A Consumer Search Explanation for Hidden Fees

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An example of hidden fee

StubHub:

1. Towards the start of the user's journey on stubhub.com, they are shown a price.

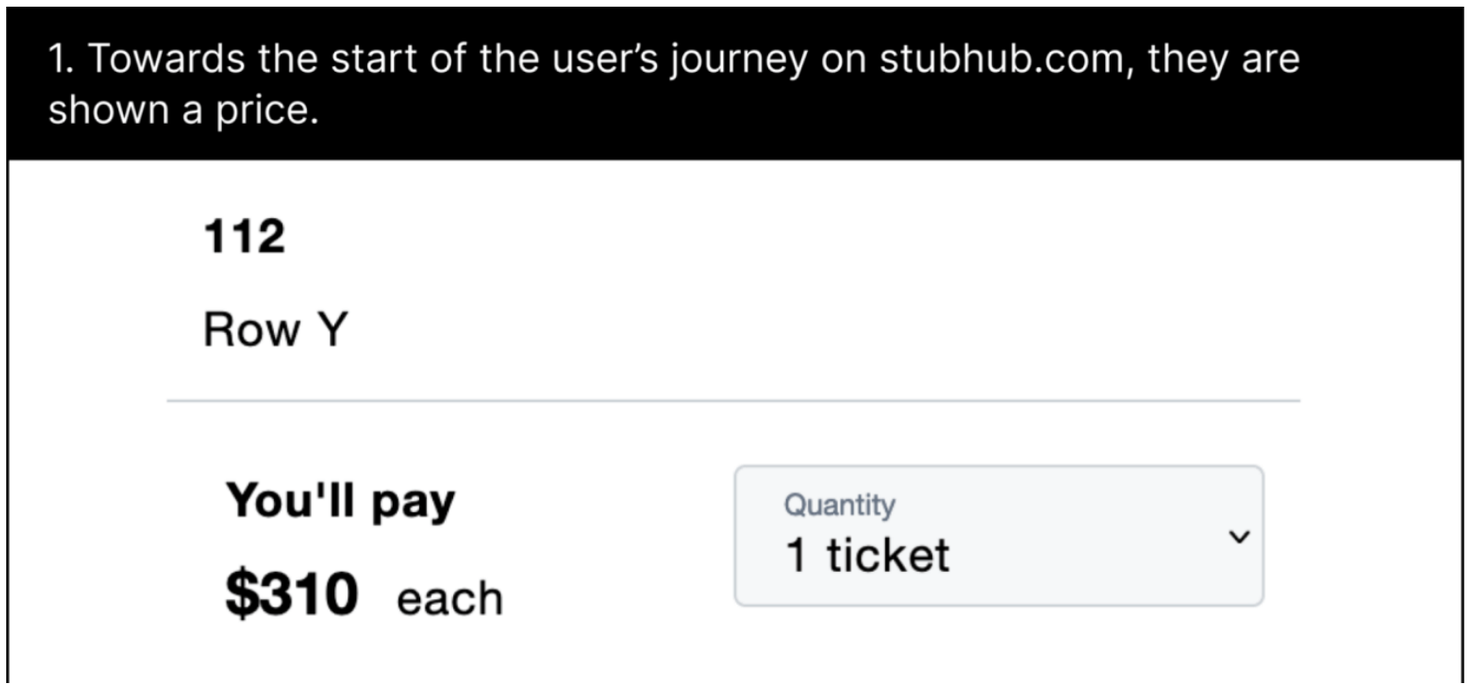

Figure source: https://www.deceptive.design/types/hidden-costs

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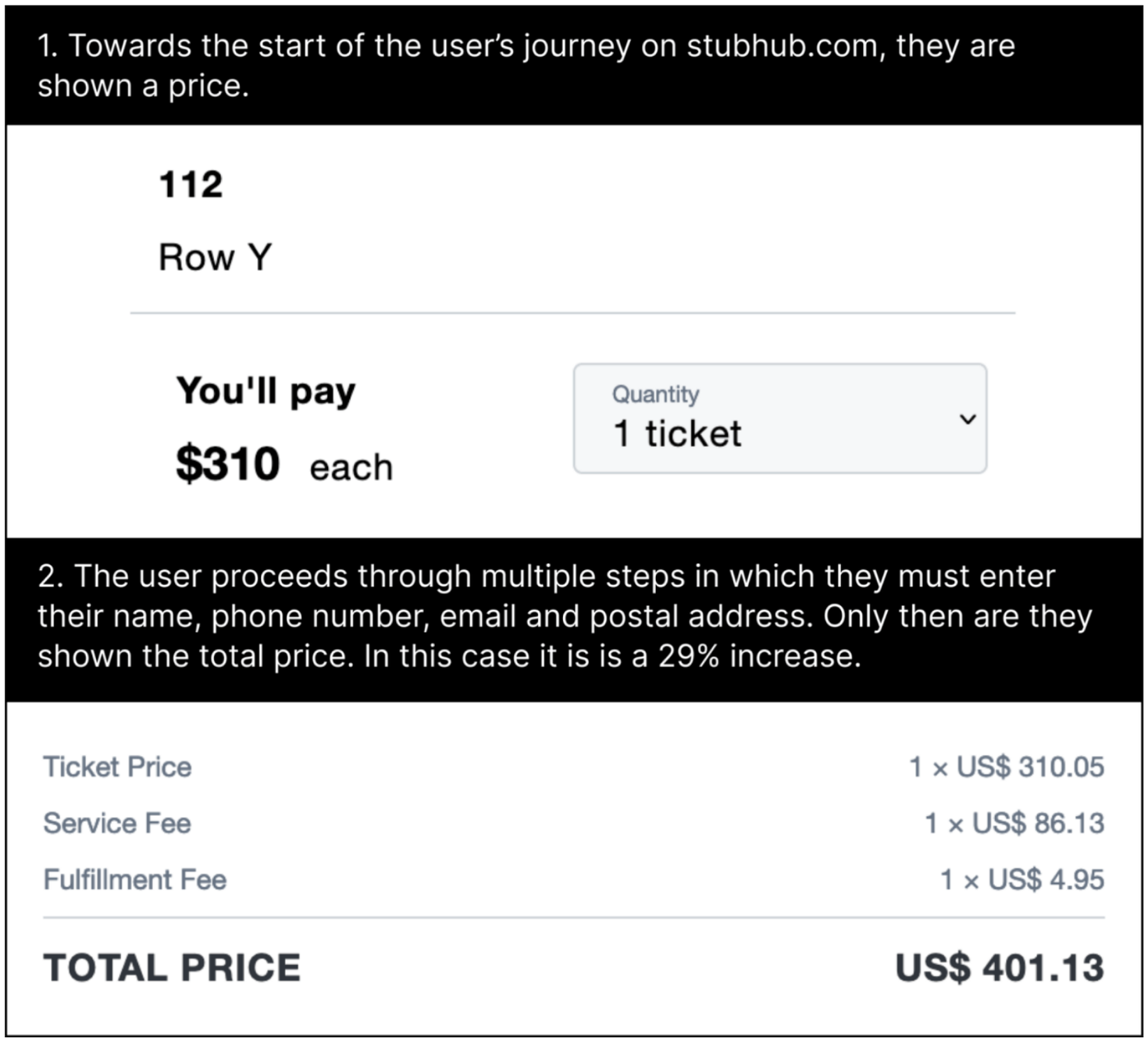


2. The user proceeds through multiple steps in which they must enter their name, phone number, email and postal address. Only then are they shown the total price. In this case it is is a 29% increase.

Figure source: https://www.deceptive.design/types/hidden-costs

Hidden fee is impactful

- Blake et. al (2021): hidden fee leads to
    - **21%** more money spent
    - **14%** higher purchase likelihood
- Many other studies find that hidden fees affect demand
    - Chetty, Looney, and Kroft, 2009; Brown, Hossain, and Morgan, 2010; Feldman and Ruffle, 2015; Feldman, Goldin, and Homonoff, 2018; Bradley and Feldman, 2020

Existing explanations for hidden fee

Chetty, Looney, and Kroft, 2009; Goldin and Homonoff, 2013; Koszegi and Rabin, 2006:

1. Consumers are unaware of hidden fees while browsing
2. Once those fees are revealed at checkout, they exhibit **behavioral biases** (e.g., limited attention, salience, loss aversion)

Some kind of **behavioral bias** leads to the final conversion

Existing explanations for hidden fee

- Blake et al. (2021):

``[Consumers] may believe that they have found a cheap enough ticket to warrant purchase, and proceed to the checkout page … Upon reaching the checkout and purchase page, the ticket's actual price - including all fees - is revealed. Absent behavioral biases, the consumer ought to exit without buying the ticket, but we assume that some consumers will complete their purchase due to ***loss aversion or other behavioral biases****.”*

This paper

- Depart from the behavioral explanations emphasized in prior work

- Q: Whether temporary unawareness alone, absent any additional behavioral biases, can be strategically exploited by firms

- Key ingredient: **consumer search**

Related Research

- Classic unraveling: Milgrom, 1981; Grossman and Hart, 1980; Grossman, 1981

- Shrouding can persist in equilibrium under consumer unawareness: Ellison 2005, Gabaix and Laibson 2006

- Empirical support: Jin, Luca, and Martin, 2021; Montero and Sheth, 2021; Brown, Hossain, and Morgan, 2010; Brown, Camerer, and Lovallo, 2012; Sheth, 2021; Sah and Read, 2020

- How consumer unawareness shapes equilibrium pricing in markets with add-ons: Gabaix and Laibson 2006; Armstrong and Vickers, 2012; Johnen and Somogyi, 2024; Heidhues, Koszegi, and Murooka, 2016; Kosfeld and Schuwer, 2017; Shulman and Geng, 2013; Geng, Tan, and Wei, 2018; Erat and Bhaskaran, 2012

Related Research

- Optional add-ons: remain unnoticed when the base product is purchased
  - Standard shrouded-attributes mechanism: consumers purchasing the base product without fully accounting for add-on prices
- Mandatory fees: disclosed before the transaction is finalized
  - Hard to reconcile with the standard shrouded-attributes logic
- Our analysis: unawareness alone can rationalize the prevalence of hidden mandatory fees

Basic consumer search model (Branco et al. 2012)

- A firm offers a product with a marginal cost of m and price p
- A consumer decides whether to buy it
- The consumer can search for information before making a decision

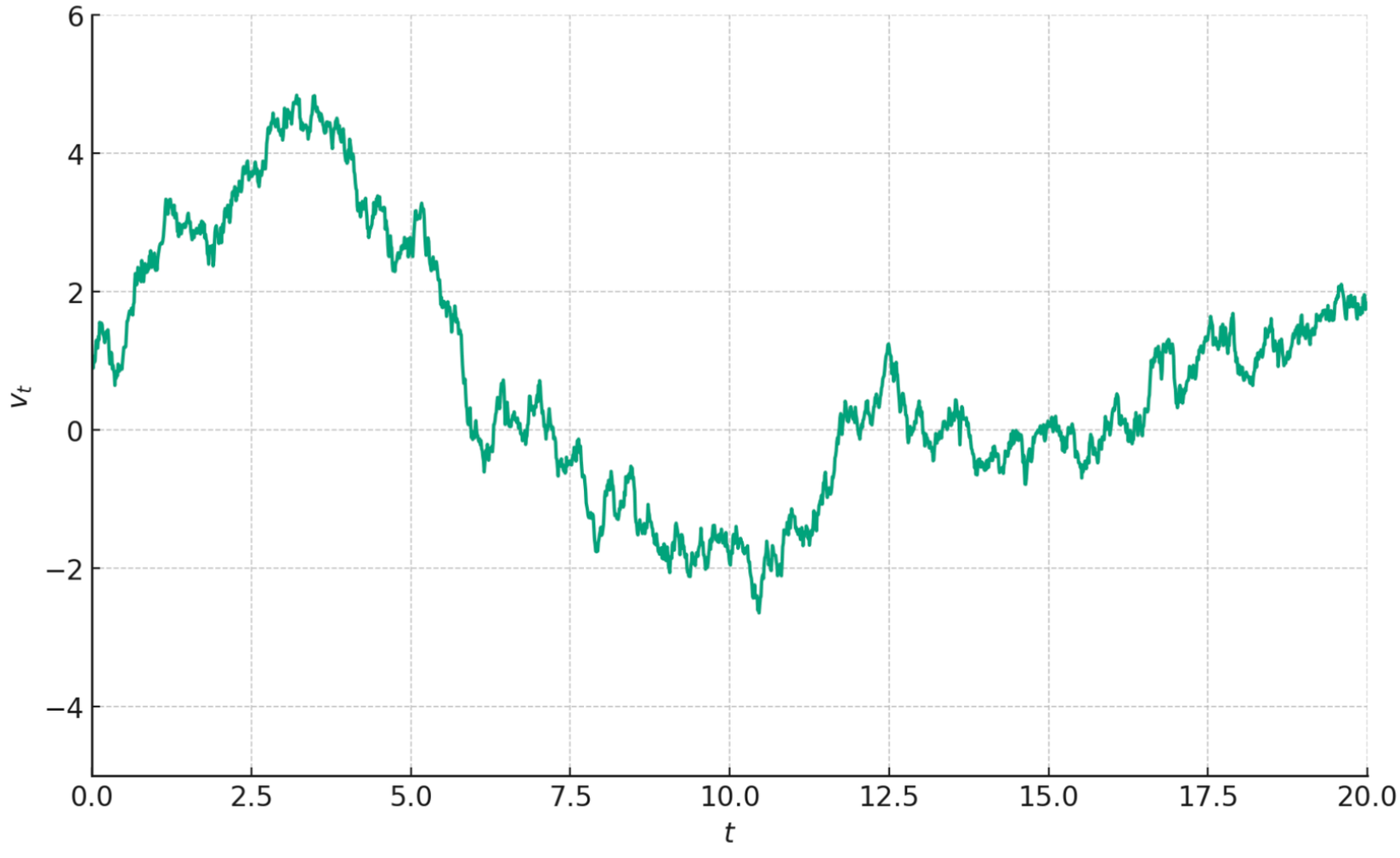
  initial valuation: v_0 (common knowledge)

  search cost: c per period of time

  consumer's valuation: $dv_t = \sigma dW_t$ (a Brownian motion)

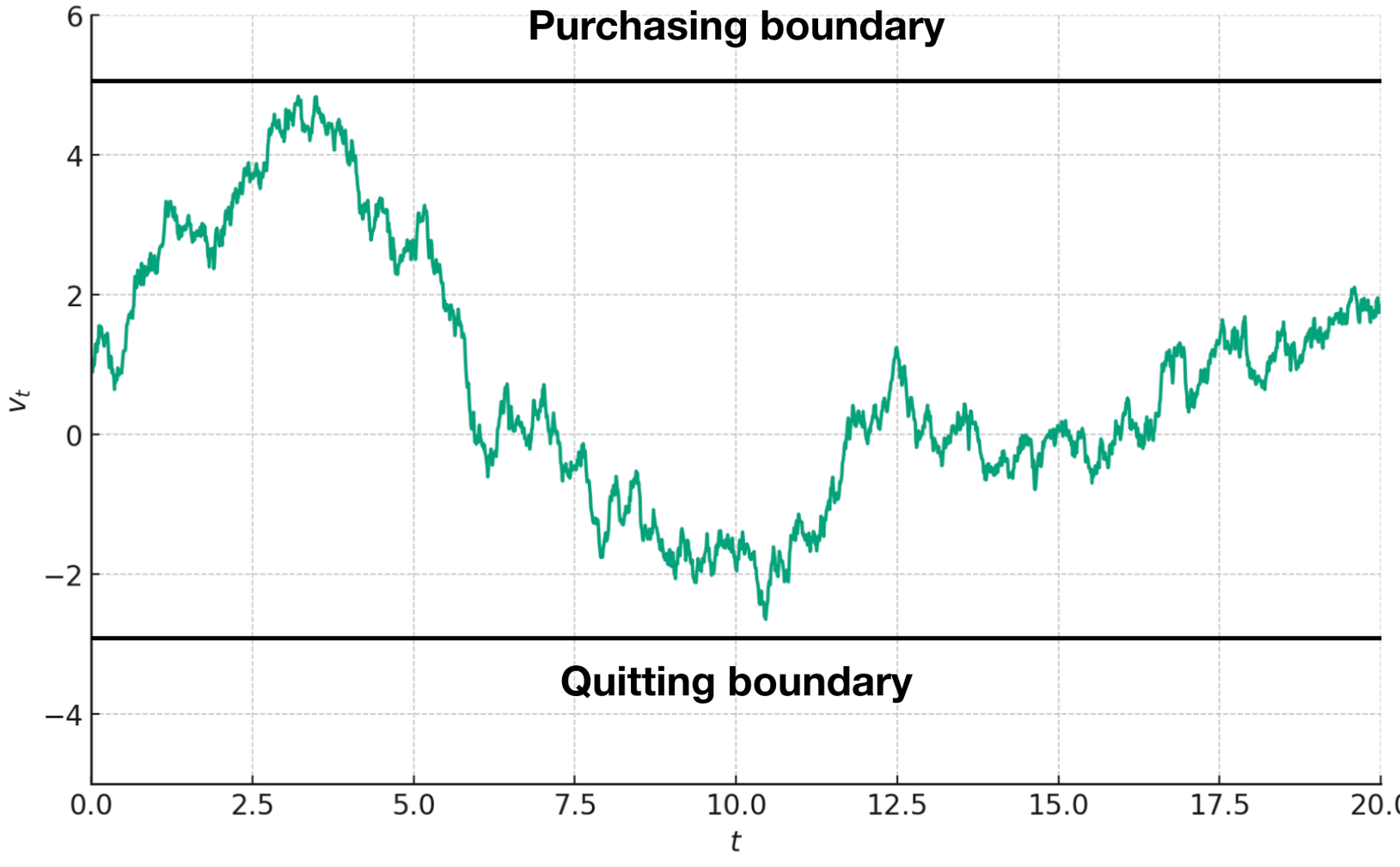
- No discounting

Sample path of the consumer's learning processes



$$v_0 = 1$$

Consumer's search strategy



$\bar{V}_1(p) = \sigma^2/4c + p$

$\underline{V}_1(p) = -\sigma^2/4c + p$

$v_0 = 1, p = 1$

Consumer search can benefit the firm

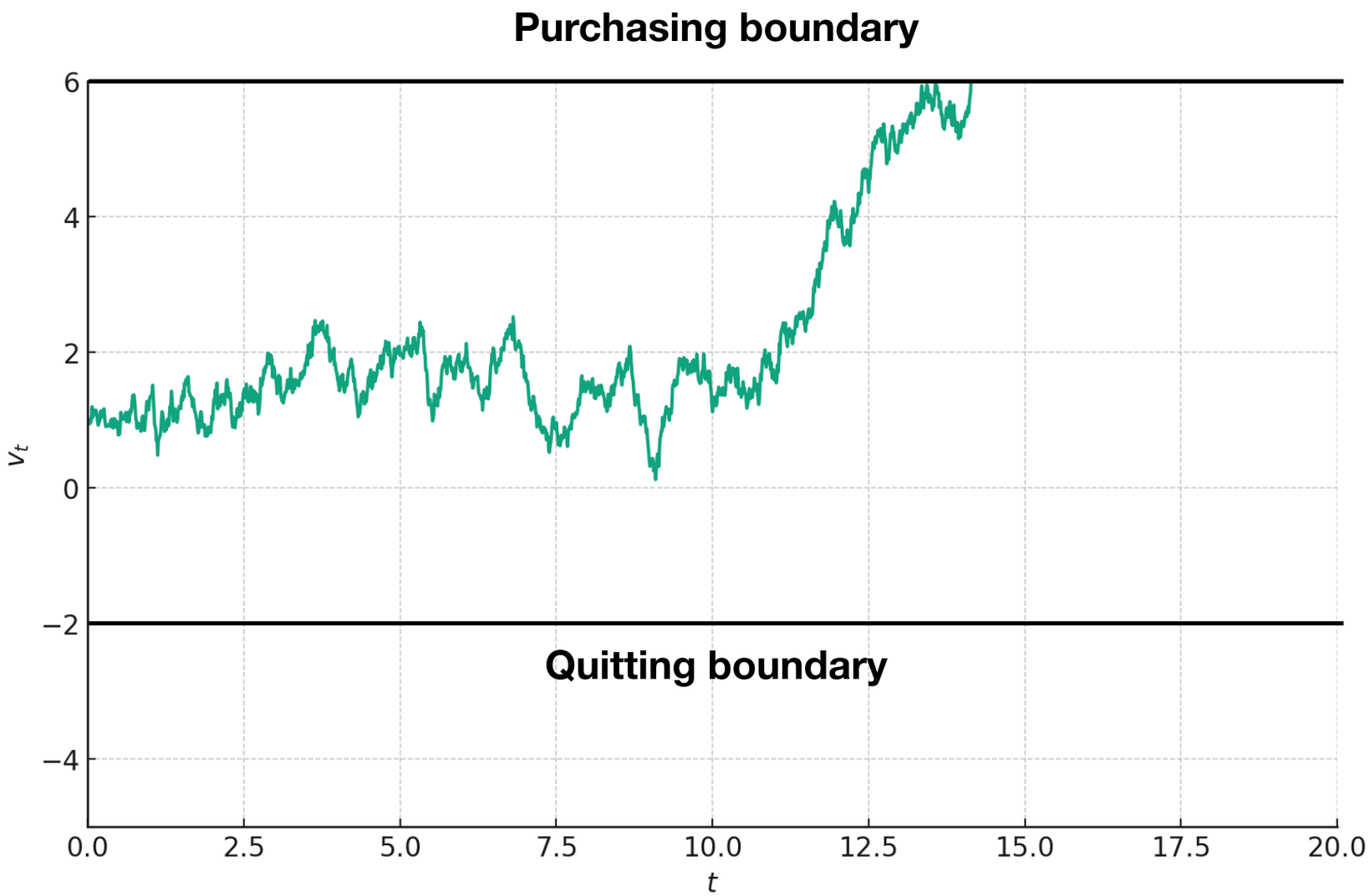
- When search is not feasible, the firm can charge at most v_0

The firm will not sell any product if the initial valuation is lower than the marginal cost, $v_0 < m$

- When search is feasible, the firm can charge a higher price

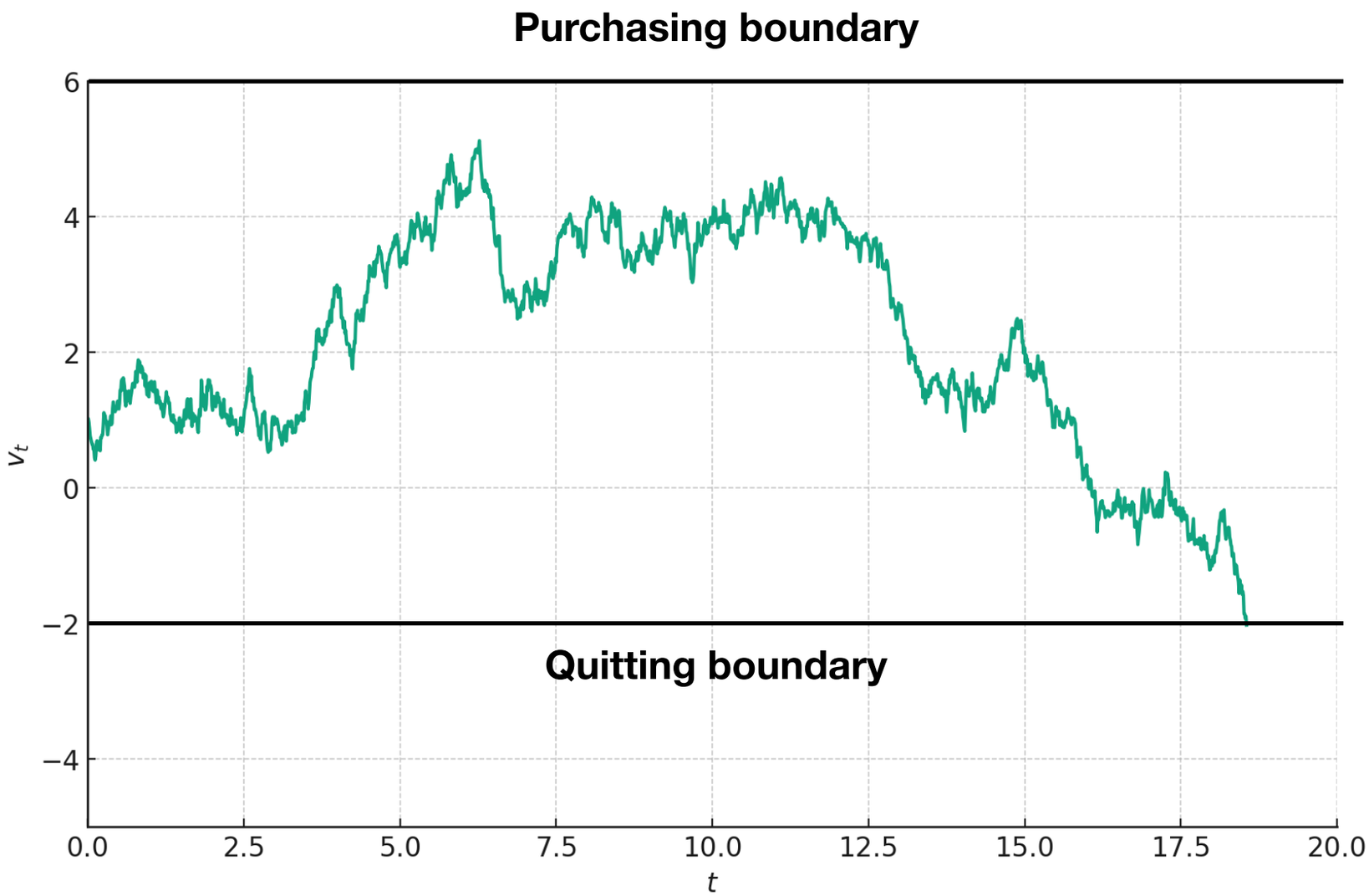
The firm can make positive profits even if $v_0 < m$

Purchase



$v_0 = 1,\ m = 1.5,\ p = 2$

No purchase



$v_0 = 1,\ m = 1.5,\ p = 2$

Without a hidden fee

- For a given valuation v and upfront price p_{wo}, the consumer's purchasing probability:

$$Q_1(v, p_{wo}) = \begin{cases} 1, & if\ p_{wo} \leq v - \frac{\sigma^2}{4c}, \\ \frac{v + \frac{\sigma^2}{4c} - p_{wo}}{\frac{\sigma^2}{2c}}, & if\ v - \frac{\sigma^2}{4c} < p_{wo} < v + \frac{\sigma^2}{4c}, \\ 0, & if\ p_{wo} \geq v + \frac{\sigma^2}{4c}, \end{cases}$$

- Expected profit: $(p^*_{wo} - m) \cdot Q_1(v_0, p_{wo})$

Without a hidden fee

- Optimal price:

$$p^*_{wo} = \begin{cases} v_0 - \frac{\sigma^2}{4c},\ if\ v_0 \geq \frac{3\sigma^2}{4c} + m \\ \frac{v_0}{2} + \frac{\sigma^2}{8c} + \frac{m}{2},\ if\ -\frac{\sigma^2}{4c} + m < v_0 < \frac{3\sigma^2}{4c} + m \end{cases}$$

- Ex-ante purchasing probability given the optimal price:

$$Q_1(v_0, p^*_{wo}) \begin{cases} 1,\ if\ v_0 \geq \frac{3\sigma^2}{4c} + m, \\ \frac{c}{\sigma^2}(v_0 + \sigma^2/4c - m),\ if\ -\frac{\sigma^2}{4c} + m < v_0 < \frac{3\sigma^2}{4c} + m, \\ 0,\ if\ v_0 \leq -\frac{\sigma^2}{4c} + m \end{cases}$$

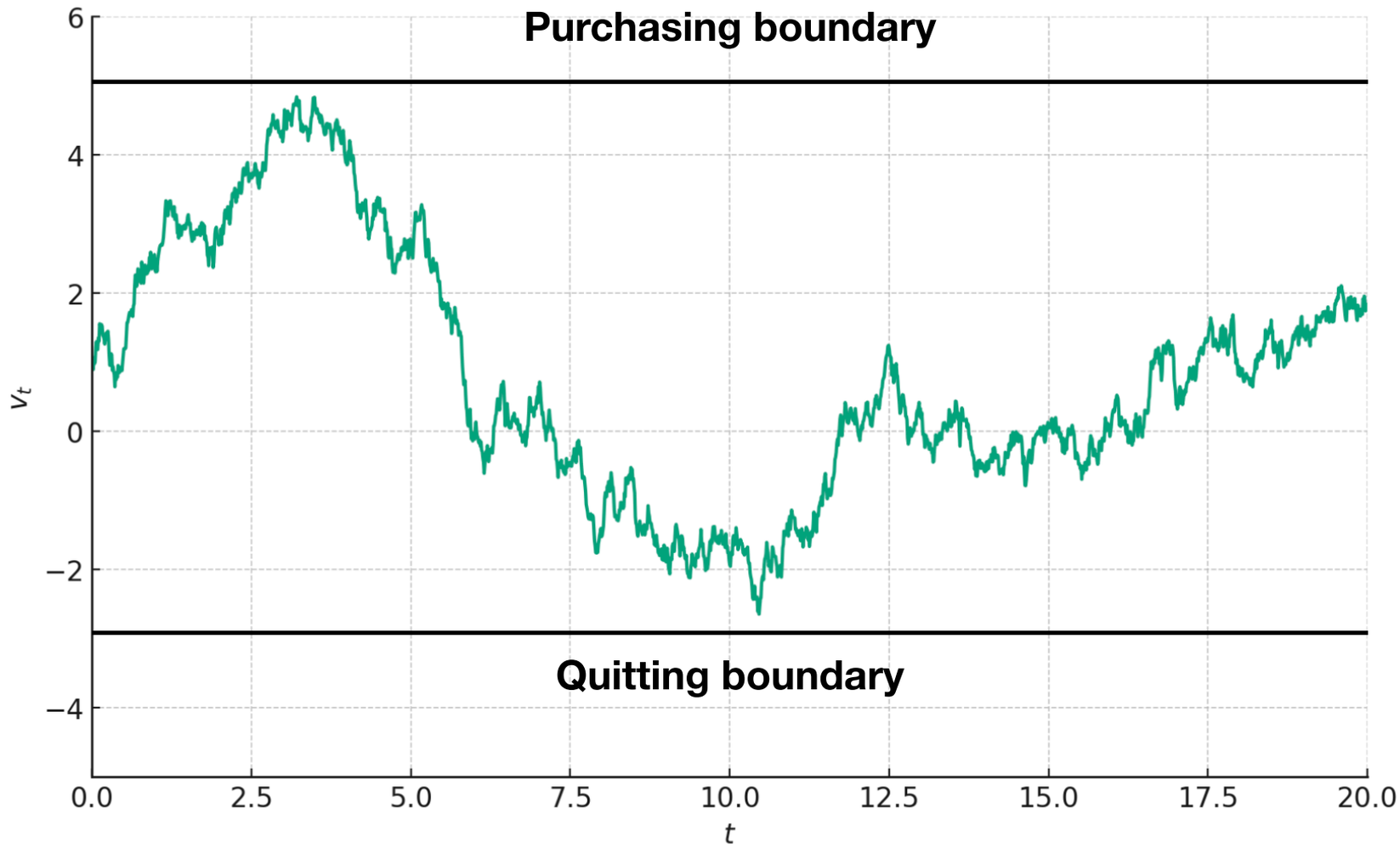
Without a hidden fee

- $v_0 \leq -\frac{\sigma^2}{4c} + m$ (quit directly): 0 search time τ_{wo}, 0 consumer welfare
- $v_0 \geq \frac{3\sigma^2}{4c} + m$ (buy directly): 0 search time, consumer welfare is $v_0 - p^*_{wo} = \sigma^2/4c$
- $-\frac{\sigma^2}{4c} + m < v_0 < \frac{3\sigma^2}{4c} + m$ (search): Dynkin's formula $\Rightarrow$

$$\mathbf{E}(\tau_{wo}) = \frac{\frac{\sigma^4}{16c^2} - (v_0 - p^*_{wo})^2}{\sigma^2} \text{ (maximized when } p^*_{wo} = v_0)$$

$$\mathbf{E}(\textit{consumer surplus}) = -c \cdot \mathbf{E}(\tau_{wo}) + \frac{\sigma^2}{4c} \cdot Q_1(v_0, p^*_{wo})$$

Expected search time

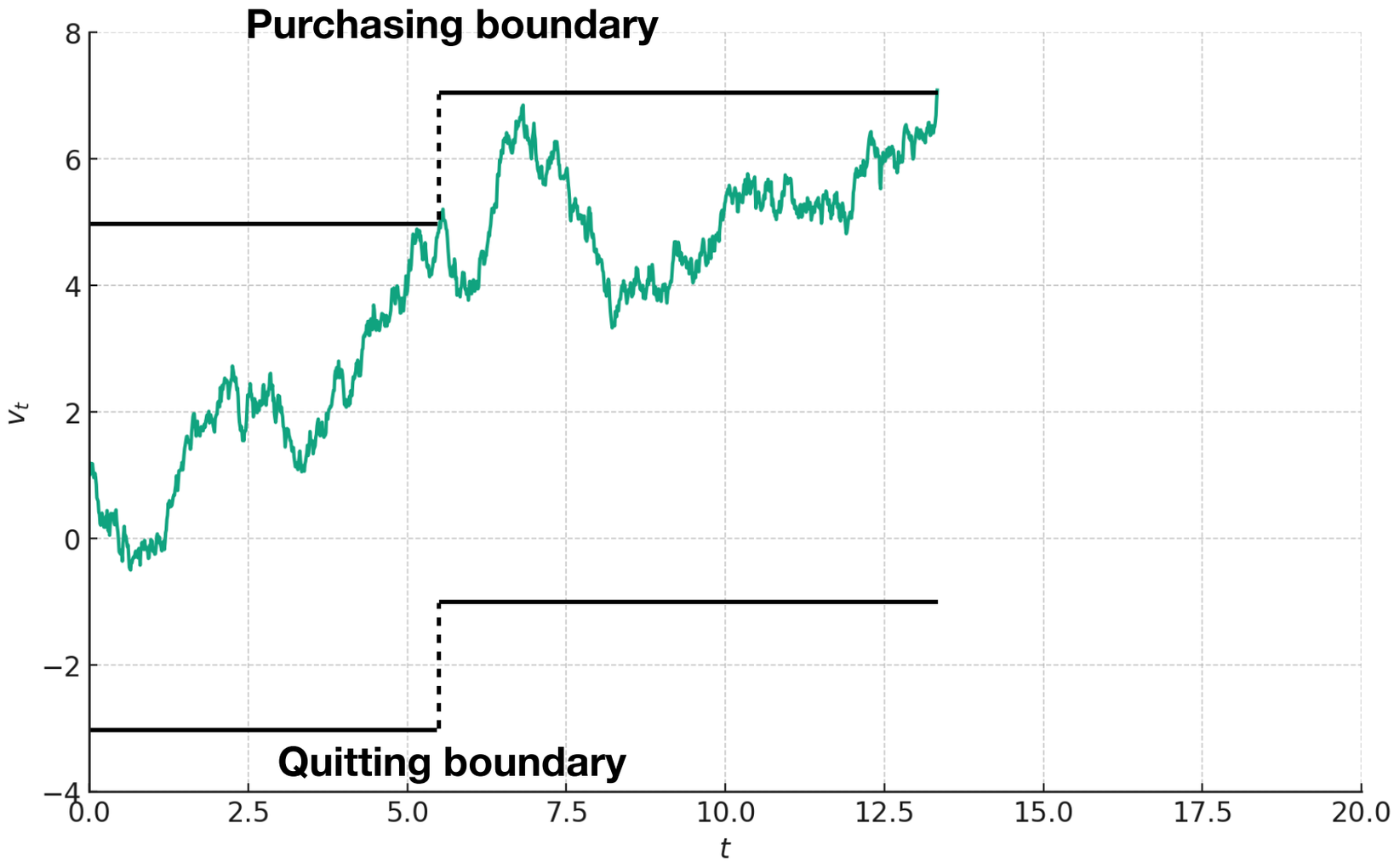


$v_0 = 1, p = 1$

+ Hidden price

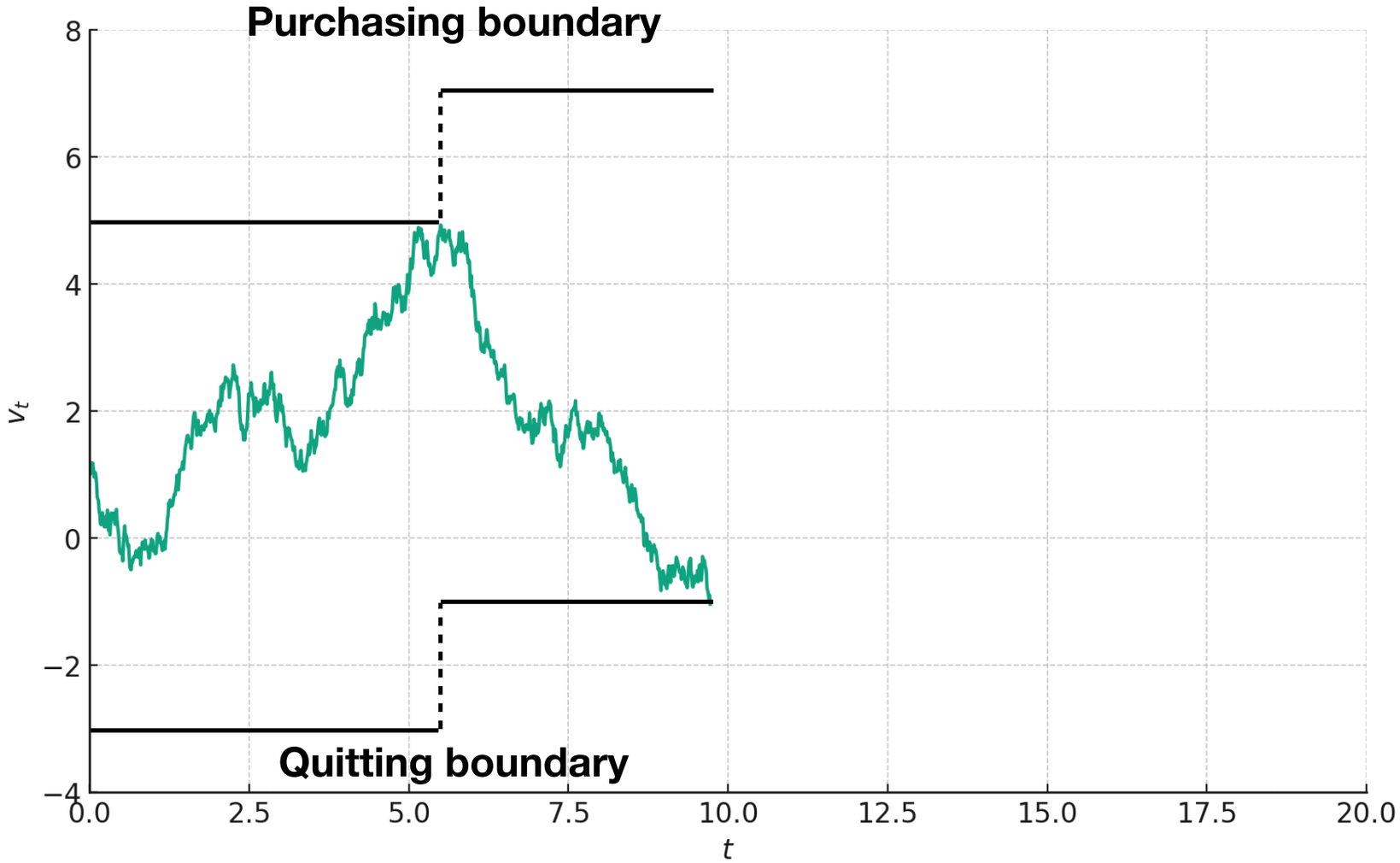
- The same setup as before, except that:
- When a consumer's valuation v_t reaches the purchasing threshold, she
  - decides to buy and go to the checkout page
  - will see an additional hidden fee Δp
  - will not buy the product **without behavioral bias** (the hidden fee raises the purchasing threshold)
  - faces an updated search problem

Search Problem with hidden fee (purchase)



$v_0 = 1,\ m = 1.5,\ p = 1,\ \Delta p = 2$

Search Problem with hidden fee (no purchase)



$v_0 = 1,\ m = 1.5,\ p = 1,\ \Delta p = 2$

Hidden fee can benefit the firm (part I)

- When hidden fee is not feasible, the consumer may search or buy directly only if $v_0 - p > -\sigma^2/4c$

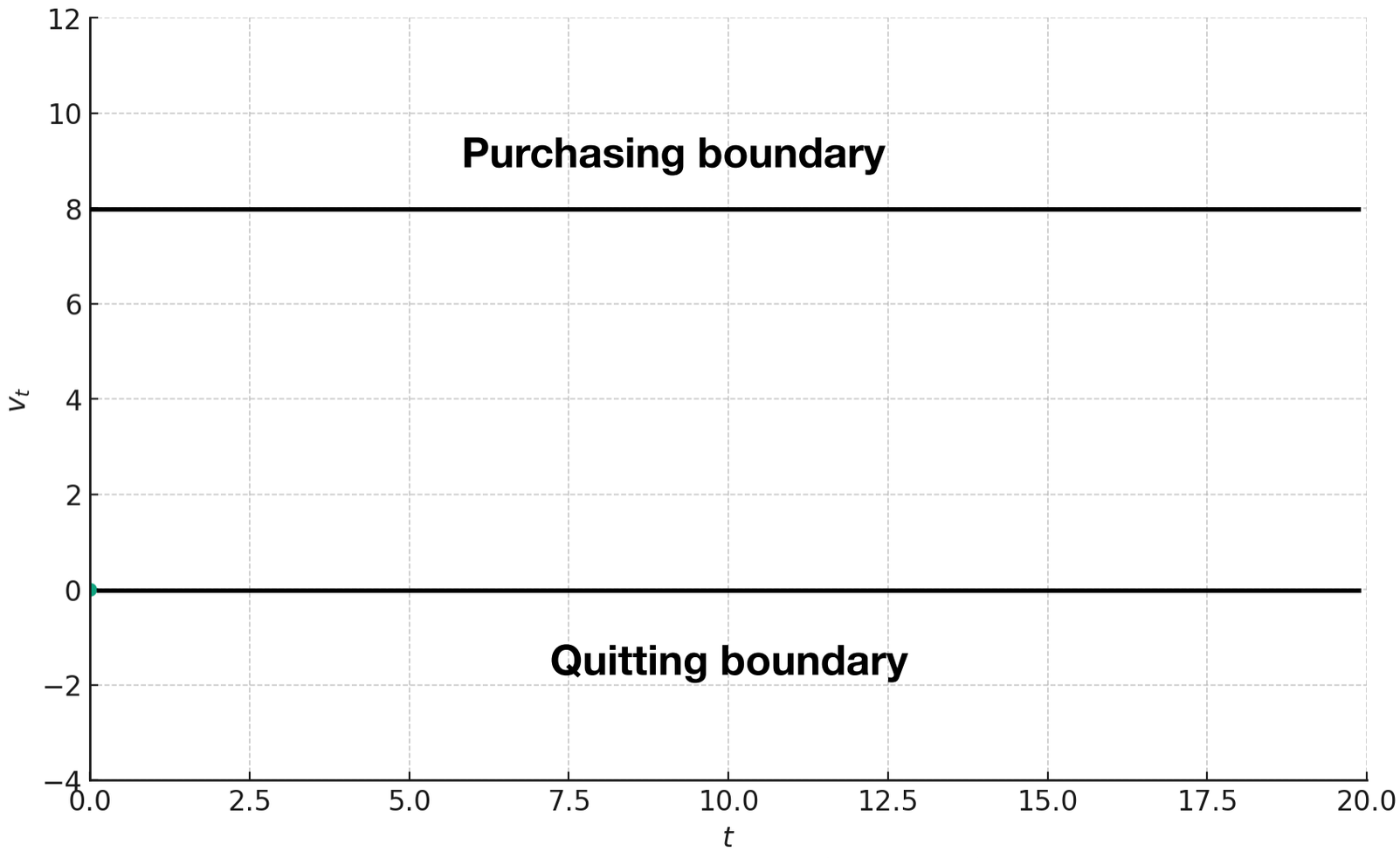
- To earn a profit, price must be higher than marginal cost p > m

The firm will not sell any product if $v_0 < -\sigma^2/4c + m$

- When hidden fee is feasible, the firm can induce the consumer to search in a wider range by offering a lower price initially

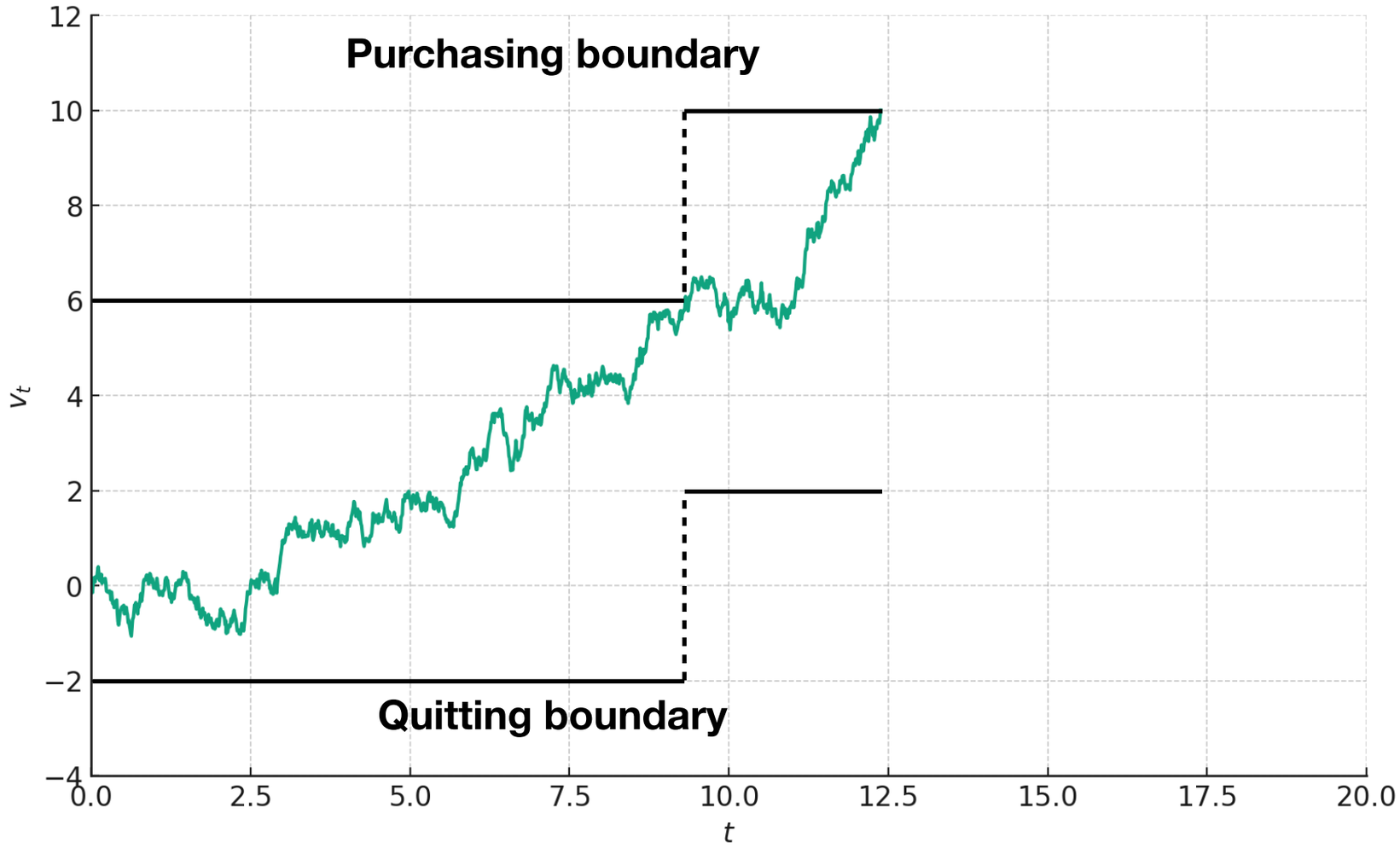
The firm can make positive profits even if $v_0 < -\sigma^2/4c + m$

Neither search nor purchase without a hidden fee



$v_0 = 0,\ m = 4,\ p = 4$

Positive expected profit with hidden fee



$v_0 = 0,\ m = 4,\ p_1 = 2,\ \Delta p = 4$

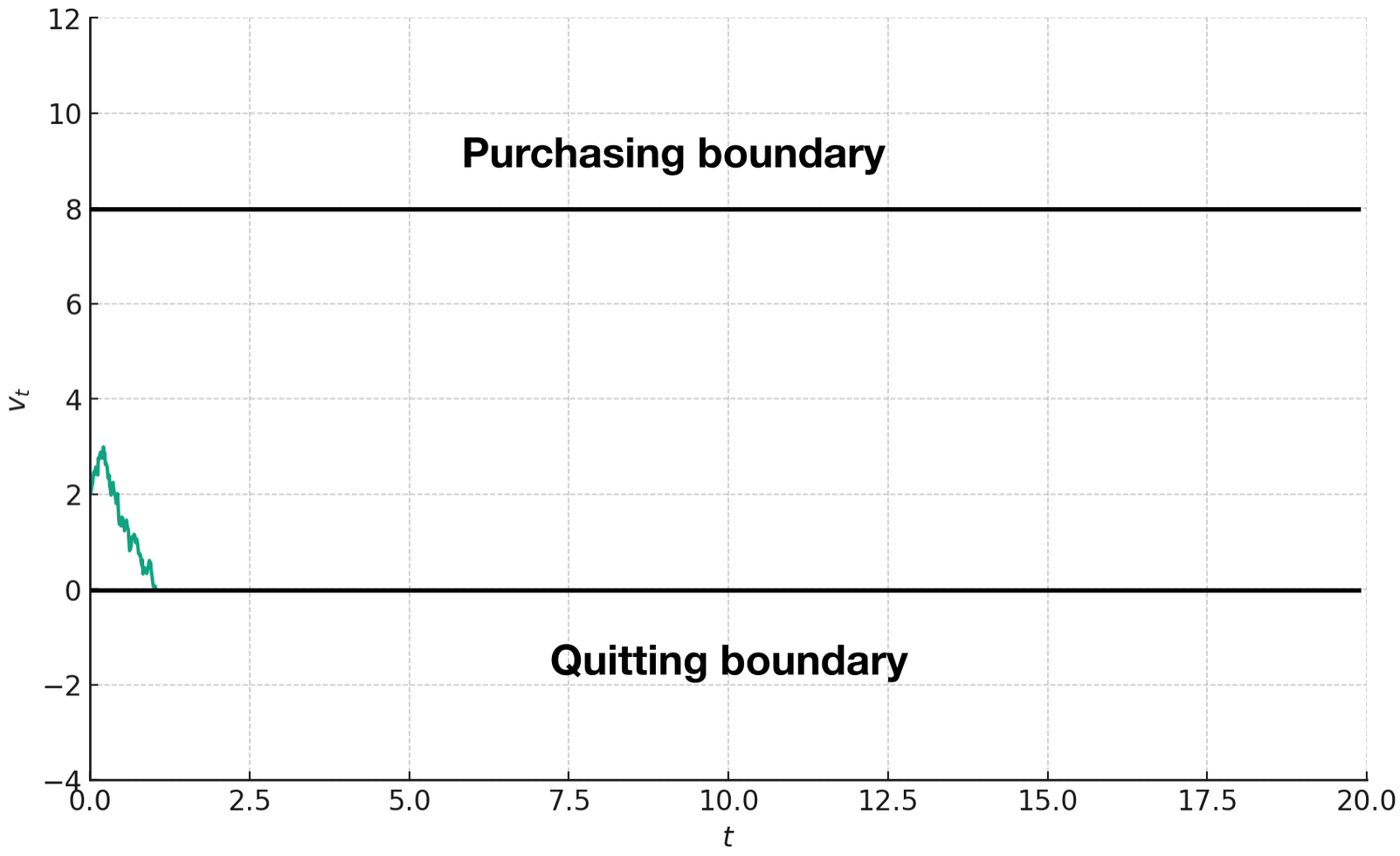
Hidden fee can benefit the firm (part II)

- Even if the firm can earn a positive profit without hidden fee when $v_0 > -\sigma^2/4c + m$, it can increase the profit by using hidden fee

$\Rightarrow$ induce consumers to continue searching in cases where early signals are unfavorable (more persistent in search)

- Parameter range: $-\sigma^2/4c + m < v_0 < 3\sigma^2/4c + m$

Quick exit after searching without hidden fee



$v_0 = 2,\ m = 2,\ p = 4$

Purchase after searching with hidden fee

$v_0 = 2,\ m = 2,\ p_1 = 2,\ \Delta p = 4$

Optimal Price with hidden fee

- When consumer valuation reaches the purchasing threshold $\bar{V}_1(p_1)$, the consumer decides to buy and proceeds to the checkout page

- The hidden fee $\Delta p > 0$ is revealed, increasing the purchasing threshold to $\bar{V}_1(p_1 + \Delta p) = \bar{V}_1(p_1) + \Delta p$

- If the initial price p_1 induces immediate purchase/quit $\Rightarrow$ the same as the upfront pricing case

- Focus on the case where p_1 induces search, $p_1 \in (v_0 - \sigma^2/4c, v_0 + \sigma^2/4c)$

Optimal Price with hidden fee

- For a given p_1, the probability that the consumer goes to the checkout page (valuation reaches $\bar{V}_1(p_1)$ before hitting $\underline{V}_1(p_1)$):

$$Q_1(v_0, p_1) = \frac{v_0 + \sigma^2/4c - p_1}{\sigma^2/2c}$$

- If the hidden fee Δp is too high, the consumer will quit immediately

$\Rightarrow$ in equilibrium, the hidden fee must be moderate, $\Delta p \in (0, \sigma^2/2c)$

- Purchasing probability conditional on reaching the checkout page:

$$Q_2(\Delta p) = 1 - \frac{\Delta p}{\sigma^2/2c}$$

Optimal Price with hidden fee

- Firm's overall expected profit:

$$\begin{aligned}
&\Pi_w(p_1, \Delta p) \\
&= \underbrace{(p_1 + \Delta p - m)}_{\text{profit per sale}} \cdot \underbrace{Q_1(v_0, p_1)}_{\text{probability of reaching the checkout page}} \cdot \underbrace{Q_2(\Delta p)}_{\text{conditional probability of purchasing}} \\
&= (p_1 + \Delta p - m) \cdot \frac{2c}{\sigma^2}(v_0 + \frac{\sigma^2}{4c} - p_1) \cdot (1 - \frac{2c}{\sigma^2}\Delta p)\,.
\end{aligned}$$

Optimal Price with hidden fee

- Firm's constrained optimization problem:

$$\max_{p_1,\Delta p} \ (p_1 + \Delta p - m) \cdot \frac{2c}{\sigma^2}(v_0 + \frac{\sigma^2}{4c} - p_1) \cdot (1 - \frac{2c}{\sigma^2}\Delta p)$$

$$s.t. \ \ p_1 \geq 0,$$

$$p_1 \in (v_0 - \sigma^2/4c, v_0 + \sigma^2/4c),$$

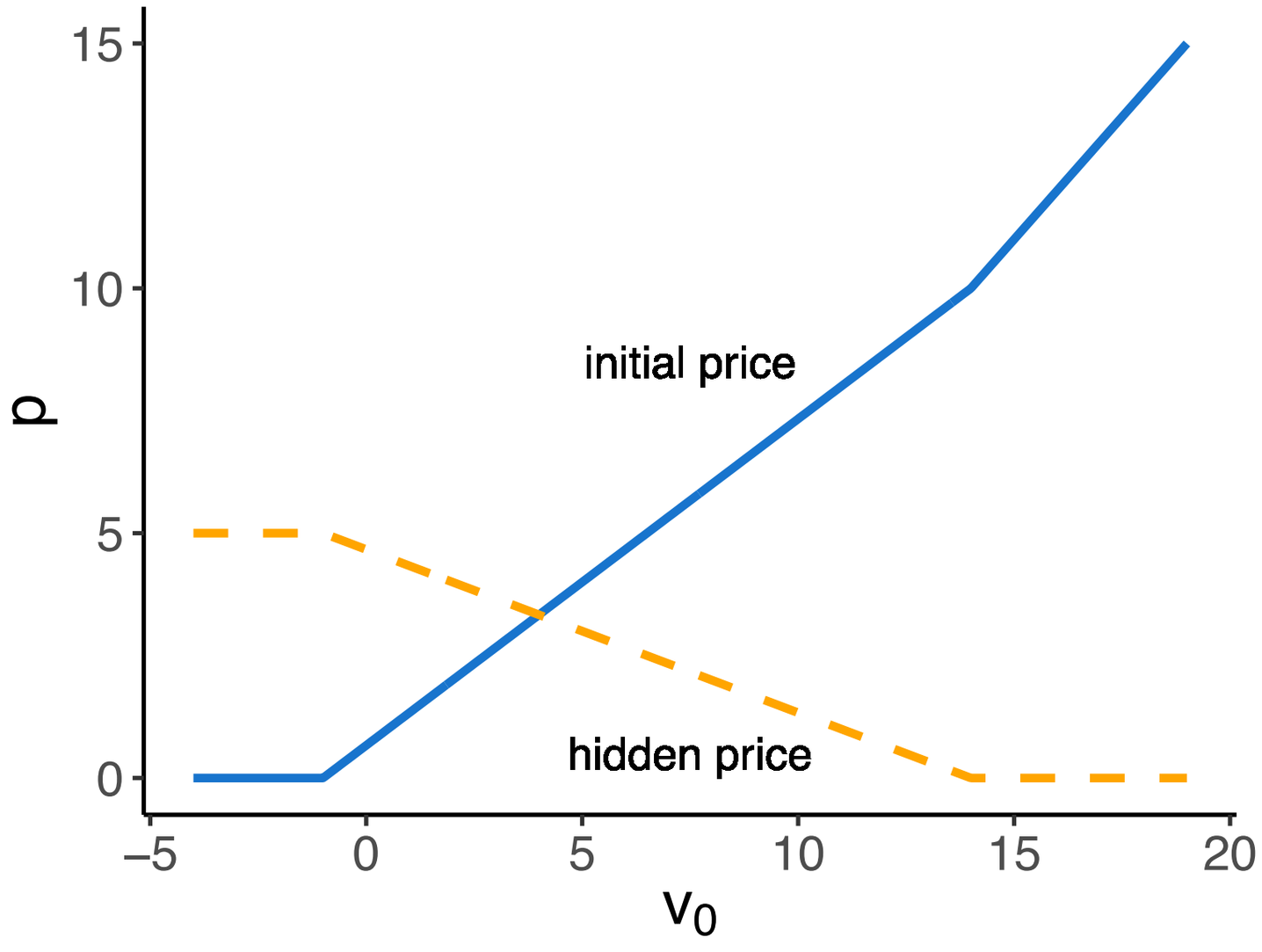
$$\Delta p \in [0, \sigma^2/2c) \, .$$

Optimal Price with hidden fee

Proposition 2. *If* $\max\{-m/2, -3\sigma^2/4c + m\} < v_0 < 3\sigma^2/4c + m$*, then the optimal initial price is* $p_1^* = 2v_0/3 + m/3$ *and the optimal hidden fee is* $\Delta p^* = \sigma^2/4c + (m - v_0)/3$*. The optimal total price is* $p_1^* + \Delta p^* = v_0/3 + \sigma^2/4c + 2m/3$*, which is strictly higher than the optimal price without a hidden fee,* p_{wo}^**.*

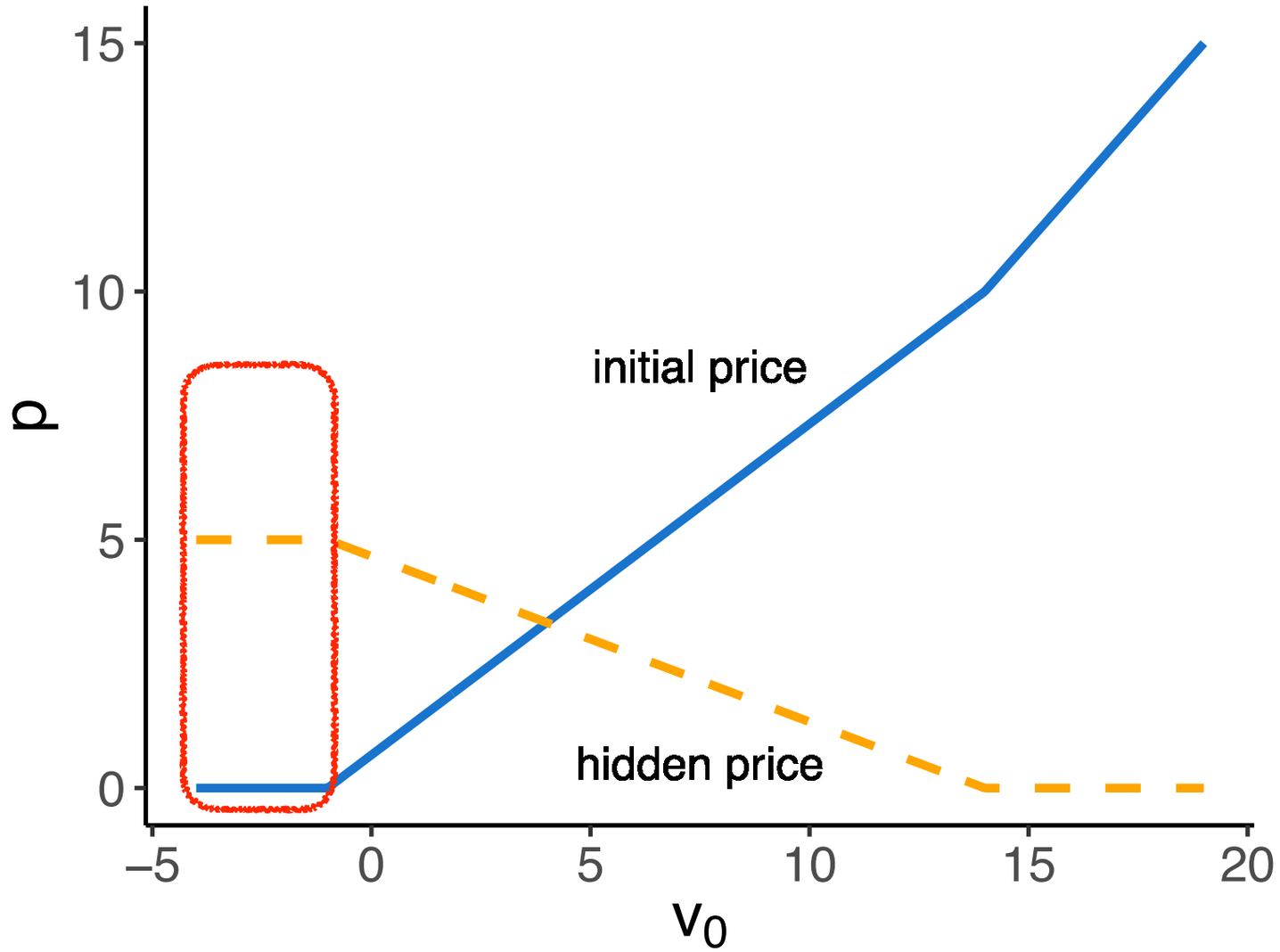
If $-\sigma^2/4c < v_0 \leq -m/2$*, then the optimal initial price is* $p_1^* = 0$ *and the optimal hidden fee is* $\Delta p^* = \sigma^2/4c + m/2$*.*

Optimal Price with hidden fee



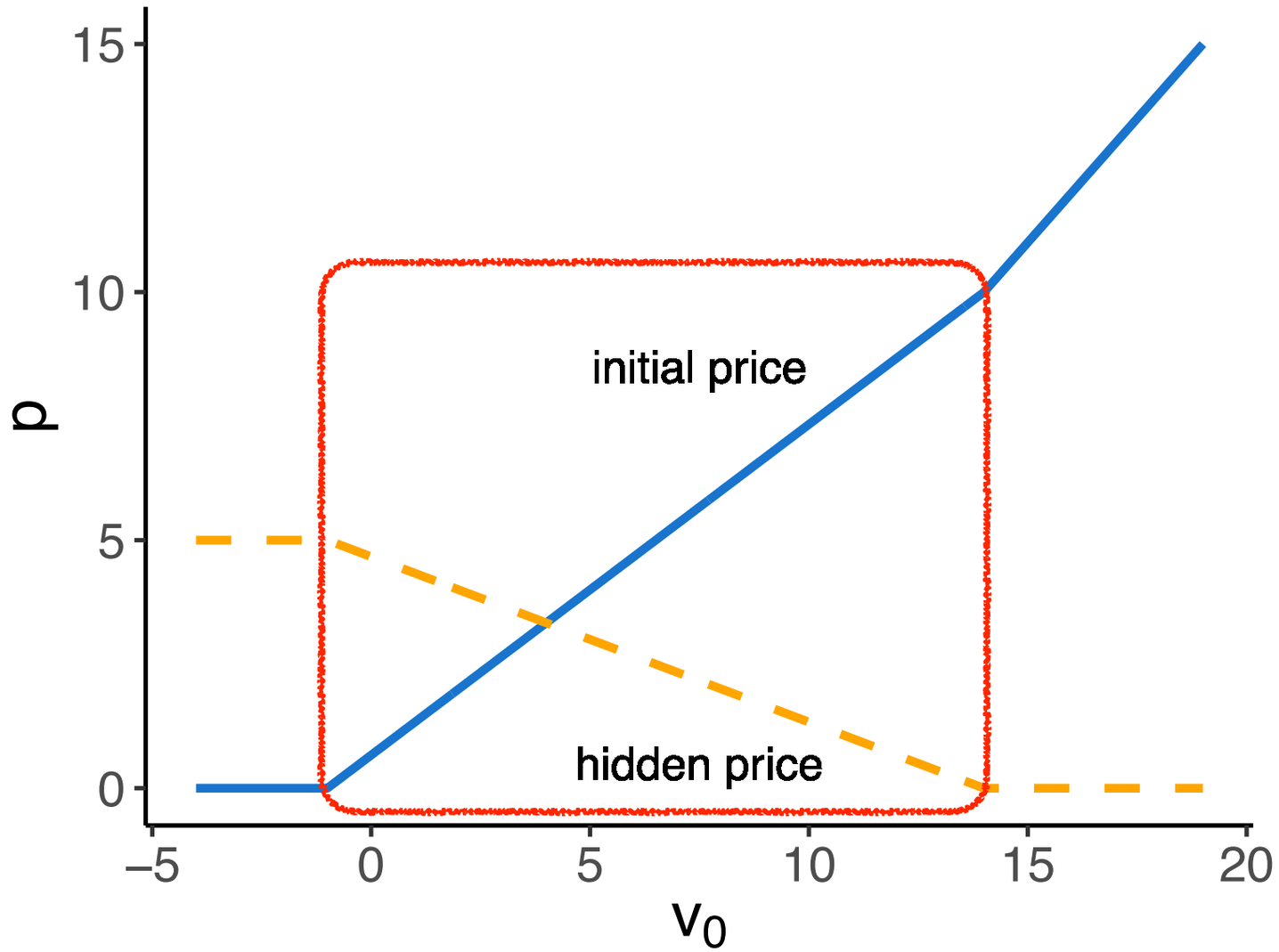
$m = 2,\ \sigma = 0.4,\ c = 0.01$

Optimal Price with hidden fee



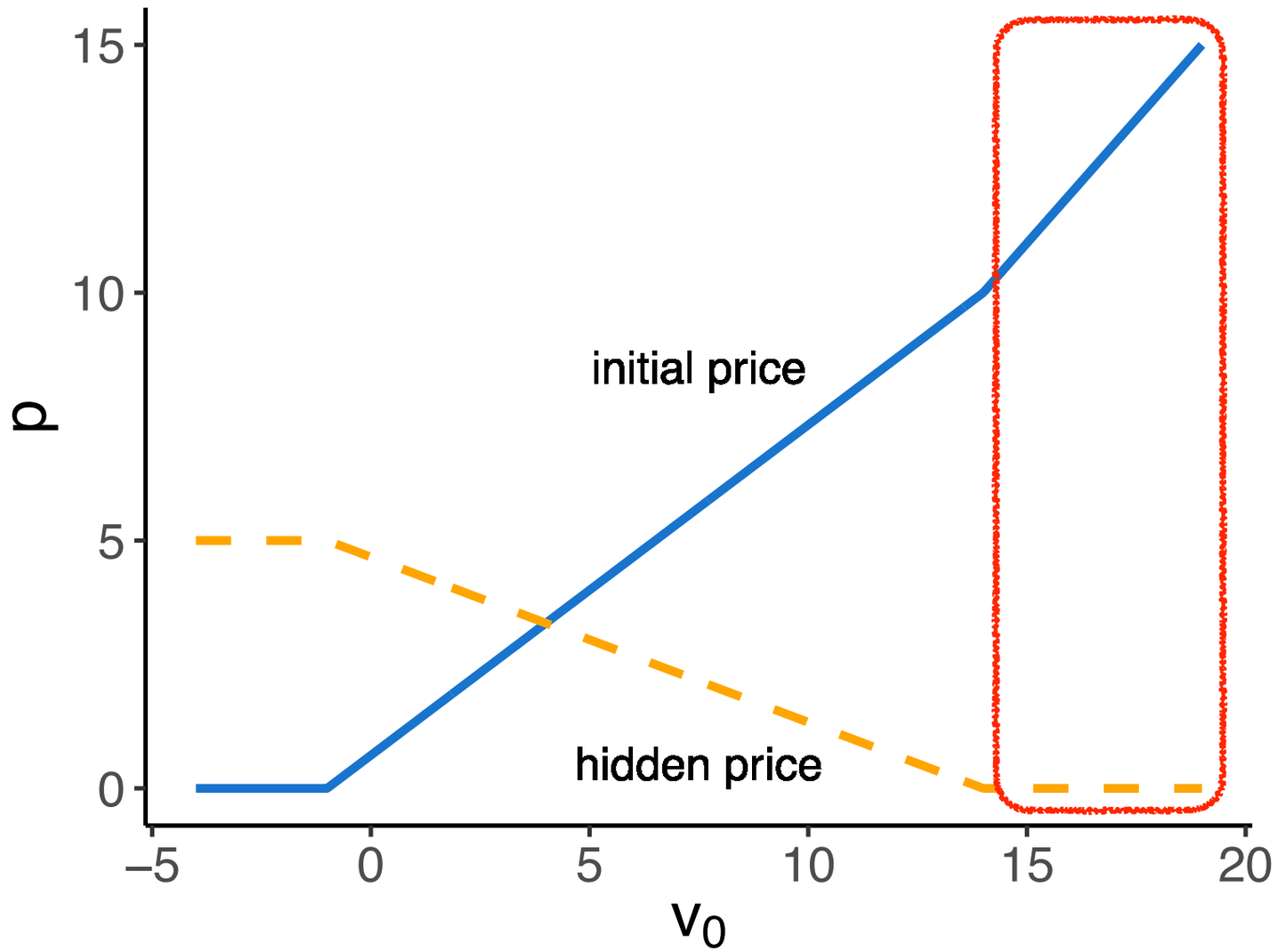
$m = 2,\ \sigma = 0.4,\ c = 0.01$

Optimal Price with hidden fee



$m = 2,\ \sigma = 0.4,\ c = 0.01$

Optimal Price with hidden fee



$m = 2,\ \sigma = 0.4,\ c = 0.01$

Comparative statics of the optimal price with hidden fee

- The hidden fee Δp increases in the signal informativeness σ^2, the marginal cost m, and decreases in the search cost c, the initial valuation v_0

- The initial price p increases in v_0 and m (it does not depend on σ^2 and c)

- The total price $p + \Delta p$ increases in v_0, σ^2, m, and decreases in c

Expected search time

- Relatively high initial valuation v_0

$$\mathbf{E}(\tau_1) = \mathbf{E}(\tau_2)$$

The firm **perfectly smooths** consumers' search behavior across stages

- Intuition: (consider a fixed total price)

Initial price too high ⇒ quick exit if gathering a few negative signals early on ❌

Initial price too low 1) ⇒ go to the checkout stage with a high probability

2) ⇒ a high hidden fee ⇒ quick exit ❌

The optimal price balances consumers' incentives to continue search before and after fee disclosure

Expected search time

- Relatively low initial valuation v_0

$$\mathbf{E}(\tau_1) < \mathbf{E}(\tau_2)$$

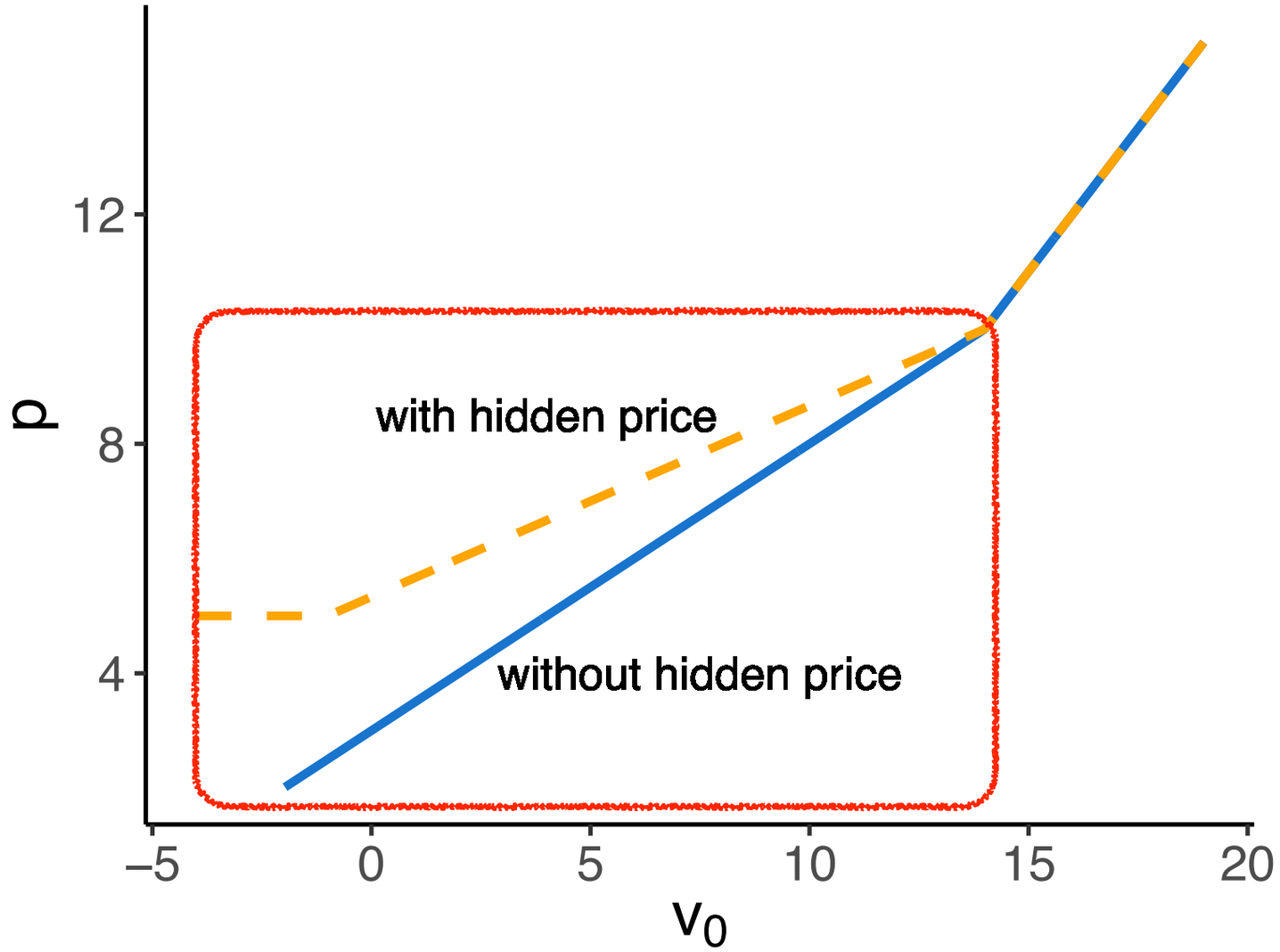
- Intuition:

Low v_0 ⇒ quitting boundary is close to v_0 even with a low initial price
⇒ quick exit if the consumer gathers a few negative signals

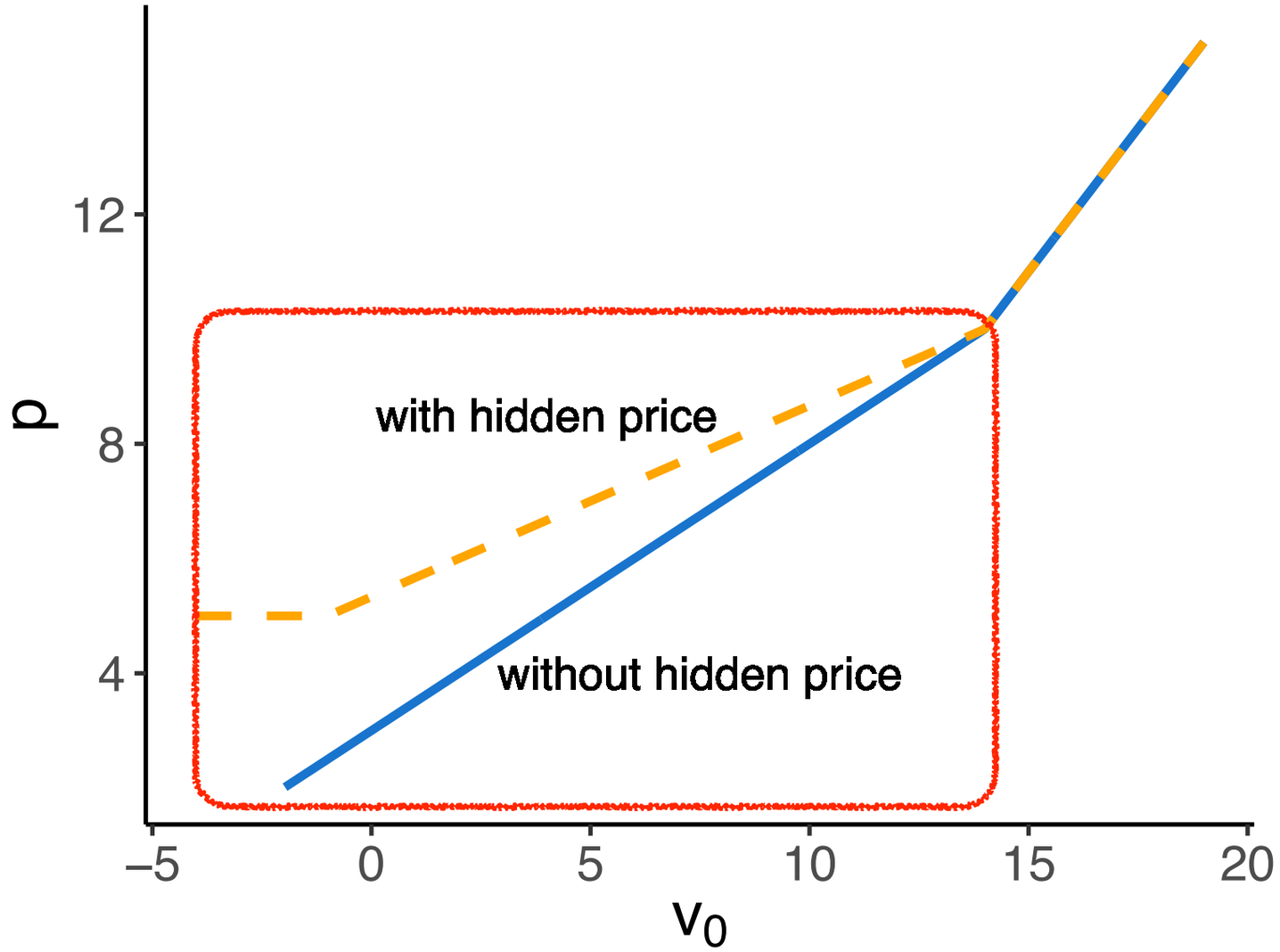
If a consumer reaches the checkout page ⇒ a much higher valuation
⇒ willing to keep searching even if she receives some negative signals

Impossible for the firm to perfectly smooth consumers' search behavior.

Strictly higher profit with a hidden fee in the red area



Strictly higher expected search time with a hidden fee in the red area



Heterogenous consumers

Heterogenous consumers

1. Heterogenous learning speeds

2. Heterogenous Initial valuations

Heterogenous learning speeds

- Two groups of consumers with $\sigma \in \{\sigma^H, \sigma^L\}$, where $\sigma^H > \sigma^L$
- $Prob(\sigma = \sigma^H) = \rho_\sigma$
- Distribution of consumer types is common knowledge
- Realized type is each consumer's private information
- Firm's pricing decision can lead to different strategic effects on different consumer segments
  - e.g., a higher price may generate higher profits among fast-learning consumers, but may drive slow-learning consumers out of the market

Total price with hidden fees may be lower than the price without hidden fees

- Sufficient condition:

$$\rho_\sigma < \widehat{\rho_\sigma},\ \sigma_H > \sqrt{5}\sigma_L,\ \max\{-m/2, -3\sigma_L^2/4c\} < v_0 < -\sigma_L^2/4c + m$$

- Key mechanism:

<u>Without hidden fees:</u>

Not profitable to sell to slow-learning consumers

Sellers set the price optimal for fast-learning consumers (high price)

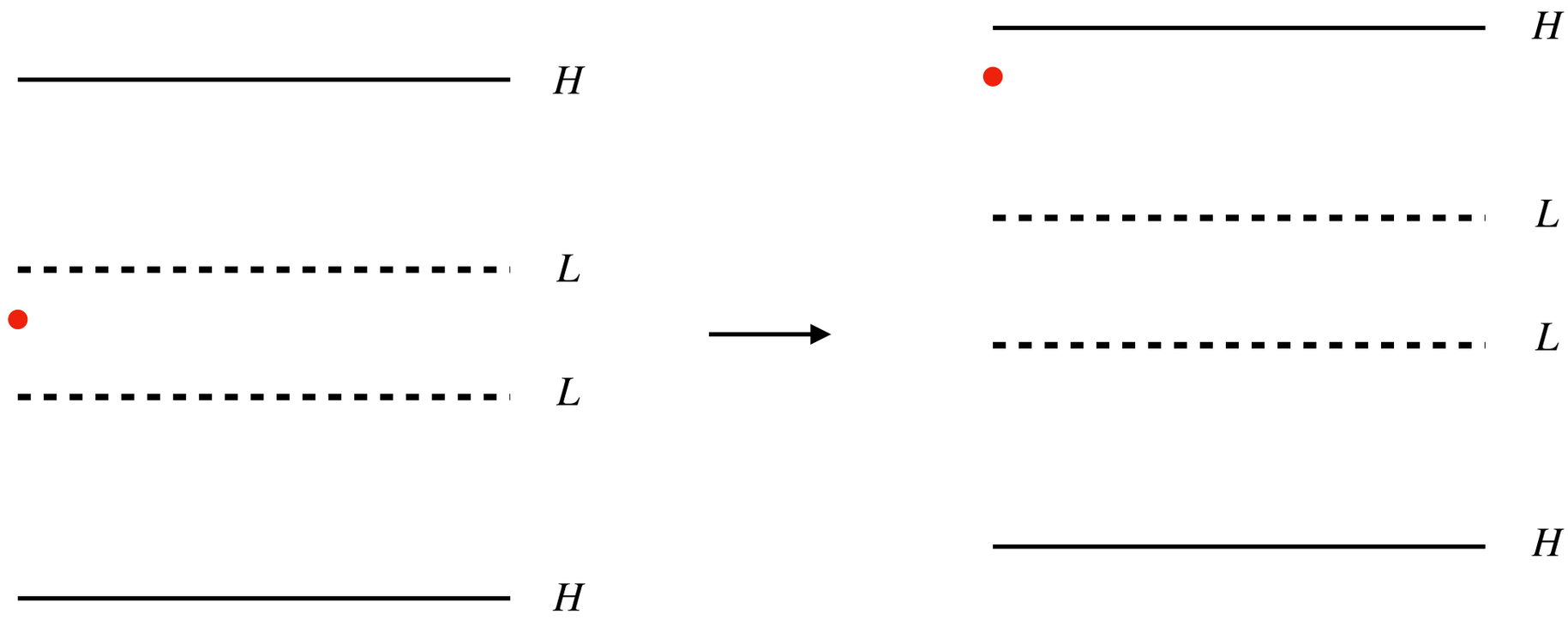
<u>With hidden fees:</u>

profitable to sell to both types of consumers

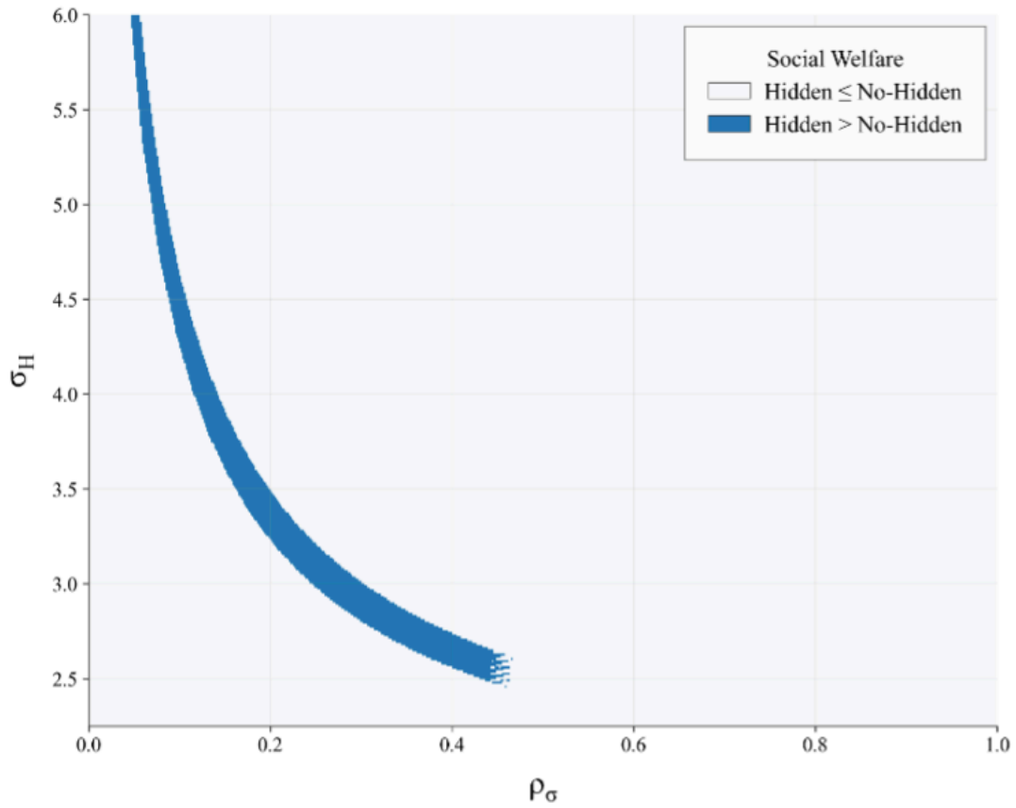
reduce the price to expand the market (low price)

Expected search time

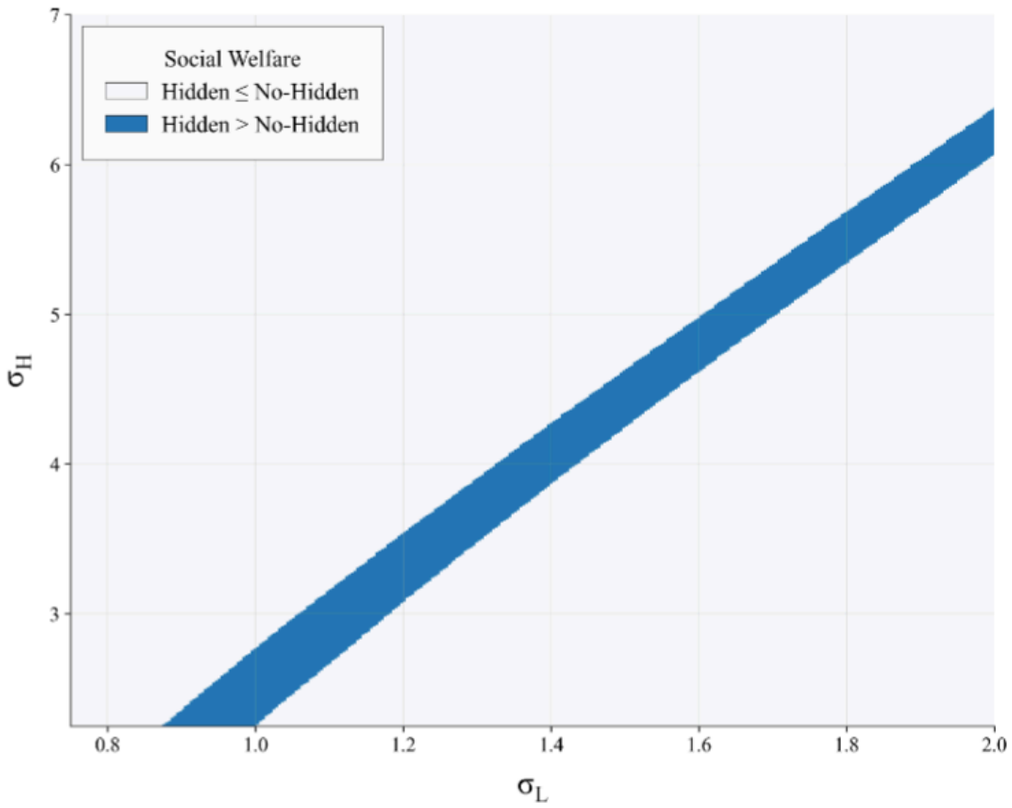
- Consumer search behavior exhibits different patterns when compared with the homogeneous consumer case
- Homogeneous case: $\mathbf{E}(\tau_1) \leq \mathbf{E}(\tau_2)$
- This case: $\mathbf{E}(\tau_1^H) > \mathbf{E}(\tau_2^H)$



The use of hidden fee can even increase social welfare



(a)



(b)

Heterogenous initial valuations

- Two groups of consumers with $v_0 \in \{v_0^H, v_0^L\}$, where $v_0^H > v_0^L$
- $Prob(v_0 = v_0^H) = \rho_v$
- Distribution of consumer types is common knowledge
- Realized type is each consumer's private information

Total price with hidden fees may be lower than the price without hidden fees

- Sufficient condition:

(1)$\rho_v < \widehat{\rho_v}$, $v_0^H - v_0^L > \sigma^2/c$, and
$\max\{-m/2, -3\sigma^2/4c + m\} < v_0^L < -\sigma^2/4c + m < v_0^H < 3\sigma^2/4c + m$

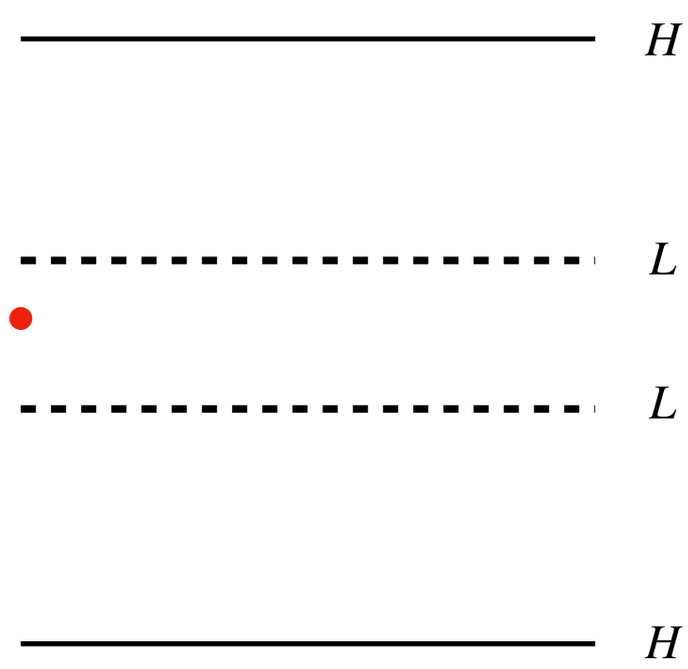
or

(2) $\rho_v < \widehat{\rho_v}'$, $v_0^H - v_0^L > \sigma^2/c$,
$-\sigma^2/4c < v_0^L < -\sigma^2/4c + m < v_0^H < 3\sigma^2/4c + m$, $v_0^L < -m/2$, and
$m < \sigma^2/2c$.

Expected search time

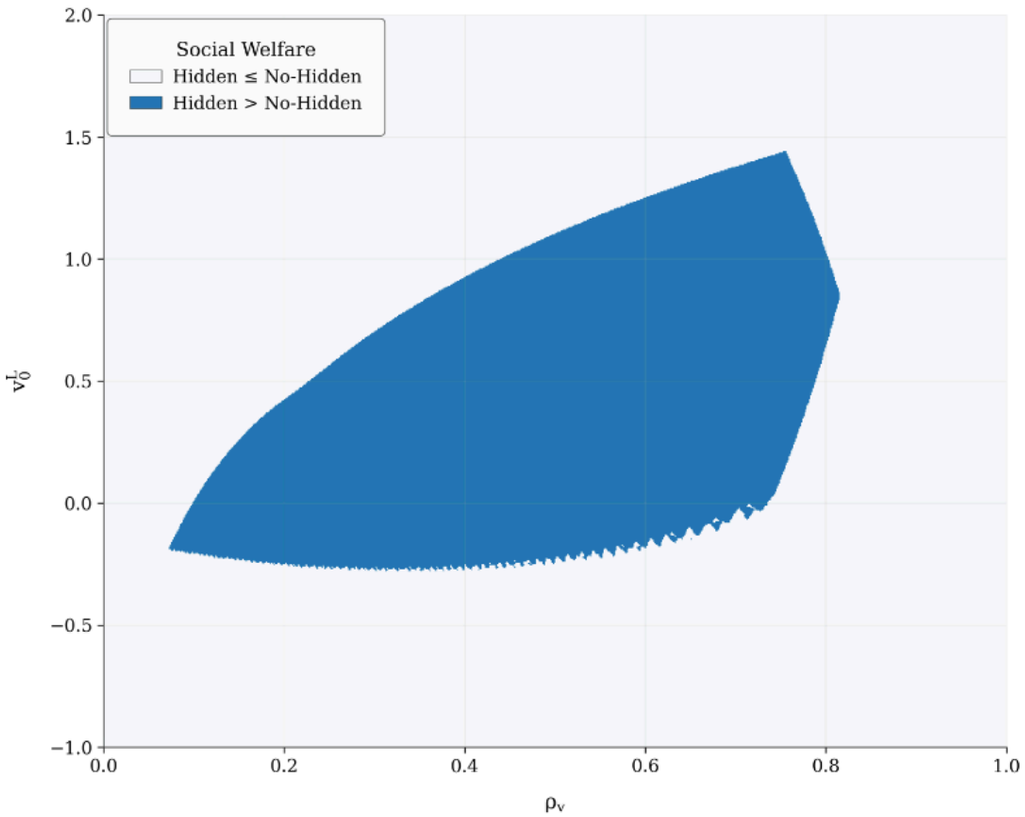
- Consumer search behavior qualitatively differ from the heterogeneous learning speeds case
- This case: $\mathbf{E}(\tau_1^H) = \mathbf{E}(\tau_2^H) = 0$

heterogeneous learning speeds



heterogeneous initial valuations

The use of hidden fee can even increase social welfare



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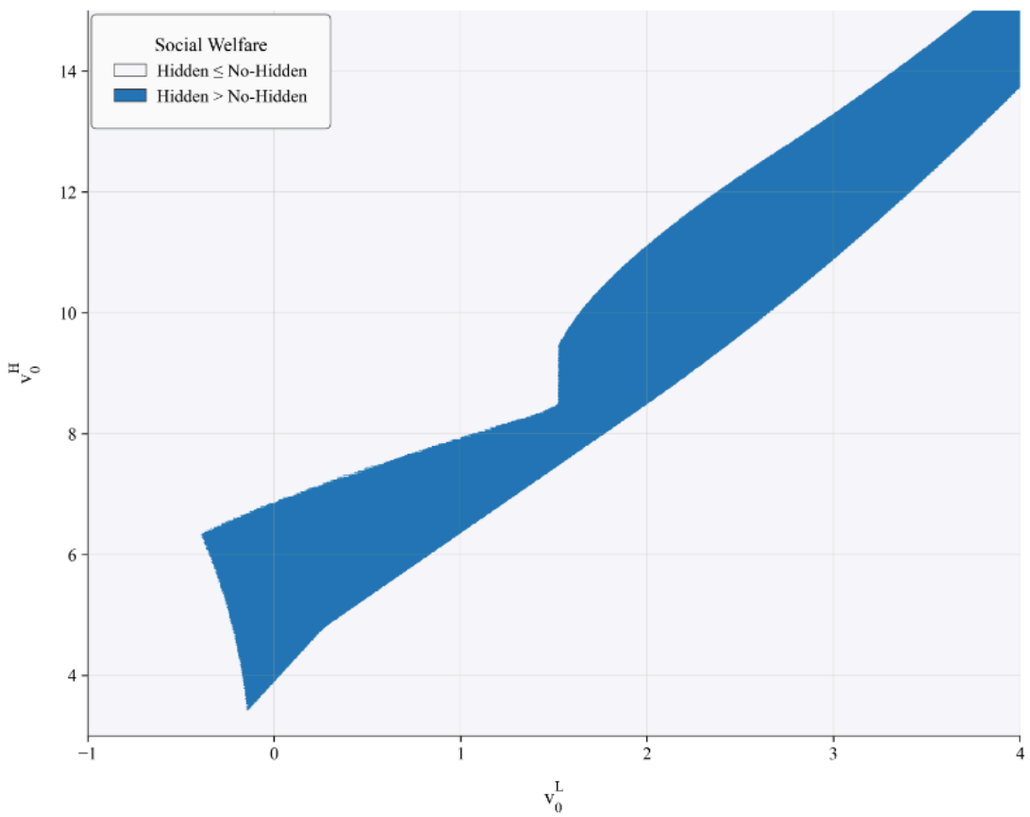

(b)

Extension

Some consumers are aware of the hidden fee

- ρ proportion of the consumers are unaware of the possibility of hidden fees

- Remaining $1-\rho$ proportion of the consumers are aware of it $\Rightarrow$ rationally anticipate the seller's pricing strategies in the second stage

- Proposition: For any $\rho > 0$, there exist parameters such that the firm's expected profit is strictly higher with a hidden fee.

Thanks!

Broader Research Agenda

- Strategic considerations of AI/ML

<u>Algorithmic targeting:</u>

Precision-Recall Tradeoff in Competitive Targeting (with Ganesh Iyer and Zemin (Zachary) Zhong)

Marketing Science

<u>Disinformation detection:</u>

Strategic Disinformation Generation and Detection (with Wenxiao Yang and Pengxiang Zhou)

Minor revision at **Management Science**

Broader Research Agenda

- Role of information in marketing strategy
  - Consumer search and its marketing implications

Retargeting: A Dynamic Model of Optimal Retargeting (with J. Miguel Villas-Boas) **Marketing Science**

Information provision: Dynamic Persuasion and Strategic Search **Management Science**

Search fatigue: Search Fatigue, Choice Deferral, and Closure (with J. Miguel Villas-Boas) **Marketing Science**

Advertising: Invitation to Search or Purchase? Optimal Multi-attribute Advertising Major revision at **Management Science**

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