

Flexible Global Climate Change Policy

ESD.71 Application Portfolio: December 2009

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Presentation Outline

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Problem Overview

- Current climate change policy decisions are based on deterministic views of the future events, dominated by considerations of a single optimal carbon emissions path.
- Many aspects of the future remain highly uncertain, creating the need for flexible climate policies.
- Implementing an R&D-inducing carbon tax policy today provides a form of “insurance” against future carbon-emissions related climate damages, representing an important form of flexibility.
- The following project examines the opportunities that flexible global climate change policy can have on the overall net present welfare of the global economy.

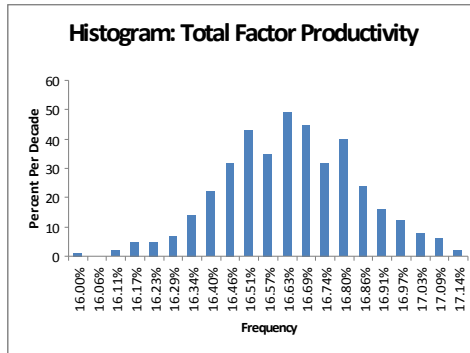
Application System

- Key Components of System
 - Aggregated Global Economy, includes
 - Production = $f(\text{Capital, Labor, Fossil-Fuel Energy Sector})$
 - Physical Environment
 - Population's Utility Function (Preferences for Consumption v. Investment)
- Dynamic Integrated model for Climate and the Economy (DICE-99) is used as the evaluation model for system performance
- Timeframe is 2015 through 2335

Sources of Uncertainty (1 of 3)

Total Factor Productivity Growth Rate:

TPF is the contribution to economic output not accounted for by inputs such as labor and capital; level of technology in the economy

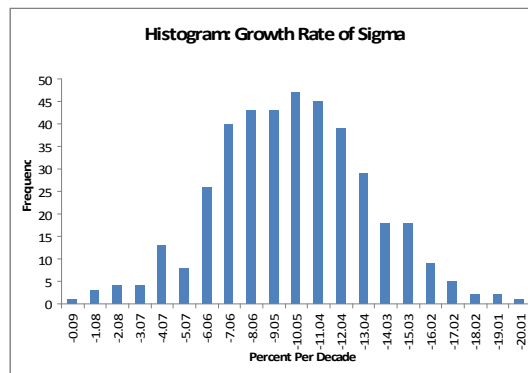


Data: MIT Joint Program

Sources of Uncertainty (2 of 3)

Emissions Intensity Growth Rate:

Emissions intensity is the trend in CO₂-equivalent emissions per unit of output without a carbon-reducing policy in place

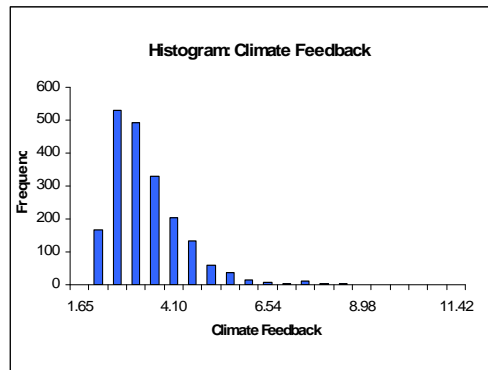


Data: MIT Joint Program

Sources of Uncertainty (3 of 3)

Climate Feedback

A cloud-related parameter that represents the sensitivity of the climate to GHGs



Data: MIT Joint Program

Fixed and Flexible Designs

- Fixed Design
 - In both studies: Business-as-usual case with no carbon-tax policy
- Flexible Designs
 - Investigation 1 (2 Period): High or low carbon tax policy implemented in Period 1 with an option to change tax level in Period 2.
 - Investigation 2 (6 Period): Option to implement a medium carbon tax at any period.

Decision Analysis (1 of 2)

Policy Design Alternatives and Uncertainties

Design	Emissions Reduction (μ_e) (\$ Tax)
Fixed "No" Policy ("Business-as-Usual")	No Control (\$0 per ton) Both Decision Points
Flexible Policies (Carbon Taxes)	2015: High (\$30) / 2065: High (\$80) 2015: High (\$30) / 2065: Low (\$30) 2015: Low (\$10) / 2065: High (\$80) 2015: Low (\$10) / 2065: Low (\$30)

Uncertain Parameter	High	Medium	Low
Emission Intensity	$P(\sigma = -30.055) = 0.185$	$P(\sigma = -15.885) = 0.63$	$P(\sigma = -1.082) = 0.185$
Growth Rate (σ_g)			
Climate Feedback Parameter (λ_c)	$P(\lambda = 4.682) = 0.185$	$P(\lambda = 2.908) = 0.63$	$P(\lambda = 1.134) = 0.185$

Decision Analysis Components

Stages: 2 (2015-2055 and 2065-2335)

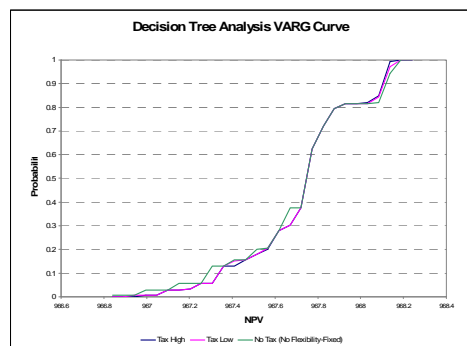
Decision in Period 1: Tax High, Tax Low, or No Tax

Uncertainties Considered: Emission Intensity Growth Rate and Climate Feedback

Payoff Value: NPV Welfare

Decision Analysis (2 of 2)

Decision Tree Solution Optimal Strategy: Tax Low in Period 1; Tax High in Period 2

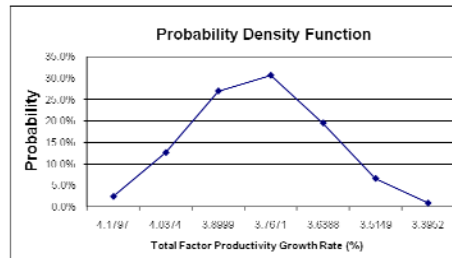


Decision Tree Analysis VARG Curve

Risk Assumption	Preferred Period 1 Design
P10	Tax Low
P15	Tax High
P50	No Tax (Inflexible Case)
P75	No Tax (Inflexible Case)
P90	No Tax (Inflexible Case)

Lattice Analysis (1 of 2)

- Policy Design Alternatives
 - BAU No-Tax Case
 - Option to Begin Implementing a \$45 per ton Carbon Tax in any Period (Modeled as a "Call Option")
- Uncertainty Considered: TPF Growth Rate
- "How long should we wait to implement a carbon tax?"

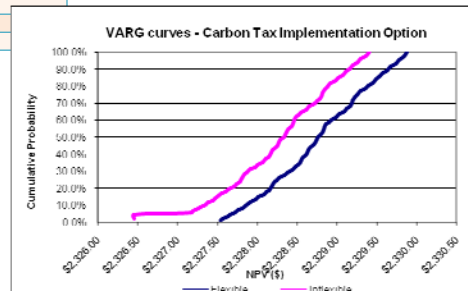


Lattice Analysis (2 of 2)

Dynamic Programming Decision Analysis Optimal Strategy:
Always Decide to Implement \$45 per ton Carbon Tax

Period	t=0	t=1	t=2	t=3	t=4	t=5	t=6
Exercise	NO	YES	YES	YES	YES	YES	YES
CALL							
OPTION?		YES	YES	YES	YES	YES	YES
			YES	YES	YES	YES	YES
				YES	YES	YES	YES
					YES	YES	YES
						YES	YES
							YES

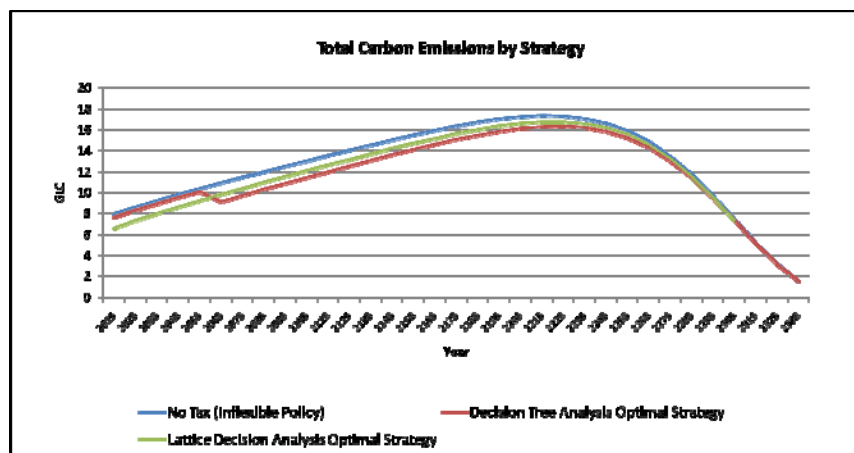
Risk Assumption	Preferred Period 1 Design
P10	Flexible Case
P25	Flexible Case
P50	Flexible Case
P75	Flexible Case
P95	Flexible Case



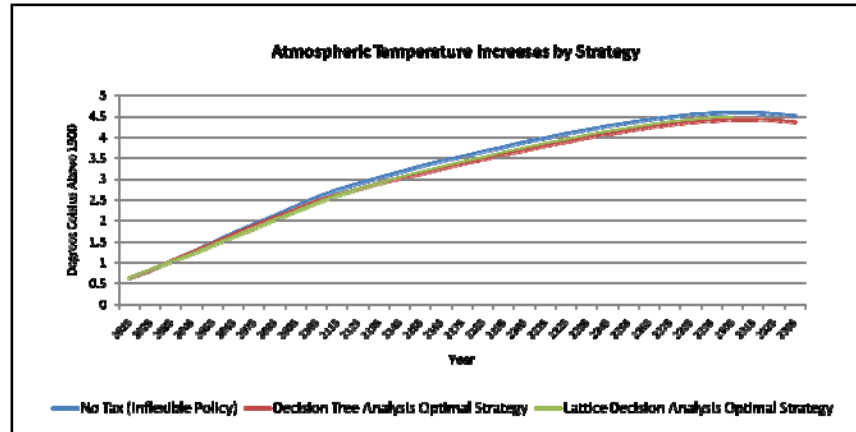
Conclusions

- Investigation 1 (Decision Tree Analysis): The value of flexibility was \$0.019316 trillion for the optimal strategy.
- Investigation 2 (Lattice Analysis): the value of the call option to implement a carbon-tax when deemed appropriate was \$0.51 trillion.
- Flexible policy strategies are chosen over inflexible policy strategies in both investigations.

Conclusions



Conclusions



Thank You!

Questions?
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Acknowledgments
Professor Richard de Neufville
TA Michel-Alexandre Cardin