VICTORIA UNIVERSITY OF WELLINGTON
Te Whare Wānanga o te Ūpoko o te Ika a Māui

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ECONOMICS & SUSTAINABILITY

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CONTEXT: WHY IS SUSTAINABILITY IMPORTANT IN 2007?

Increasing environmental awareness

- pollution
- extinction of indigenous species & ecosystems
- depleting fossil fuel stocks
- climate change

NZ political agenda

- Kyoto obligations
- ‘carbon neutrality’
- a counter-reaction (political alternative) to the economically-motivated policies of 1980s and 1990s?

WHAT IS SUSTAINABILITY?

Some buzz-phrases

- sustainable development?
- sustainable growth?
- ecologically sustainable development?

“Human activities that do not do permanent damage to the environment or rob resources from future generations”

THREE PARTS – BUT BIG CAVEATS

Human activities

- but are humans the only actors with influence?

Do not permanently damage the environment

- what is ‘damage’?
  - implies loss of value – but how is value determined?
  - ‘damage’ is a value judgement (pejorative)
    - is all permanent change ‘damage’?
  - who will define the relevant value scale (what are ‘good’ and ‘bad’, what do they mean)?
- what is ‘the environment’?
  - physical? economic? social?

Do not rob resources from future generations

- introduces the dimension of time
- presumes future generations will hold same value definitions and preferences among competing uses as the current generation

SUSTAINABILITY IS AN ECONOMIC ISSUE

Economics is the social science that provides a way of thinking about how scare resources are (or ought to be) allocated amongst competing uses:

- who will own the assets (allocative decisions)
- which productive activities the assets will be applied to (productive decisions)
- time is a dimension that matters (static – current time period vs dynamic – across time)

Opportunity cost is the relevant measure of value:

- *the cost of a good or service measured in terms of the foregone opportunity to pursue the next best alternative*

Relativity

- all activity is a transformation with economic consequences
- 'more' economic value is better than 'less'
  - includes option values (valuing doing something now or having the option of doing something else in the future)

ECONOMICS IS A SCIENCE

The economy is a complex adaptive system

It functions within wider physical and social environments

- families and social networks
- trading clusters (firms, markets, etc.)
- political localities (nation states, trading blocs, political alliances)
- geographic localities (neighbourhoods, cities, islands, continents, planet, universe)

Physical boundaries imposed by physical geographical & ecological environment

- the physical (ecological??) environment is also a complex adaptive system

Economic analysis involves the application of scientific principles

- scientific analysis of interaction of complex adaptive systems

WHAT IS ‘CARBON NEUTRALITY’?

A statement about what crosses the boundary of a defined system

“what goes out must be no greater than what goes in”

A realistic objective?

- ‘neutrality’ is simply a precondition for ongoing survival (equilibrium condition = stasis)
  - less coming in than needed = death of system
- growth predicated on value coming in exceeding value of resources consumed in the system’s productive activities
- neutrality in every time period for every entity is neither natural nor rational
  - natural variation => neutrality ‘on average over time’ is survival prerequisite – ‘overs’ and ‘unders’ traded for megasystem neutrality (trade across time periods is ‘insurance’)

THE LAWS OF THERMODYNAMICS and complex adaptive systems

1. **Constant energy**
   - assumes there is a finite amount of energy in the universe
   - all activity is the conversion of energy from one form into another
   - all the potential is already there – simply awaiting a conversion (discovery)
2. **Entropy (the time dimension)**
   - once a change has occurred, the previous state cannot be reverted to, as energy (resources) must be devoted to undertaking the conversion (therefore the allocations of energy can never be the same as before the change took place)
3. **Chaos**
   - the natural state is the movement from states of high order (requiring commitment of energy (resources) to maintain order) to states of disorder (energy (resource) used to maintain order is ‘freed’ for other tasks)

WHERE WE DRAW THE BOUNDARY MATTERS

No earthly system is truly closed

- extra-planetary influences – e.g. solar radiation, the moon, comets

No economic subsystem can ever be truly closed either

- North Korea, Communist Europe, China in 11th to 20th century

Sealing the boundaries limits all change to that of endogenous nature

- it was there always, just waiting to be discovered/developed (Romer)
- bounded rationality means it takes time to discover/develop it all

Exogenous change is induced from trading (interacting) across the boundary

- 'shocks' stimulate adaptations that must occur in response to changes in other systems (Schumpeter, Solow, Darwin, Gould)
- competence (value) destroying vs enhancing (Tushman, Anderson)

THE NATURAL STATE IS TRADE ACROSS THE BOUNDARIES

We cannot have all we need within our closed system, so we increase the value we accumulate by trading across the boundaries

- moon and earth
- motive for agrarian settlement (Diamond)
- colonisation

All trade across the boundaries will induce change in both systems

Constant change is the natural state

- for ecological systems
- for economic systems
- for all actors within the systems (the sub-systems)

There is no going back (2nd law)

SO WHY ACT TO PRECLUDE CHANGE?

Vested interests prefer the status quo

- resource allocation implications

The future is unknown

- decision-making frame constrained by boundaries of experience
- outcome of technological change is uncertain
  - but change is inevitable
  - it is path-dependent
  - it will change the scale of economics by an order of magnitude

We are comfortable with the current environment

- it is convenient from our point of view

BOUNDED RATIONALITY

Human beings are not omniscient

- our activities are limited by what we know
- our knowledge increases as time goes by

Information which governs trades and exchanges across the boundaries has grown over time

- if we don't know what we do causes costs, how can we realistically price the costs into the transaction?
- when we learn, we can alter the contracts/agreements
  - losses of value reduced
- but there will always be things that we don't know, so our contracts are never perfect
  - the things we have not incorporated in the terms of trade are 'externalities'
  - future generations may/will likely have the knowledge to deal with some of the externalities we cannot
    - every time we take an action, we are always (unknowingly) creating costs as well as benefits for our heirs
  - Sahara desert, rabbits in Andalucia

EXAMPLE: CARBON EMISSIONS

Consuming carbon 'sunk' in forests and fossil fuels releases it into the atmosphere

- the consumer gets benefit (food, motive power, etc)
  - but does not bear the costs of increased carbon (relative to the non-consuming state) crossing the boundary
- outcome = exogenous climate change

Pricing the emission (externality) becomes feasible

- taxes, tradeable permits shift the cost from the 'atmosphere' system to the 'consumer' system
- economic incentives will reduce the level of consumption, stimulate the search for endogenous solutions
- delays the onset of exogenous change
  - preserves the status quo
  - but precludes any value enhancements from the exogenous change

WHAT IS THE ‘OPTIMAL’ LEVEL OF CARBON IN THE ATMOSPHERE?

It depends on what ‘state of nature’ we wish to preserve

- one from the past (e.g. 1990 - Kyoto)? the dinosaurs?
- the present?
- or do we merely wish to delay/pre-ordain the future?
  - compatibility with human biology at its current state
  - but creates path-dependence for future interactions

‘State of nature’ also includes the allocation of scarce resources prevailing in that state

- who owns the resources, recoups the benefits?
- who makes the decision about the ‘optimal’ state?

What happens if there is an exogenous change over which the appointed decision-makers have no control (e.g. volcanic eruption, comet strike)?

IS IT REASONABLE TO APPLY MORAL VALUES WHEN MAKING A SCIENTIFIC DECISION?

Christianity, Islam, Judaism

- all living things are subject to man

vs Buddhism, Taoism, Hinduism

- man lives in harmony with his environments; no single actor has supremacy

Intelligent design (monotheism)

- omniscient and omnipotent creator

vs Systemic interaction (polytheism)

- Karma – we just accept the outcomes as natural consequences (e.g. of the gods/systems interacting)

The moral background of the decision-maker frames the decision and therefore the outcomes

ASSUMING WE CAN DETERMINE AN OPTIMAL LEVEL

How do we enforce the limitations?

Voluntary compliance?

or

Allowing the investor to reap the benefits and making the cost-causer bear the costs?

Voluntary compliance rarely has the desired effect

- individual (firm/entity/national) optimisation typically prevails

EXAMPLE: THE ‘TRAGEDY OF THE COMMONS’

- **Village ‘commons’ in feudal England (the system)**
- **Individual village residents (the sub-systems)**
- **Anyone could use commons to grow crops, graze stock (private benefit)**
- **But use depleted commons productivity (externality => cost to all current and potential future users)**
  - no single user prepared to fertilize as all others could reap the benefits =>no fertilizers applier, productivity reduced
- **Solution = private property rights**
  - fences allowed exclusion of free-riders
  - investor able to recoup returns to investment (fertilizer)
  - productivity increased
  - ‘SUSTAINABLE’ LAND USE
    - productive potential the same for future generations

COMMUNAL PROPERTY OWNERSHIP IS NOT SUSTAINABLE IN THE LONG TERM

No-one has responsibility - free-riding emerges

Communal ownership occurs naturally as a consequence of the costs of maintaining and enforcing individual property rights being higher than the losses arising from free-riding (Coase, Williamson, Hansmann)

- early Maori settlement in NZ

When free-riding costs exceed costs of enforcement of private rights, excludable private property emerges as the welfare-enhancing consequence

- later precolonial Maori inter-tribal warfare, post-colonial competition for scarce resources

21ST CENTURY EXAMPLES

Fishing quota (New Zealand)

Demand-sensitive pricing of California electricity

- information alone not enough to alter consumption
  - some individuals consumed more electricity than usual when they were informed that a demand spike was coming (ensuring they got ‘their share’ in the event of a shortage?)
- dynamic pricing changed consumption behaviour
  - even though cost savings only a small proportion of household income
  - sustained across time (not just a one-time response)

Prices change behaviour

- wherever possible, make the person who exerts the choice to create the ‘bad’ pay the cost of the choice
- the system then does not create externalities (costs unwillingly borne by others in other systems)
- strong financial incentives for the decision-maker to invest in technological innovation to reduce costs, or substitute to other (cleaner) alternatives

RESOURCES WITH UNCLEAR PROPERTY RIGHTS AND NO PRICES

- **Water, air, radio spectrum, etc**
- **No price => “free” input**
- **Consequence = over-consumption, depletion of resource, externalities**
  - e.g. depleted waterways, roading congestion creating time delays
  - who has the incentive to invest?
- **Different demands in different locations**
  - there is no single “correct price”
- **Solution = create property rights to assets**
  - trading of property rights will result in asset belonging to individual with highest valuation (and greatest incentive to conserve/preserve as this leads to highest long-term return)

    e.g. water rights in rural Victoria - often worth more than the farmland they are used to irrigate; big factor in the economics of dairy farming

PRICING THE EXTERNALITIES

Taxes or permits?

Taxes

- increase cost of the ‘bad’, so decrease the quantity produced
- predictable cost – every unit of carbon used is taxed equally
- increased costs flow through to products in downstream markets
  - alters demand for the downstream products – essential as this demand is ultimate cause of the ‘bad’ (e.g. electricity)

Compensate the losers from proceeds

- i.e. must clean up environment, not add tax revenues to consolidated fund
- if damage caused by ‘bad’ is less than revenue raised by the tax, then you can compensate the losers and still be better off
- compensate losers via income increases to allow them to purchase essential quantities rather than manipulating prices for different groups (subsidised prices for favoured groups (e.g. elderly) ‘undo’ demand-changing effects in the favoured group)

PERMITS ('CAP AND TRADE')

Cap permissible level of the 'bad' – control quantity

Let polluters price the right to pollute above cap by trading permits

- the more valuable the right to pollute, the higher the price at which permits trade (and stronger the incentive to innovate)
- but transaction costs of monitoring adherence to cap

Create windfall profits for the first owners

- substantial effort invested in lobbying to influence initial allocation (resources diverted from innovation, relative to taxation)

Gifting, proceeds from initial sale, can be used to compensate losers

- e.g. gifting initial carbon credits to forest owners – if selling credits more valuable than cutting trees, then trees stay (gift compensates foresters for lost income when trees that would otherwise would have been felled are left standing)

THE EVIDENCE (SHAPIRO)

"Based on recent economic analyses and evidence, it is clear that carbon taxes are the more effective and efficient strategy for addressing climate change and provide stronger incentives to develop alternative fuels and more energy-efficient technologies"

International consensus, collaboration needed

- no compulsion = free-riding nations, gains from arbitrage between different systems 'on the table'

Taxes have lower price volatility

Cap-and-trade affected by base from which country starts

- liabilities difficult to control (e.g. fast economic growth increases liability, economic slump created an artificial boon)

Cap-and-trade more costly to monitor and enforce

CASE STUDY: ‘SUSTAINABLE’ ROADING IN NZ

The current system

- roads are funded from general tax and rating revenue
- use of roads is not priced directly
  - some very imperfect proxies to constrain the total quantity consumed – road user charges (commercial vehicles) and petrol tax (private vehicles) – but no direct connection to the allocation of scarce resources as revenues added to consolidated fund rather than applied to roading infrastructure
  - the same ‘notional’ price signal is faced by road users, irrespective of the actual piece of road used
- cross-subsidies rampant
  - over-use of congested roads, no good price signals to inform location choices for transport-intensive industries (e.g. Ports of Auckland)
  - no political will to use market signals (e.g. tolls, congestion charges) to direct new investment decisions or induce substitution (creates winners and losers, and the compensation equation is considered too hard?)

A real live ‘Tragedy of the Commons’

- the antithesis of a ‘sustainable’, self-funding roading model

BY CONTRAST, RAIL

Ontrack onbills 100% of the cost of track maintenance and enhancement directly to rail users (after a one-off capital injection on its inception)

- sustainable as long as rail operators can cover costs of operation
- new spurs will be built as (sustainable long-term) demand dictates
  - e.g. forestry lines in central North Island

Ideal = substitute from road to rail freight in most congested regions

- but price of roading use invariant to location, congestion, choices of other users
- hence no strong financial incentive to substitute

Solution = demand-sensitive pricing of roading

- just like California electricity
- tolls, congestion charging, variable regional taxes etc.

PERSISTANCE WITH THE ‘PUBLIC GOOD’ FUNDING MODEL PERPETUATES AN ‘UNSUSTAINABLE’ ROADING INFRASTRUCTURE

Continually reliant on ‘tax transfers across the boundary’ to build new infrastructures

- political rather than commercial allocation of investment

No direct financial connection between the locus of investment decision-making (Government officials in Wellington) and the locus of the costs arising from the externalities (motorists)

- a ‘commons’ – no-one owns the problem, so no-one has an incentive to invest in fixing it as no-one can appropriate the benefits of solving it, so no-one takes any action
- consequence is we bequeath the problem to the next generations (and it is a bigger problem than ever after each successive generation abrogates the responsibility of making the necessary decisions)

CHARGING OR TAXING

Roads will be built where demand (congestion) indicates as prices create incentives to invest (cover costs of capital employed)

Subsidies from the consolidated fund only needed for regions which are genuinely economically unsustainable (c.f. 'Broadband Challenge')

Why do we persist with the status quo?

- just as in any system, vested interests with decision-making power prefer the way the systems currently interact – 'closing the boundaries' may shut off an externality that currently benefits one party overly at the expense of another

Remember, political institutions are complex adaptive systems as well! Can we trust them to make some of these decisions?