Uncertainty, Loss Aversion and Markets for Energy Efficiency

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Markets for energy efficiency have a bias that leads to undervaluing energy efficiency.

- “Energy paradox” or “Energy Gap”
- Not, strictly speaking, a “market failure”
- Combination of Uncertainty and Loss Aversion creates the Bias (ULAB).
- Net Value = PV(E Savings) – Incr. Cost
- Loss averse consumer weights potential for loss at about twice potential for gain
- Equipment manufacturer acts as consumers’ agent in adopting energy efficient technologies.
- ULAB is measurable, “correctible”.

Consider three stages of energy efficiency market decisions:

- Decision to invest in energy efficiency R&D affects availability of technology.
- Manufacturers' decisions to implement technologies in energy-using equipment affect options available to consumers.
- Consumer's decisions to purchase energy efficiency equipment or not affect realized energy efficiency.

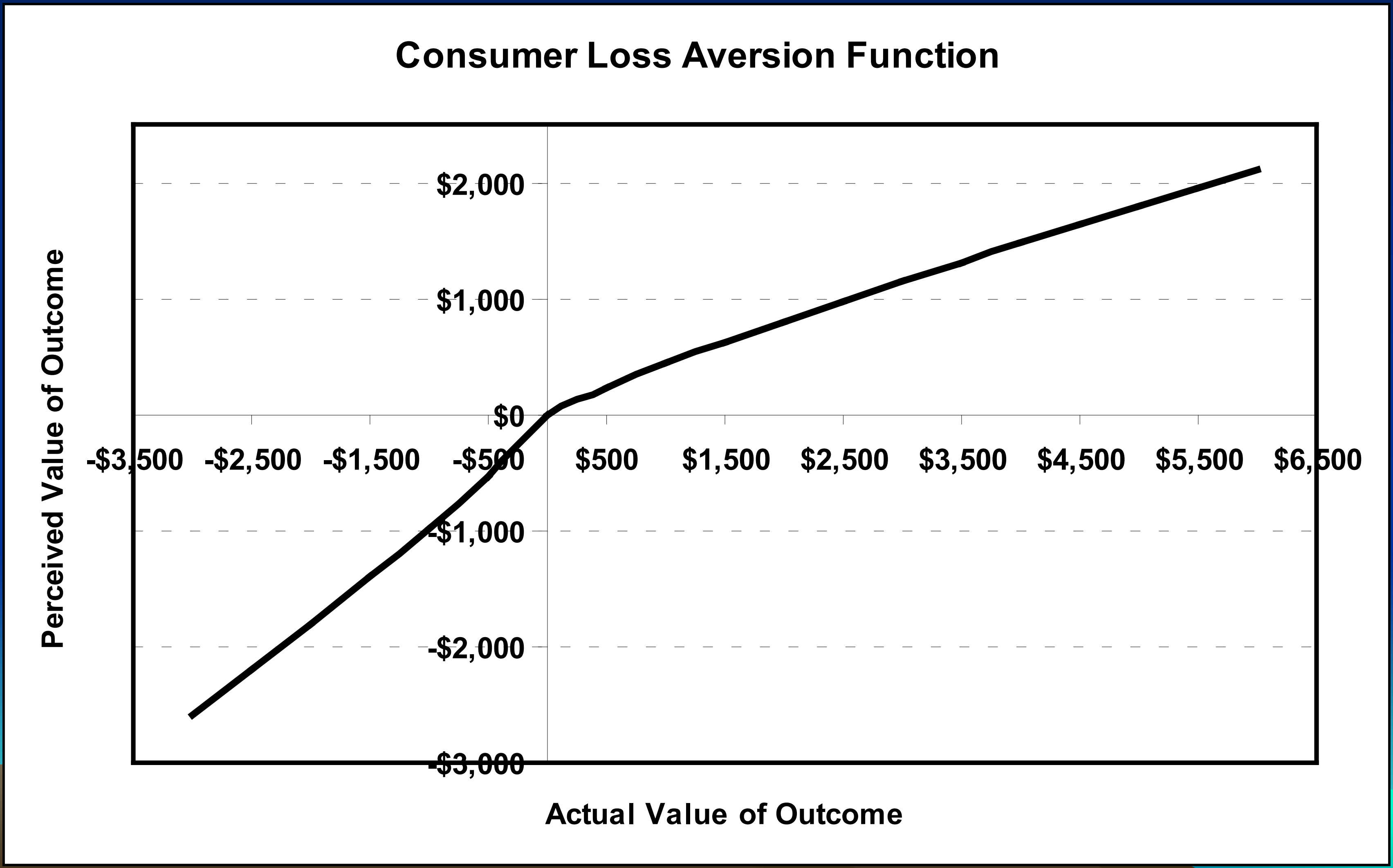
To be sure, there are market failures, as well.

- Principal agent conflicts
- Information asymmetry
- Transaction costs
- Bounded rationality
- External costs and benefits

Loss aversion differs importantly from ***risk aversion*** in that it arises from context dependent preferences.

- Cannot be explained by decreasing MU of income (Rabin, 2000)
- Poses special problems for consumers' surplus measurement and C/B analysis.
- Consumer's reference point matters: status quo ante or status quo post?
- Arrow-Lind (1970) insurance principle does not necessarily apply.

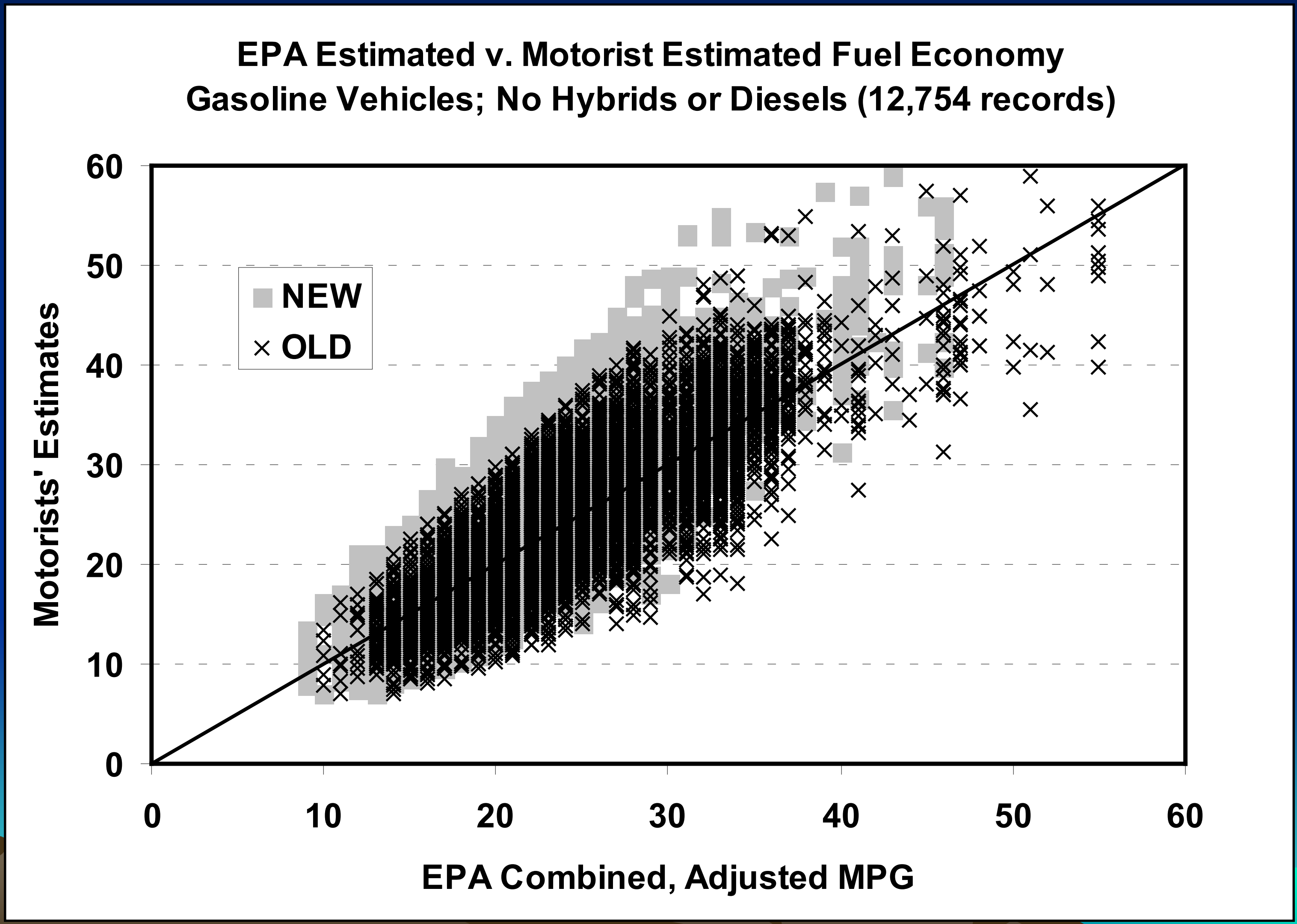
Losses count approximately twice as much as gains and the weighting is nearly linear. "A bird in the hand…"?



What are the sources of uncertainty?

- Actual v. rated energy efficiency
- Future energy prices
- Useful life of equipment
- Usage rate
- More…

Automobile fuel economy is one example.



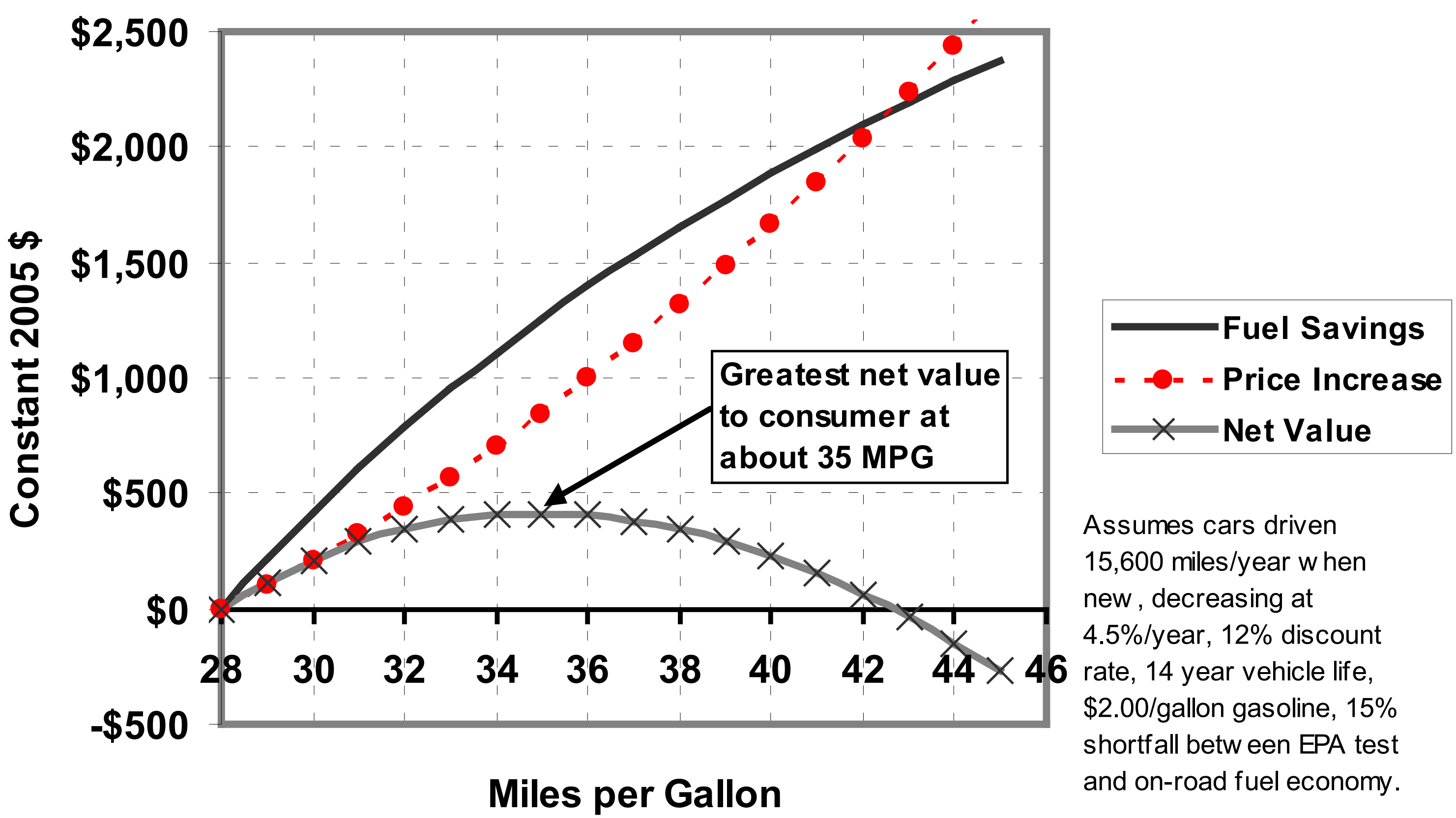
Assumptions were taken from the 2002 NAS CAFE report.

Table 1. Key Parameters of the Consumers' Fuel Economy Choice Problem

Variable	Value Assumed
Miles traveled (first year)	5%=14,000, mean=15,600, 95%=17,200
Rate of decline in usage	4.5%/year
Rate of return required by consumer	12%/year
Vehicle lifetime (extreme value)	5% = 3.6, mean = 14 years, 95% = 25.3
Gasoline price distribution (lognormal)	5% = $1.78, mean = $2.05, 95% = $2.63
Incremental price distribution	5% = $665, mean = $974, 95% = $1,385
Fuel Economy Lower	5% = 21 mpg, mean = 28, 95% = 35
Fuel Economy Upper	5% = 28 mpg, mean = 35, 95% = 42
In-Use Fuel Economy Factor	0.85

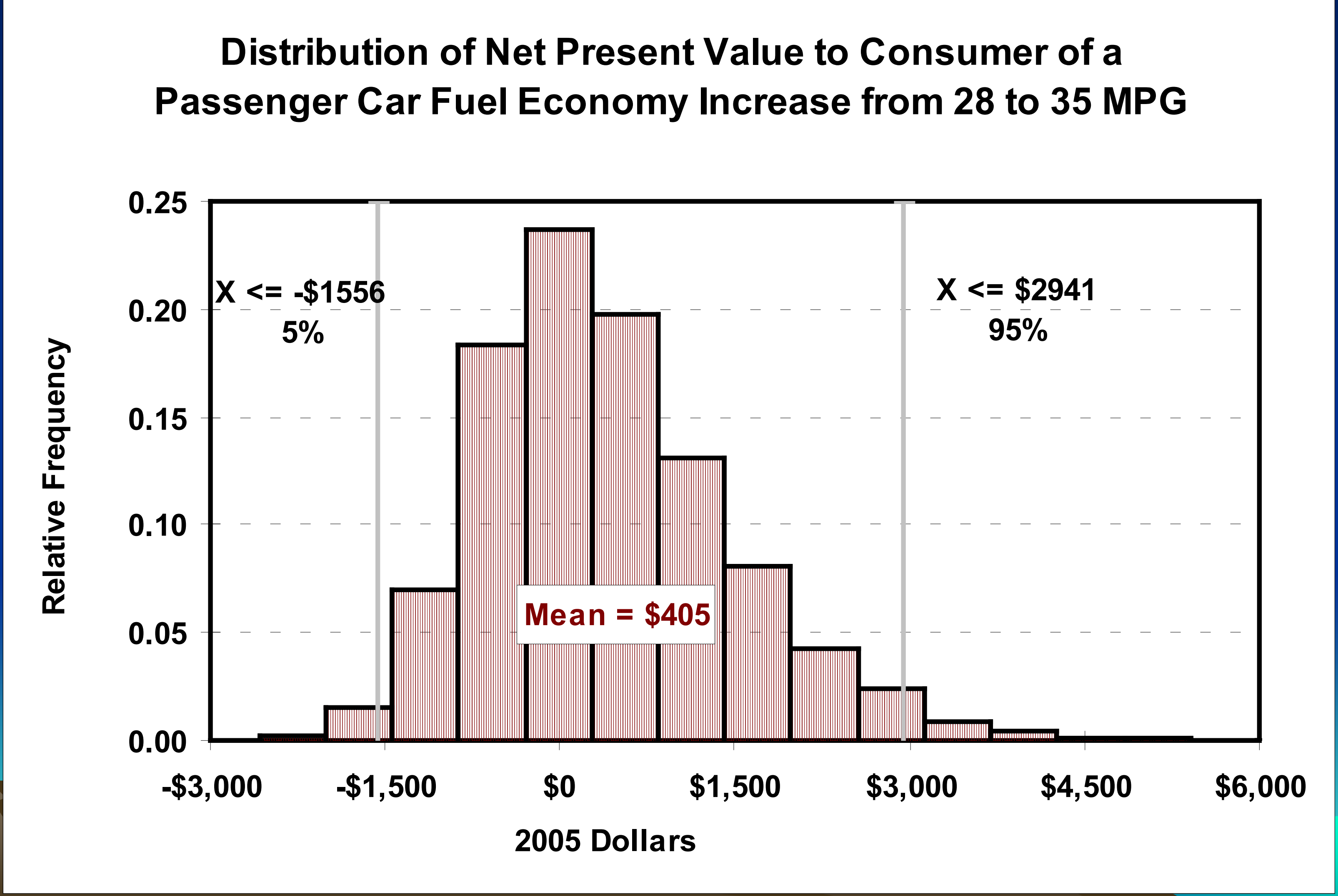
Given complete certainty about future fuel savings and cost, an increase to about 35 MPG appears optimal, providing a net present gain of over $400.

Price and Value of Increased Fuel Economy to Passenger Car Buyer, Using NRC Average Price Curves

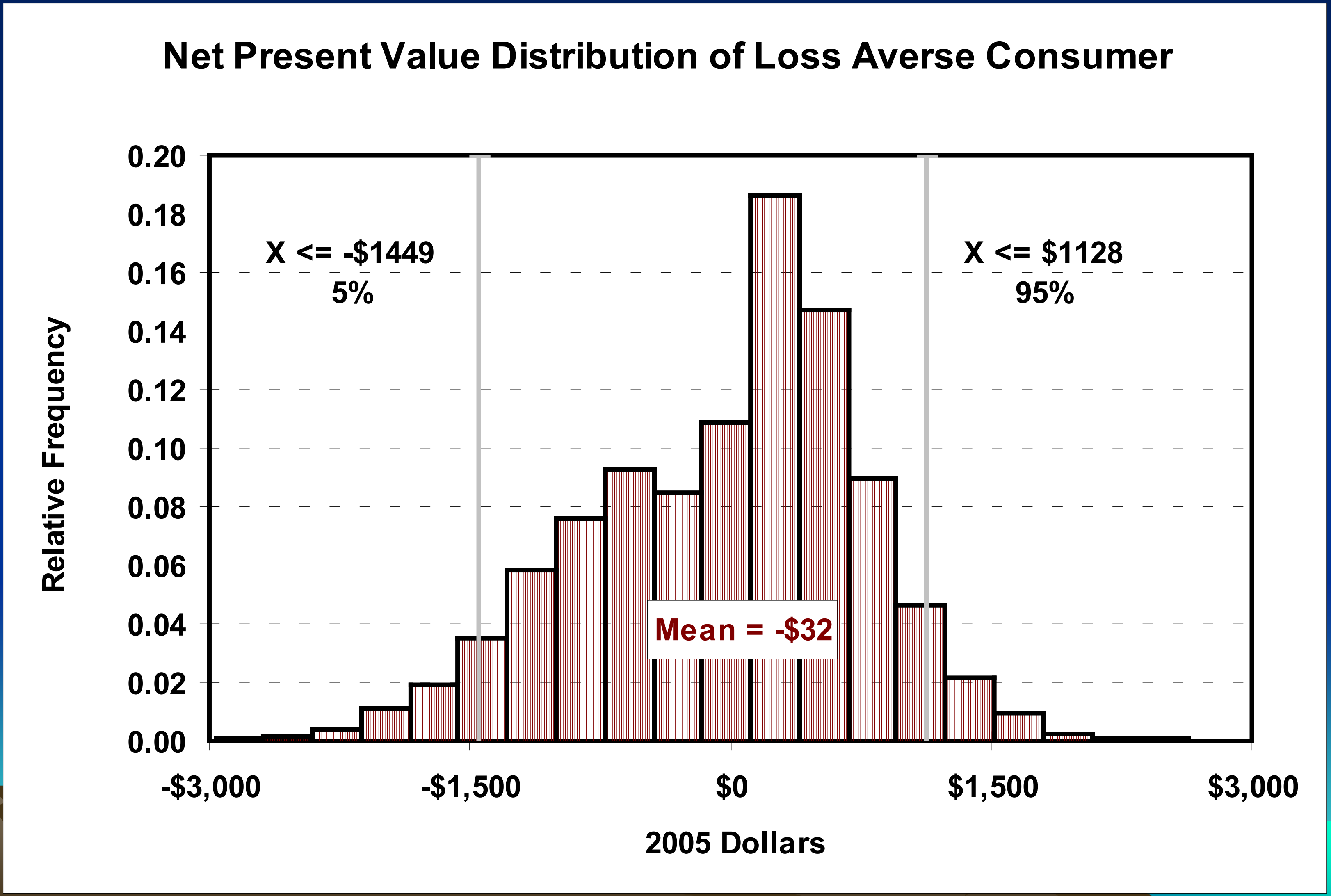


Assumes cars driven 15,600 miles/year when new, decreasing at 4.5%/year, 12% discount rate, 14 year vehicle life, $2.00/gallon gasoline, 15% shortfall between EPA test and on-road fuel economy.

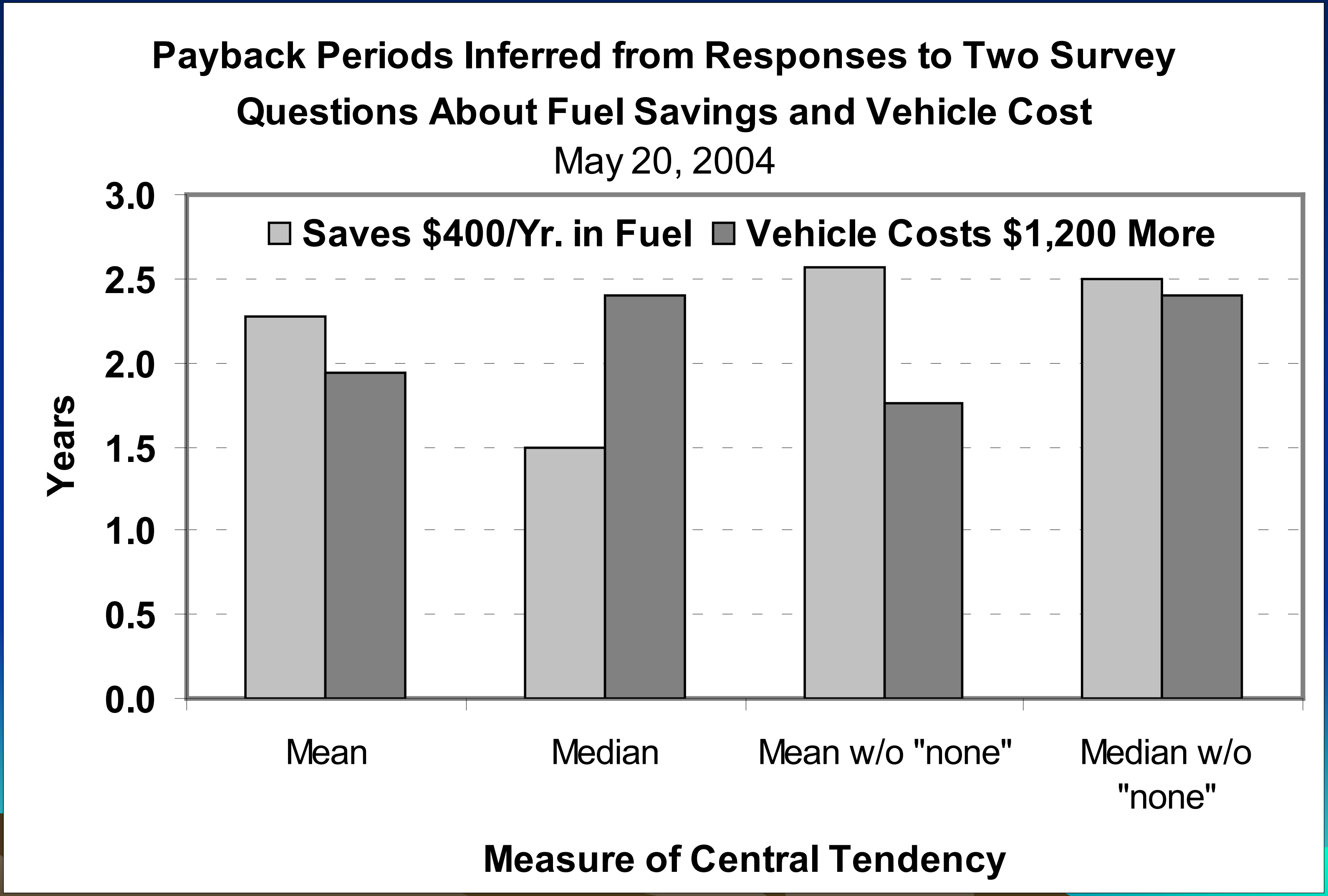
Incorporating uncertainty produces a probability distribution of net present value, that includes the possibility of loss, rather than a single number.



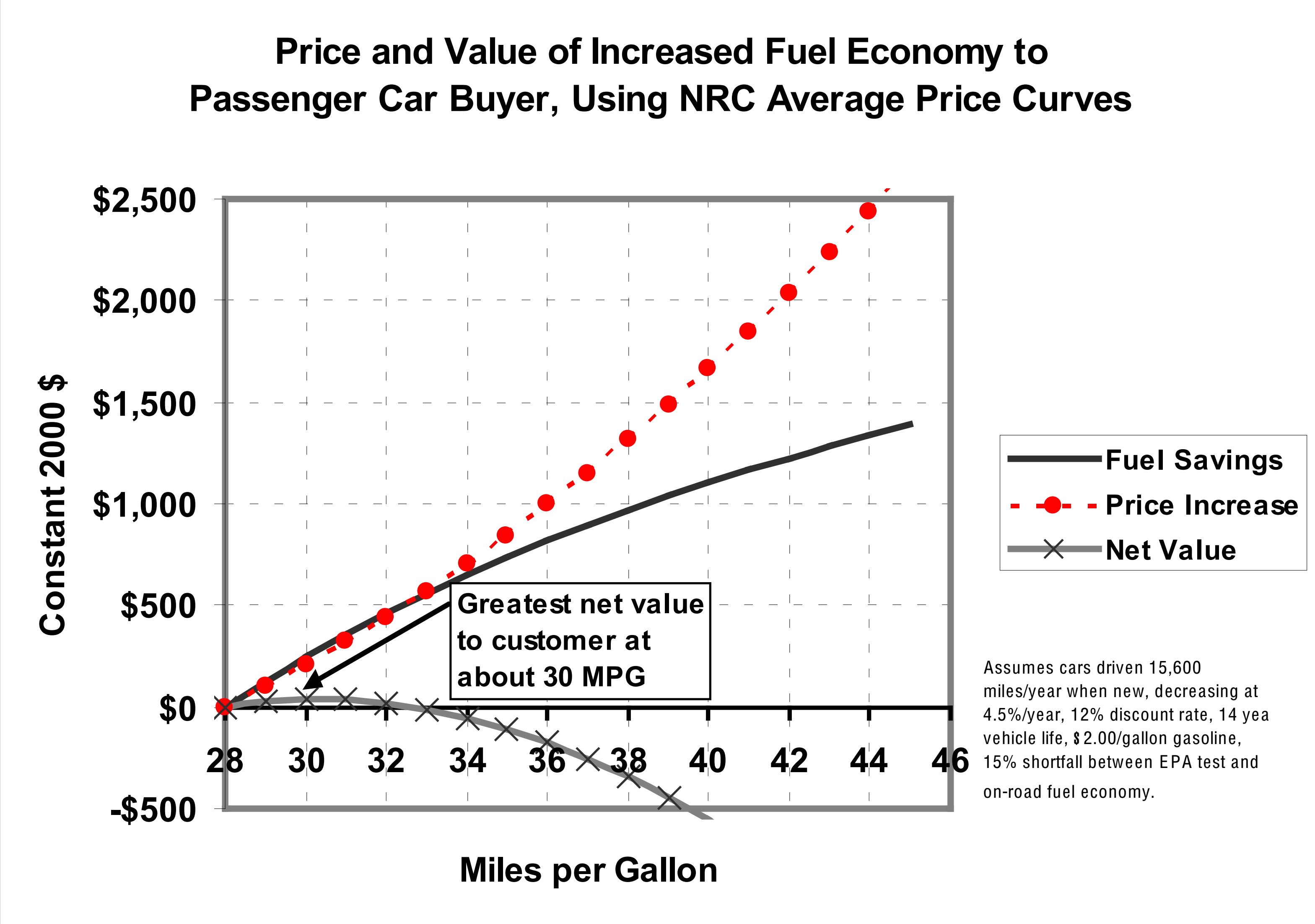
Incorporating loss aversion results in an expected value of -$32 or essentially $0.



Carmakers believe consumers require short payback periods for fuel economy. But few actually think about gas mileage in financial terms (Turrentine & Kurani, 2007).



The ULAB result is very similar to the manufacturers' rule of thumb. Why invest $billions to produce something about which consumers are indifferent?



What to do?

- Arrow and Lind (1970) ***risk*** aversion: government should intervene ***iff*** it insures consumers against risk.
- But loss aversion is different in that it arises from context dependent preferences.
- Welfare implications unclear.
- Proposal: government should intervene only if there is a compelling societal benefit.

Markets for energy efficiency have an ULAB that leads to undervaluing energy efficiency.

- "Energy paradox" or "Energy Gap"
- Not, strictly speaking, a "market failure"
- Net Value = PV(E Savings) – Incr. Cost
- Substantial uncertainty due to "invisibility" of energy efficiency, uncertain energy prices.
- Loss averse consumer weights potential for loss at about twice potential for gain
- Equipment manufacturer acting as consumers' agent in adopting energy efficient technologies also faces risks.
- ULAB should cause underinvestment in R&D as well as downward bias in demand for energy efficiency.
- ULAB is measurable, "correctible".

THANK YOU.