



- 1 Wanted: economics. Dead or alive?
- 4 Bagging broadband productivity
- 6 Climate change: winners and losers in NZ's electricity market
- 9 Institutions rule
- 10 Strategopoly: playing with the nation's assets
- 12 Broadband for all?

WANTED: ECONOMICS Dead or Alive?

The 2008 global financial crisis resulted in a number of casualties. In the eyes of many, one such casualty is economics itself. According to these critics, economics has failed dismally: it failed to prevent the crisis, it failed to predict the crisis, and it even contributed to causing the crisis. Glenn Boyle argues that proponents of such a view have much in common with medieval monarchs who removed the heads of those bearing unwelcome news, and that sensible commentary on economics has been the real victim of the crisis.¹

How healthy is the current state of economics? Not very – according to Paul Krugman, George Soros, and a host of lesser lights. Australian economist Steve Keen puts it thus:

Economics is extremely unhealthy at all levels, from introductory pedagogy to high research ... As the global economy enters what could well be the Second Great Depression, economic theory is as useless a guide to how the economy actually functions as it was in the late 1920s.²

Much of the criticism arising as a result of the global financial crisis has, unsurprisingly, zeroed in on financial economics. A particularly popular target for attack is the efficient markets hypothesis (EMH): the view that security prices reflect all available information. Here, the critics – such as Louis Uchitelle – are in no doubt that either the EMH is dead:

To put it bluntly, [the] efficient market hypothesis does not work. It never has. Markets are not self-correcting.³

or it should be dead:

The incredibly inaccurate efficient market theory [caused] a lethally dangerous combination of asset bubbles,

lax controls, pernicious incentives and wickedly complicated instruments [that] led to our current plight.⁴

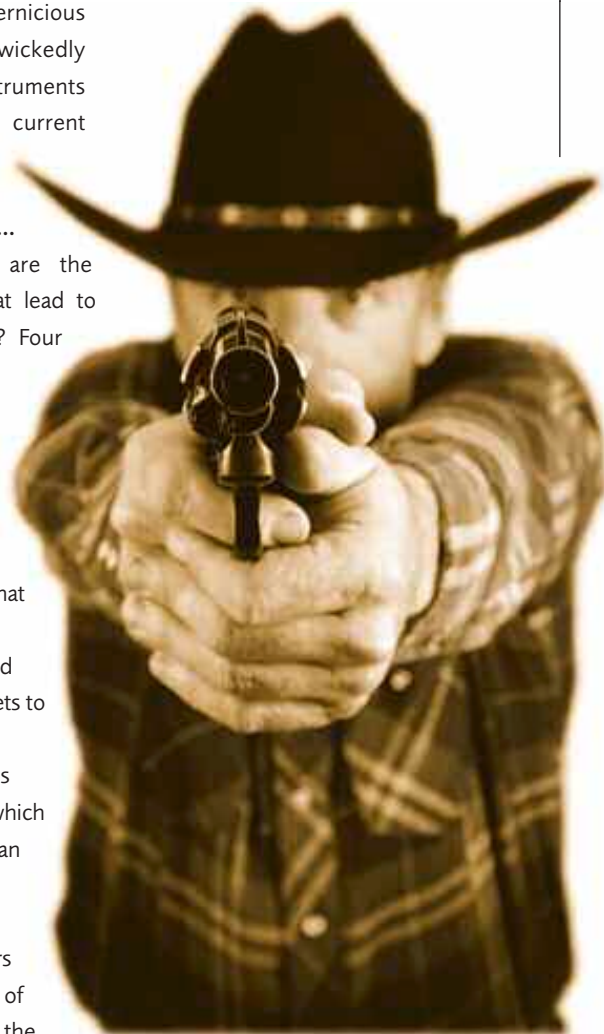
Give a dog a bad name ...

But what specifically are the failings of the EMH that lead to such damning criticism? Four appear to be central:

- Financial economists didn't *predict* the crisis, thereby 'proving' that markets can't be efficient in the way that economists believe.
- The collapse occurred too *quickly* for markets to be efficient.
- There was an obvious asset price *bubble*, which is incompatible with an efficient market.
- *Belief* in the EMH by traders and regulators created a false sense of security that allowed the crisis to occur.

Those who argue that a failure to predict the crisis disproves the EMH are simply confused, since a central insight of the EMH is that such events *should* be unpredictable. In a market where prices already reflect all existing information, only *new*

information can change prices. But new information by definition is unpredictable, both in content and in timing. Ergo, price changes must also occur unpredictably – implying that no investor can consistently earn



Members of ISCR are:

- Contact Energy Ltd
- Fonterra Co-operative Group Ltd
- MainPower Trust
- Meridian Energy
- Powerco Ltd
- Telecom Corporation of New Zealand
- Victoria University of Wellington
- Westpac Institutional Bank

from page 1

above-average returns, net of the costs of acquiring information. If financial economists as a group had announced in December 2007 that financial markets would collapse in nine months' time and that they had sold all their securities and taken on as many short positions as possible and *then* the collapse had occurred just as predicted in September 2008, *that* would have constituted strong evidence against the EMH. But what actually happened was entirely consistent with the EMH.

Similarly, prices *should* respond quickly in a market that processes information efficiently: when a fire breaks out in the theatre, it's perfectly rational for everybody to head for the exits at once. A slow and gradual downturn – which is what the critics seem to think should happen in an efficient market – would in fact have been a strong indicator of market inefficiency.

The EMH does not imply that security prices are always 'right' in some fundamental sense, only that it's impossible to tell whether prices are right or wrong. If all available information is incorporated in prices, there cannot be any information left to determine whether prices are 'right' or 'wrong'. Any new information could confirm that prices are 'right' or indicate that they are 'wrong'; but because this information is unpredictable, it's impossible to tell beforehand which is the case.

Consequently, the formation of so-called asset price 'bubbles' is inconsistent with the EMH only to the extent that these are identifiable at the time they occur. While there were a number of commentators who regularly 'cried wolf' over many years prior to the 2008 crisis, few (if any) seem to have withdrawn from securities markets altogether – which, as Ray Ball points out, is the only reliable test of predictability.⁵ As Robert Lucas noted in *The Economist* on 8 August 2009, a central lesson of the crisis is the futility of attempting to find central bankers and regulators who can identify bubbles: such

people are unlikely to exist in the first place, and would be unaffordable if they did.

... or barking mad?

The most serious charge against the EMH is that it helped cause the crisis. Did financial market traders load up on risk and debt in the belief that an efficient market would give them early warning if they went too far? Did regulators sit on their hands secure in the knowledge that they could rely on an efficient market to do their job for them?

The answer to both questions is surely 'no' – if anything, the behaviour of both traders and regulators exhibited a lack of belief in the EMH. Traders have never subscribed to the EMH – after all, their principal *raison d'être* is to outperform the market. And in the years leading up to the 2008 crisis, some loaded up on risk and leverage in a self-defeating attempt to attain this objective. Nor did regulators behave as if they had even the remotest belief in the EMH. If they had, they would have looked very closely at the suspiciously good performance of Freddie Mac and Fannie Mae and at the leverage of Lehman and Bear Stearns. They would certainly have been crawling all over Bernie Madoff. But instead they behaved as though they believed consistently high, above-market returns were nothing at all to be sceptical about.

So the critics have got it the wrong way round. To the extent that there was indeed a link between the emergence of the crisis and belief in the EMH, the problem was too little belief (rather than too much). If traders had believed more in the EMH, they would have given up trying to beat the market and would have reduced their risk.⁶ If regulators had believed more in the EMH, they would have spotted, and taken action against, the high-risk and fraudulent strategies staring them in the face.

$d \ln x^a / dx = a/x$!@#&*

The other favourite post-crisis whipping boy has focused on the supposedly excessive use

of mathematics in economics in general, and in financial economics in particular. Such a view has long held sway in other business and social science disciplines – economics, they say, is fundamentally about the behaviour of people, and attempts to mathematically model human behaviour are motivated by 'physics envy', and so are deeply misguided.⁷

Yet these criticisms are themselves somewhat suspect. After all, the worlds of business, economics and finance are inherently numerical, whatever the advocates of stakeholder theory and triple-bottom-line accounting might try to tell us. Attempting to get by in these worlds without mathematics is like driving in the dark with the headlights off. And eschewing mathematics would seem to imply resorting to a purely literary form of exposition – perfectly adequate for writing novels and essays, but hardly up to the task of adequately capturing the details of increasingly complex financial systems.

Nevertheless, the mathematical sceptics claim to have been vindicated by the 2008 financial crisis – that this was due at least in part to an over-reliance on mathematical methods and models that over-simplified the real world and so overlooked what really mattered. Unfortunately for this view, the evidence suggests otherwise.

First, the picture that has emerged post-crisis of the internal organisation of banks and financial firms is not one of too much reliance on mathematics, but rather a mismatch between those using the mathematics and those making the asset-allocation decisions. All too often, it now transpires, the latter did not understand the models of the former – and hence were incapable of not only asking the right question, but also of recognising the right answer when it happened to be offered.⁸ In these circumstances, blaming the use of mathematics for bad decisionmaking is like blaming arithmetic for Enron, or history for World War II.

Second, the US Securities and Exchange

ISCR Competition & Regulation Times is the newsletter of the New Zealand Institute for the Study of Competition and Regulation Inc. PO Box 600, Wellington, New Zealand. Ph: +64 4 463 5562, fax: +64 4 463 5566, e-mail: iscr@vuw.ac.nz, website: www.iscr.org.nz

The ISCR editorial team for this issue was Bronwyn Howell and Kathy McKenzie.

The views expressed in **ISCR Competition & Regulation Times** are the views and responsibility of the contributing authors.

ISSN 1175-2912

Commission was alerted on three separate occasions to the impossibility of Bernie Madoff's claims (by an economist, no less). Unfortunately, the lawyer-dominated regulator was apparently unable to comprehend the mathematical arguments involved. As a result, Madoff was able to continue his fraudulent ways for many more years.

Third, a recent study by the Federal Atlanta Reserve finds that, among the group of subprime mortgage holders, mathematical aptitude was a very strong predictor of the likelihood of default.⁹ In particular, those in the bottom quintile of mathematical ability were three times more likely to default than those in the top quintile, even after controlling for differences in income, education, size of loan and other potentially important variables. This suggests that banks may want to supplement their usual loan screening devices with a simple maths test!

In all of these cases, the problem was not too much use of mathematics but too much ignorance of it. Rather than revealing an over-reliance on mathematics by the financial sector, the true lesson of the 2008 crisis is that many of its worst consequences could have been avoided if individuals, bankers and regulators had bothered to acquire a much greater understanding of mathematics.

Some are more equal than others

All disciplines periodically experience real (not just imaginary) crises. Some recent examples include:

Accounting: The Enron, WorldCom and Arthur Anderson collapses in the early years of the century constituted about as grave a crisis as could be imagined for accounting – the entire credibility of accounting numbers was called into question.

Volcanology: The left-hand picture in Figure 1 shows Mt St Helens (in the US) as it traditionally appeared; the right-hand picture shows what it looked like a few days before it erupted in May 1980. Despite the obvious 'bubble', volcanologists were unable to say exactly when, or even if, the volcano would erupt. As a result, 57 people died.

Physics: Andrew Lo and Mark Mueller (himself a physicist) point out that, in a strange irony, the week of 15 September 2008 saw not only the collapse of Lehman Brothers and AIG, but also the breakdown of the Large Hadron Collider.¹⁰ Repair required 14 months of

Figure 1



Left image: USFS Photograph, Jim Nieland, U.S. Forest Service, Mount St Helens National Volcanic Monument. Right Image: USGS Photograph, Peter Lipman.

10,000 physicists working around the clock at huge expense.

What happened following these crises? Were there government hearings, primarily dominated by the views of people with no expertise in the three disciplines? Was new legislation introduced covering the organisation and management of accounting firms, volcanology institutes and particle accelerators? Were compensation limits introduced for senior accountants/volcanologists/physicists? Did media commentators announce the death of these disciplines?

Such questions are clearly rhetorical. In each of the above three cases, the discipline's 'experts' were left to get on with sorting things out themselves. An obvious explanation for the different treatment meted out to economics is that physics and volcanology are too complicated for the public to understand, while accounting is too boring. But as Lo and Mueller note, the complexity of the Hadron Collider, while immense, is nothing compared to that of a modern financial system. Another argument is that accounting, physics and volcanology can all be safely left to their respective specialists, but economics is too important to be left to economists. If true, this places greater responsibility on economics commentators to know what they're talking about – not less.

I have seen the enemy, and he is us

Ultimately, economists must take a large share of the blame for the demise of sensible commentary on economics. Too many seem

all too happy to offer up regular forecasts of financial market variables such as exchange rates and short-term interest rates, despite a huge research literature indicating that changes in such variables are not predictable. Such economists need to learn some humility. Too many others seem all too happy to advocate significant government intervention in financial markets on the slightest pretence, despite a huge research literature indicating that such action inevitably has unintended consequences. Such economists need to learn some economics.

- 1 This article is an abridged version of the BNZ Annual Lecture, delivered in Christchurch on 1 July 2010.
- 2 S Keen (2009) 'Why neoclassical economics is dead' (available at www.eastasiaforum.org/2009/05/30/why-neoclassical-economics-is-dead).
- 3 L Uchitelle (2010) 'Your money, their pockets' *New York Times* 22 April.
- 4 Jeremy Grantham quoted in J Nocera (2009) 'Poking holes in a theory on markets' *New York Times* 5 June.
- 5 R Ball (2009) 'The global financial crisis and the efficient market hypothesis: what have we learned?' *Journal of Applied Corporate Finance* 21 pp8-16.
- 6 During the BNZ Lecture, I was asked where ethics fitted into all of this. The obvious answer – which I was too slow-witted to think of at the time – is that belief in the EMH is about as ethical a stance as it's possible to imagine in business, as it dissuades investment professionals from misleading clients about what the latter can reasonably expect to earn from their investments.
- 7 In my experience, the holding of such views is often associated with the lack of any expertise in even the most basic aspects of mathematics.
- 8 See, for example: F Salmon (2009) 'Recipe for disaster: the formula that killed Wall Street' *Wired* 23 February.
- 9 K Gerardi, L Goette and S Meier (2010) 'Financial literacy and subprime mortgage delinquency: evidence from a survey matched to administrative data' Atlanta Federal Reserve Working Paper 2010-10.
- 10 A Lo and M Mueller (2010) 'WARNING: Physics envy may be hazardous to your wealth' MIT working paper.

Glenn Boyle is the BNZ Chair of Finance at the University of Canterbury and an ISCR Distinguished Research Fellow.



bagging BROADBAND productivity

Fast internet access is widely considered to be a productivity-enhancing factor, leading to calls for governments to finance new fibre-to-the-home (FTTH) networks. But Mark Obren has surveyed the literature on productivity gains from broadband deployment – and he finds that the relationship is neither simple nor straightforward.

To take one example: the New Zealand Institute has estimated that the economic benefits to the country from an FTTH network would be in the order of \$2.7 to \$4.4 billion per year,¹ a figure which has been used extensively in support of the government's current \$1.5 billion investment plan. Although there are undoubtedly some benefits to be gained from faster network deployment, it is far from clear that gains of the magnitude being used to support funding proposals are in fact reliable estimates.

Most claims lack rigorous empirical support, instead being based upon extrapolations from extremely limited qualitative and case-study analyses or even subjective 'guesses' proffered by 'industry experts' with (quite likely) vested interests in a network of a particular typology being deployed in a specific economy. The use of such studies to support government spending has led DSL Prime's Dave Burstein to observe 'both the economic and social benefits of

broadband are wildly overstated ... There's a social return to better broadband, but it's far, far lower than the hype suggests. Most of the numbers thrown about are from skills and zealots. Honest academics looking for the effects find only modest ones'.²

Reality check

Empirical evidence of the impact of broadband on economic performance is sparse but growing and, as Burstein observes, finds only modest gains which are often highly nuanced. For example, research using US zip-code data finds that the gains are quite small and do not accrue evenly to all sectors of the economy;³ it also finds that the benefits are decreasing as broadband penetration increases.⁴ New Zealand firms with access to broadband internet connections were found on average to be around 10 percent more productive than their counterparts without broadband, but those with 'fast' connections were no more productive than firms with standard-speed

broadband connections.⁵

Moreover, even in those sectors such as education and health which have been heralded as areas where large gains can be made from wider availability of faster broadband, empirical results crowd-out optimistic hopes. Two examples: analysis of the performance of North Carolina grades 5 to 8 after the introduction of home computers and broadband access found statistically significant and persistent negative effects on student mathematics and reading test scores and a broadening rather than a narrowing of achievement gaps;⁶ analysis of live versus internet media instruction of an otherwise identical introductory microeconomics course at a large US university found face-to-face instruction outperformed internet instruction.⁷

That the observed returns to broadband investment are turning out to be far smaller than might have originally been projected leads to the question of whether evidence is emerging of a 'broadband productivity

paradox' reminiscent of the 'computer productivity paradox' of the 1980s and 1990s that led Robert Solow to famously state 'you can see the computer age everywhere but in the productivity statistics'.⁸ That such a possibility might exist was raised in ISCR research as early as 2002,⁹ when it was noted that broadband is simply a subset of information and computer technologies (ICTs) and so might exhibit similar productivity characteristics. More recent research by Howell and Grimes¹⁰ draws attention to the fact that there are both positive and negative productivity consequences arising from faster broadband deployment – and it challenges policymakers to think carefully about a wide range of factors rather than unquestioningly assuming that faster broadband will be unequivocally beneficial.

Drawing upon questioning frameworks developed to address the likely causes of the computer productivity paradox, Howell and Grimes developed two contrasting hypotheses: that the productivity gains from faster broadband are real but are yet to be detected; and that the gains are not detected because they don't exist – that is, broadband is simply not as productive as its proponents have led us to believe that it will be. They then critically assess each of the hypotheses, using theoretical and empirical evidence.

Now you see it, now you don't

In respect of the first hypothesis, real gains may not have been detected because of any one of these reasons:

- A lack of clear delineation in speeds between 'fast' and 'slow' broadband may have confounded the results.
- As fast broadband is still in its early days of deployment, it may be too soon to discern productivity gains because the applications taking advantage of it have not yet been developed – or they have been developed but it will take time for users to know of their existence, learn how to use them productively, or make other complementary investments that liberate the gains.
- The benefits are garnered at some other point in the production chain that was not observed in the study (such as customers with reduced search costs).

Support for this hypothesis comes from a growing body of evidence that productivity

gains from ICTs have been found to be critically dependent upon complementary investments (such as in human capital and redesigned production processes), and that they lag behind the time of investment by several years. However, in order to attribute the gains to investment in faster (as opposed to standard speed) broadband, it must be clear that the additional benefits come from the speed of the broadband connection and from the applications that are operational only on those faster connections (rather than from simply the availability of any broadband access or even dial-up internet access). In the absence of any compelling new or different applications emerging in those countries where faster broadband networks have been made available longest (such as Japan and Korea, where they have been available for more than five years) or where resources have been devoted specifically to the development of such applications (such as the Netherlands), it becomes more difficult to justify investments in faster networks using the argument that 'you don't see faster broadband in the productivity statistics, but wait a bit and you will'.

There's no there, there

The second hypothesis asserts that 'you see faster broadband everywhere but in the productivity statistics because faster broadband is not as productive as you think'. Five plausible arguments support this hypothesis:

- Returns to investment in broadband speed are diminishing, because the biggest gains were made when the relevant applications were first made available on the internet. The remaining benefits are marginal rather than average ones, and are decreasing relative to the costs of enabling them.
- Most of the observed gains are simply one-off adjustments and are not sustainable growth engines. They relate to single applications that support the production of standard (rival and excludable) products; they are not 'information goods' exhibiting increasing returns.
- The contribution of broadband-enabled activities comprises only a very small part of the value chain for most economically significant activities, and so a small change in a factor that is a small part of the overall

value chain will render only a small (and possibly empirically undetectable) change.

- Broadband networks are leading to an alteration in the composition of the firms in an economy by altering the balance between existing (highly productive – the intensive margin) users and new (less productive – the extensive margin) users, to the detriment of aggregate economic productivity measures.
- Externalities are created that detract from the benefits accrued. Examples include the use of the technology to maintain existing market positions (rather than to increase productivity), duplication of existing processes, and increasing consumer costs (which arise from consumers being required to choose from a wider range of more complex options).

Think again

The ways in which broadband contributes to economic growth are complex, but one important factor stands out: applications, not networks, will determine the ultimate dividend.

- 1 www.nzinstitute.org/Images/uploads/Broadband%20aspiration%20Sept%202007.pdf; www.nzinstitute.org/index.php/weightlesseconomy/mediarelease/the_new_zealand_institute_proposes_the_creation_of_a_new_vehicle_to_deliver/
- 2 D Burstein (2010) 'NBN deal a good thing but don't overstate the benefits' *Communications Day 21 June p10* (available at www.commsday.com/commsday).
- 3 S Greenstein and R McDevitt (2009) 'The broadband bonus: accounting for broadband internet's impact on US GDP' NBER Working Paper 14758.
- 4 W Lehr, C Osorio, S Gillett, and M Sirbu (2006) 'Measuring broadband's economic impact' originally presented at the 33rd Research Conference on Communication, Information, and Internet Policy (TPRC) in Arlington, Virginia on 23-25 September 2005 and revised 17 January 2006 (available at http://ebusiness.mit.edu/sponsors/common/2005-Fall-Res-Seminars/Lehr_MeasuringBroadbandsImpact.pdf).
- 5 A Grimes, C Ren, and P Stevens (2009) 'The need for speed: impacts of internet connectivity on firm productivity' Motu Economic and Public Policy Research Working Paper 09-15.
- 6 J Vigdor and H Ladd (2010) 'Scaling the Digital Divide: home computer technology and student achievement' NBER Working Paper 16078.
- 7 D Figlio, M Rush and L Yin (2010) 'Is it Live or is it Internet? Experimental estimates of the effects of online instruction on student learning' NBER Working paper 16089.
- 8 R Solow (1987) 'We'd better watch out' *New York Times Book Review* 36 (July 12).
- 9 B Howell and M Obren (2002) 'Broadband Diffusion: Lags from Vintage Capital, Learning by Doing, Information Barriers and Network Effects' (available at www.iscr.org.nz/n222.html).
- 10 B Howell and A Grimes (2010) 'Productivity Questions for Public Sector Fast Fibre Network Financiers' *Communications and Strategies* 78

Mark Obren is an ICT strategist, a Massey University Doctorate of Business Administration graduate, and a former ISCR research assistant.

CLIMATE CHANGE: winners and losers in NZ's electricity market

Lewis Evans and Graeme Guthrie employ their dynamic continuous-time model of the New Zealand electricity spot market to provide insights into the effects that climate change – and policies such as the Emissions Trading Scheme (ETS) – might have on key market-performance indicators.¹ They find that ETS solves some problems but creates others.

A framework that usefully assesses the effect of climate change on an electricity market's performance should incorporate the salient features of electricity production and consumption that are susceptible to climatic variation and have explicit links to relevant natural-resource characteristics. For New Zealand's electricity market, this requires recognition that hydro generation accounts for some 55% to 65% of generation capacity, that the capacity of storage lakes is low, and that inflows into these lakes naturally fluctuate.

River-flow characteristics together with reservoir-storage constraints mean that generation decisions must be based on expectations about a risky future as well as on current and past weather, demand, and storage.² Many static electricity-market models rely almost exclusively on observed contractual information about marginal costs. This model differs because it employs a forward-looking approach that reflects both historic information and future uncertainties. Specifically, it captures the effects of:

- resource-availability uncertainties

- decisionmaking that trades off the returns from storing water for future generation against the returns from generating now, given the actual and anticipated costs of fuel for alternative generation (in New Zealand, this is gas-fired generation).

It does this by treating stored water as an asset.

Stored water must satisfy the asset pricing equation:

$$\text{required return} = \text{current period pay-off} \\ \text{plus expected future capital gain}$$

Hydro and gas generation are managed in order to maintain this relationship. Hydro-generation decisions are based on the shadow price, or value, of the water that is a by-product of this asset-equilibrium condition. Expectations are concerned with future inflows and resulting (future) price and quantity outcomes. As there is some correlation of inflows between periods, inflow expectations are informed by past inflows. For firms the required rate of return is measured as profit; and for society it is measured as total welfare (in economists' jargon: consumer plus producer surplus). Provided that generation is

unconstrained by the capacity of plant or limits of storage and that gas availability is unconstrained at its market price, the shadow price of water will equal the cost of an extra unit of gas-fired generation.

Start here: the electricity market

Figure 1 shows the market model, with these assumptions:

- Consumer demand for electricity is uncertain.
- Generators supply this demand from a combination of hydro generation and gas generation, depending upon the relative costs of each up to the maximum generation capacity for each type.
- Water flows continuously into storage lakes, but the rate of inflow varies a lot.
- Water can be used directly for generation, be stored or (if the lake is full) be spilled.

Partly because demand must equal supply at each instant in time and spot-market trading periods are short, the structure of Figure 1 is implemented at each instant of time.

A social planner will seek to maximise the expected present value of total welfare

produced by the electricity market; a monopolist will seek to maximise the expected present value of profits. Our model compares market outcomes under each of these two objectives, termed respectively 'competition' and 'monopoly'. It is calibrated to the New Zealand market at an aggregate level.

A process for the inflows is estimated for the New Zealand market as a whole and used to simulate inflows for a 30-year period. A 'solution' is found for each daily trading period by finding the optimal hydro and gas generation and storage for each day of the 30 years, based on current and past inflows, the generation- and storage-decision rules, and the state of the system each day.

Tweaking the base case: 'competition' and 'monopoly'

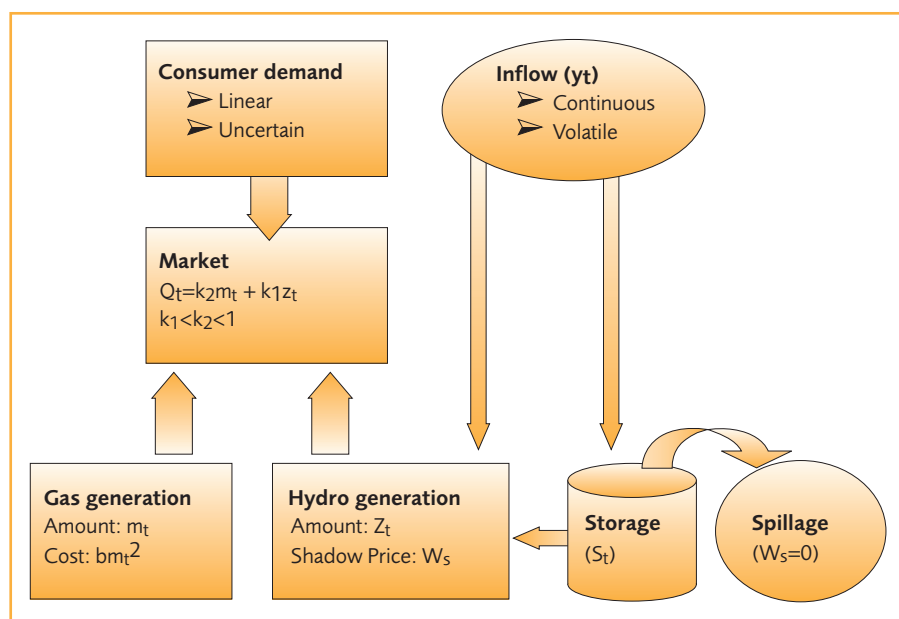
Under 'competition' we found that the market price varied considerably, period by period, but was less volatile than inflows. This comparatively lower variation in prices occurred because both water storage and gas generation can be used to reduce the volatility of hydro generation. Large price falls are associated with a low shadow price of water, which itself coincides with high levels of storage and inflows. Welfare is affected by the structure of supply and demand, by fluctuations in inflows and demand, and by the level and degree of forecastability of inflows.

By comparison 'monopoly' resulted in higher prices and lower welfare, as expected. Storage levels were also higher. Notably, gas generation was much reduced – as was volatility in generation, consumption price and welfare. This is because gas generation has a real financial (fuel) cost that hydro generation lacks; and so the monopolist, in cutting back on aggregate generation to raise revenues and profits, chooses to reduce gas generation. (In consequence, it is less costly for the monopolist than for the social planner to manage fluctuations in inflows by varying gas generation.)

The lower volatility under 'monopoly' is significant and is not reflected in the welfare calculation. It is as though the 'monopolist' does not run the system as hard as 'competition' would; and if lower volatility had a real social cost attached to it, the difference in welfare loss from 'monopoly' (relative to 'competition') would be considerably reduced.

To assess the effect of additional storage,

Figure 1: The electricity market



the base models were also simulated with a higher reservoir capacity. Increasing current storage capacity by 23% in the 'competition' scenario significantly increased producer surplus but left consumers worse off. In the 'monopoly' scenario, both the consumer and the producer surpluses (total welfare) increased. These results reflect the shape of demand – which in turn reflects whether consumers or producers benefit more-or-less from stabilised prices and also that, under 'competition', water inflows are fully utilised over the 30 years (under 'monopoly', the expanded storage would induce more output).

Add climate change ...

Climate change affects both average inflows and fluctuations in inflows. Changes in average inflows will affect the performance of the electricity market because it amounts to a change in fuel supply over any significant period. Changes in the fluctuations of inflows will affect decisionmaking, but will not provide more fuel over the 30-year period.

The National Institute of Water & Atmospheric Research (NIWA) forecasts that average inflows are likely to increase with climate change. However, we examined the opposite: a decrease in inflows. Table 1 summarises the results of two additional scenarios – reducing inflows by 30% and increasing inflow fluctuations by 30% – relative to the base case.

Reducing average inflows by 30% decreases total generation, induces substitution of gas for hydro, reduces welfare,

and substantially reduces the value of additional storage capacity. These findings are unsurprising: the reduction in average inflows increases the shadow price of water, leading to more gas generation. The higher proportionate use of gas by the monopolist reflects the monopolist's low base-case gas generation. Consequently the price does not increase to the same extent in the 'competition' and 'monopoly' scenarios. Reduction in the value of storage is induced by a lower demand for shifting hydro generation between time periods and by a lower likelihood of spilled water (which is a result of the reduced average inflows).

By contrast, if the predictability of inflows falls, so will generators' abilities to forecast particular future benefits from stored water. Consequently, the value of additional storage capacity is much greater with higher volatility of inflows than under the base case. While there is little change in average prices or welfare, these are much more variable. The difference between 'competition' and 'monopoly' in the volatility of outcomes remains unchanged, however.

... and some carbon tax

Implementing the ETS in any realistic model is complicated because the carbon price can be expected to be volatile and the ability to generate will be affected by the availability of carbon units: the result will be roughly analogous to managing inflows for hydro production. Instead, we consider the effect of a carbon tax. The results are reported in Table 1, relative to the base case of no such tax.

The carbon tax raises the marginal cost of (and hence causes a reduction in) gas generation, but there is little change to hydro generation. This result reflects that water is generally fully utilised under both 'competition' and 'monopoly' over the 30-year period. Under 'competition', the shadow price of water rises, as expected, with the increase in the gas cost – and so does the market price, albeit by only half the increase in the marginal cost of gas. (This sharing of the burden between consumers and producers is a standard effect of taxes.) Total surplus falls, but more under 'competition' than under 'monopoly'. The producer surplus is higher with the carbon tax than in the base case, because hydro generators benefit from price increases (their fuel costs do not alter).

A mixed result

Overall, the results suggest that climate change will significantly reduce/increase total welfare from the electricity market as average inflows decrease/increase. It also suggests that the increased unpredictability of inflows has small effect on welfare (although it does increase the social value of storage capacity). However, producers and consumers are likely to value the benefits of increased storage differently.

Carbon taxes will increase prices and reduce total welfare slightly, and will likely exacerbate producer/consumer tensions as higher prices lead to higher profits from hydro generation. Carbon taxes have little effect on the merits of additional storage.

- 1 This article draws upon the work of Lewis Evans, Graeme Guthrie, Andrea Lu and John Nash. For more detail see: L Evans, G Guthrie and A Lu (2010) 'A New Zealand Electricity Market Model: Assessment of the effect of climate change on electricity production and consumption' (available at www.iscr.org.nz/f585,16761/16761_NZ_Electricity_Market_Model.pdf).
- 2 L Evans and G Guthrie (2009) 'How options provided by storage affect electricity prices' *Southern Economic Journal* 75(4) pp681-702.

Lewis Evans is an ISCR Distinguished Research Fellow and is Chair of Economics at Victoria University of Wellington. **Graeme Guthrie** is Professor of Economics and Finance at Victoria University of Wellington.

Table 1: Climate-change scenarios relative to base case

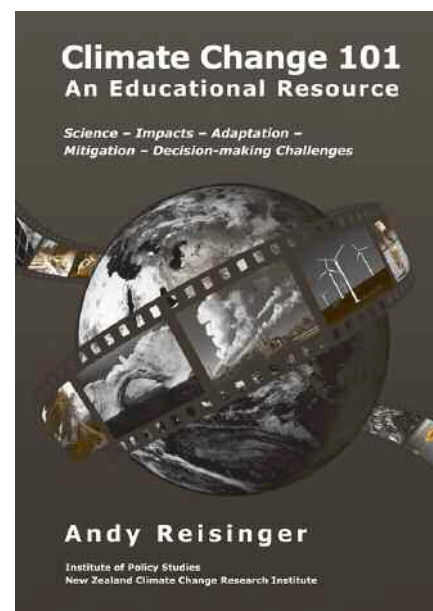
Change relative to base case	Competition %	Monopoly %
Average inflows reduce by 30%		
Hydro generation	70	71
Gas generation	126	283
Price	124	107
Social welfare	91	93
Profit	104	96
Social value of extra capacity	31	17
Market value of extra capacity	44	70
Inflows more unpredictable (fluctuate by 30%)		
Hydro generation	100	98
Gas generation	100	112
Price	100	100
Social welfare	100	100
Profit	99	100
Social value of extra capacity	223	158
Market value of extra capacity	174	156
Carbon tax \$25/t CO₂		
Hydro generation	100	100
Gas generation	90	93
Price	112	101
Social welfare	98	99
Profit	109	100
Social value of extra capacity	115	114
Market value of extra capacity	112	101

CLIMATE CHANGE 101 An Educational Resource

by Andy Reisinger

Climate Change 101 – An Educational Resource provides a clear, succinct, and measured summary of our current knowledge of climate change, its potential impacts, and the scope for reducing greenhouse gas emissions and adapting to inevitable changes.

Climate Change 101 draws its substance mostly from the findings contained in the *Fourth Assessment Report* of the Intergovernmental Panel on Climate Change. But it also highlights more recent scientific developments and illuminates the key issues that underpin the current international negotiations for a new global agreement on climate change. This book is intended as an educational resource for anyone seeking a robust scientific overview of the complex and interdisciplinary challenge that climate change represents for the global community.



An Institute of Policy Studies and New Zealand Climate Change Research Institute co-publication by Andy Reisinger.

For further details visit www.ips.ac.nz/Publication



INSTITUTIONS RULE

How have 800 years of political and economic developments in western society resulted in modern-day efficient markets? Cheyne Cudby, in a 2010 essay for ECON330, explored the institutional foundations underlying market behaviour and how these have evolved over time to facilitate efficient coordinated activity. This article is an abridged version of her essay.¹

Early economic theory held that institutions had no particular relevance to the dynamics of economic development. Efficient economic activity was presumed to occur because, in a world of no transaction costs, bargaining between parties led to the optimal outcome – regardless of the initial allocation of property rights. In reality, however, transactions nearly always have costs because of asymmetrically held information and the need for at least one party to acquire the information they lack.

Institutions – which are the rules, beliefs and norms of society that prompt individuals to follow specific behaviour – play a fundamental role in regulating interactions where there are high transaction costs. They provide the foundations of markets by allocating and protecting property rights, promoting efficient contracts and encouraging specialisation and trade (thereby reducing the transaction costs that arise from information asymmetries).

The trader's dilemma

Institutional evolution is illustrated in the medieval 'solution' to the difficulties of long-distance trade. Despite the fact that self-interested individuals can (at times) cause defection from the optimal outcome, the market can still achieve coordinated activity – provided economic and political institutions effectively promote this outcome.

Trade between different cities and nations did occur in medieval times. But in the absence of a common legal system to enforce contracts between trading parties in different civic jurisdictions, opportunistic purchasers had an incentive to renege on their contracts with vendors from other cities. Many otherwise-beneficial trades were foregone – which offers evidence for the contention that coordinated activity requires more than just formal institutions and suggests that, in absence of norms such as the rule of law, legal institutions may still fail to work effectively.

To solve problems associated with long-



distance medieval trade in Europe, a 'community responsibility system' was established: this made whole trading communities liable when one member failed to uphold a contract. The nation of the party who suffered could impound all goods from the other party's nation in order to motivate the debtor to make payment. Because of their huge dependence on trade, communities were motivated to pay their debts, protect their reputations, and avoid trade boycotts.

While this system seemed effective, it became economically inefficient as communities expanded and trade extended beyond domestic borders. It was gradually revoked in several nations and replaced by alternative enforcement institutions.

The drive to optimise markets

One of these alternative institutions was the reputation-based private-order contract enforcement exercised by communities such as the Maghribi traders, a group of Mediterranean Jewish merchants who engaged in principal-agent relationships with

foreign agents. The Maghribi reduced the costs and risk associated with trade by establishing a repeat-transaction relationship with foreign agents and selling their goods in overseas markets through these agents.

This worked effectively because the agent's ongoing reliance on his reputation in the merchant's community encouraged him to convince the merchant prior to trade that he would not act opportunistically. If the agent were to defect from his agreement with one merchant, his reputation would be tarnished within the entire Maghribi community and thus his future business would suffer.

We've got here – but where are we going?

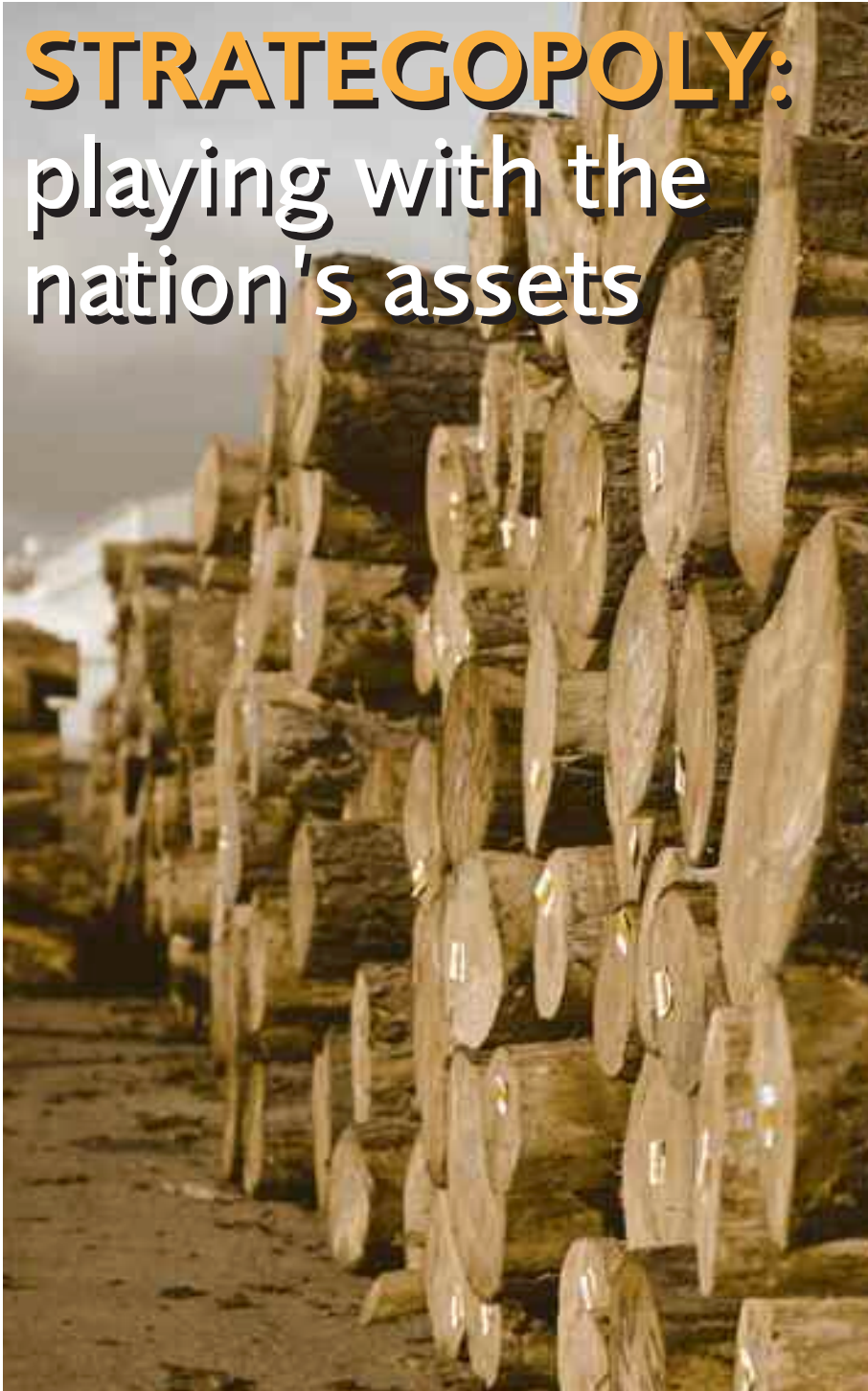
Since then, there's been a dramatic shift from private enforcement institutions to centralised (political and legal) institutions. A governing state that's capable of enforcing property rights beyond domestic boundaries while conforming to underlying societal norms is essential for ensuring formal rules are respected. Furthermore, no modern-day society is complete without an impartial court system capable of providing mechanisms to solve transactional issues where the quid and the quo are separated.

Modern institutions such as the World Trade Organization and the international courts have evolved to address the challenges of modern international trade, but their efficacy is likewise constrained by self-interested individuals. Formal and informal institutions are essential to efficient coordinated activity – and they will continue to evolve as they address the specific challenges posed by the costs and risks of transacting.

¹ It draws in material from: K W Dam (2006) 'Institutions, History and Economic Development' Olin Working Paper No 271. University of Chicago; V Dutraive (2009) 'Economic Development and Institutions' (available at <http://regulation.revues.org>); A Greif (2006) *Institutions and the Path to the Modern Economy: lessons from Medieval Trade*. Cambridge University Press. p3; A N Licht (2008) 'Social Norms and the Law: Why Peoples Obey the Law' *Review of Law & Economics* 4; R H McAdams (2008) 'Beyond the Prisoners' Dilemma: Coordination, Game Theory and Law' Olin Working Paper No 437. University of Chicago; D North (1994) 'Economic Performance through Time' (available at <http://nobelprize.org>); D North (1992) 'The New Institutional Economics and Development' (available at www2.econ.iastate.edu/tesfatsi/NewInstE.North.pdf).

Cheyne Cudby is a Law and Economics student at Victoria University.

STRATEGOPOLY: playing with the nation's assets



Air New Zealand in 2001; Auckland International Airport and KiwiRail in 2008 ... the New Zealand government has on at least three occasions in the not-so-distant past intervened in private market transactions to secure for itself, or place limitations upon, who can own or control so-called 'strategic assets'. And in recent months the 'strategic asset' label has been applied to dairy farms¹ in order to justify restrictions on foreign ownership. Dave Heatley and Bronwyn Howell ask what characteristics of an asset make it strategic, particularly in the national policy context.

The answer to this question is important. It pertains directly to the circumstances in which it is appropriate for the government, rather than private individual or corporations, to own and control the asset – especially when government assumption of control disadvantages those individuals and

corporations. A cynical view often expressed² is that an asset becomes strategic simply when it suits politicians to regard it so – giving rise to the risk that they might over-use their powers of compulsion in declaring assets strategic, and make declarations for political rather than public-good purposes. However, whether or

not an asset is strategic comes down to a wider question: what objective is served by control of that asset?

The asset game

'Strategy' is a concept most closely associated with the military, games and business. In these spheres the meaning of 'strategic asset' is straightforward: an asset is strategic if control over that asset is essential to achieving a particular and well-defined objective – that is, there is no other alternative means of securing the desired outcome. This makes the relevant asset a 'must have' rather than just 'nice to have'.³

Control may mean a variety of things. But the important considerations in its meaning are the right to use the asset – and the right to *exclude opponents from using it*, which thus limits their strategy choices. It is also important to distinguish between simple possession of an asset ('ownership') and control of a bundle of rights associated with the use of the asset.⁴ For example, I may 'own' my land but my ability to do whatever I like with it is significantly constrained by the fact that others (such as my bank, which holds the mortgage; or my local authority, which has obligations under the Resource Management Act) control many of my rights of use.

Ultimately, it is the control of specific rights rather than possession of the physical asset that is essential for achieving a strategic objective. This control can be acquired in many ways: for example through conquest, purchase, contractual agreement, or control by allies.

From a public policy perspective, what makes an asset strategic should follow from its role in achieving a given objective. During wars or national emergencies, governments may deem it necessary to make compulsory acquisitions of (for example) land and transportation networks in order to guarantee the country's defence. In other situations, control may be necessary in order to deliver net public benefits – such as acquiring land to build a road or electricity distribution grid, the benefits from which (net of compensation paid to the original owner) exceed the costs.

Furthermore, where assets are physically located within New Zealand, the government has access to legislative and regulatory mechanisms by which it can obtain control of strategic assets.⁵ Although in some circumstances (such as under the Public Works

Act) the government is required to compensate the original owner when it assumes control rights, in most other cases the government can assume control by dint of 'executive action' for which no compensation is paid – for example, when it limits the types of house renovations that can be carried out in areas covered by historic preservation orders⁶ or when it requires incumbent telecommunications network operators to share their assets with rival firms⁷).

Playing two game(s)

The Local Government Act 2002 defines a strategic asset as any asset held by a local authority which is deemed necessary for maintaining that authority's capacity to achieve or promote any outcome that it determines to be important to the current or future wellbeing of its community. The Act further defines two particular strategic assets: equity holdings in any port or airport company; and land or buildings required to provide affordable housing.

The means of assessing the current or future wellbeing of the community is not specified, offering local authorities considerable discretion in determining both their objectives and the strategic assets required to realise these objectives. Nor does the Act distinguish between possession of an asset and the control rights associated with that asset. For example, shares held in ports and airports are automatically deemed strategic even when they amount to a minority stakeholding that confers no ability to exert effective control of the port or airport.

Furthermore, once statutory processes have been invoked to declare an asset strategic, the local authority is required to consult with its community if it ever wants to dispose of that asset. This obligation for community consultation, combined with the considerable discretion given to a local authority in setting its objectives, opens up the opportunity for assets to be declared strategic as a way of increasing the difficulty for any future authority to dispose of assets that were deemed essential for delivering the policies (both public-good-oriented and self-serving) of its predecessors. So a specific policy – which may be only one of many ways of delivering a given public-good objective – can become 'locked in' for extended periods by one set of politicians in order to frustrate their political opponents.

... it is the control of specific rights rather than possession of the physical asset that is essential for achieving a strategic objective.

When making a determination under the Overseas Investment Act 2005, ministers are required by regulation 28(h) to consider whether a proposed overseas investment will, or is likely to, assist New Zealand in maintaining control of strategically sensitive infrastructure on sensitive land. 'Strategically sensitive infrastructure' is not defined; so, unlike the Local Government Act, the Overseas Investment Act provides no clear process by which such assets can be specifically identified as, or declared to be, strategic. This regulation is invoked only when overseas entities (essentially any entity where more than 25% of the control is held by non-New-Zealand entities) seek to purchase more than 25% of the relevant asset. It was introduced in March 2008, when the government sought the means to decline approval for the Canadian Pension Plan Investment Board's proposed purchase of 40% of the shares of Auckland International Airport Limited.

Control freaks

Although the focus of the Overseas Investment Act is the ownership of assets (particularly land) located in New Zealand, regulation 28(h) makes a clear statement about the importance of control. This would appear to address the distinction between mere possession of an asset and the ability to make decisions about its use. Regulation 28(h) allows foreign investment if it assists 'New Zealand' (the state, as custodian of the national interest) in maintaining control of the 'strategic asset'.

However, if the asset is already in private ownership, the private owner can sell only those residual rights over which the state does not already exercise formal control via other legislative instruments. The foreign purchaser

of, for example, a farm business would be subject to the same environmental and animal protection laws as a New Zealand owner. It is difficult to see how any foreign investment could ever assist in altering the extent of formal state control of a privately-held asset. However, if there is an implicit assumption that control of those remaining rights by a private New Zealander in some way acts as an unwritten proxy for the exertion of control by the state in its pursuit of the objective for which the asset is a strategic necessity (that is, the state has gained control of the relevant rights via an unwritten 'alliance' with the New Zealand owners), then a transfer to foreigners will dilute that informal control – and hence will dilute the Government's ability to achieve its objective.

Nevertheless, an unwritten alliance provides no certainty that even a New Zealand owner will always exercise the residual control rights in a manner consistent with the Government's objectives. If control of the remaining rights is truly essential to delivering the objective and there is no alternative means of doing so, and if the rights are 'strategic' and an unwritten alliance involves risks in achieving the objective, then the government should acquire them.

Possession of a 'strategic asset' may be 9/10ths of the law, and control may confer 100% of the ability to achieve strategic objectives – but neither guarantees that the strategy is worth pursuing in the first place.

- 1 See D Heatley and B Howell (2010) 'Regulatory restrictions down on the farm' *Competition and Regulation Times* issue 32 p4 (also available at www.iscr.org.nz).
- 2 See for example *The New Zealand Herald* (2008) 'Strategic asset only if it suits' editorial 30 April.
- 3 Political motivations notwithstanding, it could be argued that the 2008 government purchase of KiwiRail did indeed secure a strategic asset, in that operational control was considered crucial to the fulfilment of the then government's transport-strategy objectives and was unobtainable via any other legislative or contractual means.
- 4 L Evans, N Quigley and K Counsell (2009) 'Protection of Private Property Rights and Just Compensation: An Economic Analysis of the Most Fundamental Human Right Not Provided in New Zealand' (available at www.iscr.org.nz).
- 5 These mechanisms are, of course, unavailable to businesses or individuals.
- 6 D Heatley (2009) 'Non-compensation – it's not just' *Competition and Regulation Times* issue 29 p14 (also available at www.iscr.org.nz).
- 7 B Wilkinson (2008) 'A Primer on Property Rights, Takings and Compensation' (available at www.wgtn-chamber.co.nz).

Bronwyn Howell is ISCR's General Manager; Dave Heatley is a research fellow at ISCR.

BROADBAND for all?

Stanford Levin reflects on international trends in broadband universal-service policy – and asks whether policymakers are clear on the important distinction between availability and use.¹

Not too long ago one might have thought that universal service in more developed countries was pretty much settled. Nearly all households had voice telephone service, and those that did not were often so remote that providing traditional wireline service was inordinately costly. Such households could, if policies permitted, sometimes be reached instead by fixed-base wireless service or (less frequently) by mobile wireless service. While not all parties might agree on whether or not universal service objectives had been fully met, or on the desirability of the funding mechanism used to achieve them, it was generally the case that universal service was no longer a pressing policy issue.

This situation changed, however, with the advent of broadband internet service. Dial-up internet service was generally available over the voice network, but broadband service required something more. Just as voice telephone service moved fairly quickly from being a luxury (or novelty) to being considered an essential service, broadband internet service is following this same path – although not with universal agreement. Nevertheless, policymakers in many countries are under pressure to include broadband service as part of any universal service obligation.

While countries have generally made clear their objectives for broadband universal service (these are usually expressed as a certain percentage of households connected at a certain minimum speed), the rationale for these objectives is usually less than clear. To date, the connection between broadband penetration and economic growth is not well documented; and the causality may run from economic growth to broadband penetration, instead of the other way as broadband policy

advocates might wish. If economic justifications for universal service for broadband are not always robust, it may be that countries will articulate a social justification – although this has generally not been the case. There is certainly a great deal of enthusiasm around the world in more developed countries for increasing broadband penetration and for increasing broadband speeds, but this enthusiasm has not been matched by cogent and convincing rationales.

Availability versus use

When policymakers and others discuss broadband, they are not always clear whether the issue is the *availability* of broadband to subscribers (the percentage of households, for example, that have access to broadband) or its actual *use* (the percentage of households that subscribe to the service). This is an important distinction, as policies to address availability are different from those to address use. For example, 94% of US households have access to broadband service at 4MB (megabits) or more per second – yet broadband is used by only somewhere between 66% and 71% of US households.

Subsidy programmes to extend broadband service can increase availability or speed, but they may not do anything to increase use (if that is the objective). Policies to increase use are different: they may, for example, involve reducing monthly usage charges or subsidising the cost of equipment necessary for accessing the internet while at the same time educating individuals about the value of internet use. It is important to be clear on whether the objective for broadband access is availability or use – and also to adopt policies that will meet that objective (something that has not always been the case).

To the extent that the objective is use, it is likely that lowering the cost of broadband access alone will not meet aggressive adoption targets. In the US, for example, price subsidies for broadband access (and other programmes to make broadband affordable) will not be sufficient to reach the FCC's goal of 90% of households using broadband by 2020. On the other hand, broadband in the US is often priced at a flat rate regardless of use: some form of tiered pricing, where the price of broadband access is related to the amount of use, would lower the price for customers who use broadband the least (and are likely to value it the least). Such tiered pricing could boost adoption.²

It is also peculiar that mobile communications – and, in particular, mobile broadband – are more or less ignored in the debate about broadband universal service. Certainly there are a growing number of individuals who use mobile services to access broadband. Ignoring these users distorts data and narrows the technological options under consideration for achieving universal service objectives.

Ultimately, it is important for any policy or government intervention to have a rationale as well as clear objectives of what is to be achieved. Broadband universal service is no exception.

¹ Excerpt from the keynote address at the Asia-Pacific Regional Conference of the International Telecommunications Society, Wellington, 26 August 2010.

² Tiered pricing is offered in New Zealand.

Stanford Levin is Emeritus Professor of Economics at Southern Illinois University Edwardsville and a board member of the International Telecommunications Society. He co-chaired the Society's first Asia-Pacific Regional Conference, held in Wellington on 26-28 August.