo Sites	2	4520
AOL Time Warner Network	3	3579
Telstra Sites	4	3213
Aust Fed Govt Sites	5	2819
Google Sites	6	2157
F2	7	1786
News Corp. Online Sites	8	1674
Commonwealth Bank Sites	9	1634
Lycos Sites	10	1598

Source: Digital Media (2002).

TABLE 6
E-commerce Transaction Profile

	%
Location of purchase/order	
Australia only	52
Overseas only	23
Both Australia and Overseas	22
Number of occasions purchase/order made	
One	26
Two to four	41
Five or more	33
Value of purchases/orders	
0–100	26
101–500	41
501–1000	12
> 1001	18
Don't know	3
Paid online for goods	82
Types of goods/service purchased/ordered	
Books or magazines	36
Music	20
Computer software	18
Entertainment	16
Holidays	13
Clothing or shoes	12
Food and groceries	11
Computer hardware	10
Other goods/services	35

Source: Australian Bureau of Statistics (2001).

According to the ABS (2001), one in 10 adults have engaged in e-commerce via the Internet. Of these, half purchased goods only from Australia while a quarter purchased only from overseas. Table 6 reveals, over a 12-month period,

[15] The ACCC (1998) defines a competition notice as the method by which the ACCC sets out a breach of the Competition Rule. The Competition Rule prohibits telecommunications carriers from engaging in anti-competitive conduct.

three-quarters purchased goods online at least twice, and two-thirds paid up to AUD $500 per transaction. Most frequent purchases are printed materials, music and software.

While these data usefully describe the present state of Australian e-commerce activity, they provide little indication as to its perceived growth and composition, and potential to impact on the industrial organisation of markets. To better appreciate the future evolution of e-commerce markets requires a formal definition of e-commerce and an analysis of its structure. Wigand (1997) defines e-commerce as any form of business activity conducted on the Internet/WWW and includes electronic data interchange (EDI), email and related types of communication. Electronic data interchange is a subset of e-commerce encompassing B-to-B electronic transactions. Commercial transactions involving households are called business-to-consumer (B-to-C) electronic transactions. Non-commercial transactions conducted electronically are excluded (Globerman 2002). The economic history of the locomotive and telephone suggest it is not unreasonable to expect that a singular technological event such as the emergence and subsequent growth of the WWW (and e-commerce) can alter the industrial organisation of many markets (Rosenberg 1994). In particular, changes are expected to occur in both market structure and participant behaviour (Hagel & Armstrong 1999). The impact on traditional markets includes an expansion of the geographical scope of markets and a decrease in their concentration, and prices better matching costs. Generally, more efficient markets generate greater total surplus. Surplus-seeking consumers seek markets that are more economically efficient, while lowering costs tend to increase producer surplus (Ward 2002). Available evidence suggests that prices on the Internet are lower than those for comparable goods purchased through other commercial channels (Bronnenberg & Vanhonacker 1996).

The choice of location to conduct economic activity is a trade-off between costly transportation and positive externalities. The former leads economic activity to diffuse outwards for conveniently transporting output to users, while the former suggests locating production in one place (Fujita *et al*. 1999). Internet economic activity poses a challenge to this conventional wisdom in its promise to dramatically reduce transportation costs. Sectors of the economy most affected by e-commerce are where output is intangible or 'weightless', for example, financial and consulting services (Quah 2001). E-commerce is likely to promote competition through the expansion of geographical markets and so reduce market concentration by expanding the geographical scope over which firms can economically compete. Further, e-commerce can reduce barriers to entry, especially for small firms, thereby enhancing contestability. In particular, e-commerce is alleged to lower required sunk costs of investment relative to traditional distribution channels (Brynjolfsson & Smith 2000). However, while the costs of opening an e-storefront is reasonably inexpensive, it is increasingly difficult to gain visibility. To improve access to Internet browsers, many online merchants use heavy traffic net search engine sites as a springboard to their sites. This impact is somewhat mitigated as online shopping tools are primitive (Hoque & Lohse 1999).

Conversely, the growth of industry portals (i.e., web sites that bring together a number of firms within an industry or upstream and/or downstream industry related firms) may facilitate non-competitive pricing by dominant sellers or buyers. That is, to the extent industry portals enjoy a reputation for guaranteeing product quality and distribution reliability, areas of bottleneck monopoly or monopsony power may emerge. In certain areas of B-to-B and B-to-C commerce, established multiproduct e-tailors, such as Amazon.com, are competitors to certain industry group websites. This source of competition is less robust, the more technically specialised the set of products concerns (Ward 2002).

Transaction costs are incurred in physical search, establishing and fulfilling contracts, ensuring the terms of contracts are met and in making changes to contracts over time (Wigand 1997). A decrease in transaction costs suggests increased equilibrium output. Such a welfare gain through price reductions is more likely to occur in search good markets. Search goods have attributes that are easily identified by inspection (for example, router equipment has technical specifications that are both meaningful and easy to communicate). An illustration is the prevalence of internet auction sites, which provide another mechanism for consumers to obtain information about products (Lucking-Reiley 2000). Using auction sites, consumers can easily find unique items that match their preference for attributes. In this case, the Internet has likely reduced total transactions costs sufficiently that

many items of small monetary value are bought and sold rather than discarded. Search goods are usefully distinguished from credence goods whose attributes may not be identifiable even after their utilisation, for example, medical services. While it is technically possible for credence goods to be distributed over the WWW, their fungibility with directly or personally supplied goods is problematic. For example, medical practitioners can be contacted at Web sites, however, diagnoses are usually qualified to minimise litigation risk. This reduces the substitutability of web-based medicine for personally supplied medical services.

Less discussion has occurred about the potential impact of e-commerce on non-search transaction costs. The widespread adoption of standardised electronic contracts can lower the average cost of contracting, especially for B-to-B transactions, since repetitive activity with high variable costs can be replaced by once-off effort with relatively high fixed (and sunk) costs but low variable costs. To the extent that the perceived risks of opportunistic behaviour are no lower for e-commerce, electronic contracts may still need to be complex and adapted frequently, however. E-commerce therefore may not reduce costs of maintaining and enforcing contracts, including those of litigation. Conversely, to the extent that e-commerce growth expands geographical markets, buyers and sellers should experience lower costs in switching transaction partners. Lower switching costs should reduce incentives for opportunistic behaviour and so reduce costs of establishing, maintaining and enforcing contracts (Globerman 2002).

The demand for intermediation is not necessarily reduced by e-commerce. While simple executions of buy-and-sell orders are increasingly performed online, companies are emerging to advise consumers on the merits of particular electronic finance brokers. Established intermediaries who gained expertise in conventional marketing media are not guaranteed success in e-commerce markets. While there has been a shift from traditional brokers to online services the vast majority of retail customers continue to employ local brokers (Globerman *et al.* 2000). It appears that periodic personal contact with financial advisors is still valued.

E-commerce activity has also introduced a form of intermediation called Web hosting whereby major Web portals (Yahoo!) provide selling space for unaffiliated retailers. Also, popular commercial Web sites, for example, Amazon.com, allow unaffiliated retailers to solicit sales on its site. In addition, Amazon provides billing and transport services for those retailers. In other cases, companies have established electronic malls and smaller companies can lease Web space at those malls.

The central question is whether new intermediaries substitute for conventional intermediation. To the extent that e-commerce cannibalises sales from conventional commercial channels it would be expected there is a substantial degree of substitution across electronic and nonelectronic intermediation. The available evidence points to e-commerce as largely siphoning sales that would otherwise have been made through conventional commercial channels. A recent consulting report estimates that six per cent of B-to-C e-commerce is new spending (*Business Week* September 27, 1999, EB 96).

Picot *et al.* (1997) contend that electronic mediation of market transactions will not automatically lead to price reductions when compared to conventional market organisations, since sellers will implement strategy to reduce market transparency and so preserve price and income levels. For example, prices on the WWW may only be the basis for further negotiation. In this manner some price discrimination remains possible based on buyer urgency and the opportunity cost of time. The use of bundled pricing and complicated charging schedules can also obscure price differences (Bakos & Brynjolfsson 2000). A more subtle form of price discrimination may occur through the electronic identification of on-line purchasers and the tailoring of prices according to their known characteristics (obtained from previous transactions or from purchased data bases).

Clearly, increased market efficiency online could induce efficiency in off-line markets. For example, Merrill Lynch slashed its brokerage fees in response to increased competition from online brokers. The magnitude of this spillover depends on cross-channel substitutability. Goolsbee (2000) provides some evidence of substitutability between off-line and online channels. Ward (2001) investigates product category substitution between online, in-store and direct mail channels, and finds more substitutability between online and direct mail channels than online and in-store channels.

The extent of these changes has inevitably led to speculation of the structural impact at the

aggregate level. E-commerce is a manifestation of general technical progress, contributing to economic growth through shifts in the production frontier and/or increasing returns (Romer 1986, 1990; Grossman & Helpman 1991; Aghion & Howitt 1998). Theory also shows that increased economic growth may lead to greater disparity between rich and poor. Following on from the *E-commerce Beyond 2000* study, which sought to forecast the economic impacts of e-commerce to 2016, the National Office for the Information Economy (NOIE) commissioned the *E-commerce Across Australia* study into the economic impacts of e-commerce on State and regional economies.[16] According to the Monash Multi-Regional Forecasting (MMRF) model projections, e-commerce is likely to contribute an extra 2.8 per cent to output Australia-wide. Associated with the permanent increase in output are long-run increases in average real wages and employment. Other benefits identified by NOIE (2001) are reduced costs of isolation and distribution, enhanced access to export markets and downward pressure on inflation. It is also anticipated that e-commerce will impose transitional adjustment costs on most regions, and in some cases may result in permanently reduced output (NOIE 2000, p. 30).[17]

Perhaps most visible is the expected upward pressure on exchange rates driven by increased capital inflows to fund e-commerce opportunities (NOIE 2000, p. 79). While in the long term the investment pressure slackens, the terms of trade improvement created by e-commerce adoption may lead to lower import prices relative to exports. As a result, tourism and related services, such as air transport, would receive an increased share of GDP at the expense of commodity exports. At the industrial level, the retail and primary (mining, agriculture, forestry and fishing) sectors are expected to decline in real terms. Further, industries that can be dis-intermediated by increased use of e-commerce are likely to experience reduced growth relative to other industries. These transitional adjustments are likely to be distributed unevenly across regions. From the MMRF projections, NOIE (2000) identify capital cities, with the exception of Darwin and Perth, as areas with the most to gain from e-commerce, but also the most likely to incur the highest transition costs. Conversely, non-metropolitan areas are considered least likely to benefit. In the NOIE study, MMRF projects an average long-run reduction in non-metropolitan employment of −0.4 per cent, while metropolitan areas can expect a 0.6 per cent increase. Most susceptible is North-West Queensland with a 2.8 per cent reduction in employment along with a permanently sustained 0.6 per cent output contraction. Non-metropolitan regions expected to reap positive net benefit include Mid-North Coast (NSW) with output peaking at 3.8 per cent before stabilising at a long-run increase of 0.6 per cent and an associated 0.7 per cent increase in employment. However, while experiencing net benefit, the Mid-North Coast region will experience an industrial shift from agriculture and retail to construction, property and business services. NOIE conclude that e-commerce is expected to have an order of magnitude effect broadly consistent with the national competition policy reforms.

The projected growth of e-commerce is critically dependent on the quality of the underlying IT infrastructure. Efficient provision of IT facilitates the ordering and delivery of traded goods, while e-commerce promises to make trade less expensive, easier to transact and more extensive in geographical scope (International Telecommunication Union, ITU, 1997). As new technology and applications become available the potential to open up information-based service markets occur. IT investment and reform are a priority for many governments and international development agencies (European Bank for Reconstruction 1995; Kaji 1996; Federal Communications Commission 1997; OECD 1997b; World Trade Organization 1997). IT trade has both direct and indirect

[16] In considering the MMRF simulation results several potentially important assumptions of the model need to be identified. The most important is that the model cannot capture increasing returns to scale. Four other (related) issues of the MMRF are: (i) its lack of micro-foundations for the theory of investment, that is, lack of attention to the derivation of the investment decision as the outcome of a forward looking rational NPV maximising objective of the firm; (ii) its lack of consideration of issues of decision making under uncertainty; (iii) its lack of micro-foundations for the savings decisions of consumers; (iv) its inability to handle issues associated with economic growth. All of the above are crucial to modeling the issues of importance to the role of the Internet.

[17] To quantify these adjustments, NOIE (2000) developed a dislocation index. The index measures the extent of structural change for the regional economies, as a result of increased use of e-commerce and the degree of the associated movement of resources and employment between them (NOIE 2001, p. 29).

impacts on economic growth. Maddock (1995) identifies information diffusion and market integration as important indirect influences on growth. To formally consider the role of IT in trade performance, Madden and Savage (1998) augment a neo-classical growth model that relates GDP growth to the investment share, employment growth, telecommunications exports growth, growth of telecommunications exports multiplied by the ratio of telecommunication exports to GDP, growth of net exports, and growth of net-exports multiplied by the ratio of net exports in GDP (Song & Chen 1995). Model estimation on data from 11 Asia-Pacific nations for the period 1989 through 1993 show IT exports have a positive-inelastic impact on growth.

V Conclusions

Internet technology is having a fundamental impact on telecommunications markets. The telecommunications industry is being transformed from circuit to packet switching technology and has enabled carriers to extract substantial efficiency gains. In the process, the aggressive pursuit of scale economies has destroyed former national monopoly settlement arrangements, forcing incumbents to engage in large interlocking corporate alliances, conduct bandwidth trading and scrap now obsolete physical networks. The resulting plunge in telecommunications costs and the explosion in bandwidth capacity have accelerated the adoption of e-commerce. In turn, e-commerce is generating efficiency gains through market expansion, reduced barriers to entry and transaction costs.

The implications of the wide-ranging impact of the Internet are only now being realised, with most of the ramifications still unknown. Australia is not exempt. To date, there are few comprehensive studies assessing the likely long-run impacts of the Internet and e-commerce. The Internet provides new scope to study the processes of technology change and innovation and their impacts on productivity and economic growth. In addition, there are likely to be fundamental impacts on industry cost structure, the possible reintroduction of increasing returns to scale and the creation of new industries. While it is not possible to make definitive projections of the future of the Internet and e-commerce markets, the work of Standage (1998) provides some insight. Standage notes that impact of Internet and telegraph technology diffusion are similar in character. That is, they gained rapid global adoption, generated informal communications channels, redefined business practice and provided challenges to regulatory regimes. Further, both technologies were first adopted by service sectors. Additionally, Standage's thesis suggests the telegraph was a general-purpose technology, for example, it directly motivated the invention of the telephone. Telegraph also stimulated electrical transmission technology and provided an early commercial application of electricity, permitting the proliferation of electrical transmission networks. Such observations suggest the Internet has the potential to radically impact on industrial organisation, with significant implications for microeconomic and competition policy. While developments relating to the telegraph are clear in hindsight, it remains difficult to anticipate exactly the form Internet-motivated invention and innovation might take. However, its similarity to the telegraph suggests substantial innovation is likely to follow.

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