Flexible Global Climate Change Policy

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Presentation Outline

- Problem Overview (1)
- Application System (1)
- Sources of Uncertainty (3)
- Fixed and Flexible Designs (1)
- Decision Tree Analysis (2)
- Lattice Analysis (2)
- Conclusions (2)
- Questions?

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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 a 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.

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Application System

- Key Components of System
  - Aggregated Global Economy, includes
    - Production = f(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

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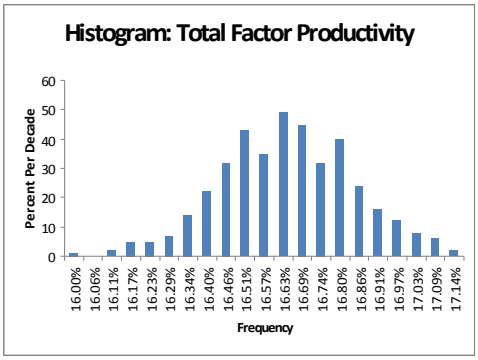
Sources of Uncertainty (1 of 3)

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



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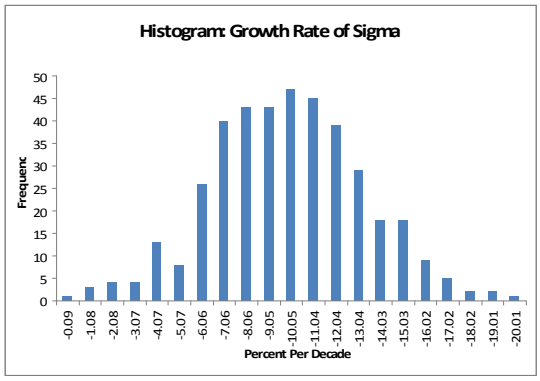
Sources of Uncertainty (2 of 3)

Emissions Intensity Growth Rate:

Emissions intensity is the trend in CO_2-equivalent emissions per unit of output without a carbon-reducing policy in place



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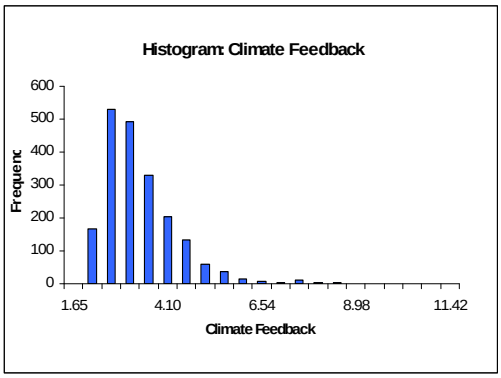
Sources of Uncertainty (3 of 3)

Climate Feedback

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



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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.

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Decision Analysis (1 of 2)

Policy Design Alternatives and Uncertainties

Design	Emissions Reduction (μ_t) ($ 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 Growth Rate (σ_t)	P(σ=-30.055) = 0.185	P(σ=--15.885) = 0.63	P(σ=-1.082) = 0.185
Climate Feedback Parameter (λ_t)	P(λ=4.682) = 0.185	P(λ=2.908) = 0.63	P(λ=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

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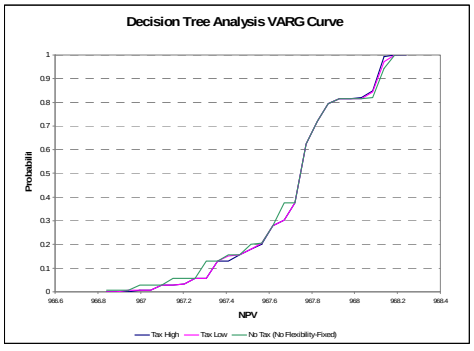
Decision Analysis (2 of 2)

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)

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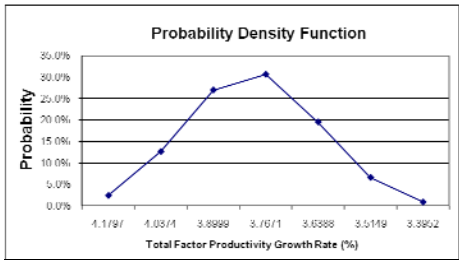
Lattice Analysis (1 of 2)

- 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?"



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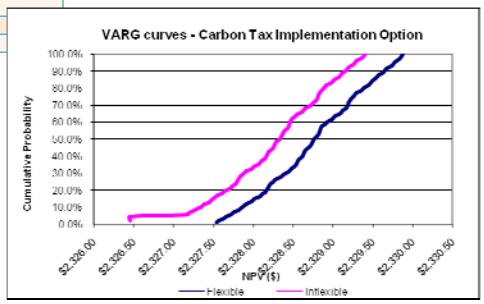
Lattice Analysis (2 of 2)

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 CALL OPTION?	NO	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



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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.

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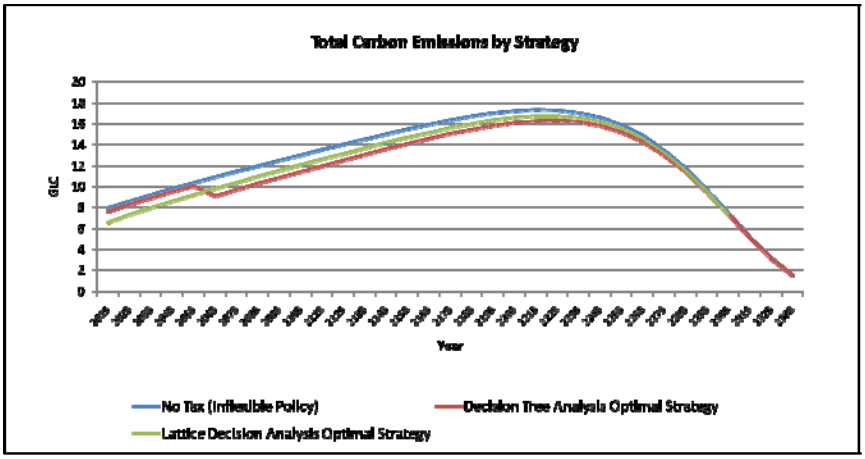
Conclusions



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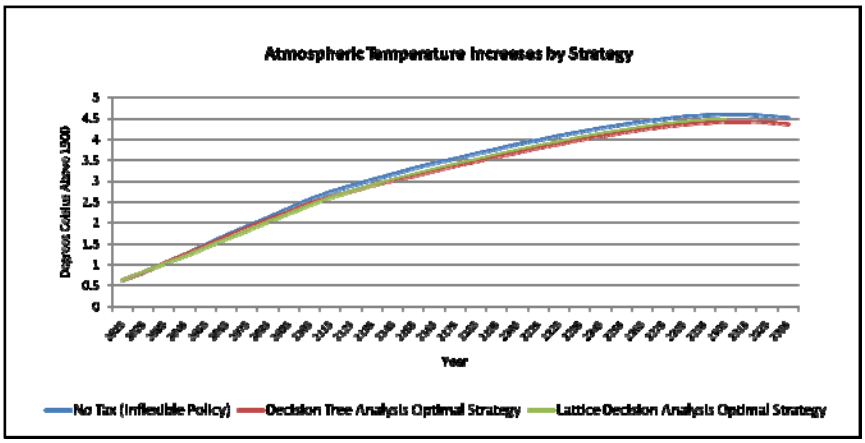
Conclusions



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Thank You!

Questions?

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