Submission to the
Senate Environment, Communications, Information Technology and the Arts Legislation Committee

Inquiry into the Telstra (Transition to Full Private ownership) Bill 2005 and related bills

by

AAPT Ltd
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1. Introduction

AAPT Ltd is pleased to have the opportunity to make a submission to the Senate Environment, Communications, Information Technology and the Arts Legislation Committee's Inquiry into the Telstra (Transition to Full Private ownership) Bill 2005 and related bills.

AAPT has been a participant in the Australian telecommunications regime as a service provider since 1991 and as a carrier since 1997. Our involvement began as a consequence of the experiences of our original parent company, Australian Associated Press, in trying to distribute its content services to its customer base in the regulated environment that existed in the 1970s and 1980s. As AAPT we have been active participants not only in the market for customers, but also in the consideration of telecommunications policy.

While we welcome our ability to comment on the bills, one of our comments is that for a section of the economy as important as telecommunications and for legislation as detailed and extensive as this, the process of inquiry should be more complete.

Apart from these general concerns which are outlined in the next section, AAPT is concerned that the proposed "clarification" of the Long Term Interests of End-users test will have the consequence of fundamentally changing access pricing and as a consequence industry structures.

We have significant concerns that the process of operational separation can be "gamed" to result in either no effective separation or in the Minister effectively writing the plan.

In addition we repeat our suggestion that a Commissioner of the ACCC be appointed who is exclusively concerned with telecommunications issues to facilitate decision making and ensure a suitable focus.

We welcome the proposals to conduct a full review of the industry arrangements in July 2009, however we believe the legislation should provide further guidance as to who will be conducting that review.

While we have these criticisms, it is important to note that the policy intent of the legislation is wholly supported by AAPT and there is much detail that has been incorporated well. Unfortunately, we cannot conclude that we have considered all the items, including those included in the terms of reference, in detail.

2. Process

The Minister for Communications, Information Technology and the Arts, Senator Coonan, announced in December 2004 that she was undertaking a review of the telecommunications regulatory regime in conjunction with the further consideration of Telstra privatisation. A discussion paper, however, was not released until April 2005 which coincided with this Committee's (or the references committee) inquiry into the telecommunications regulatory regime.

The Minister only announced the conclusions of that review together with the other announcements included in the bills in late August 2005. Industry participants were briefed by Departmental officers on Thursday 1 September, but not provided with exposure drafts. The legislation was introduced into the Parliament on 7 and 8 September, and the hearing will be conducted on 9 September.

This rushed process should be compared to all the public consultation processes required in all the sub-ordinate legislation processes under the regime. In relation to ACMA and ACCC decision making both agencies are required to publish public consultation drafts, in the case of self-regulatory instruments there is an expectation (and a requirement to receive funding under the new provisions of Schedule 3 of the "Future Proofing Bill"). Yet the crowning document, he legislation, is exposed to virtually no effective scrutiny.

This may not be a concern, except that telecommunications is a large and complex industry that has great significance to the economic and social well-being of all Australians, and the history of amendments is that they end up being gamed.

The importance of telecommunications should not be underestimated. Industry revenues are about $33B p.a., all Australian businesses are reliant upon the services as are consumers. The ACA estimated that GDP had grown by 1.6% as a consequence of the reforms to telecommunications. The Productivity Commission estimates that more than 25% of growth can be attributed to the utilisation of ICT. This is a vital part of the economy.

Previous amendments have not worked as effectively as planned. Two case studies are considered in the boxes below.

Box 1. Backdating

As part of the 1999 amendments to the telecommunications regime, an amendment was introduced to clarify that the ACCC in making a final determination could express the determination to have effect from the date of the notification of the dispute.

However, in its subsequent decisions the ACCC interpreted the provision as having only authorised backdating from the date the amendment took effect – from 5 July 1999. AAPT had been in dispute with Telstra from December 1998 in relation to PSTN interconnect charges from July 1998. The ACCC only determined the dispute from 5 July 1999, on the above interpretation.

Telstra requested the determination be reviewed by the Australian Competition Tribunal. In the review AAPT asked that the Tribunal determine from 1998. Telstra instituted Federal Court proceedings that, in part, asserted that even if the ACCC had the power to backdate, the amendment suppressed any power to backdating prior to July 1999.

As the dispute was settled, no decision was ever handed down in relation to the effect of the amendment.

Box 2. Accounting separation

As part of the 2003 amendments, an accounting separation regime was introduced. The sequence below is an abbreviated interpretation of the sequence of events.

1. Industry complained that despite the ACCC's dispute resolution competitors were not getting "the same deal" as Telstra retail.
2. The ACCC argued they didn't have the power to extend the Regulatory Accounting Framework to make it effective.
3. The Department argued the ACCC did have the powers.
4. Industry convinced the Department/Minister that it was necessary to clarify the powers, but that to ensure the powers were used the legislation should include the power for the ACCC to be directed to use its powers.
5. The legislation was introduced with the provision for accounting separation to come about through Ministerial direction, and the ACCC gained no additional powers other than those included in the direction.
6. When the direction was issued it was extremely limited in its effect to a small group of "core services".

The current bills have all the characteristics of these examples. There are amendments referred to as "clarification" but they will have significant substantial effects. There are amendments that only have the effect that subsequent Ministerial directions provide.

Telecommunications policy deserves better than this. The processes of inquiry are littered with participants who describe themselves as experts who are little more than advocates. One of Telstra's frequently used advocates, Mr Henry Ergas, recently commented that;

> *Canadian policy makers take a closer look at Australia's regulatory regime, which is far more relaxed, less administratively burdensome and in most respects more balanced*[1]

This is not, of course, an endorsement of the regime. In a different submission Ergas noted;

> *By granting an incumbent's rivals access to its infrastructure at prices intended to emulate those that would occur in an effectively competitive wholesale market, competition rather than regulation can be relied upon to constrain retail prices, avoiding the need for retail regulation of any kind.*[2]

This is an endorsement of the policy direction adopted by the Government.

[1] H. Ergas and L. Waverman, "Would Canda Benefit from Australia-Style Regulations?", A Submission on Behalf of Bell Canada to the Telecommunicaitons Policy Review Panel, August 2005. Available at http://www.telecomreview.ca/epic/internet/intprp-gecrt.nsf/vwapj/Appendix_D8.pdf/$FILE/Appendix_D8.pdf

[2] H. Ergas and F. Mathewson, "Establishing an Efficient Regulatory Regime for Telecommunicaitons in Canada", A CRA International Submission on Behalf or Bell Canada to the Telecommunicaitons Policy Review Panel, August 2005. Available at http://www.telecomreview.ca/epic/internet/intprp-gecrt.nsf/vwapj/Appendix_D6.pdf/$FILE/Appendix_D6.pdf

Unfortunately, it is necessary to recognise the complexity of arguments and the positions of submitters. There are no experts who can be relied upon – this has even extended to legal proceedings. The decision in the Australian Competition Tribunal review of the Qantas and Air New Zealand merger noted;

> *We note that on many occasions in the present proceeding two experts in particular ... appeared reluctant to respond to questions whose answers might have been adverse to the case put by the party calling them. Instead, they provided non-responsive answers and deviated to discussions of other issues which supported the case of [their clients]. On some occasions, the presiding member asked the experts whether they could answer the question put to them and asked them not to give a long explanation, but to no avail. Such an attitude and conduct of an expert witness leads to a conclusion of partiality and an inability to express an objective expert opinion upon which reliance can be placed.*[3]

Recommendation: The Senate should delay the passage of the Bills and request the Minister to consult more widely with stakeholders on the operation of the amendments to the Trade Practices Act and the provision of operational separation.

3. LTIE test

Schedule 9 of the "Competition and Consumer Issues Bill" introduces an amendment that fundamentally changes the application of the test, though departmental officers apparently believe it is an innocuous clarification.

AAPT submitted at length on the question of whether the regime adequately compensated for investment and risk, and concluded it did. The current amendment, especially when read in conjunction with the explanatory memorandum, would have the consequence of justifying Telstra being compensated for its investment, the risk on new investment, and the cost of stranding its existing investment when the new investment is made.

All the competitive benefits would be lost and most competitors would exit the market. A more complete analysis of this amendment is included in Appendix 1 and includes a paper recently presented by Dr Kris Funston.

Recommendation: That Schedule 9 be deleted from the Bill.

4. Operational separation

There are two immediate concerns with these provisions.

The first is that the process can effectively run forever or until such time as the Minister by directing that the plan will 'include these provisions and no other" writes the plan. This is clearly an inadequate outcome that can only be resolved by providing Telstra with an

[3] The case is at http://www.austlii.edu.au/cgi-bin/disp.pl/au/cases/cth/ACompT/2004/9.html?query=%5e+qantas+air+new+zealand and it is para 222.

incentive to complete a satisfactory plan, e.g. that something akin to the provisions of Schedule 9 could come into effect once the plan was accepted.

The second is that the list of "designated services" is essentially a one off list prepared by the Minister, and the list is not known until after the legislation is passed. The list could consist of few services and therefore be ineffective.

Finally, the process as a whole includes the Minister in too much of the operational process, and the ACCC insufficiently as the accountable agency.

Recommendation: The provisions be reviewed in public consultation by the Department and the Bill reintroduced with the draft Ministerial determination.

5. Telecommunications Commissioner

AAPT's arguments in this regard were fully detailed in our submission to the Telecommunications Regulatory Regime inquiry.

6. Future Review

AAPT applauds the provision of the proposed section 61A of the telecommunications Act included in Schedule 11 of the "Competition and Consumer Issues Bill". However we believe it would be preferable that the provision include a specific reference that the review will be conducted by the Productivity Commission, and that the Productivity Commission not be restricted by inclusion of any additional terms of reference.

7. Conclusion

The Minister and Government need to ensure wider consultation on the mechanisms of their proposals, Such consideration should not delay the ability of the Government to further privatise Telstra.

This industry is too important to allow rushed legislative processes.

APPENDIX 1 – SCHEDULE 9 of the Telecommunications Legislation Amendment (Competition and Consumer Issues) Bill 2005

1. Introduction

In the briefing by the Department of Communications, Information, Technology and the Arts (DCITA) about the draft *Telecommunications Legislation Amendment (Competition and Consumer Issues) Bill 2005*, AAPT was informed that Schedule 9 involves a proposed amendment to the way in which the long-term interests of end-users (LTIE) test is to be applied and interpreted by the Australian Competition and Consumer Commission (ACCC). It outlines that the ACCC must, amongst other things, have regard to future investments that will provide the existing services, and the risks associated with making these investments. While DCITA appeared to be of the view that this combination of amendments merely explicitly formalised the types of considerations that are already being taken into account by the ACCC, and the changes are insubstantial, AAPT has a number of concerns about the proposed changes. In particular, AAPT believes that it is possible for the amendments to be interpreted so that the legislation now requires the ACCC to allow Telstra to claim the risks associated with future investments, such as FTTH, in the access prices of services that are currently provided over its existing assets. This would make it easier for Telstra to successfully claim what is known as a "real option" surcharge on the access price for declared services provided over the existing assets such as the PSTN. AAPT believes that this would not only allow for the over-recovery of the true cost of capital associated with the investment, it legitimises an incorrect application of real option theory to justify significant mark ups in the current access prices for services provided over the existing assets.

2. A Brief Introduction to Real Option Theory, and the Impact of Real Option Theory on the Regulated Access Price

The real option theory of investment is a recent development in the theory of investment, and represents an extension to the traditional neoclassical theory of investment. **Real option theory** is a technique that is more appropriate than the traditional neoclassical approach in assessing whether **new investments** in infrastructure that are subject to **significant**

uncertainty and significant sunk costs, should be undertaken. A real options approach could therefore by applied to new investments where:

- **there is not an established industry standard.** This implies the investment in new technology is more likely to be sunk and subject to significant technological uncertainty; and

- **the speculated future demand relies on the introduction of service applications that will arise in the future, that presently do not exist.** This implies the new technology investment is subject to significant demand uncertainty.

In the context of telecommunications, the above two points suggest that real option theory is more applicable for assessing commercial investments in next generation networks (NGNs) — eg 3G or fibre-to-the-home (FTTH) networks — that deliver new data services, rather than, new investments in the copper that delivers voice and existing data services.

Access providers have argued that a real options approach should be used in determining the access price for regulated investments. A major reason for this appears to be that real option theory leads to exorbitant mark ups or surcharges in the existing access prices that are allowed by the regulator. For example in the US, a real options approach led to the local exchange access provider Pacific Bell (now SBC) in 1996 claiming a 135 per cent mark up in the cost-based access price for links.[1]

It is important to note that no regulator has ever incorporated a real options approach in determining the regulated access price. Further, while the UK regulator Ofcom is currently

[1] Pacific Bell also claimed a 23 per cent mark up on the current access price for links. Ultimately their arguments were rejected by the regulator. Ultimately their arguments were rejected by the regulator. See CPUC, *Interim Decision Setting Final Prices for Network Elements Offered by Pacific Bell*, California Public Utility Commission, Decision 99-11-050, 18 November 1999, at ftp://ftp.cpuc.ca.gov/gopher-data/telecom/d9911050.doc.

considering incorporating a real options approach to determine the allowed fair rate of return on regulated investments, Offcom (2005) has expressed the initial view:[2]

- on p 46, that, it would be inappropriate to use a real options approach to assess new investments in the copper network, as this is not subject to the requisite degree of demand and technology uncertainty for the technique to applied; and

- on p 48, that a real options approach is only applicable to new investments in NGN networks, and is less applicable to investments that deliver the existing core voice and data services over the new technology. It is more appropriate to use when considering new investments that will deliver the high bandwidth services that it is speculated will use the new technology in future.

Finally, it is important to recognise that even if real option theory can be applied commercially to an investment, it does not necessarily mean that a regulator should provide a surcharge on the investment. Amongst other things it is highly debatable that a regulator does in fact regulate access to those services in immature markets. Traditionally, for the services that are regulated, the technology standard has tended to be in place and the demand for the service reasonably consistent or guaranteed. For example, the ACCC has chosen not to regulate SMS or VoIP services for the time being, and while it has chosen to regulate 3G voice mobile termination access services,[3] it has still refrained from regulating data services on the basis that they are too immature.[4]

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[2] Ofcom, *Ofcom's Approach to Risk in the Assessment of the Cost of Capital*, January 2005, at http://www.ofcom.org.uk/consult/condocs/cost_capital/condoc.pdf

[3] ACCC, *Mobile Services Review: Mobile Terminating Access Service — Final Report*, July 2004, available at http://www.accc.gov.au/content/item.phtml?itemId=520596&nodeId=file40e2657cac70b&fn=Final%20report%20-%20mobile%20terminating%20access%20service%20(June%202004).pdf

[4] The ACCC (2004) note on p xvii, that they were not convinced that the data services provided on 2.5G or 3G networks were "sufficiently mature" to warrant regulation.

3. Telstra's Previous Real Options Arguments & How Telstra Can Exploit the Amended Legislation to Inappropriately Claim a Real Option Surcharge on Existing Assets

Telstra has not yet claimed a real option surcharge on any of its new investments. However, it indicated in 2001, that it while it would not at that time claim any real option surcharge on PSTN origination and termination access charges, it believed such a mark up was likely to be appropriate in the future. Consequently, a real option surcharge was included in the access price, but to avoid any public debate over the issue, set equal to zero.

If Telstra were currently to claim a positive real option surcharge was required for *new investments* in the fixed-line copper network — ***it cannot and should not be allowed to claim such a surcharge for existing investments in the network*** — it faces the problem that generally economists do not consider there to be the significant uncertainty associated with such new investments.[5] For example, even if it could be maintained that PSTN voice services were falling, this is at least being partially, if not fully offset, by the increase in xDSL services. Further, it has been suggested by Hubbard and Lehr (2000) that a correct analysis of the real option theory would actually recognise the impact of internet technologies, which have tended to increase the value of the existing investments in the local exchange.[6] According to the authors the impact of this on existing assets, offsets any surcharge required on the new investments, and could even lead to an overall decrease in the access price being required.

The combination of the proposed amendments could be interpreted as requiring that the ACCC must provide Telstra with compensation for those risks associated with providing the existing services on a future networks, in the access prices on Telstra's existing network. If

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[5] For example, J. Gans and S. King, "Access Holidays for Network Infrastructure Investment", *Agenda* 10, pp 163-4, note that augmentations to fixed line telephony often carry little risk.

[6] R.G. Hubbard and W.H. Lehr, "Telecommunications, The Internet, and The Cost of Capital", in I. Vogelsang and B.M. Compaine (eds.), *The Internet Upheaval*, MIT Press, 2000. An earlier draft of this paper is available at http://www.gsb.columbia.edu/faculty/ghubbard/Papers/HubbardLehr_TPRC_Dec99.pdf

this is the case, then it is more likely that a claim for a real option surcharge on existing investments in the fixed-line copper network would be successful. The logic is as follows. It is reasonable to assume that in the future, existing services over the fixed-line copper network will be provided over a FTTH network. Therefore, a regulator that is required to take into account the risks associated with future technology investments, will have to consider the risks associated with a new FTTH investment. As based on the discussion in Section 2, a new FTTH investment is more likely to warrant the application of a real options approach, a regulator under a requirement to take into account risks associated with future technologies, may now have to incorporate a real option surcharge in the access price for existing services provided over the copper network. This occurs even though it contradicts the proper application of the real option theory of investment, which should only ever be applied to examine new investments, not existing or historical investments in the network. Schedule 9 therefore allows for the opportunistic application of real option theory by Telstra, and means that:

- the Government would be allowing the access price for the existing copper network to cross-subsidise a FTTH network that Telstra has not yet even invested in. It may have simply contemplated an investment in such an asset. It is a reward for contemplating, not undertaking a new investment; and

- Telstra could potentially be allowed to "double-dip" and be substantially over-compensated for the investment at the expense of access seekers. The reason is that Telstra would still be able to claim a real option surcharge once the new investment in the FTTH network is actually made. While not necessarily agreeing that the provision of a surcharge in the fair rate of return to Telstra is appropriate once the **new investment** has been made — other issues outlined by Funston (2005) still need to be considered by the regulator[7] — it would at least be a more correct application of the theory, compared to simply allowing for a surcharge on the existing copper network.

[7] K. Funston, "Real Option Theory: A Real Option for Telecommunications Regulation?", A Paper prepared and presented to the International Telecommunications Society Africa-Asia-Australasia Regional Conference, Curtin University of Technology, Perth, Western Australia, 28-30 August 2005.

4. Conclusions

While Telstra has not previously requested a real option surcharge on its existing copper network investment, it has canvassed the possibility of claiming this surcharge at some time in the future. AAPT believes that in the event of the proposed phase out of the Access Deficit Contribution (ADC) on the copper network, Telstra is more likely to request a positive real option surcharge on the copper network sooner, rather than later. AAPT considers that as it currently stands, Schedule 9 increases the likelihood that Telstra will be able to successfully claim for such compensation. As outlined in this note, this would provide Telstra with substantial over-compensation for the cost of capital of its existing asset, and would represent an inappropriate method of compensation, as real option theory should only apply to new investments.

Real Option Theory: A Real Option for Telecommunications Regulation?*

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Abstract

The existence of uncertainty and sunk costs in telecommunications investments has led to an emerging number of papers promoting the adoption of real option theory to assist in determining the regulated access price. This paper reviews and assesses arguments for and against the use of real option theory in telecommunications regulation. Advocates of a real options approach have maintained that an access provider should be compensated for regulation extinguishing a call option to delay the investment, but this is likely to be inappropriate. Not only does it ignore the increased growth opportunities that often exist in telecommunications once an investment in infrastructure is made, more significantly it compensates the access provider for the loss of market power that results from regulation. While it may be appropriate for regulators to adopt real option theory to account for the impact of "regulatory truncation" on investments in new services, the need to include any real option surcharge diminishes if the investor vertically integrates its downstream retail functions with this investment in the network.

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* This paper has been prepared for the International Telecommunications Society Africa-Asia-Australasia Regional Conference, Curtin University of Technology, Perth, Western Australia, 28-30 August 2005.

r I would like to thank Dr Robert Albon, David Havyatt and Phong Ngo for their comments and suggestions regarding the work in this paper. All errors contained in this paper are of course my own. Further, the views expressed in the paper are solely my own and do not necessarily represent the views of AAPT.

1. Introduction

The capital-intensive nature of regulated telecommunications investments means that the allowed fair rate of return on capital set by the regulator has become a crucial determinant of the cost-based access price. If the allowed fair rate is set too low, the regulated access price under-compensates the access provider for the investment, which will deter future upgrades of its existing facilities. If the allowed fair rate is set too high, then the regulated access price could lead to significant consumer welfare loss in the downstream retail market.

Telecommunications regulators in numerous countries have adopted an approximation of the long-run marginal cost on the total service, to determine the appropriate cost-based price to be paid by access seekers for interconnection.[1] This involves using neoclassical investment theory or the net present value (NPV) rule, which allows the access provider to earn a fair rate of return on the investment comprised of a commensurate rate of return on an asset of equivalent risk, and a rate of return of the asset. One criticism of the approach is that neoclassical investment theory sets the allowed fair rate below the user cost of capital and under-compensates the access provider, as it fails to deal with the interaction between sunk costs and uncertainty — key features of telecommunication network investments. It is argued that to compensate the access provider adequately for such an investment, real option theory should instead be used.

The real option theory of investment is a method of valuing the options that exist when new investments are made in real assets that are subject to irreversibility and uncertainty. Advocates of adopting a real options approach in telecommunications access regulation claim that, when faced with uncertainty the ability of an access provider to defer an irreversible investment in a network is something of significant value that should be taken into account through some type of real option surcharge.[2] Professor Jerry Hausman appears to have been the first to raise real option arguments in his written submission to the Federal Communications Commission (FCC) in 1996.[3] Since this time there has been academic debate over whether or not a real options approach should be adopted to price telecommunications access. Evidence of this debate is highlighted in the book by Alleman and Noam (1999).

Although the use of real option theory was initially rejected by the regulator in the US, other regulators seem to be considering the possibility of incorporating a real options approach. For example, in New Zealand, the Commerce Commission (2002) states on p 79 (para 357) that:

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[1] For example, in Australia the ACCC has adopted the Total Service Long-Run Incremental Cost (TSLRIC) to price access, while in the US the FCC has employed the Total Element Long-Run Incremental Costs (TELRIC) method. For further detail about this type of cost-based access pricing see King and Gans (2004a) or AAPT (2005) Appendix A.

[2] See Hausman (1997, 1999) and Alleman (1999, 2002) and Alleman and Rappoport (2002).

[3] See *Reply affidavit of Jerry Hausman*, *In the Matter of Implementation of Local Competition Provision in the Telecommunications Act of 1996*, CC-Docket No.96-98, 30 May 1996. The arguments put forward in his testimony were later more formally presented in the Hausman (1997, 1999) papers.

> …the obligation to provide interconnection services removes the option for access providers to delay investment in their fixed PSTNs. If this option has a value, the costs of foregoing the option is a cost that should be reflected in interconnection prices.

Further, in the UK, Ofcom (2005) outlined its initial view (p 48, para 6.45) that it should consider ways to estimate the value of the real option to delay investment — or what it refers to as a "wait and see option" — for British Telecom's (BT's) next generation networks (NGNs).

This paper critically assesses whether or not real option theory should be used to regulate access in telecommunications. It does not seek to question the well-established literature on the real option theory of investment, or the use of real options by private firms to make commercial decisions about investments. In the context of access regulation it has been suggested by Ergas and Small (1999) that real option theory should be used to calculate the appropriate premium for what the Productivity Commission (2001a, 2001b, 2004) has labelled the "truncation problem". This paper assesses the application of real option theory to telecommunications, before proceeding to examine the truncation problem and the appropriate regulatory response.

The structure of the paper is as follows. Section 2 briefly contrasts the neoclassical theory of investment with the real options approach. Section 3 examines the real option to delay the investment and uses a simple numerical example to illustrate the difference between the NPV and real option approach. Section 4 assesses the argument made for the regulator to compensate the access provider for its call option to delay the investment. To do this it looks at; the applicability of real option theory to telecommunications investments; the increased growth opportunities, or "put option", which can arise once a telecommunications investment is made; the first-mover advantage and the incentive to strategically pre-empt investment; and the potential for the real-option-to-delay surcharge to compensate the access provider for lost market power that results from regulation. Section 5 analyses the truncation problem arising from access regulation, and the potential for the use of real option theory. Section 6 concludes the discussion.

2. Neoclassical Investment Theory versus the Real Option Theory of Investment — A Brief Introduction

Traditional neoclassical investment theory states that, *the firm will undertake an investment if the present value of future expected net revenue streams — usually discounted by some risk-adjusted discount rate — is greater than or equal to the direct cost of investment, or alternatively, the net present value of the project is greater than or equal to zero (i.e. NPV ≥ 0).* Although this so-called "NPV rule" is commonly used to evaluate projects, critics such as Dixit and Pindyck (1994) point out that it implicitly assumes the investment is reversible, and that the investment involves a "now or never" decision. That is, it does not account for the sunk costs which arise from investments in industry-specific productive capital, and assumes that there is a binary investment decision, where if the investment is not immediately undertaken, it is foregone forever. These assumptions neglect the important role managerial

flexibility plays in determining the timing and scale of new investments that are the subject of uncertainty and irreversibility. Consequently, critics assert that "the simple NPV rule is not just wrong; it is often very wrong",[4] and it is one reason "why neoclassical investment theory has failed to provide a good empirical model of investment behaviour".[5]

By using the Black and Scholes (1973) technique for valuing financial options, a technique was established for valuing the options that exist when a firm considers undertaking an uncertain and irreversible investment in a real asset. Known as the real option theory of investment, it recognises the importance of managerial flexibility to adapt its future actions in response to altered and uncertain market conditions. While Trigeorgis (1993) and Lander and Pinches (1998) review and summarise the many different types of real options that have been used to analyse a wide range of topics,[6] it is recognised that economists have tended to analyse the real option to wait or to delay the investment.[7] As arguments for compensating the access provider for a lost real option to wait have also typically arisen in the context of challenges to telecommunications access regulation, the following Section examines the real option to delay the investment in greater detail.[8]

3. The Real "Call" Option from Delaying the Investment

Real option theory contends that the ability of the investor to defer an irreversible and uncertain investment is something of significant value, as it allows an investor to receive new information as time passes, which assists in resolving some of the uncertainty surrounding the investment. The ability to defer the irreversible investment provides the investor with something similar to a financial option, known as an American call option.[9] That is, the firm has the opportunity, but not the obligation, to undertake the investment at some future point in time. Given that the investor holds this valuable option, when the investment does actually occur, and the firm "exercises" its option to invest, it foregoes the opportunity to defer the investment and wait for further information to arrive. As this is an additional opportunity cost associated with undertaking an investment, it must be added to the direct costs in order for the appropriate investment decision to be made. Taking this call option to invest into account, the NPV rule must be modified so that under real option theory, *the firm only undertakes an investment in any period if the present value of the future expected revenues generated by the investment minus the direct investment costs, are greater than or equal to the value of the option to invest* (*i.e. NPV ≥ Option to Invest*). Using "reasonable parameter values",

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4 Dixit and Pindyck (1994) on p 136.

5 Pindyck (1991) on p 1112.

6 An example of a website highlighting the many different applications of real option theory, is available at: http://www.puc-rio.br/marco.ind/ro-links.htmlThe real option literature.

7 Alleman and Rappaport (2002) outline this on p 391, and cite for their examples, the work done by McDonald and Siegel (1986) and Dixit and Pindyck (1994).

8 For example, Ofcom (2005) states (p 44, para 6.33) that "BT's recent submission to Ofcom focused on the value of wait and see options, focusing on the incentives that, absent regulatory intervention, give an incumbent incentives to delay investment."

9 Unlike financial options, real options are generally not tradeable.

McDonald and Siegel (1986) show that the value of the option to wait is significant, and leads to the sunk investment only being undertaken if "the present value of the benefits from a project is *double* the investment cost."[10]

To demonstrate the value of the option to wait, a numerical example is worked through in Box 1. This compares the results from the traditional NPV approach and the real option theory of investment. The example is similar to those employed by Dixit and Pindyck (1994) on pp 26-30, and highlights amongst other things, how the value of the option to invest is derived from the ability to asymmetrically alter the payoffs under uncertainty, and how the real option to delay represents an additional opportunity cost of undertaking the investment.

Box 1 The Value of the Real Option to Delay the Investment: A Simple Numerical Example

To capture the essence of real option theory for an irreversible investment under uncertainty, it is assumed here for simplicity that the uncertainty being modelled in this example is:
- only over the net cash flows π;
- all resolved after just one year i.e. at time t =1; and
- binomially distributed.

In addition to these properties of uncertainty, it is assumed that:
- the investor is risk neutral;
- once the irreversible investment of I = \$6000 is made, the project is instantaneously operational, immediately generating a net cash flow to the investor;
- the net cash flow π at time t = 0 (i.e. π_0) is certain and equal to \$300, but at time t = 1 the net cash flow may increase with probability p = 0.5 to π^+ = \$350 or decrease with probability (1-p) = 0.5 to π^- = \$250. The net cash flow will remain at the resulting level from time t = 1 onwards (i.e. t = 1, 2…∞); and
- the risk over future net cash flows is fully diversifiable so the firm can discount cash flows using the risk-free interest rate r_f = 0.05 or 5%.

Using these assumptions, the traditional NPV approach yields,

$$\text{NPV} = -\$6000 + \$300 + \sum_{t=1}^{\infty} \frac{0.5*\$400 + 0.5*\$200}{(1+0.05)^t} = \$300 \qquad \text{(B.1)}$$

As the NPV > 0, under standard neoclassical theory, the investment in the project is undertaken. However, if the firm has the managerial flexibility necessary to delay the investment, this would be a mistake. The reason is the immediate investment ignores the opportunity cost associated with foregoing the opportunity to invest in the instance when the net cash flow increases in period 1. This is highlighted by calculating the NPV of holding the "option to invest" in the following period when the net cash flow rises to \$400:[11]

$$\text{Option to Invest} = \$0 + 0.5*\left[-\frac{\$6000}{(1+0.05)} + \sum_{t=1}^{\infty} \frac{\$350}{(1+0.05)^t}\right] + 0.5*\$0 = 0.5*\left[-\$5714.29 + \$7000\right] = \$642.86 \qquad \text{(B.2)}$$

Hence, an investor with flexibility will want to postpone the irreversible investment until the following year, as the "option to invest" of \$642.86 exceeds the NPV from investing at time 0. By investing time 0, the firm foregoes \$342.86, which is the *additional opportunity cost of investing today*, and the real option to delay the investment. That is,

$$\text{Option to Delay or Wait} = \text{Option to Invest} - \text{NPV} = \$342.86 \qquad \text{(B.3)}$$

[10] McDonald and Siegel (1986) at p 708.

[11] In the instance when the net cash flow decreases the firm chooses not to invest. Part of the attraction of the "option to invest" is therefore that management — by accounting for the asymmetry of the outcomes — is able to skew the distribution of possible outcomes towards the upside.

Box 1 A Simple Numerical Example (Cont)

Alternatively, this $342.86 figure can be thought of as representing the price that an investor is willing to pay to acquire the managerial flexibility necessary to defer the investment for one period.

Following Holm (2000) on p 62, the value of the option to delay the investment is broken into three components:

(i) The lost net cash flows from not investing at time t = 0 (i.e. $-\pi_0$), which is equal to -$300;

(ii) The cost saving from deferring the investment until time t = 1 (i.e. $I - \frac{I}{(1+r_f)}$), which is equal to $285.714; and

(iii) The expected value from avoiding the bad outcome (i.e. $(1-p)*\left(\frac{I}{1+r_f} - \sum_{t=1}^{\infty} \frac{\pi^-}{(1+r_f)^t}\right)$), which is equal to $357.143.

It is evident from this that the value of the option to delay the investment is driven by the magnitude and likelihood of the bad outcome. This is consistent with Benanke (1983), who notes that, the willingness to undertake an investment depends only on the severity of the bad news, and the potential good news does not matter at all. He refers to this outcome on p 91 as the "bad news principle of irreversible investments". Dixit and Pindyck outline a similar result on p 40, stating that it is "the ability to avoid the consequence of "bad news" that leads the investor to wait".

In the example here, holding all other things equal, an increase in the probability of the bad outcome to 0.75 increases the value of the option to delay to $521.43. Meanwhile, if the overall expected net cash flow was to remain unchanged, but the net cash flow in the bad state decreases to $200 (i.e. there is a mean-preserving spread), then the value of the option to delay will increase to $842.86.

4. Real Option Theory and Telecommunications Regulation

Advocates of adopting real option theory in telecommunications access regulation have claimed that regulators fail to compensate the access provider for the real option to wait. The argument is that by mandating the provision of access and not recognising the additional opportunity cost the real option to wait imposes on the investment, the regulator destroys the ability of an access provider to defer the investment and provides the real option to access seekers for free. Hence, to adequately compensate the access provider for the lost call option to wait, and maintain incentives for efficient future investment in telecommunications networks, the allowed fair rate of return must be increased.

As noted, the first time such real option theory arguments appear to have been used to critique access pricing regulation in telecommunications was by Hausman, in a submission prepared on behalf of the incumbent local exchange carrier Pacific Bell to the FCC in 1996. In this, Hausman calculated that the mark up required to compensate for the lost call option to delay the investment, by employing the theoretical framework of McDonald and Siegel (1986), and the parameter values of Dixit and Pindyck (1994). He subsequently estimated that a 3.2-3.4 times mark up was required in the access price on the investment component of the unbundled network elements (UNEs) of the Pacific Bell local exchange that were considered sunk. As the proportion of sunk costs on links was 0.59 and on ports 0.10, Hausman concluded that a

135 per cent mark up was required on the cost-based charge for use of links, and a 35 per cent mark up was required on the cost-based charge for the use of ports.[12]

Hubbard and Lehr (1996) provide a detailed critique of the Hausman analysis. One of their arguments on p 10 is that, "Hausman offers no justification for his application of the basic McDonald-Siegel problem to the telecommunications case under consideration." In particular, the authors questioned the appropriateness of employing the McDonald and Siegel framework to telecommunications as it assumes the investment can be indefinitely deferred, something that is unrealistic when competitive entry is possible. By augmenting Hausman's analysis with a Poisson jump, so that the model could take into account the impact of competitive entry, Hubbard and Lehr showed that the proposed mark up for the real option to delay the irreversible investment fell significantly. Further, Holm (2000) outlines on p 83 that the Dixit and Pindyck numbers employed by Hausman are "based on reasonable not necessarily representative parameters", and that these "chosen parameters have *nothing* to do with the telecom industry."

The arguments of Hausman were ultimately rejected by the California Public Utilities Commission (CPUC), which determined that the appropriate access price for UNEs should be based upon a total element long-run incremental cost (TELRIC) model with a 19 per cent mark-up to recover the shared and common costs.[13] While it appears no regulator has yet permitted the access provider to recover a call option to delay the investment in the allowed fair rate of return, regulators in New Zealand and the UK have shown a willingness to consider real option arguments. To guide the regulator in determining whether or not it is appropriate to compensate the access provider for the real option to wait, it should consider the following:

- The uncertainty and irreversibility of new telecommunications network investments;
- Whether the focus on a call option to delay the investment is too narrow;
- Strategic factors or any first-mover advantages that might motivate the access provider to invest earlier, rather than delay the investment; and
- Whether compensating for the call option to delay the investment, provides the investor with a return for market power that is lost due to regulation.

The following sub-sections address each of the above issues.

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[12] Similarly, Alleman (1999) outlines on p 173, that by not taking real option theory into account, the cost model used by regulators could underestimate the access price by as much as 60 per cent.

[13] See CPUC (1999). For a summary of Hausman's arguments and the proposed access pricing mark up, see pp 21-7.

4.1 Uncertainty and Irreversibility of New Telecommunication Network Investments

It is generally maintained that telecommunications investments are subject to significant irreversibility and uncertainty, because:

- a substantial portion of new network investments have little, if any, resale value; and

- rapid technological progress, and constantly changing demand in the industry means that the profitability of additional network investments is highly uncertain.

Some economists have though, expressed doubts over whether real option theory should apply to all new investments in telecommunications networks. For example, Hubbard and Lehr (1996) and Economides (1999) question the level of irreversibility and uncertainty of new investments by the incumbent in the local exchange in the US.[14] Hubbard and Lehr state on p 13 that,

> …much of the switch and switching center investment is clearly not irreversible. Switches can be moved to new locations and the end-office real estate can be sold. Rights of way, conduit, and even excess wire-line facilities which may faced reduced demand for ordinary telephone lines, may be sold for other uses (such as delivery of video to the home via technologies such as ADSL).

Economides outlines on p 211 that:

- those new investments in the local exchange that are sunk, such as new investments in the local loop, are unlikely to experience much demand uncertainty; and

- those new investments in the local exchange which are likely to be subject to significant technological and demand uncertainty, such as electronic equipment, "can be moved and/or resold at almost full value, or can be used for other functions."

Although the above analysis specifically evaluates new investments in the US local exchange, it highlights that both the level of irreversibility and uncertainty — and hence, instances where real option theory may apply — varies significantly, depending upon technological characteristics of the new investment, and the demand for the service that the new investment provides. For example, a new investment in a well-established technology, where there is a pre-existing customer base and a consistent pattern of demand, is unlikely to experience the level of uncertainty for real option theory to apply. In contrast, an investment in a new technology that is not an industry standard, and which relies upon the introduction of new service applications in the future, is likely to be subject to a significant level of technological and demand uncertainty, and may warrant a real options approach. This implies that standard neoclassical investment theory may be appropriate for commercially assessing new investments in the local loop, while real option theory may be appropriate for evaluating the

[14] Similarly, in a slightly different context, Gans and King (2003) note, in assessing high-risk infrastructure investments on pp 163-4, that augmentations to fixed line telephony "often carry little risk."

new investments in next generation networks (NGNs), such as fibre-to-the-premises or home (FTTP/FTTH) or third generation (3G) mobile networks.[15]

In the context of regulating access in telecommunications, the analysis suggests that regulators only need to consider compensating for a lost real option to wait, when regulating a new network investment that is subject to a high degree of technological and demand uncertainty. Therefore, as Ofcom (2005) notes on p 46, a real options approach should not be used to compensate BT for access to its copper network. Further, Ofcom draws an important distinction (on p 38, paragraph 6.4) between investments that deliver existing voice and data services using the new technology — i.e. next generation core network (NGCN) investments — and those investments that deliver the high bandwidth services that it is speculated will use the new technology in future — i.e. next generation access network (NGAN) investments. As there is likely to be technological and demand uncertainty associated with NGAN investments, but possibly only technological uncertainty associated with NGCN investments, Ofcom comes to an initial conclusion on p 48, paragraph 6.45, that it should consider methods for estimating the real option to wait on NGAN investments that are regulated, and "to a lesser extent", the real option to wait on NGCN investments subject to regulation.

It appears though that regulators already do appreciate some of the risks associated with investments in new technologies, and do not choose to regulate those services provided by these new technologies that experience uncertain demand. An example of this can be seen in is the decision by the Australian Competition Commission (ACCC) on the mobile termination access service. The ACCC (2004) decided to regulate the mobile termination access service for voice on 3G infrastructure,[16] but significantly chose not to regulate the data services, where there is still some uncertainty over the level of future demand for multimedia high bandwidth wireless services. It could even be argued that the regulator has therefore allowed early investors in 3G technology to obtain the benefit of any first-mover advantage.

4.2 Taking into Account Call Options and Put Options in Telecommunications

While the real options literature traditionally emphasises the irreversibility of the uncertain investment, and the resulting call option to delay, Abel, Dixit, Eberly and Pindyck (ADEP, 1996) develop a two-period model that examines an investment under uncertainty where there is an arbitrary degree of reversibility. Due to the assumption of reversibility, this framework not only considers the call option associated with deferring the investment, but also the put option that arises from the ability to resell the installed capital. Assessing these two options the paper shows that when the put option is of greater significance than the call option to

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[15] In outlining Sprint's views on the commercial use of real options in telecommunications, an example that Nevshemal and Akason (2002) provide of a "capital-intensive telecom technology bet" where the theory can be used, is the 3G build out. Real option theory appears suitable for analysing such decisions, as the investment in infrastructure is sunk, and the voice service aside, 3G faces uncertainty over the level of demand for the multimedia high bandwidth wireless services that it provides. For an example of a recent paper that uses a real option theory to analyse the migration towards 3G investments see Tanguturi and Harmantzis (2005).

[16] The ACCC (2004) note on p xvii, that they were not convinced that the data services provided on 2.5G or 3G networks were "sufficiently mature" to warrant regulation.

delay the investment, the user cost of capital to the investor is potentially less than the standard neoclassical user cost of capital.

Hubbard and Lehr (2000) outline that real option theory, has important implications for pricing telecommunication investments. They argue that the original debate focused too narrowly upon the value of the call option to delay the new investment, and the problem of the allowed fair rate set by standard neoclassical investment theory underestimating the true cost of capital to the access provider. Hubbard and Lehr suggest that the emergence of the Internet and technologies such as xDSL on copper has increased the value of embedded telecommunications investments in the local exchange, leading to a more general framework being required to assess the appropriate user cost of capital. Hubbard and Lehr therefore adopt the ADEP model, as it incorporates the notion that whilst investing today extinguishes an option to defer the investment, it also provides the investor with a benefit of additional growth opportunities and the strategic flexibility to adjust capital in the future. That is, contrary to the arguments of Hausman (1997, 1999), the original investment may not actually narrow the opportunities available to the firm, but increase them.

Hubbard and Lehr examine the various effects that the Internet has on the call and put option, and the user cost of capital. Some examples the authors provide are that:

- As the internet is based on open standards, it allows interoperability and flexible interconnection between heterogenous equipment, which lowers the cost of constructing and maintaining the existing network, and increases the value of the call option to delay;

- Internet networks are more flexible than traditional circuit-switched networks, and new technologies can be more easily integrated and new service more easily supported. This enhances the reversibility of the network — increasing the put option — and decreases the cost of expanding the network — increasing the call option; and

- Internet protocols have increased the number of potential applications that can be supported on the existing physical infrastructure, which increases the value of the put option.

Overall the authors indicate that the Internet is likely to reduce the value of the call option to delay, while increasing the value of the put option associated with increased growth opportunities and strategic flexibility. Therefore, whether or not the allowed fair rate of return determined using traditional NPV theory is higher of lower than the true user cost of capital for the regulated investment, will now depend upon which of the two options is more important. If the put option is significantly more important, the allowed fair rate of return using neoclassical investment theory over-compensates the access provider for its investment.

The framework of Hubbard and Lehr has important implications for those access providers who argue that the regulator should still apply real option theory when incremental new investments are being made to existing network infrastructure, such as the local access network. It suggests that the appropriate application of a real options approach to such

investments should take into account both the call and put options, which could potentially lead to the regulator recommending a decrease in the allowed fair rate of return.

4.3 Strategic Pre-Emption and the First-Mover Advantage

It is important to understand the outcomes for investment under uncertainty in a duopoly or oligopoly framework, as Weeds (2002) notes on p 729 that, "the option to invest cannot be held independently of strategic considerations." However, research in this area combining real option theory and game theory is still in its infancy. One reason for this is that the work requires the application of game theory to continuous time models, which is not yet that well developed.

From the work that has been done, it appears that the first-mover advantage and the incentive to strategically pre-empt the investment can decrease, or even eliminate the real option to wait that arises due to uncertainty and irreversibility.[17] As Weeds notes on p 729, in a framework where there are a small number of firms and there is a first-mover advantage in the industry, each firm's ability to delay the investment is undermined by the fear of pre-emption, and the traditional NPV rule will be appropriate for appraising the investment. Further, a recent paper by Mason and Weeds (2005) examines the real options in a duopoly framework when there is an advantage from investing and positive network effects between investing agents. The authors show that with increased uncertainty, rather than leading to further delay — as was the case in a standard real options framework — there is now an incentive to invest earlier.

It is these arguments about strategic pre-emption that leads Economides (1999) to claim in relation to the US local telephony market on pp 211-2 that,

> In the current oligopolistic environment with anticipation of competition, firms invest looking forward to competition and cannot afford to wait; the value to an ILEC of waiting to invest may well be negative.

Hubbard and Lehr (2000) outline that while it may be possible to defer an investment, this delay could lead the access provider to miss an industry bandwagon or forego a first-mover advantage. Although the authors acknowledge that the ability to assess the impact of a first-mover advantage is limited in the two-period ADEP model, they discuss intuitively what would happen if the analysis could be extended to a more dynamic framework. They conclude that a first-mover advantage decreases the call option value, but increases the put option value. These two effects combine to reduce any mark up that might be required in the allowed fair rate of return. To more meaningfully evaluate the first-mover advantage, the authors suggest that future research should develop a more general dynamic framework, where some form of heterogeneity is incorporated in the distribution of future returns depending upon the order in which firms enter the market.

An implication of the above results is that in a duopoly or oligopoly setting, the regulator may not need to compensate the access provider for any lost option. This is because the private

[17] Gans and Williams (1999) highlight the impact that strategic pre-emption has on investment in infrastructure, in a framework where there is no uncertainty.

incentives or motives of the access provider to derive a first-mover advantage and to strategically pre-empt the investment, may have already extinguished the real option to wait. Finally, as Clarke (1999) notes on p 223, in telecommunications,

> …gains typically do not flow to those who wait, but rather are reaped by those who can become "first movers."

4.4 The Real Option to Wait — Compensation for Lost Market Power?

Much of the original analysis examining irreversible investments under uncertainty, considered the outcome for a monopoly investor.[18] While it is shown by Leahy (1993) and Dixit and Pindyck (1994) in Chapter 8 that the single firm in a competitive market framework requires the same price threshold above cost as a monopoly investor in order to undertake the irreversible investment under uncertainty, it is established that the value of the real option to wait or remain uncommitted is competed away and will be equal to zero. This result suggests that the following questions need to be asked.

Is it appropriate for the regulator to compensate the firm for the value of a lost option to wait? If a regulator is subject to a statutory duty to simulate the effects of perfect competition, then the result suggests that the regulator should set the value of the lost option to wait equal to zero.

By claiming compensation for a loss of the real option to wait, are access providers simply requesting compensation for the loss of market power that is associated with regulation forcing them to provide access and increase the level of investment? If this is the case, then the real option surcharge that has been argued for by access providers may suffer from the same sort of problems that Tye (1994) identified with the Efficient Component Pricing Rule (ECPR). That is, the access provider is able to claim or reclassify lost economic rents as an opportunity cost of it supplying access services. It is interesting to note here that Jamison (1999) formally shows a link between the ECPR and real options approach, outlining that both identify an additional opportunity cost of production.

5. The "Truncation Problem" and Real Option Theory

In Australia, Inquiry Reports by the Production Commission into *Telecommunications Competition Regulation* (Productivity Commission, 2001a) and the *National Access Regime* (Productivity Commission, 2001b), emphasised the importance of access regulation encouraging future investment in essential infrastructure. Significantly, a concern raised in both reports was that for sunk investment expenditures subject to a high degree of risk, access regulation could potentially lead to what was described as a "truncation problem".[19] The truncation problem is also highlighted in detail by Gans and King (2003, 2004b).[20]

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[18] See Leahy (1993) on p 1105.

[19] See Chapter 9 of Productivity Commission (2001a) and Chapter 11 of Productivity Commission (2001b).

[20] Kolbe, Tye and Myers (1993) and Kolbe and Tye (1995) identify a similar type of problem when dealing with stranded costs in the US electricity industry. They refer to it as a problem of "regulatory risk". While Hausman and Myers (2002) note that the cost-based access pricing regulation used by the US Surface Transportation Board (STB) for rail, creates what they refer to as "asymmetric risk".

The truncation problem resulting from *ex post* access regulation of an asset can be understood as follows.[21] Imagine that there is an irreversible investment in essential infrastructure subject to a high degree of risk, which in the absence of regulation is considered viable because it yields a positive expected net present value. After the firm commits to the irreversible investment there are three possible scenarios that can emerge — the project may be unsuccessful, moderately successful, or very successful. Where the project is unsuccessful or only moderately successful, competitors do not want to access the essential infrastructure and enter the market. However, in circumstances when the investment is very successful and there is high demand, there will be strong incentives for the competitor to enter. If the regulator *ex post* allows competitors to access the essential infrastructure in the successful state, it decreases the high returns that can be earned from the investment. The prospect of *ex post* regulation truncates the potential upside returns from the investment, but still subjects the investor to the downside returns. An investor recognising the potential for *ex post* access regulation, therefore derives a lower *ex ante* expected rate of return from the investment, and has a lower incentive to invest. It may even be the case that the prospect of *ex post* regulation could lead to the investor deriving an expected net present value that is negative, and ultimately prevent socially-beneficial essential infrastructure from being provided.

A suggestion by the Productivity Commission for overcoming the truncation problem on such regulated investments, is to allow the access provider a mark up, or what they refer to as a "truncation premium" on the allowed fair rate of return. This allowed fair rate that is set *ex post* by the regulator removes the problem of truncation by covering all the relevant *ex ante* risk that is faced by the investor. To calculate the premium the regulator could use an arbitrary method, such as allowing for an increased beta on the allowed return on equity. It is evident though that the use of real option theory is ideally suited for calculating or estimating the size of such a premium, as it explicitly deals with such irreversible and uncertain investments.[22] Adopting this approach, the estimate for the real option to wait would now be equal to the required premium on the allowed fair rate.

Gans and King (2003) however, outline problems associated with the regulator being able to *ex ante* commit to a higher fair rate of return if *ex post* access regulation occurs. For example, they suggest on p 166 that regulators do not have the necessary discretion over access prices to allow for such mark ups, and that estimating the size of the premium will be difficult, as an access provider will have an incentive to overstate the *ex ante* risk to increase its allowed fair rate of return. Consequently, the authors propose the use of an "access holiday" arrangement, which acts like a patent, creates the incentive to invest by allowing the investor a period where it faces no access regulation.

Further, it is not clear that it will be appropriate to provide a truncation premium (or access holiday) where the access provider vertically integrates a new investment into a downstream market. In such instances it may not be necessary to provide a truncation premium; if the

[21] Gans and King (2003) provide a discussion and numerical example highlighting the truncation problem on pp 164-6.

[22] See Small and Ergas (1999).

investor is able to dominate the downstream market, there will not be quite the same adverse consequences associated with setting a fair rate or return or access price that is too low. For example, the Productivity Commission (2001a) observed on p 396, that in relation to the public switched telecommunications network (PSTN), even if Telstra's cost-based access price were set too low, the impact of this would be more than offset by the rents that accrued at that time from its dominant downstream market position. So, even if the access price were set too low, an investor that vertically integrates the investment into its downstream retail market operations will still be able to gain a competitive advantage over its rivals by increasing the effective cost faced by access seekers through discrimination on non-price terms and conditions. This behaviour has been referred to by Beard, Kaserman and Mayo (2001) as "sabotage", and the problem of a vertically-integrated supplier engaging in sabotage has been recognised in recent statements by the Chairman of the ACCC.[23]

6. Conclusion

This paper illustrates that if real option theory is applied by the regulator to assess telecommunications investment, the impact on the regulated fair rate of return will depend upon the following factors:

- **The uncertainty of the returns derived from the new investment.** If the demand for service supplied by the new technology is reasonably certain, there is less of a case for the regulator to apply a real options approach to the new investment. Further, as highlighted by Hubbard and Lehr (1996), the assumption about the type of uncertainty could significantly impact the upon the level of any mark up that is required.

- **The reversibility of the asset.** If the asset is reversible (i.e. has a high resale value) then the investor will have a put option on the asset. As Hubbard and Lehr (2000) outline, the technological convergence created by the Internet is likely to reduce the value of the call option, while increasing the value of the put option. The overall result is that the allowed fair rate of return set using the NPV approach may actually exceed the true user cost of capital to the investor.

- **Whether other factors play a more significant role in the investment decision**. Strategic pre-emption and the first-mover advantage may significantly influence the private investment decision. This means that the real option to wait would be less of a consideration when undertaking future investments and it can potentially be ignored by the regulator.

[23] See Graeme Samuel, "Current State of Telecommunications Regulation", Address to the Australian Telecommunications User Group (ATUG), Sydney, 10 March 2005, available at: http://www.accc.gov.au/content/item.phtml?itemId=591603&nodeId=file422f9e9581125&fn=20050310%20ATUG.pdf

- **Whether or not an access provider should be allowed to recover a call option to delay the investment, when this option has zero value in a competitive framework.**

When the new investment in the telecommunications network is irreversible, and there is significant uncertainty associated with the new technology and the future demand for the services using the new technology (eg NGANs), then access regulation may lead to a truncation problem arising. For such investments the real call option to wait can be used to calculate the size of the truncation premium that the investor requires. Gans and King (2003) outline though, that due to the incentives of access providers to overstate the *ex ante* risk on the investment, and the problem of regulators committing to such mark ups, an access holiday — i.e. a period where the asset is not subject to any access regulation — is likely to provide a simpler solution. Further, where the investor is able to vertically integrate its downstream retail functions with its new investment in the network, the problem associated with regulatory truncation may be of less significance, and hence there will be less justification for any real option surcharge.

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