

Non-market Valuation

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- Market impacts
 - a change in income;
 - a change in the price of a market commodity or input;
 - a change in the quality of a market commodity or input; and
 - a change in availability other than price (a change in a fixed quantity available).
- Non-market impacts
 - the effects on human health and mortality,
 - the loss of amenity from the environment, and
 - impacts on ecosystems and species
 - Etc.

Non-market values already played some role

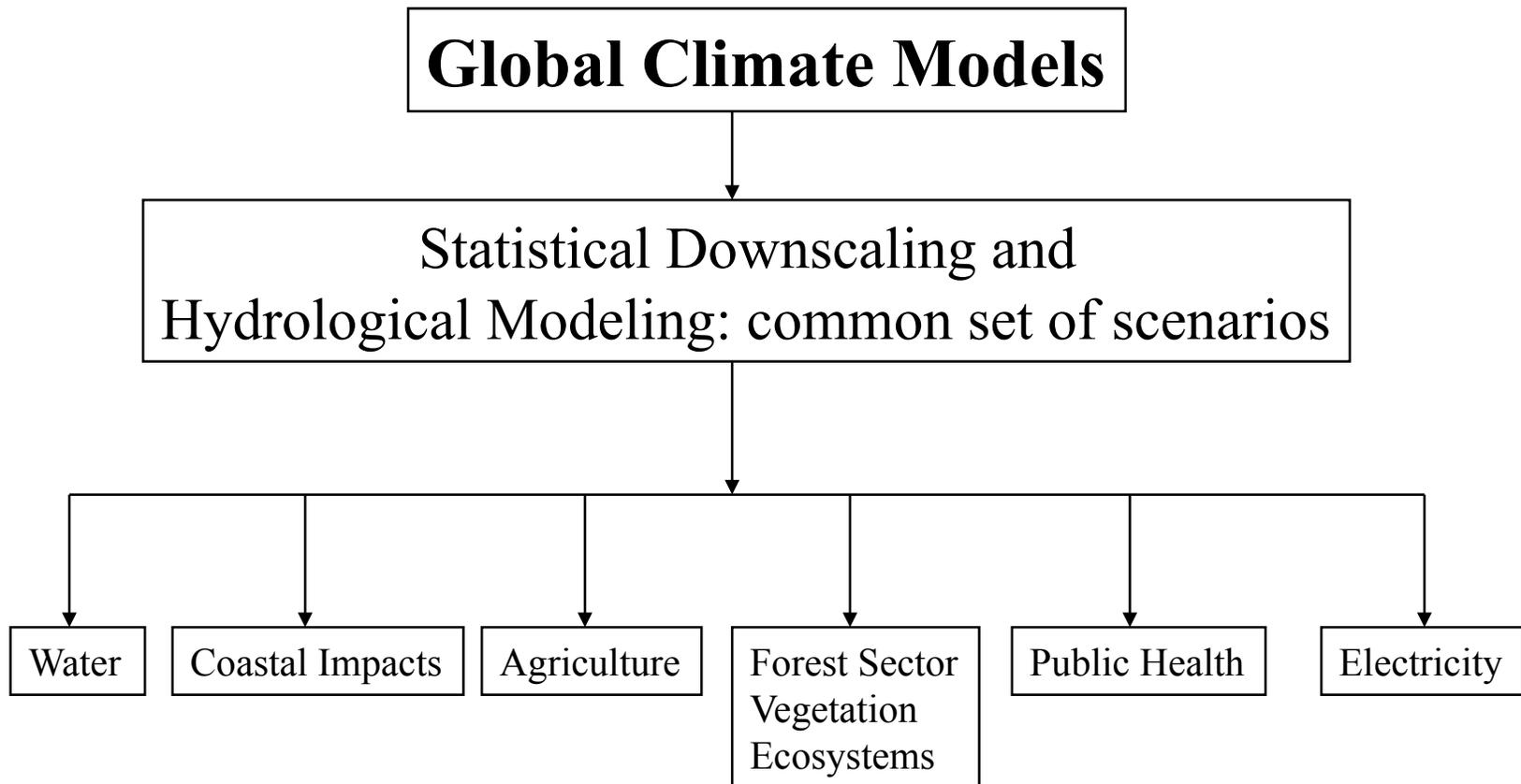
- Hanemann (2009)

REVISED ESTIMATE OF ECONOMIC IMPACT OF 2.5° C WARMING IN US			
ANNUAL WILLINGNESS TO PAY PER U.S. HOUSEHOLD (2006\$)			
		NORDHAUS	MY REVISION
MARKET IMPACTS			
Agriculture		\$46	\$180
Energy		\$0	\$50 ?
Water		\$0	\$75 ?
Sea Level		\$69	\$350 ?
MARKET SUBTOTAL*		\$126	\$655
NONMARKET IMPACTS			
Health, water quality, human life		\$22	\$60
Human amenity, recreation, nonmarket time		-\$195	-\$25 ?
Human settlements		\$69	\$69 Left unchanged
Extreme and catastrophic events		\$287	\$287 Left unchanged
Ecosystem		\$0	\$150 ?
NONMARKET SUBTOTAL*		\$195	\$541
MARKET + NONMARKET TOTAL*		\$321	\$1,196
* Total does not add due to rounding in original			

Caveats for valuation

- Valuation of impacts – both market and non-market – is *highly* uncertain.
 - “If a thing is worth doing, it’s worth doing badly.”
 - “Do it until you get it right.”
- Therefore, it is not useful to think it terms of a fine-grained policy optimization based on first-order equality conditions ($MC = MB$).
- Rather, the issue is whether, for some broad action, $MB >$ or $< MC$
 - e.g., Assertion for US that climate damage is 0.5% of GNP, mitigation cost is 1.5 – 2% of GNP.

Structure of the Overall Study



Economic Valuation

- For marginal changes in market goods, at an optimum, the marginal value of the last unit is equal to its marginal cost (price).
 - That can yield a *zero* estimate of the net value of market goods.
 - For non-marginal changes in market goods, as first pointed out in 1844, the price understates the marginal value (i.e., zero understates net value).
 - For items with no market price....
- Non-market valuation was formalized in economic theory (WTP, WTA) within a couple of years of the successful formalization of market valuation, around 1970-72. 📌
- WTP/WTA measure the amount of monetary income (or numeraire commodity) an *individual* would agree to exchange to obtain/avoid the change being valued.
- On a national basis, the aggregate monetary impact – the change in income plus the WTP equivalent of the other changes in wellbeing – is typically expressed as a percentage reduction in Gross Domestic Product (GDP), the value of the market economy.

Difficult issues

- Monetary vs non-monetary valuation.
- Aggregation over multiple outcomes/metrics.
 - Multiple metrics don't help if can't aggregate.
- Marginal vs non-marginal valuation.
 - Matters greatly if marginal value is not constant.
- Aggregation over individuals
 - Climate change is, above all, a matter of wealth re-distribution.
 - Ignoring distribution (as in Potential Pareto criterion) is singularly inappropriate.
 - Ditto assuming a representative individual.

Bottom up assessment of impacts

- While mitigation is global, impacts and adaptation are local – and heterogeneous.
- Makes analysis more laborious.
 - Given nonlinear (and asymmetric) damage function, using aggregate data on temperature change tends to understate damages.
- Spatial disaggregation is a major obstacle for economic analysis.
 - CGE models are spatially aggregated.

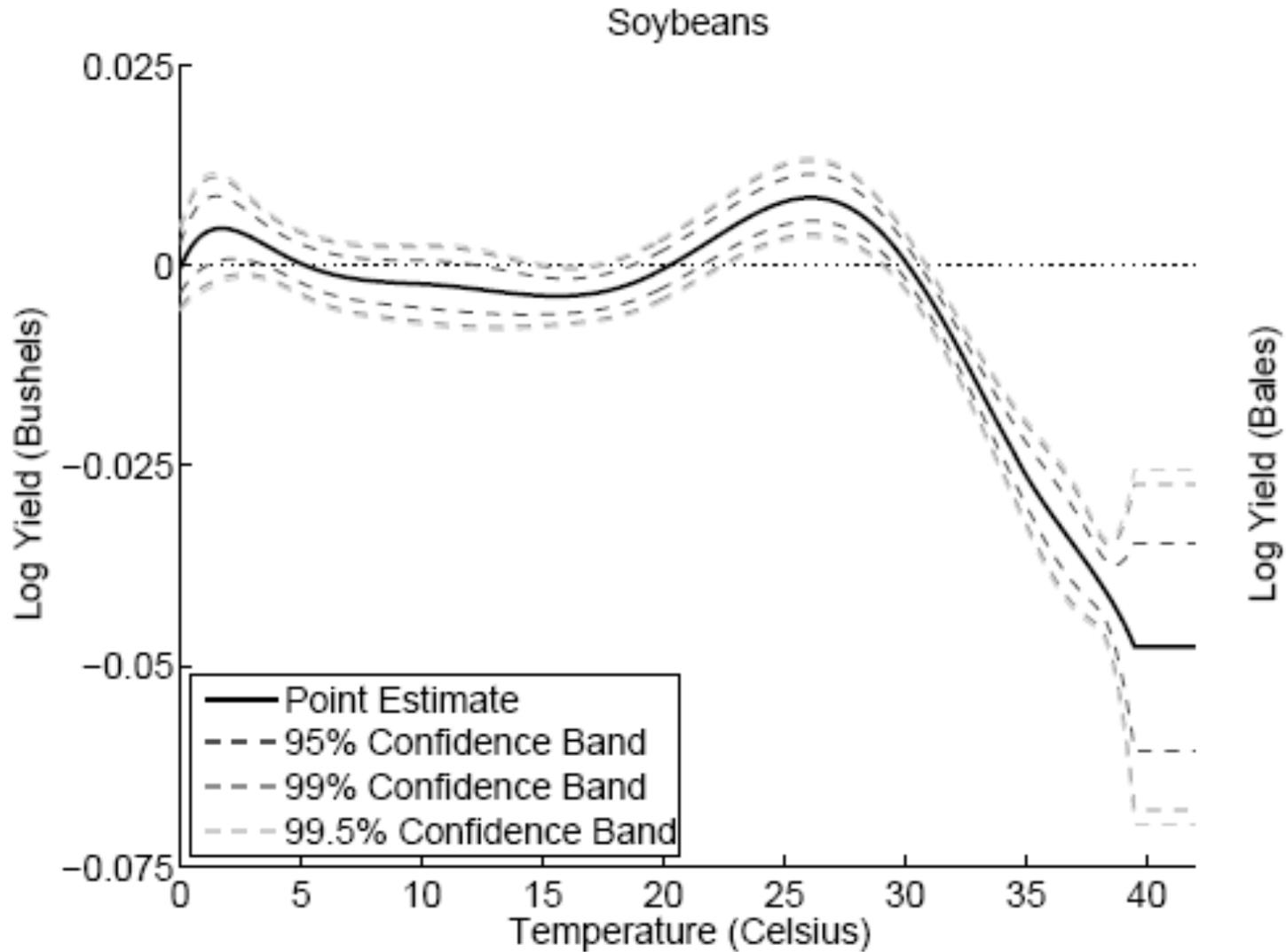
Aggregation distorts conception of temperature change

Hayhoe et al PNAS 2004

HOW TO CHARACTERIZE THE CHANGE IN TEMPERATURE, 2070-2099, USING HADCM3			
		EMISSION SCENARIO**	
		A1fi	B1
Change in global average annual temperature		4.1	2
Change in statewide average annual temperature in California*		5.8	3.3
Change in statewide average winter temperature in California*		4	2.3
Change in statewide average summer temperature in California*		8.3	4.6
Change in LA/Sacramento average summer temperature		~10	~5
*Change relative to 1990-1999. Units are °C			

Asymmetric Relation of Temperature and Crop Yield

Schlenker & Roberts (2006, 2008, 2009)



Methods of valuation

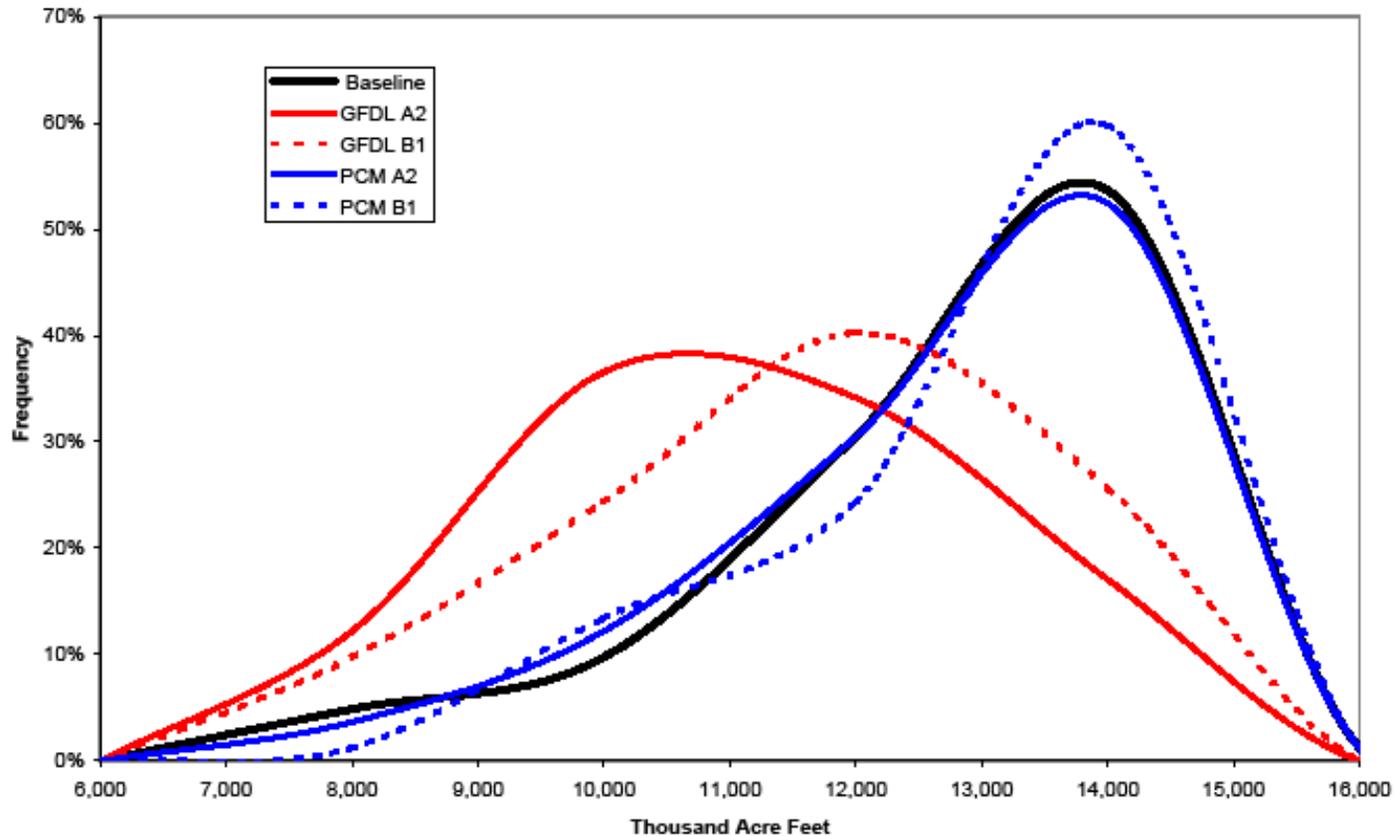
- Revealed preference
 - Hinges on ability to identify behavior involving a relevant tradeoff.
 - Typically involves an extrapolation from actual observed behavior to what behavior would be in circumstances not observed (e.g. if price were so high as to drive consumer out of market).
- Stated preference
 - The researcher creates a tradeoff and presents this to subjects via a survey or experiment.
 - Valuation of impacts
 - Estimation of WTP for GHG mitigation (e.g., Kopp & Krosnick 2008).

- To some extent, the dichotomy between revealed and stated preference is overblown, because successful implementation of stated preference requires more than passive observation of behavior. It requires interaction with subjects through the use of surveys.
- A common link between the behavioral economics and the economic model underlying non-market valuation is the Lancaster-Maler utility model.

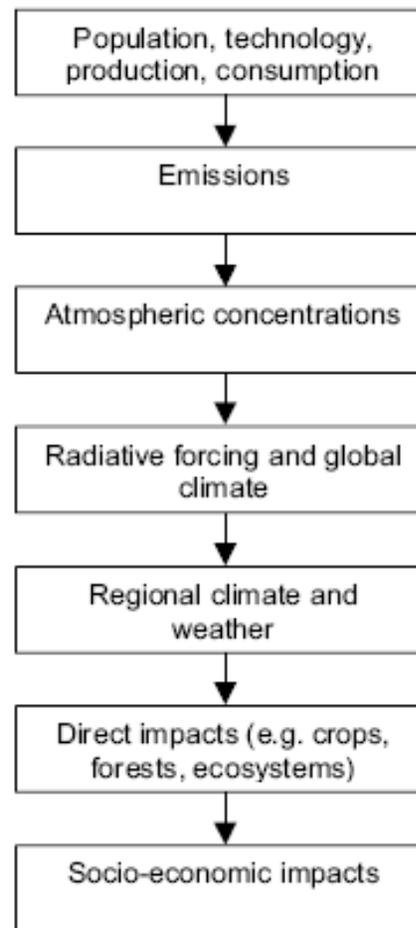
- In this model, $u = u(x,q)$.
- x is consumption of market commodities
- q is other things that you care about but you don't control them eg environmental quality, attributes of commodities, etc.
- Indirect utility function $u=v(p,q,y)$
- Choice behavior is idiosyncratic, subjective, and heterogeneous.
 - What q 's are attached to a decision depends on context, is influenced by salience.
 - How the q are perceived by the decision maker.
 - Behavior can be influenced by changing:
 - (i) the set of choice alternatives (x),
 - (ii) the q 's attached to the problem
 - (iii) the salience/weight placed on q 's
 - (iv) prices (p).
- Leads into welfare analysis with changing preferences.

- Researcher needs more than passive observation to identify attributes attached to decision, and the perceptions of these attributes.
- To the extent that behavior/concern for climate impacts involves elements of risk aversion (downside risk aversion, ambiguity aversion, etc) researcher needs an interaction to measure risk aversion etc.

Annual deliveries to Central Valley agriculture, 2085



Steps in Modeling Climate Change: From Emissions to Impacts



- All of the steps in the Figure are marked by uncertainty and some degree of scientific disagreement.
- Given a projected change in climate variables, different models use different damage/valuation functions and reach different conclusions regarding the economic cost.
- The disagreement among damage and cost functions is significantly *larger* than that among climate change projections.
 - Climate modeling has been going on for longer and at a higher level of activity than the damage and cost modeling, and is therefore in a more mature state.
 - Damage estimation is inherently more complex: it involves a high level of spatial disaggregation and a wide range of biological, chemical, hydrological and physical phenomena, most of which are not yet well modeled.
- Hence, damage functions depend very heavily on subjective judgments by the researcher.
- The economic valuation is difficult, but is by no means the largest problem or source of uncertainty.