Prospect theory: Insurance

Notes on Behavioural Economics

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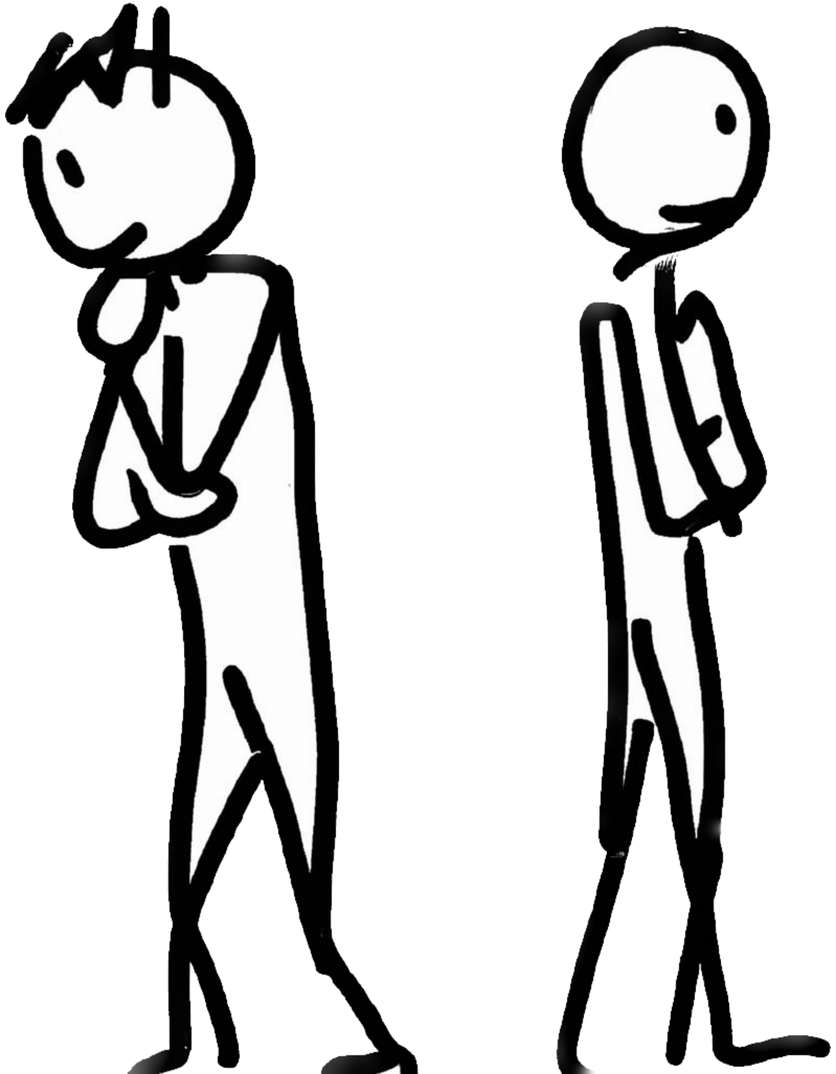

Why buy insurance?

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Expected utility theory

Risk aversion $\Longrightarrow$ insurance

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Prospect theory

Overweighting small probabilities $\Longrightarrow$ insurance

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The fourfold pattern of Prospect theory

	Gains	**Losses**
High probability	Risk aversion	Risk seeking
Low probability	Risk seeking	Risk aversion

Scenario

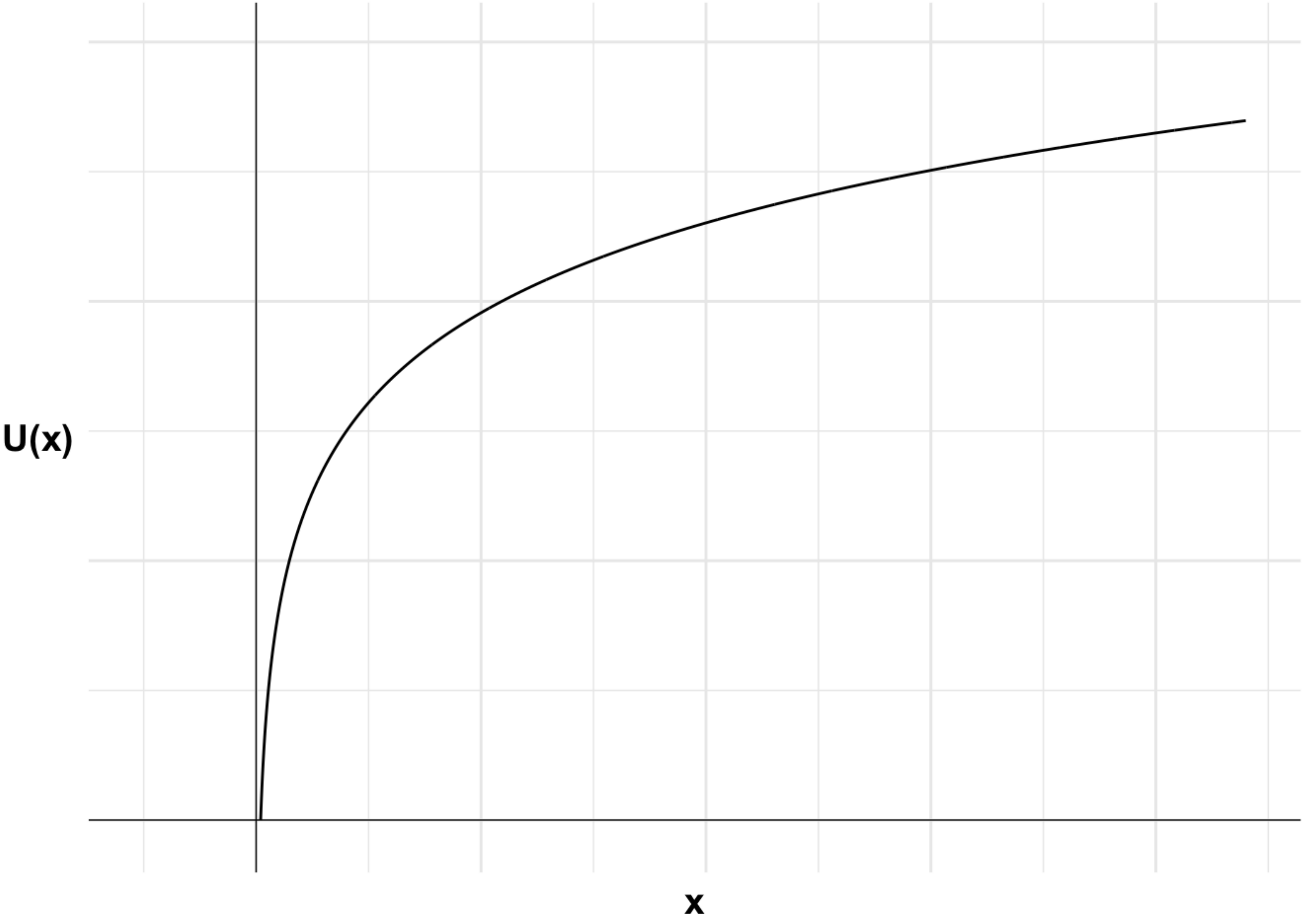
Value of the house $H = \$1\,000\,000$

Probability of fire $p = 0.001$

Insurance premium $R = \$1100$

Insurance with risk neutral expected utility maximiser

$$u(x) = x$$



Insurance with risk neutral expected utility maximiser

$$u(x) = x$$

$$\begin{aligned}\mathbb{E}[\mathrm{I}] &= -R \\ &= -\$1100\end{aligned}$$

Insurance with risk neutral expected utility maximiser

$$u(x) = x$$

$$\mathbb{E}[\neg \mathrm{I}] = p \times (-H)$$

Insurance with risk neutral expected utility maximiser

$$u(x) = x$$

$$\begin{aligned}\mathbb{E}[\neg \mathrm{I}] &= p \times (-H) \\ &= -0.001 \times 1\,000\,000 \\ &= -\$1000\end{aligned}$$

Insurance with risk neutral expected utility maximiser

$$u(x) = x$$

$$\mathbb{E}[\neg \mathrm{I}] = -\$1000 > -\$1100 = \mathbb{E}[\mathrm{I}]$$

Insurance with risk averse expected utility maximiser

$u(x) = \ln(x)$

$\mathrm{W} = \mathrm{H} + \$10\,000$

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$\mathbb{E}[U(\mathrm{I})] = u(W - R)$

Insurance with risk averse expected utility maximiser

$$u(x) = \ln(x) \qquad\qquad \mathrm{W} = \mathrm{H} + \$10\,000$$

$$\begin{aligned}\mathbb{E}[U(\mathrm{I})] &= u(W - R) \\ &= \ln(1\,010\,000 - 1100) \\ &= 13.8244\end{aligned}$$

Insurance with risk averse expected utility maximiser

$u(x) = \ln(x)$ $\quad\quad\quad$ $\mathrm{W} = \mathrm{H} + \$10{,}000$

$$\mathbb{E}[U(\neg \mathrm{I})] = p \times u(W - H) + (1 - p) \times u(W)$$

Insurance with risk averse expected utility maximiser

$$u(x) = \ln(x) \qquad \mathrm{W} = \mathrm{H} + \$10\,000$$

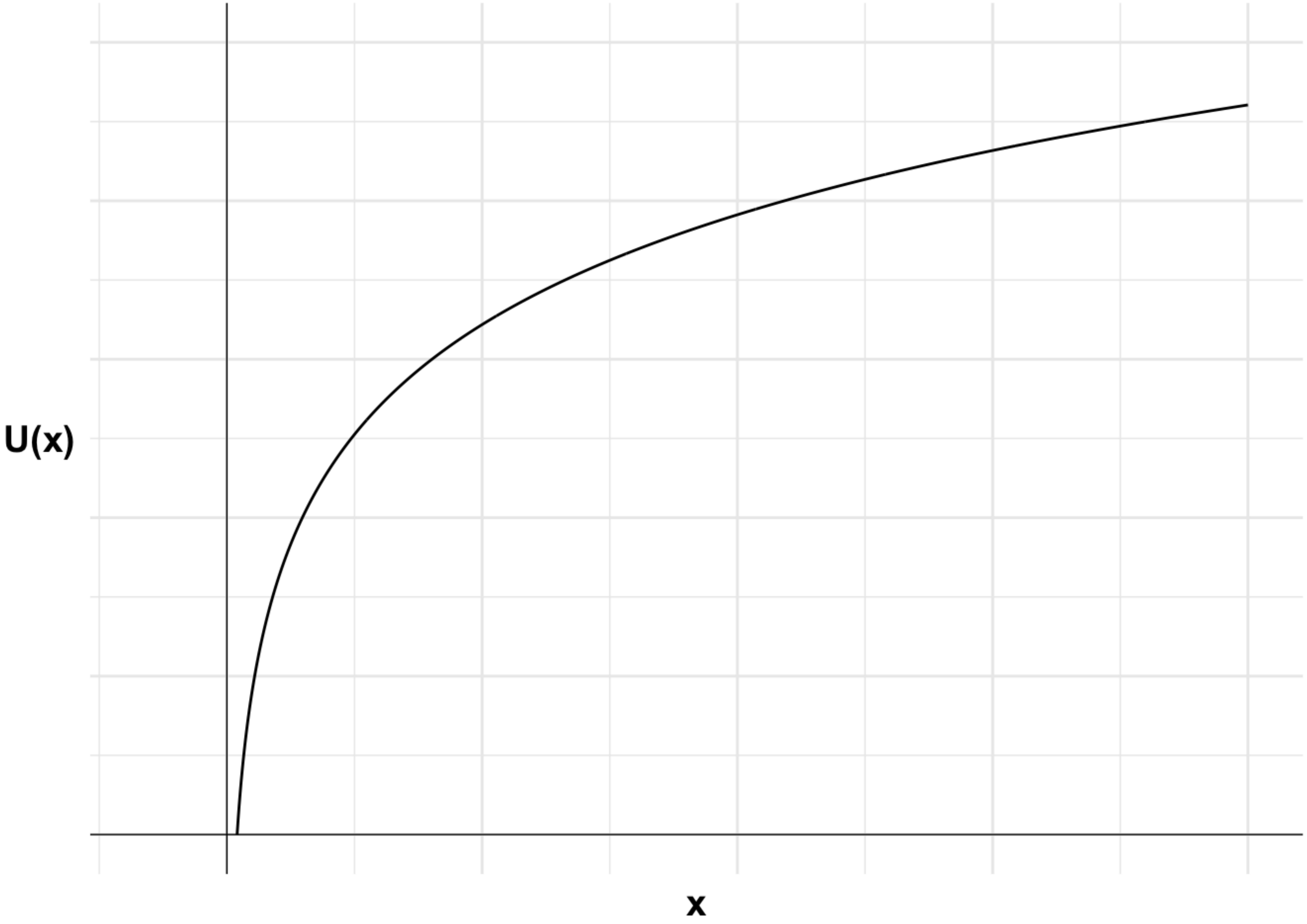
$$\begin{aligned}\mathbb{E}[U(\neg\mathrm{I})] &= p \times u(W - H) + (1 - p) \times u(W) \\ &= 0.001 \times \ln(1\,010\,000 - 1\,000\,000) + 0.999 \times \ln(1\,010\,000) \\ &= 13.8208\end{aligned}$$

Insurance with risk averse expected utility maximiser

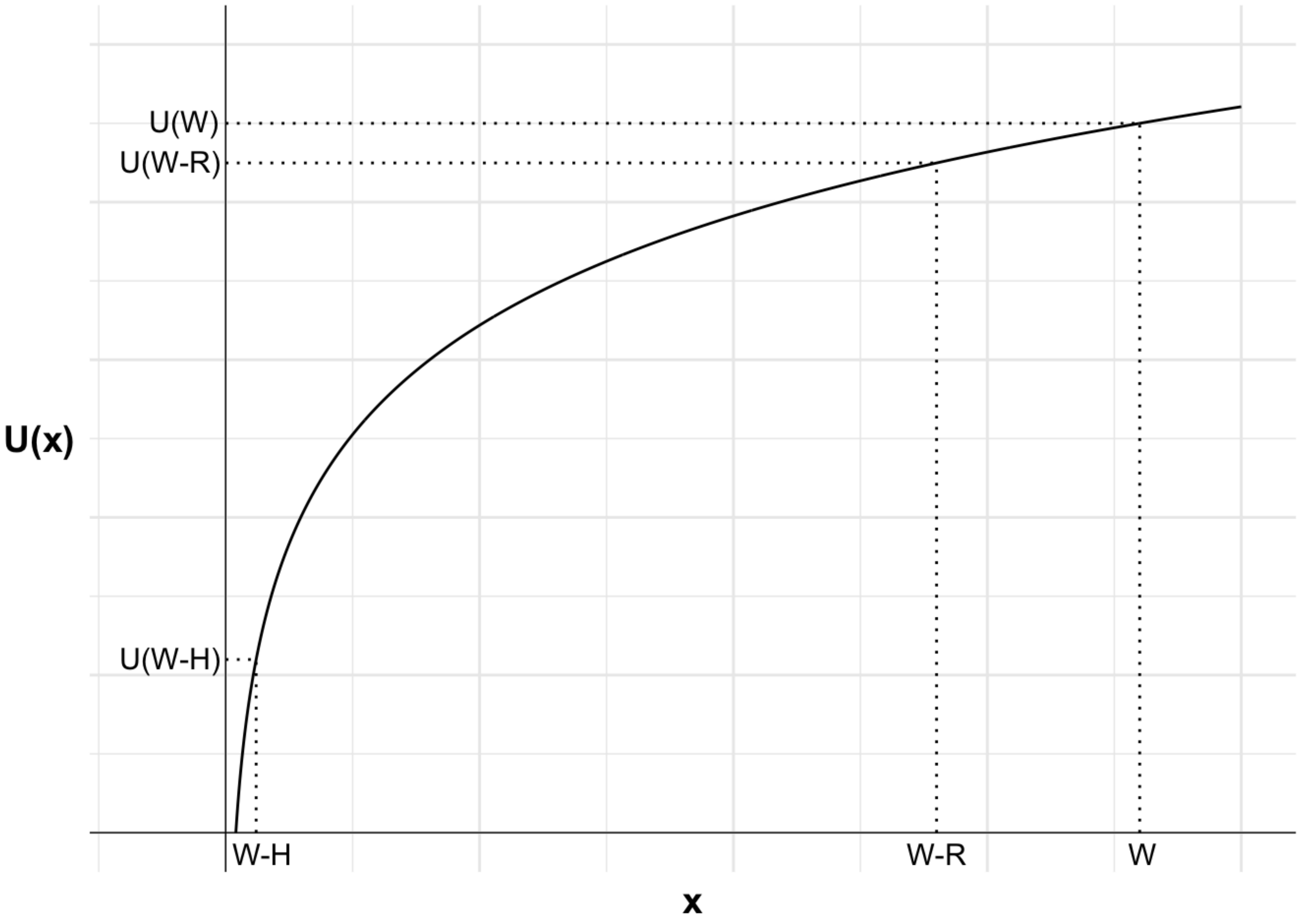
$$u(x) = \ln(x) \qquad\qquad \mathrm{W} = \mathrm{H} + \$10\,000$$

$$\mathbb{E}[U(\mathrm{I})] = 13.8244 > 13.8208 = \mathbb{E}[U(\neg\mathrm{I})]$$

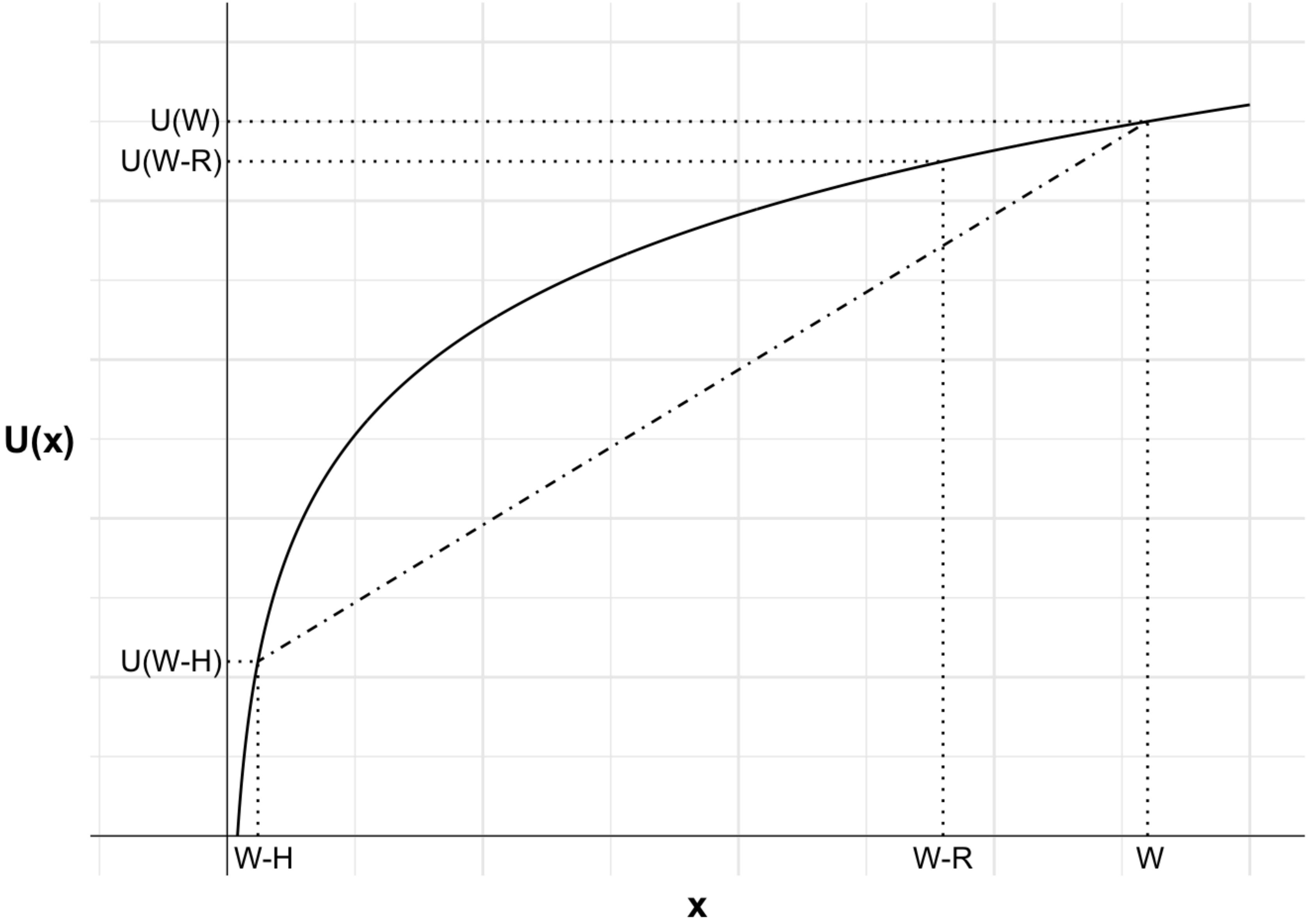
Insurance with risk averse expected utility maximiser



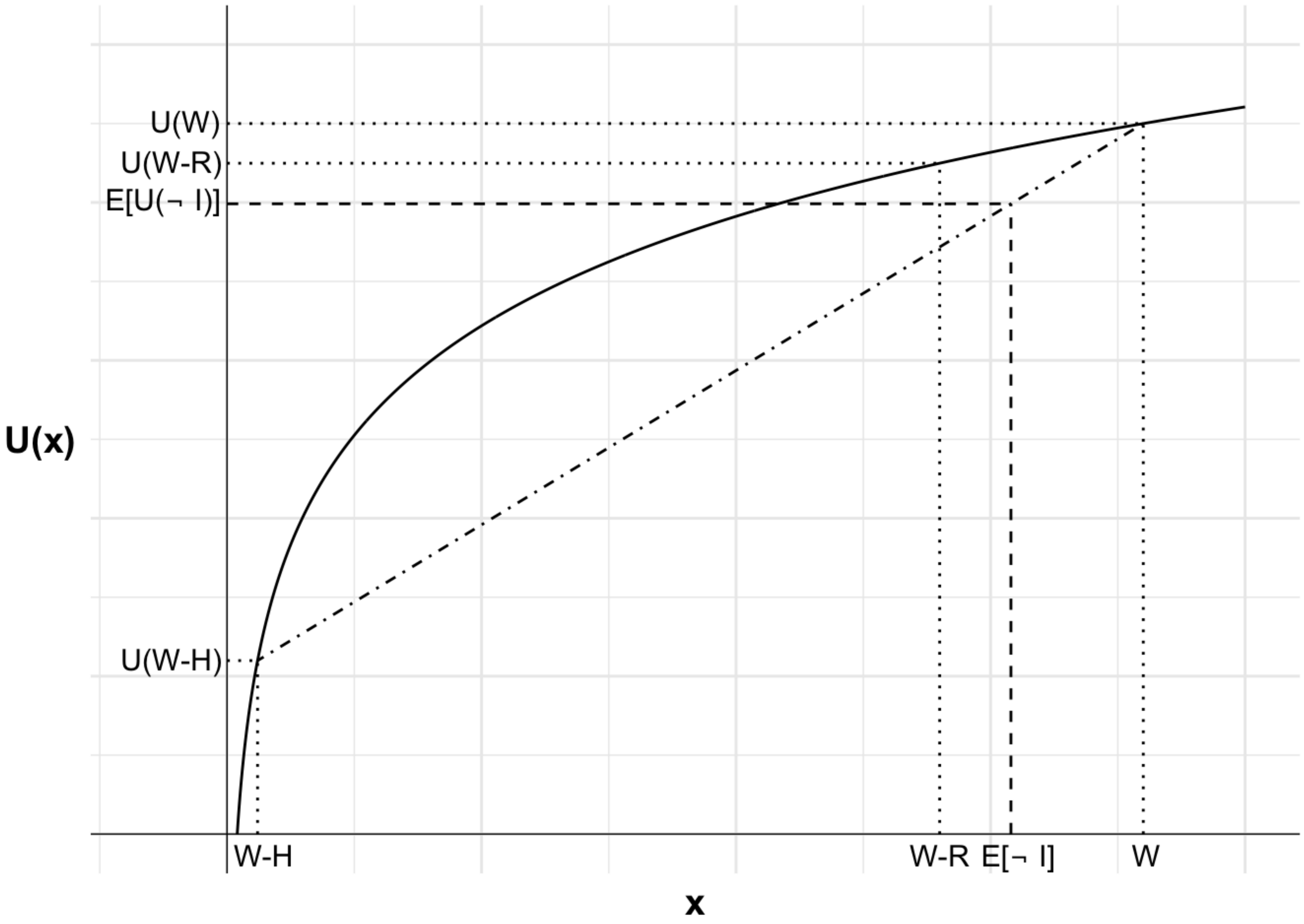
Insurance with risk averse expected utility maximiser



Insurance with risk averse expected utility maximiser



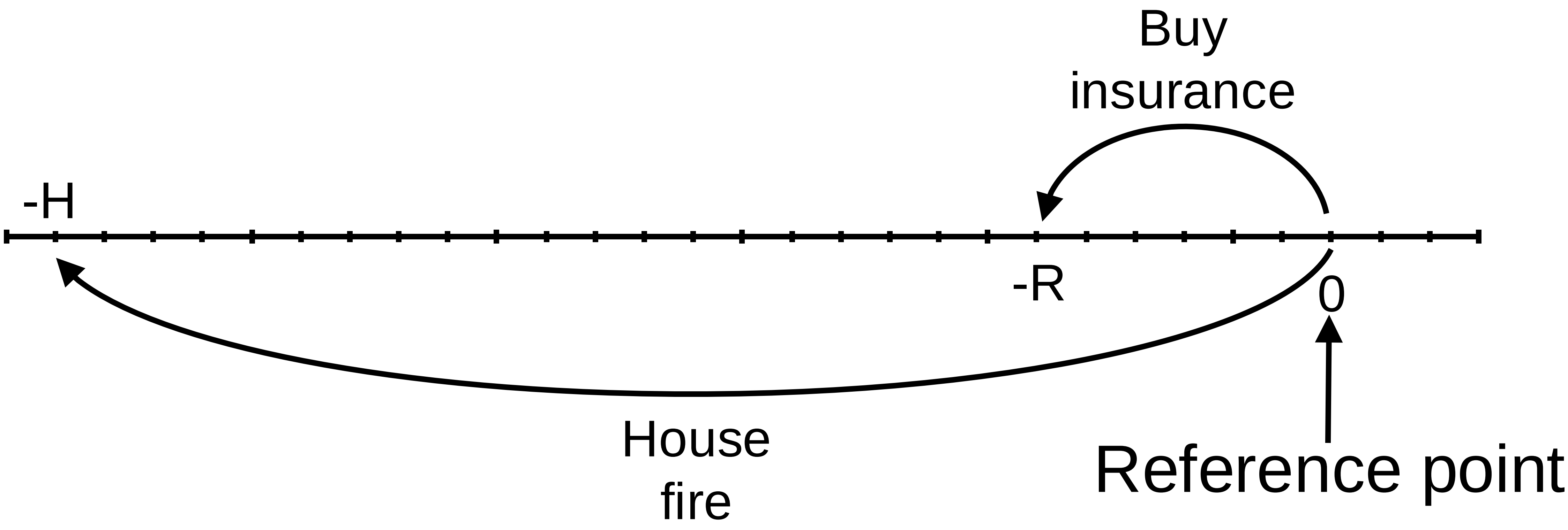
Insurance with risk averse expected utility maximiser



Insurance with the reflection effect

$$v(x) = \begin{cases} x^{0.8} & \text{where} \quad x \geq 0 \\ -(-x)^{0.8} & \text{where} \quad x < 0 \end{cases}$$

Insurance with the reflection effect



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$$\begin{aligned} V(\mathrm{I}) &= v(-R) \\ &= -(1100)^{0.8} \\ &= -271.1 \end{aligned}$$

Insurance with the reflection effect

$$v(x) = \begin{cases} x^{0.8} & \text{where} \quad x \geq 0 \\ -(-x)^{0.8} & \text{where} \quad x < 0 \end{cases}$$

$$V(\neg \mathrm{I}) = \sum_{i=1}^{n} p_i \, v(x_i)$$

$$= p \times v(-H) + (1 - p) \times v(0)$$

$$= -0.001 \times (1\,000\,000)^{0.8} + 0.999 \times 0$$

$$= -63.1$$

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$$V(\mathrm{I}) = -271.1 < -63.1 = V(\neg\mathrm{I})$$

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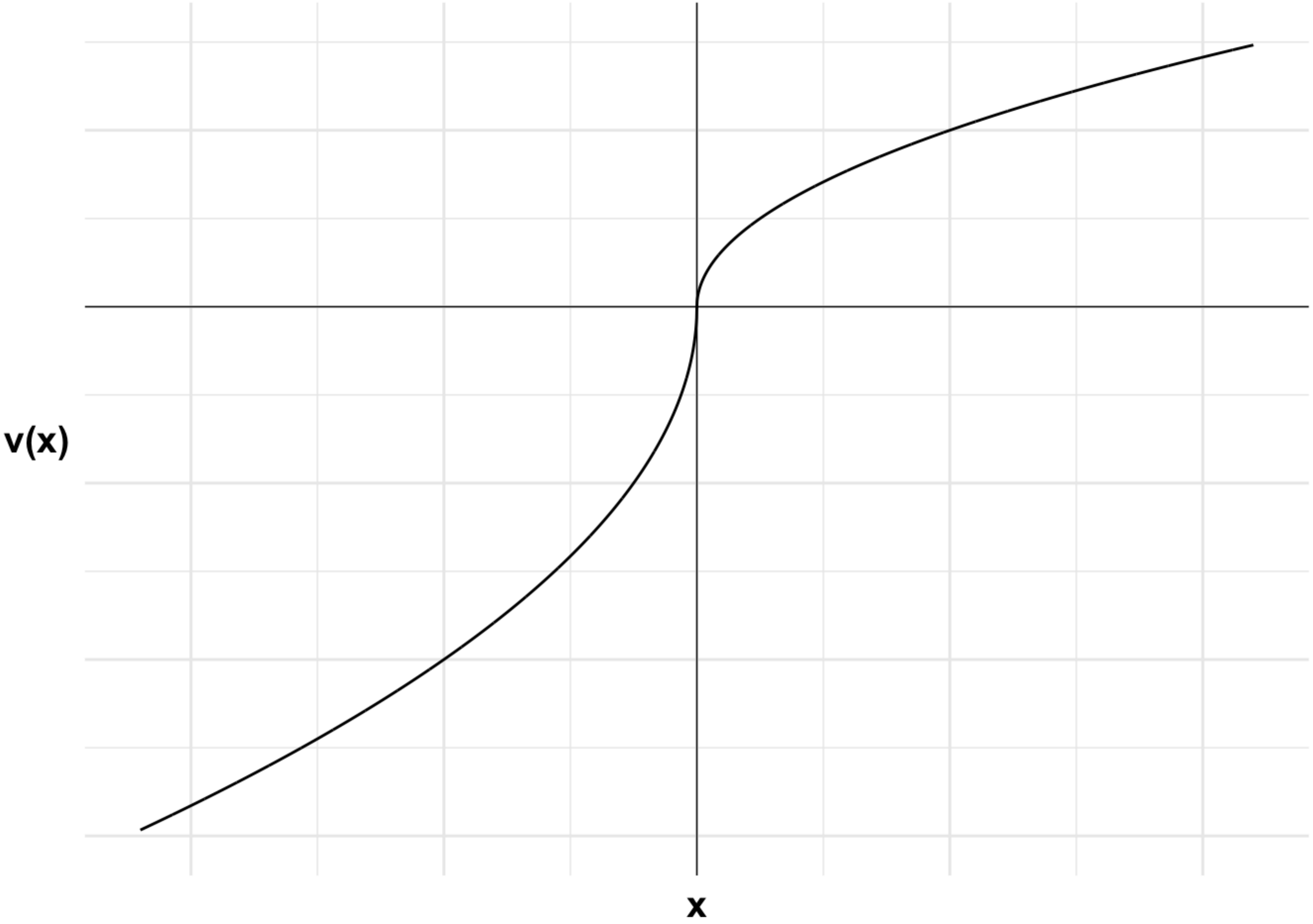

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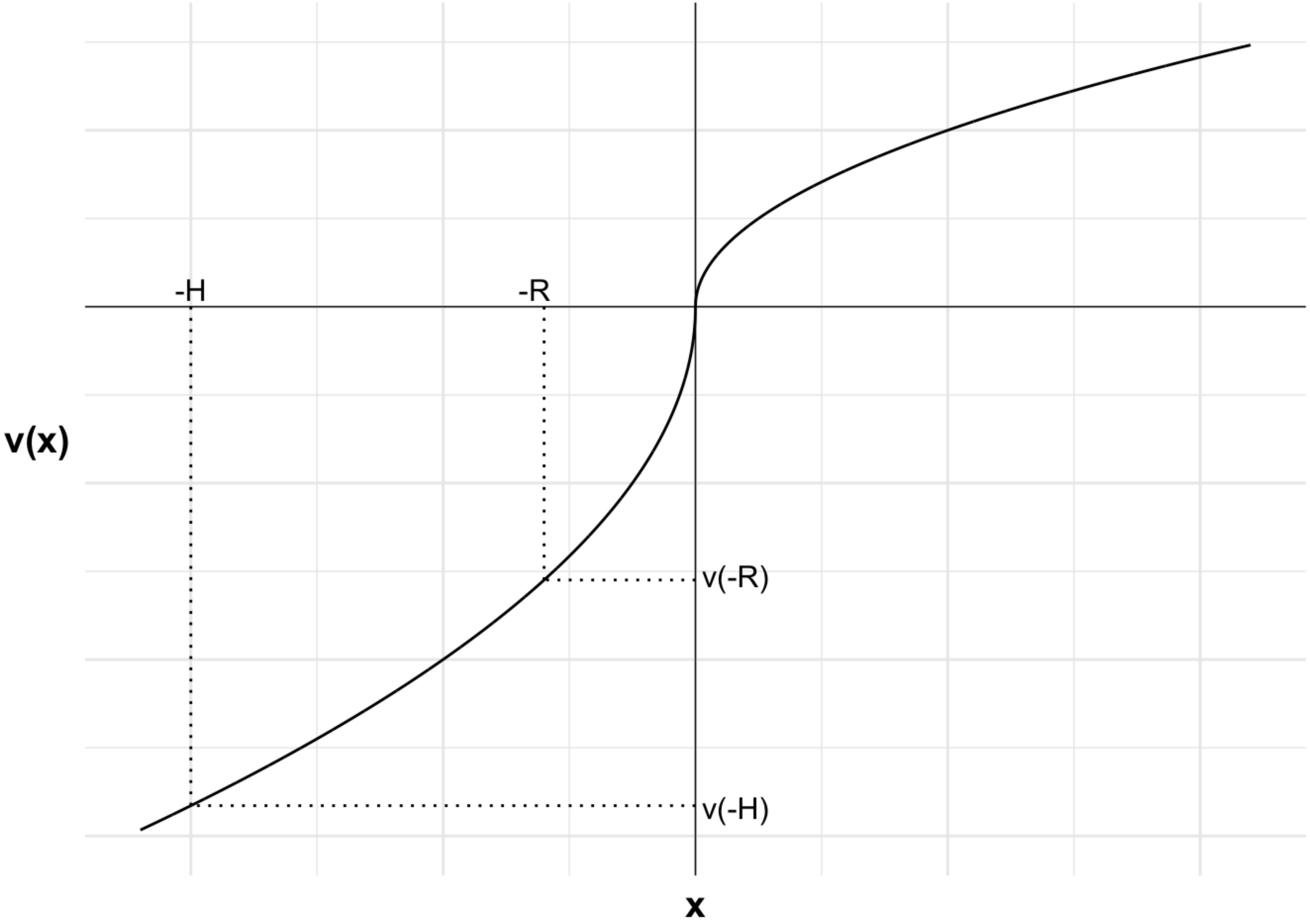

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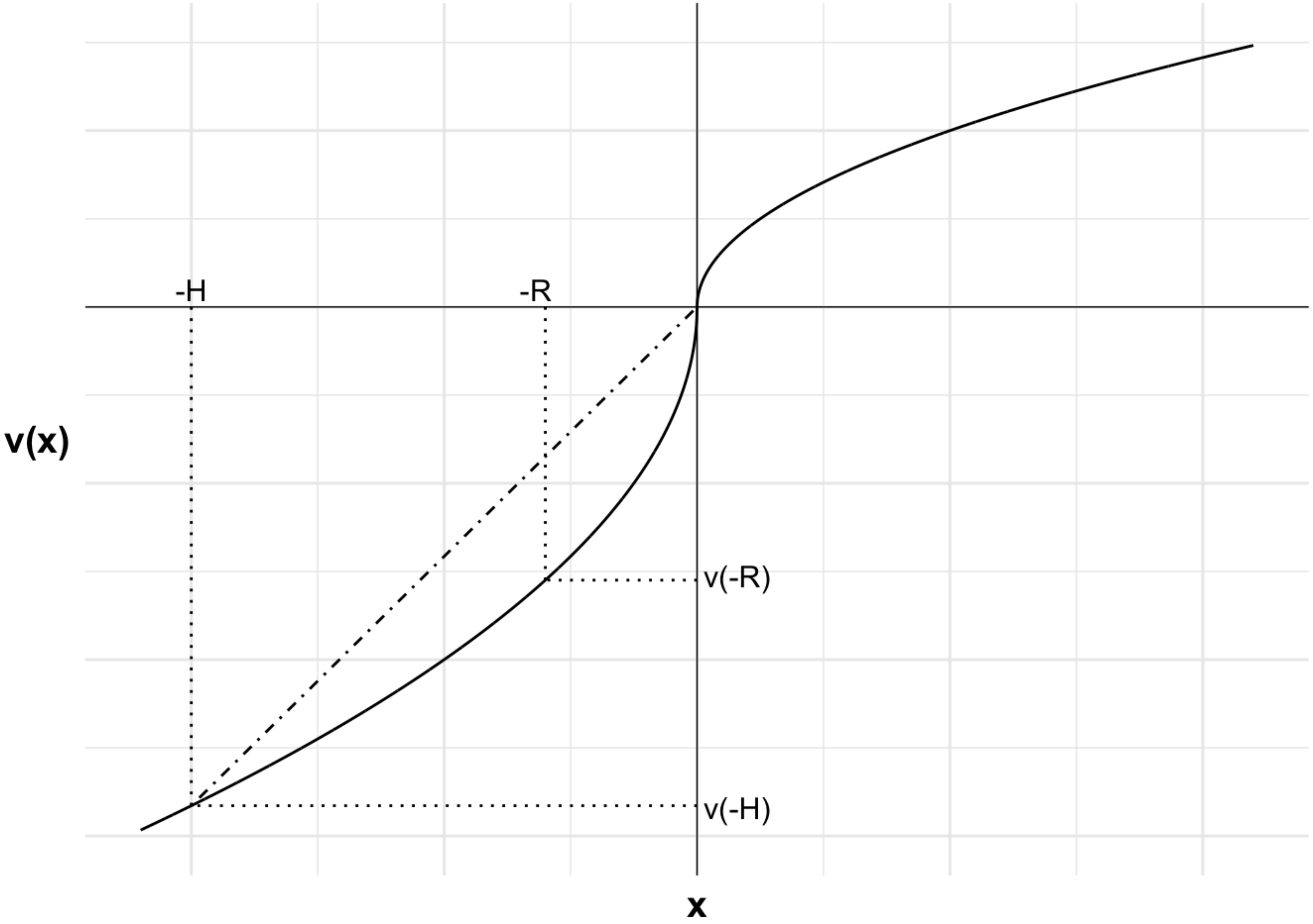

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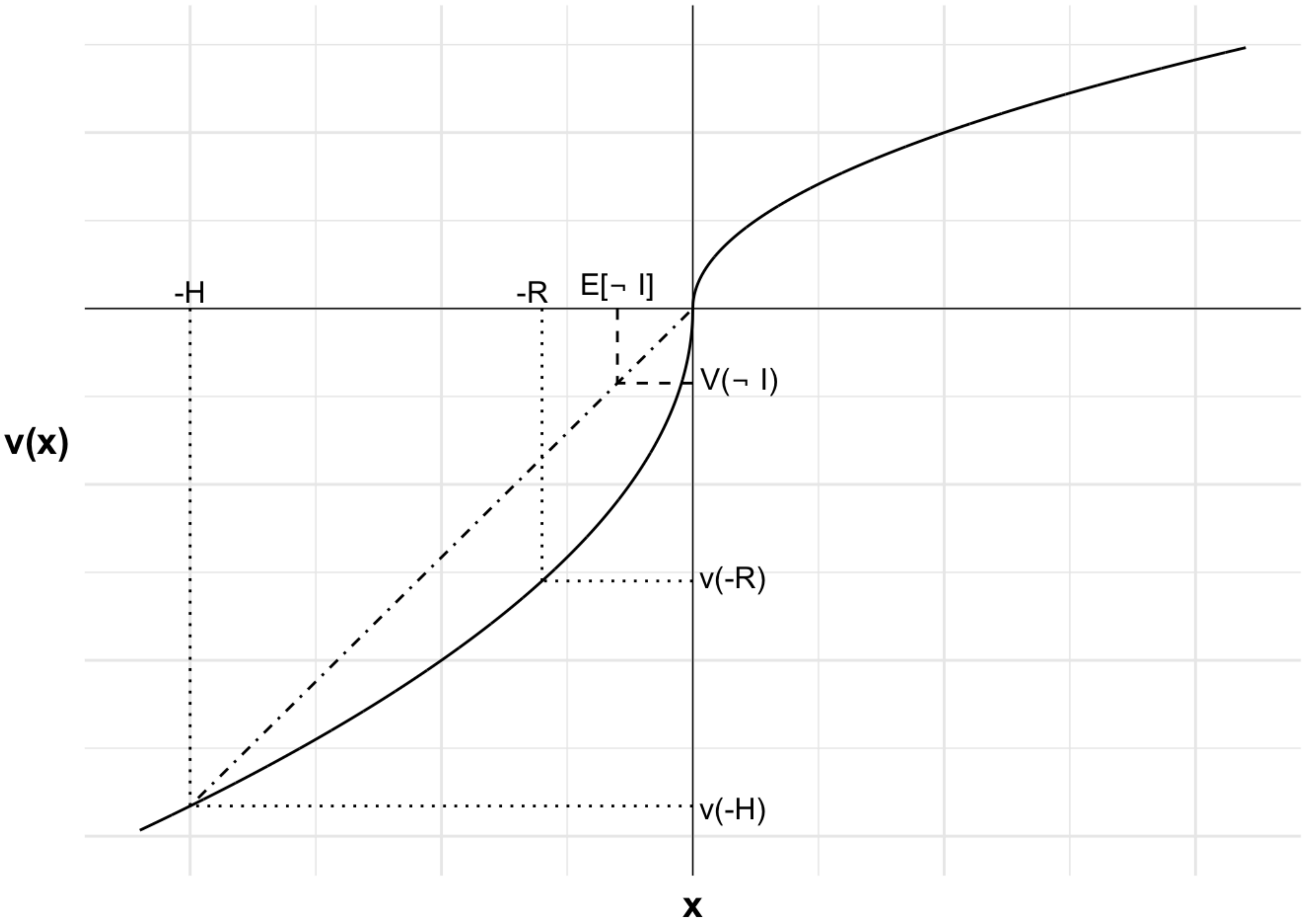

Insurance with probability weighting

Decision weights:

Probability $(\boldsymbol{p})$	0.001	0.01	0.1	0.25	0.5	0.75	0.90	0.99	0.999
Weight $\boldsymbol{\pi}(\boldsymbol{p})$	0.01	0.05	0.15	0.3	0.5	0.7	0.85	0.95	0.99

Insurance with probability weighting

$$v(x) = \begin{cases} x^{0.8} & \text{where} \quad x \geq 0 \\ -(-x)^{0.8} & \text{where} \quad x < 0 \end{cases}$$

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$$V(\mathrm{I}) = v(-R)$$

$$= -(1100)^{0.8}$$

$$= -271$$

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Probability $(\boldsymbol{p})$	0.001	0.999
Weight $\boldsymbol{\pi}(\boldsymbol{p})$	0.01	0.99

$$V(\neg \mathrm{I}) = \sum_{i=1}^{n} \pi(p_i) v(x_i)$$

$$= \pi(p) \times v(-H) + \pi(1-p) \times v(0)$$

$$= \pi(0.001) \times v(-1\,000\,000) + \pi(0.999) \times v(0)$$

$$= -0.01 \times (1\,000\,000)^{0.8} + 0.99 \times 0$$

$$= -631$$

Insurance with probability weighting

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$$V(\mathrm{I}) = -271 > -631 = V(\neg \mathrm{I})$$