NEW ZEALAND INSTITUTE FOR THE STUDY OF COMPETITION AND REGULATION INC.

The Impact of Climate Change Policy on Forest Value and Dairy Conversion Rates

Victoria University of Wellington
20 November 2006

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Government, forest owners at loggerhead

REST owners have walked out of talks away from the industry. But New Zealand Under the Kyoto protocol, New Zealand estation. To maintain forest cover the Under current policy the Gov

All forestry options open, says Anderton

Kyoto error fuels tax rise fear

Forestry warning on climate policy

Kiwi's rise hits timber exports

JAMES WEIR

THE Kiwi dollar is up to a seven-

ber market because it took a range of products. Timber is one of the top products in New Zealand's $7

New Zealand exports were also facing greater competition from higher timber production in Aus-

Plantings 'answer to Kyoto deficit'

Kyoto targets: we've given up

Big bill for missing climate change goals

NZ to buy carbon credits

MICHELLE QUIRKE

THE Government will have to buy international carbon credits to meet its climate change commitments, Treasury says.

Principal adviser Steve Rylands told a parliamentary select committee that New Zealand was unlikely to reach its Kyoto protocol emission reduction target on its own. "Some [carbon credit] buying will be inevitable if the Government wants to meet our obligations in a cost effective way."

Ministries involved in climate change work will report next month to Cabinet on how New Zealand can meet the target.

It follows the Government's decision last year to scrap the carbon tax, a key plank in policy to reduce emissions.

Officials do not yet know how many credits we would need but if we used them to cover half our expected shortfall in the first phase of the agreement, it could cost $300 to $700 million over the next six years.

Countries pay for carbon credits earned through emission reductions elsewhere because it is cheaper than achieving it at home.

New Zealand produced 0.2 per cent of the world's greenhouse gas output but our emissions continued to rise, Environment Ministry said.

FEELING THE HEAT B5

Source: Dominion Post

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Branson tags $4.6b to combat warming

■ NEW YORK

BRITISH billionaire Sir Richard Branson has committed to spending all the profits from his airline and rail businesses — an estimated $3 billion (NZ$4.6 billion) during the next 10 years — on combating global warming.

The Virgin Group chairman, whose company also includes music and mobile phone ventures, has already created Virgin Fuels, which will invest $400 million over three years in renewable energy initiatives as part of his pledge.

But profits from the Virgin Group's transport businesses, which make up nearly half the company, will also be spent on separate investments in biofuel research, development, production and distribution, and projects to tackle emissions through a planned Environmental Trust.

"We have to wean ourselves off our dependence on coal and fossil fuels," he said. "Our generation has the knowledge, it has the financial resources and, as importantly, it has the will power to do so."

Sir Richard, 56, who is known as much for his daredevil stunts as his business acumen, unveiled his plan at a news conference at the Clinton Global Initiative, a summit run by

Warm relations: Sir Richard Branson confers with former US vice-president Al Gore and former president Bill Clinton at a news conference in New York yesterday. Picture: REUTERS

Source: Dominion Post

OVERVIEW

- Disclaimer – differs to work done for FOMA
- Background
- Motivation
- The valuation problem
- Valuation approach
- Data and assumptions
- Results
- Discussion

BACKGROUND

- New Zealand has ratified the Kyoto Protocol
- This commits it to limit GHG emissions to 1990 levels, or to pay for any excess net emissions over 2008-2012 (CP1)
- One consequence is deforestation liabilities, which worsen the country's net position
- Government is liable for land use change decisions made by owners of Non-Kyoto (pre-1990) forests
- To manage this liability government needs policies to align its interests with those of such foresters

BACKGROUND – CONT'D

- Current policy is that government will bear deforestation liabilities in CP1 rather than devolve them to Non-Kyoto forest owners

- However, it has capped its total liability at 21 $MtCO_2e$, and left its options open re what might happen then:
  - Devolve deforestation liabilities
  - Raise the cap
  - Manage deforestation
  - …

- A "cap and trade" system is being considered, but until then the cap represents a "commons"

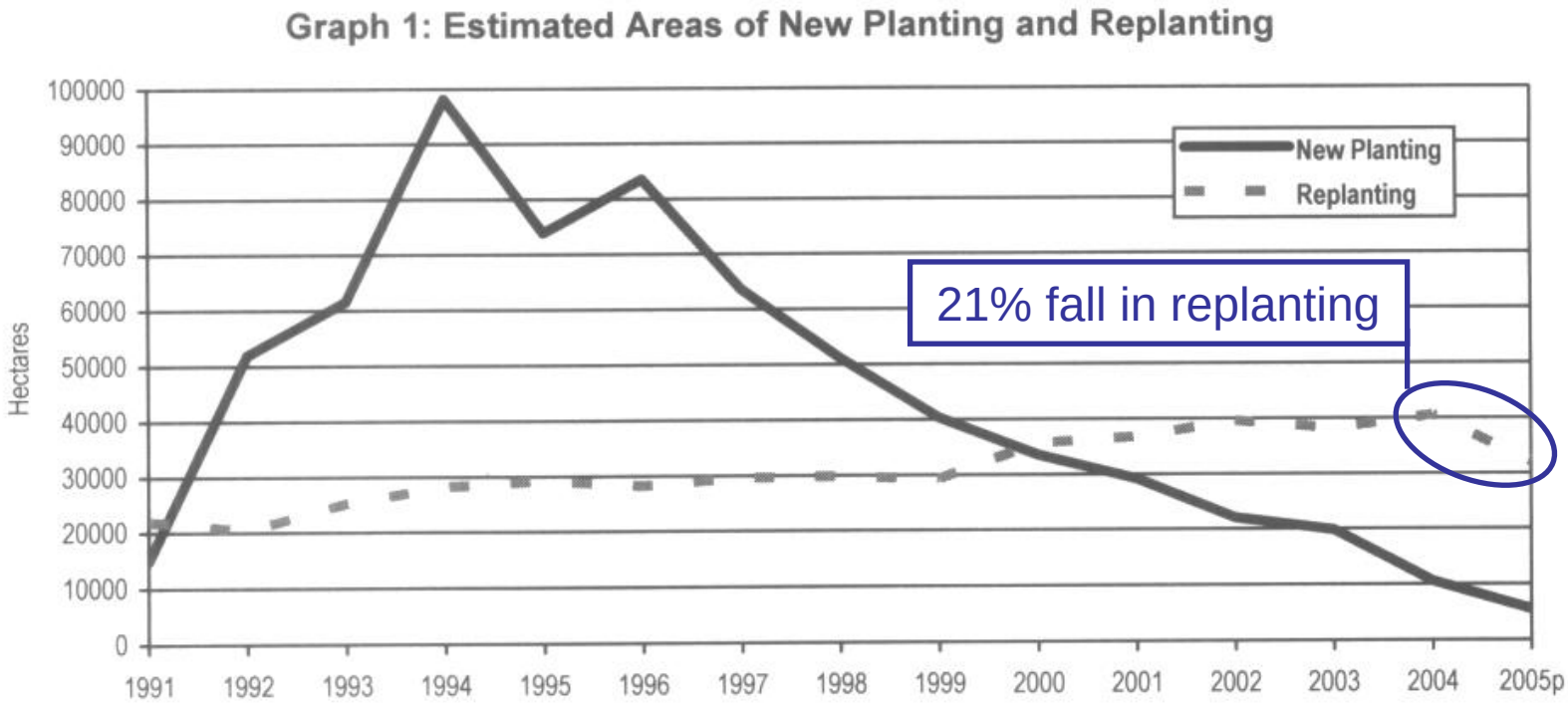
BACKGROUND – CONT'D

- New Zealand's net CP1 position is projected to be a 41.2 $MtCO_2e$ deficit (versus earlier surplus)

- As at June 2006 Treasury valued this liability at $656 million, assuming a carbon price of $15.92

- The projection assumes actual deforestation in CP1 will equal the 21 Mt cap, but MfE notes deforestation could be as high as 38.5 Mt

MOTIVATION

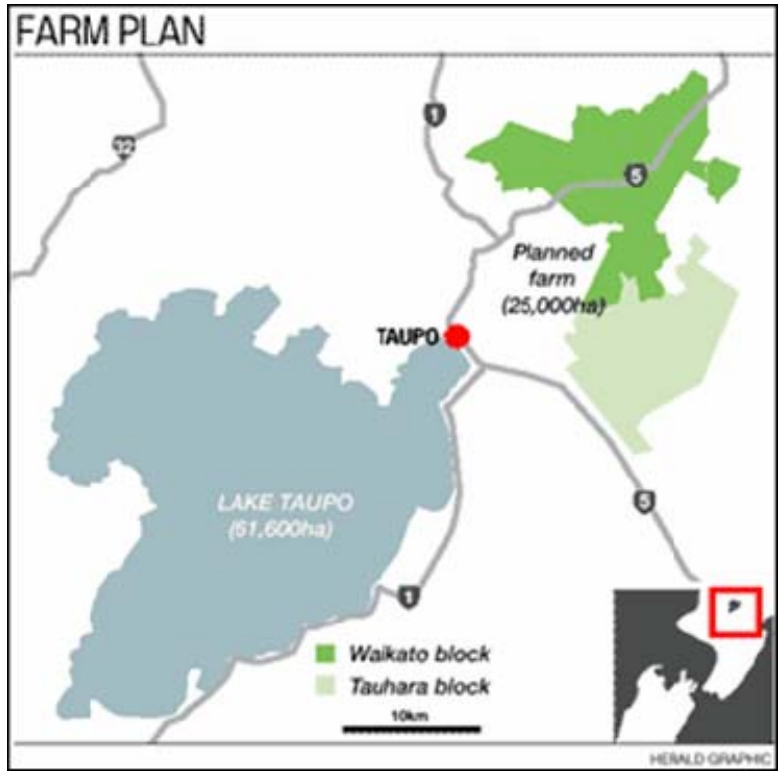


p = provisional

Source: MAF, Forestry Planting – 2005 (Provisional), 1 February 2006

MOTIVATION – CONT'D

- Wairakei Pastoral and Landcorp are converting 25,000 ha of forests into dairying
- Other foresters also converting
- Economic fundamentals of dairying versus forestry an obvious contributor
- Industry also cites the deforestation cap as a motivator



Source: New Zealand Herald

→ How do you value deforestation under alternative climate change policy scenarios?

THE VALUATION PROBLEM

- Foresters only face a deforestation liability if they convert forest land into a non-forestry use
- They face no deforestation liability pre-CP1
- They might face a deforestation liability in or after CP1
- Impact of possible future climate change policy thus depends on:
  - What the policy is
  - When it might be implemented
  - The future price of carbon (relative to other prices)
  - The basic economics of deforestation (i.e. conversion)

THE VALUATION PROBLEM – CONT'D

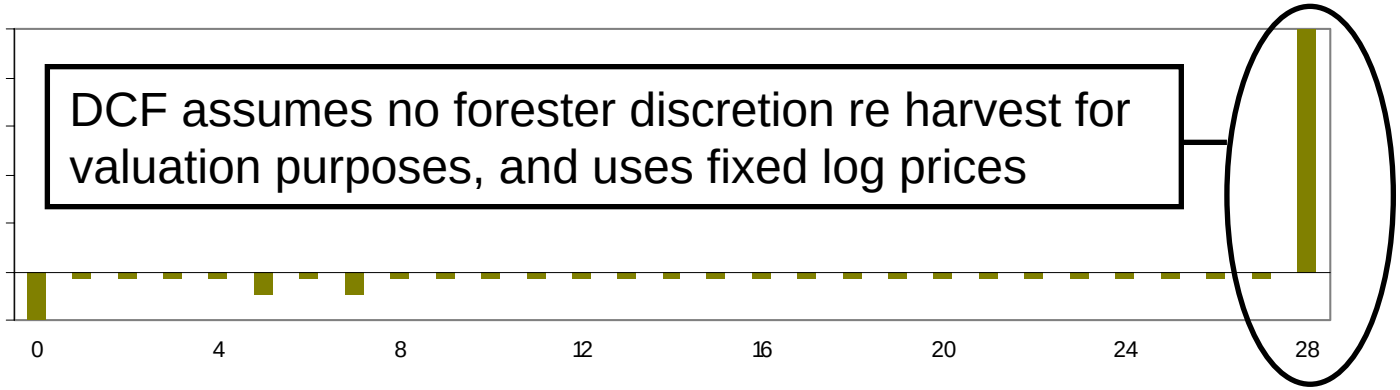
- Conventional Discounted Cash Flow (DCF) valuation analysis is not helpful:
  - Estimates value based only on long-term expectations of key variables – log prices, milk prices, carbon prices, …
  - Hard-wires the forester's replanting or conversion decision – forest will be harvested at age 28, …
  - Ignores the possibility and value of foresters waiting for new information – e.g. deforestation liabilities devolved or not?
  - Conventionally makes simplistic assumptions regarding the future course of key decision variables – constant real log prices, …

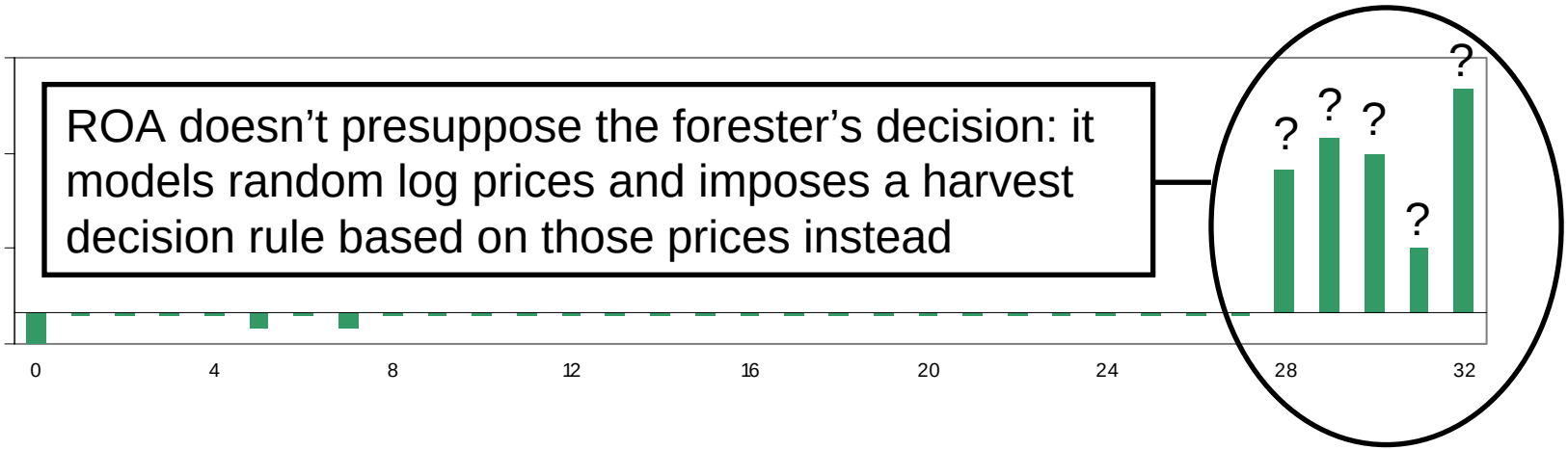
THE VALUATION PROBLEM – CONT'D

- Real Options Analysis (ROA) is better suited to the task:
  - Models key decision variables as random (i.e. "stochastic") processes
  - Recognises that foresters have discretions as to future harvest, replanting and conversion decisions
  - Allows such discretions to be based, *pro forma*, on information available in the future

- But – ROA gets quite tricky to implement, once the problem becomes more than just a little sophisticated: trade-offs are required

DCF vs ROA – SIMPLE FORESTRY MODEL





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VALUATION APPROACH

- To model deforestation, augment traditional forest valuation by adding a dairying conversion option
- Assume that forests can be economically harvested, and land use change decisions made, within a wide window (ages 20 – 35)
- At annual rests within this window, foresters are assumed to choose between either:
  - Harvesting and replanting – "HR"
  - Harvesting and converting (into dairying) – "HC"
  - Waiting (or Abandoning) – "W" (or "A")
- Aside: obey ROA "Golden Rule" – never assume more information than you have available at any given time

VALUATION APPROACH – CONT'D

- ROA tells us there can be a valuable "option to wait", or "option to defer", when making a decision

- This option arises when:
  - Asset owners get to choose what to do in the future based on information that is available then
  - Decisions are at least partly irreversible
  - Future decision variables (e.g. prices) are uncertain

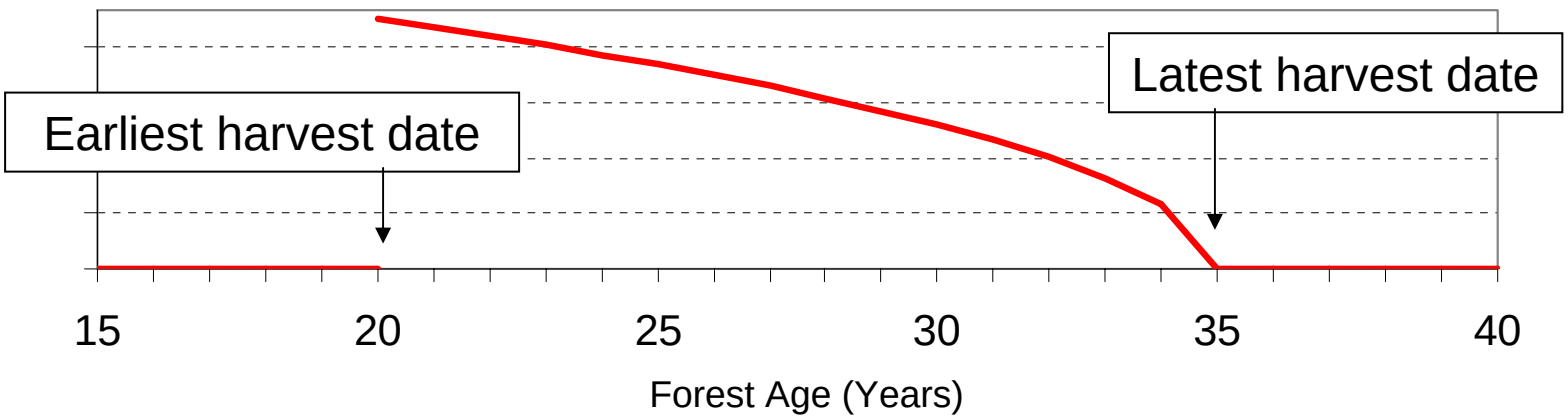
- Momentarily assume the HR and HC decisions are independent, then at any time t forester should only:
  - HR if Net Present Value of doing so (NPV(HR, t)) exceeds the value of the option to defer HR
  - HC if NPV(HC, t) exceeds the value of the option to defer HC

VALUATION APPROACH – CONT'D

- Valuable option to defer harvest comes from:
  - Next year's log prices might be better than now
  - The trees might still be growing strongly
  - …

- Option to defer HR is assumed to run out as we near the latest economic harvest date (e.g. log diameters too great for milling, …)

Approximate HR value to waiting – Paramaterised by "Alpha"

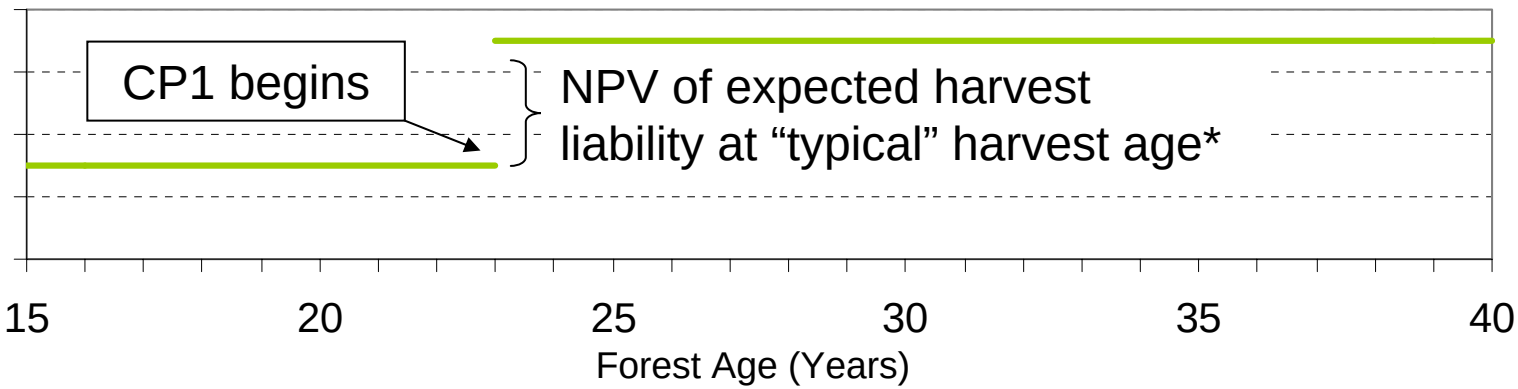


VALUATION APPROACH – CONT'D

- Valuable option to defer conversion comes from:
  - Next year's relative milk prices might be better than now
  - Herd genetics might be improving
  - …

- Option to defer HC is assumed constant, but worth less in the lead-up to CP1 (since pre-CP1 conversion escapes any liability)

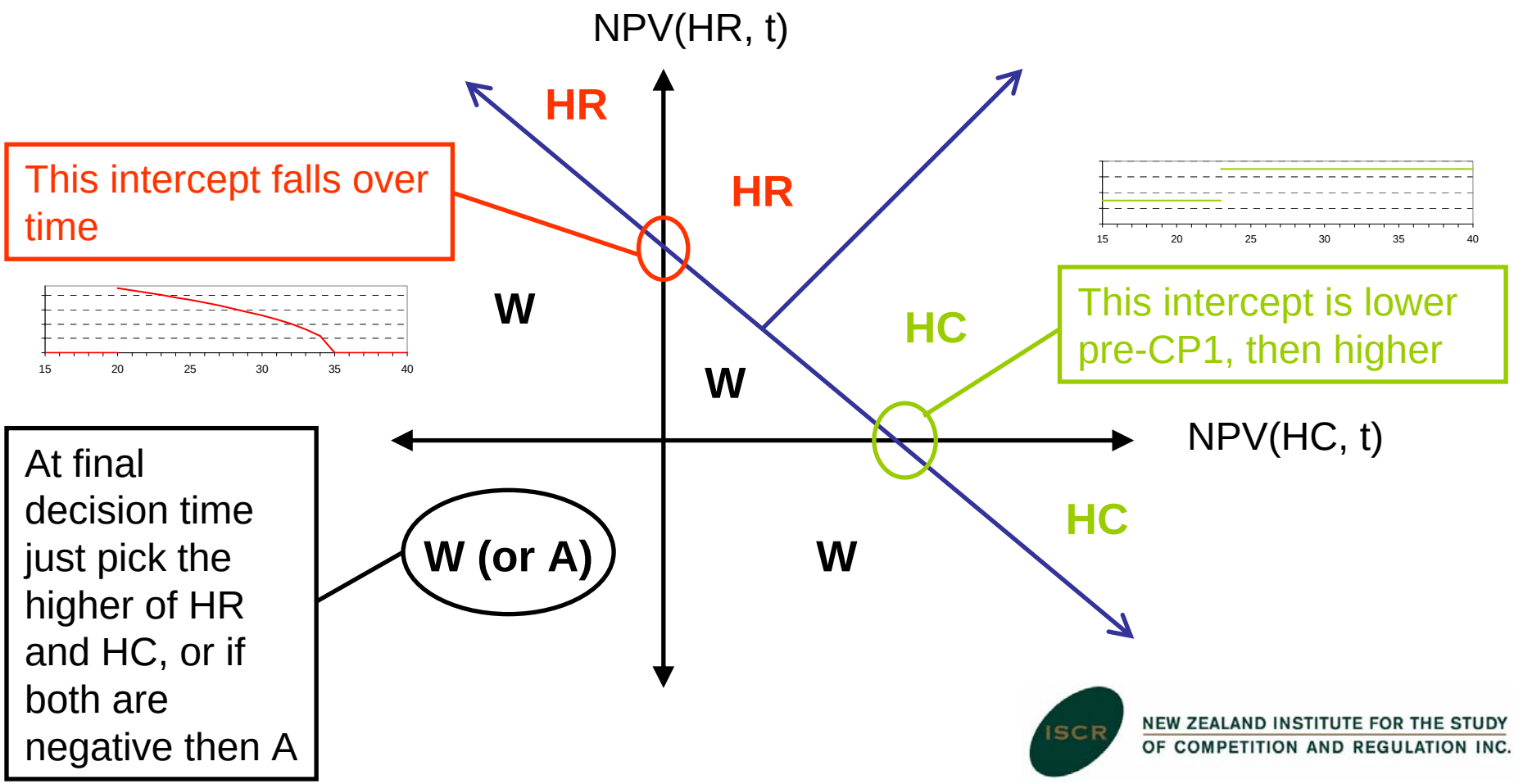
Approximate HC value to waiting – Paramaterised by "Beta"



* Requires an assumed second rotation conversion probability distribution, taken to be related to NPV(HC, t)/NPV(HR, t)

VALUATION APPROACH – CONT'D

- Combining our two decision rules, at each annual rest (i.e. t) within our decision window we have a "decision map" along the lines of:



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VALUATION APPROACH – CONT'D

- Have 5 random prices (3 log, 1 milk, 1 carbon), as well as 3 possible decisions at any time (HR, HC, W)

- To keep things manageable, use "poor man's" ROA, or "No. 8 fencing wire" ROA:

  – Simple modelling tools – Excel spreadsheet, and Monte Carlo Simulation using @RISK software

  – "Smart then dumb" (hybrid ROA/DCF) – model discretions and uncertainty at first, but more DCF-like methods thereafter

  – "Boot-strap" – borrow on key intuition of ROA without explicitly calculating the "optimum": re-run the simulation repeatedly to find the values of (Alpha, Beta) producing the highest NPV

→ In short, do better than DCF (if not formal ROA)

VALUATION APPROACH – CONT'D

- Value three deforestation liability <u>policies</u>:
  - "Retention"/status quo – government retains liabilities within cap → **0 < P(Dev'n) < 1**
  - "Devolution" – government devolves liabilities to foresters → **P(Dev'n) = 1**
  - "Committed Retention" – government commits to retaining liabilities come what may → **P(Dev'n) = 0**

- Deforestation liability, if liabilities devolved, equals the then carbon price times tCO_2e sequestered, after tax

- Given devolution probability in any year, P(Dev'n), model devolution probability after n years using an exponential distribution

DATA AND ASSUMPTIONS

- Hybrid ROA model used to value a 350 hectare Non-Kyoto *p. radiata* forest that is 20 years old as at 30 June 2005 (pre-CP1)
- HR or HC assumed feasible for forest aged between 20 and 35 years
- Assume "typical" harvest age of 28 years for the current rotation, but 30 years for any subsequent rotation(s)
- Data sources:
  - Log prices – MAF
  - Log yields – Canterbury University School of Forestry online models
  - Forestry costs – NZIF *Forestry Handbook*, 2005
  - Milk prices, and dairying cash flows – MAF, and *MAF National Dairy Budget 2004/05*
  - Dairying conversion costs – farming consultants
- All simulations use 5,000 runs

DATA AND ASSUMPTIONS – CONT'D

- For "Retention" policy assume **P(Dev'n) = 25%**
- Other critical input is current world price of carbon dioxide – **NZ$15/t$CO_2$e** as at valuation date (30 June 2005)
- Log, milk and carbon prices are modelled as "mean-reverting" statistical processes, using Ornstein-Uhlenbeck model (vs GBM):
  - Carbon price dynamics (vs level) estimated based on ETS data
- All cash flows computed in real terms, and use 3.6% real unlevered cost of equity (based on Evergreen asset beta of 0.3)
- Approximate tCO_2e sequestered as 0.77 x TSV m^3 (vs TRV)
- **Kyoto Protocol is assumed to roll over post-CP1, as is any decision by government to devolve deforestation liabilities**

RESULTS (BASE CASE)

NPVs not vastly different under each policy …

Policy	Optimal Alpha	Optimal Beta	Decision Age	NPV ($m)
Ret'n	30k	40k	24.6 yrs	11.0
Dev'n	30k	40k	24.7 yrs	10.8
C. Ret'n	60k	40k	25.9 yrs	11.7

- Committed Retention produces highest NPV as expected
- Little difference between Retention and Devolution decision ages or NPVs, with NPV 7–8% less than under Committed Retention

RESULTS (BASE CASE) – CONT'D

But contrast the HC Rates under each policy …

Policy	Pre-CP1	CP1	Post-CP1	Total
Ret'n	45%	31%	23%	99%
Dev'n	48%	26%	25%	99%
C. Ret'n	20%	47%	32%	100%

- Committed Retention would give foresters the least incentive to HC early (there would be no impending deforestation liabilities to avoid)
- Retention and Devolution produce higher HC Rates Pre-CP1 and in CP1 (74–76%) than Committed Retention (67%), and only slightly less overall (99% vs 100%)

RESULTS (SENSITIVITIES)

NPV ($m) …

Policy	P(Dev'n) = 10%	**P(Dev'n) = 25%**	P(Dev'n) = 40%
Ret'n	11.2	**11.0**	10.8
Dev'n	n.a.	**10.8**	n.a.
C. Ret'n	n.a.	**11.7**	n.a.

HC Rate Pre-CP1 (CP1) …

Policy	P(Dev'n) = 10%	**P(Dev'n) = 25%**	P(Dev'n) = 40%
Ret'n	39% (41%)	**45% (31%)**	46% (29%)
Dev'n	n.a.	**48% (26%)**	n.a.
C. Ret'n	n.a.	**20% (47%)**	n.a.

RESULTS (SENSITIVITIES) – CONT'D

NPV ($m) …

Policy	Carbon = $5/t	**Carbon = $15/t**	Carbon = $25/t
Ret'n	11.4	**11.0**	10.5
Dev'n	11.3	**10.8**	10.2
C. Ret'n	11.7	**11.7**	11.7

HC Rate Pre-CP1 (CP1) …

Policy	Carbon = $5/t	**Carbon = $15/t**	Carbon = $25/t
Ret'n	35% (47%)	**45% (31%)**	57% (19%)
Dev'n	36% (45%)	**48% (26%)**	61% (12%)
C. Ret'n	20% (46%)	**20% (47%)**	20% (48%)

DISCUSSION

- Health warnings:
  - Model is “simple” – ignores nitrates rules, dairying complexities, …
  - “Rule of thumb” decision structure imposed
  - Results sensitive to assumptions

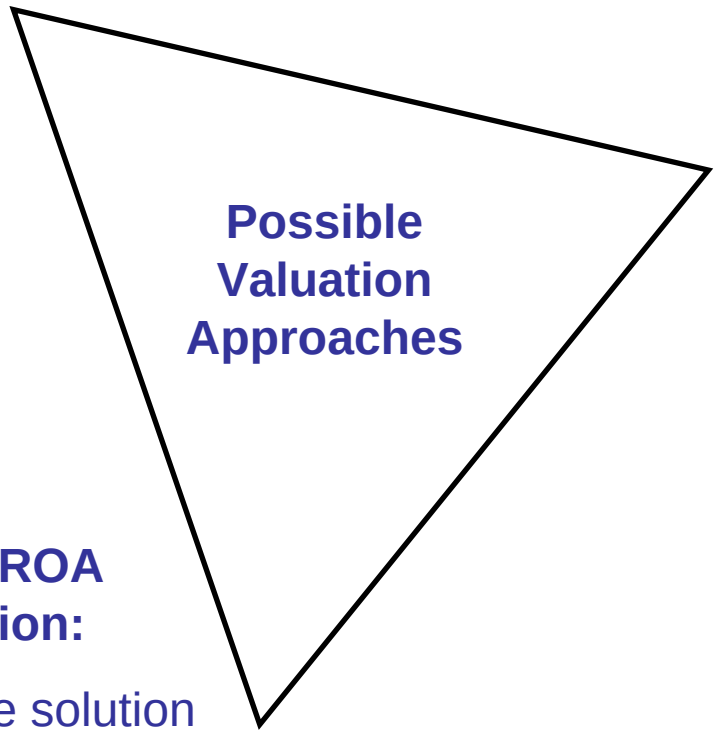
- Approach can be extended to value “Kyoto” forests – those first planted after 1990, qualifying for carbon credits but also incurring harvest (vs deforestation) liabilities

- Takes a different tack to Guthrie and Kumareswaran (2004):
  - They formally apply ROA to produce an optimal decision rule and corresponding NPV
  - To keep things tractable they compromise on model complexity (using a constant carbon price, only one stochastic log price, and a constant “conversion” (i.e. salvage) value)
  - My model prefers reality over formality (all prices stochastic, and conversion value is state-dependent, but results are more approximate)

DISCUSSION – CONT'D

Formal ROA:

- Optimal solution
- Harder to implement
- Less realistic setup



Formal ROA Approximation:

- Approximate solution
- Harder to implement
- More realistic setup

"Heuristic" ROA Approximation:

- Approximate solution
- Easier to implement
- More realistic setup

DISCUSSION – CONT'D

- Under this model's structure and assumptions:
  - Forest NPVs differ modestly under alternative deforestation liability policies, with Committed Retention NPV the highest
  - Retention and Devolution are largely alike with even a small P(Dev'n), although Devolution produces higher pre-CP1 deforestation with a higher carbon price
  - Rising carbon prices reduce total pre-CP1 and CP1 deforestation under both Retention and Devolution
  - A harder stance re the 21 Mt cap (higher P(Devn)) would raise (lower) pre-CP1 (CP1) deforestation under Retention
  - Committed Retention would minimise total pre-CP1 and CP1 deforestation, but has no higher overall HC Rate

Thank you – any questions?

Source: NZIF, *Forestry Handbook*, 2005