Due Diligence

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Big Picture

- Standard models assume that transactions are executed once a buyer and seller agree on a price.
  - Auctions
  - Bargaining
  - Search and Matching

- In practice, there is usually a period of "discovery" after terms have been agreed upon *but prior to execution.*
  - Implicit: one party retains the option to withdraw

- Due diligence is pervasive in corporate transactions
  - Public M&A, private equity, venture capital, real estate ...
  - Practitioners claim it is crucial, is it economically important?

Motivation

The goal of due diligence in the M&A process is for Buyer to confirm Seller's financials, contracts, customers, and all other pertinent information. In other words, the goal is to make Buyer ***comfortable enough*** *to go through with the deal and close.*

Buyers often have other partners (usually banks or private equity firms) who are providing some of the financing and have stricter requirements than the Buyer does. In other words, Seller may have to overcome both Buyer's demands and Buyer's financial partner's demands.

Snow (2019)

Mergers & Acquisitions (for dummies)

This paper

How does the acquirer's right to conduct due diligence affect our understanding of market transactions?

- Acquirer learns about the value during due diligence
- Transaction may not be executed if due diligence fails
- Right to conduct due diligence ⇒ acquirer "wins" a real option

This paper

1. A (far too) simple model of due diligence
   - Symmetric information
   - Identical buyers (common value)
   - Contract≡ contingent price
   - Acquirer has the right to conduct due diligence

Findings

- A higher price is not necessarily better for the seller
- Buyers make positive expected profits
- Seller may (or may not) benefit from due diligence
- Buyers are too diligent relative to social optimum

Extensions

- The timing of due diligence
- Enriching the contract space
- Seller private information
- Costly due diligence
- Endogenous effort

We have also considered (but will not discuss):

- Debt financing, equity vs cash offers, deadlines, private values

Literature

Auctions of Real Options: Board (2007) and Cong (2018, 2019)

- Broaden scope, seller vs buyer private information

Auctions in M&A: Bulow and Klemperer (1996), Hansen (2001), Ye (2007), Quint and Hendricks (2018), Gorbenko and Malenko (2018,19)

- We add a due diligence phase

Auctions with Information Acquisition: Matthews (1984), Stegeman (1996), Persico (2000), Shi (2012)

- Acquisition *prior to* bidding

Learning before trading: Daley and Green (2012, 2019)

- Learning occurs *before* agreement reached

Model

- A single seller owns a durable asset
- A set of identical bidders
- Asset type is $\theta \in \{L, H\}$
  - θ is unknown
  - Players have common prior that $q_0 = \mathbb{P}_0(\theta = H)$
  - Sellers value is k, independent of θ
  - Bidders value is V_θ, where $0 = V_L < k < V_H$
- All players are risk neutral and discount at rate r

Model: Timing

- Bidders simultaneously make bids to the seller
- If the seller accepts a bid
  - The winning bidder (acquirer) has the right to conduct due diligence
  - Decides when (if ever) to complete the deal at the winning bid
- While conducting due diligence, the acquirer uncovers information via a Brownian diffusion process

$$dX_t = \mu_\theta dt + \sigma dB_t$$

Signal to noise ratio: $\phi = (\mu_H - \mu_L)/\sigma$

Model: Beliefs

- The acquirer updates about θ during due diligence
- Using Bayes rule, the belief at time t is

$$q_t = \mathbb{P}(\theta|\mathcal{H}_t) = \frac{q_0 f_t^H(X_t)}{q_0 f_t^H(X_t) + (1-q_0) f_t^L(X_t)} \tag{1}$$

where f_t^θ is pdf of $X_t|\theta$, which is $\mathcal{N}\left(\mu_\theta t, \sigma^2 t\right)$

The acquirer's problem

- Suppose the winning buyer's bid is P
- Then the acquirers's due diligence problem is

$$F_B(q|P) = \sup_{\tau} \mathbb{E}_q[e^{-r\tau}(V_\theta - P)]$$

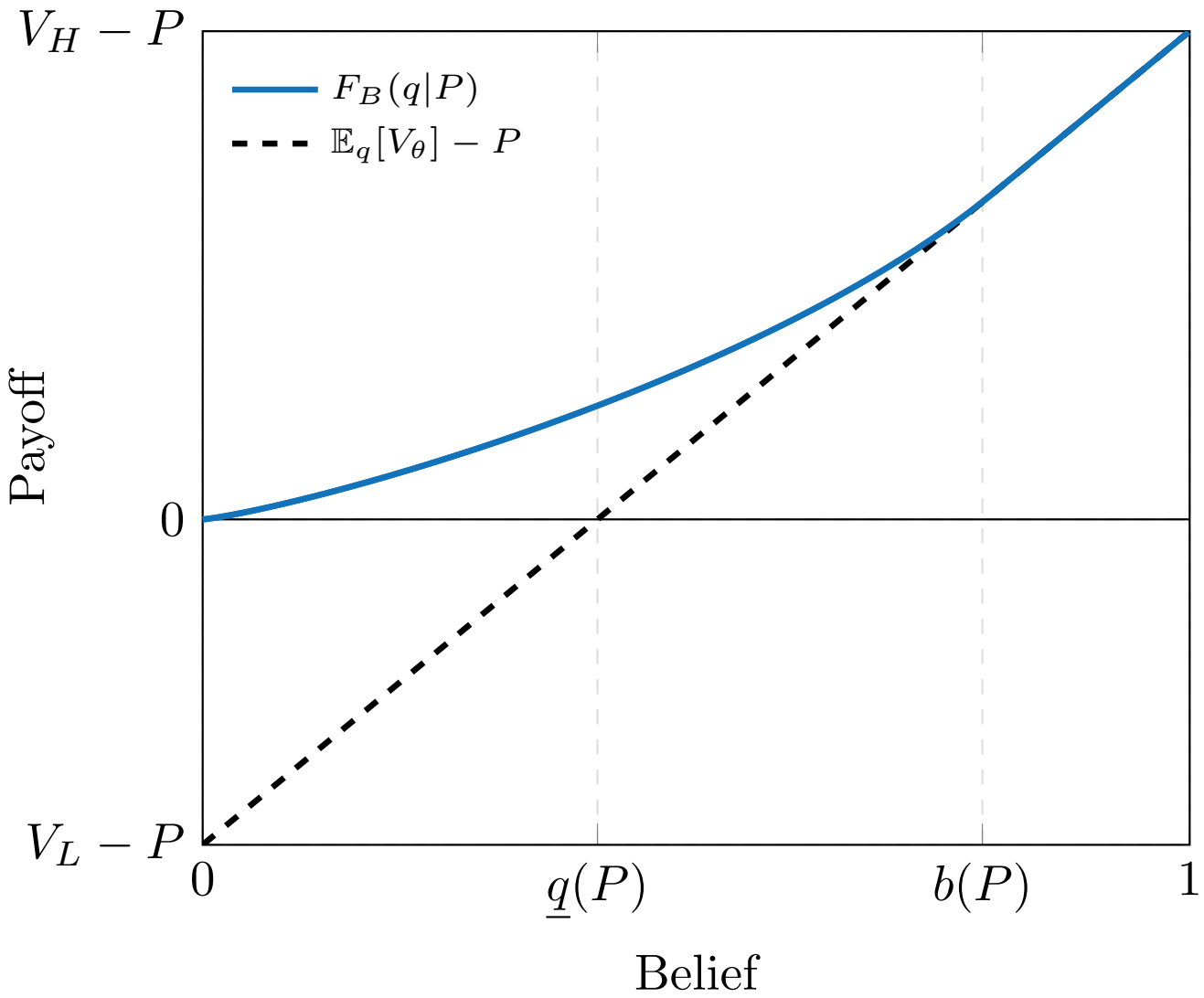
Lemma

The solution to the buyer's problem has a threshold form:

$$\tau^*(P) = \inf\{t : q_t \geq b(P)\}$$

Moreover, the threshold $b(P)$ is increasing in P.

Illustration of the Acquirer's Problem



Induced seller preferences

- What is the seller's preferred price?
- Seller's expected discounted payoff is

$$F_S(q|P) = \mathbb{E}\left(e^{-r\tau^*(P)}\right) P$$
$$= \Pr\left(\tau^*(P) < \infty\right)\mathbb{E}\left(e^{-r\tau^*(P)}|\tau^*(P) < \infty\right) P$$

- A higher price leads to:
  - Higher payoff conditional on completion 
  - More due diligence conditional on execution 
  - Higher chance of deal failure 
- The seller does not necessarily prefer a higher price

Seller-optimal price

- Define $P_0(q) \equiv b^{-1}(q)$ as the highest price such that the buyer is willing to forego due diligence and execute immediately

- Consider the hypothetical stopping problem

$$\sup_{\tau} \mathbb{E}_q \left[e^{-r\tau} (P_0(q_\tau) - k) \right] \qquad \text{(SP-h)}$$

- Assume solution to (SP-h) has a threshold form
  - We provide (mild) sufficient conditions in paper
  - e.g., $k \geq \bar{k} \approx 0.05 V_H$ or $\phi \geq \bar{\phi}$

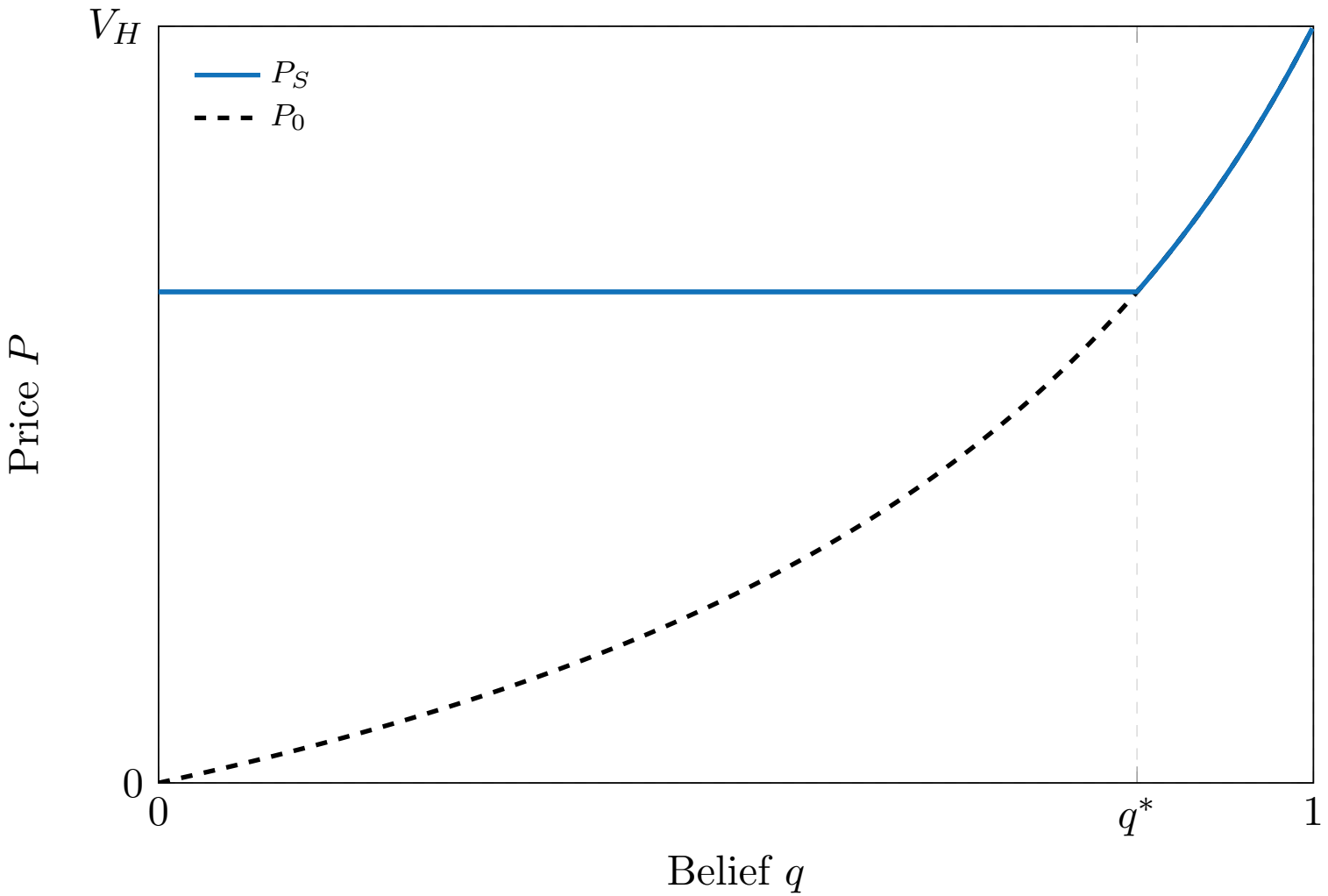
Seller Optimal Price

Lemma

There exists a unique $q^* \in (0,1)$ *such that*

- *If* $q_0 \leq q^*$, *then the seller-optimal price is* $P_0(q^*)$
- *If* $q_0 > q^*$, *then the seller-optimal price is* $P_0(q_0)$

Seller Optimal Price



Equilibrium

Proposition

In the unique equilibrium:

- *The winning offer is the seller-optimal price*
- *The acquirer conducts due diligence if and only if* $q < q^*$

- The acquirer has a strictly positive payoff, whether or not she conducts due diligence.
  - Option to conduct due diligence facilitates rent extraction
- The seller's payoff is the same as in (SP-h)
  - *As if* there is bidding during due diligence

When should "due diligence" begin?

We assumed that:

- Bidding takes place at $t = 0$
- Due diligence takes place at $t > 0$

Question: What if we also allow for due diligence during bidding?

- Answer: The predictions are unchanged
  - Seller's payoff as the same as if $P_0(q_t)$ is always available
  - $P_0(q_t)$ is the highest price at which acquirer will be willing to execute
  - Seller and acquirer payoffs are identical to static bidding

Takeaway: Our key assumption is that the winning buyer has the option to do more due diligence after her offer is accepted.

- Not when DD is allowed to takes place.

Comparison to the socially efficient benchmark

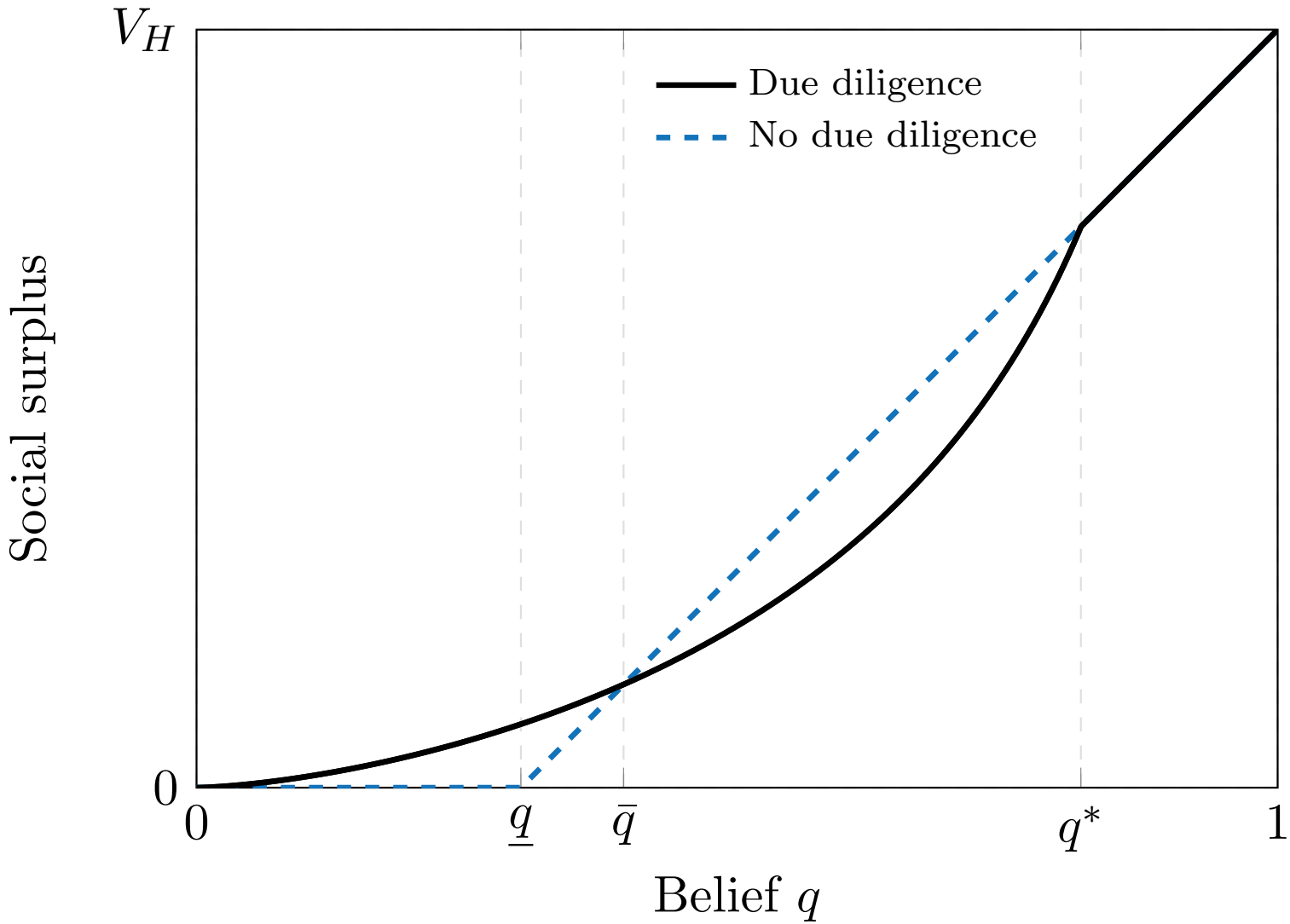
- Socially efficient due diligence solves:

$$\sup_{\tau} \mathbb{E}_q \left[e^{-r\tau} (V_\theta - k) \right]$$

- Socially efficient policy: execute iff $q \geq b(k) < b(P^*)$
- In equilibrium, there is too much due diligence compared to the social optimum (and too many deals fail)

Intuition: buyer only captures part of the total surplus $\implies$ does not internalize the true (social) cost of delay

Social value of due diligence



Due diligence can benefit or harm social efficiency (and the seller)

Simple solution

Enrich the contract space: $C \equiv (U, P)$

- $U \geq 0$ is an upfront unconditional transfer
- P is the price paid contingent on execution

Seller-optimal mechanism:

- $P = k \Rightarrow$ efficient execution $\Rightarrow$ maximize social surplus
- $U = F_B(q|k) \Rightarrow$ seller extracts all surplus

Interpretation?

- U resembles "earnest money"
- Formally equivalent to a break-up fee if $r = 0$

Asymmetric Information

- Seller private information hinders the implementability of the simple solution just described
- Seller knows the asset's type $\theta \in \{L, H\}$ but bidders do not
- Seller's reservation value depends on the asset's type k_θ with $V_H > k_H > k_L > V_L = 0$
- Seller posts a contract $C = (U, P)$ and bidders update their beliefs and decide whether (or not) to accept

Asymmetric information: constrained efficiency

- Constrained efficient execution solves

$$\sup_{\tau} \mathbb{E}_q \left[e^{-r\tau} (V_\theta - k_\theta) \right] \tag{2}$$

- There exists a price, $P_{SP} < k_H$, that achieves this outcome
- At this price, the high-type seller prefers the deal not to be executed
- For q small, maximal U buyers are willing to offer is not enough to compensate
  - $F_H(q_0|P_{SP}) + F_B(q_0|P_{SP}) < 0 \Rightarrow$ high type rejects constrained efficient outcome
- What is a "reasonable" equilibrium?

Can a separating PBE exist?

If θ is revealed by the offer:

- Nothing to learn from due diligence
- Acquirer should execute immediately or never
- Low type payoff must be zero
- If immediate and H accepts, then L strictly prefers to accept

Conclusion: In any separating PBE, the transaction is never executed.

Candidate equilibrium

A natural candidate is the high type optimal (HTO) equilibrium.

- Any HTO equilibrium involves full pooling on single contract.
- A HTO equilibrium satisfies both divinity (Banks and Sobel, 1987) and the undefeated criterion (Mailath et. al 1993).
- Any non-trivial PBE that satisfies these refinements is a HTO equilibrium.

Characterizing the HTO equilibrium

The HTO contract solves:

$$\max_{U,P} \; U + F_H(q_0|P)$$

$$s.t. \quad F_B(q_0|P) - U \geq 0$$

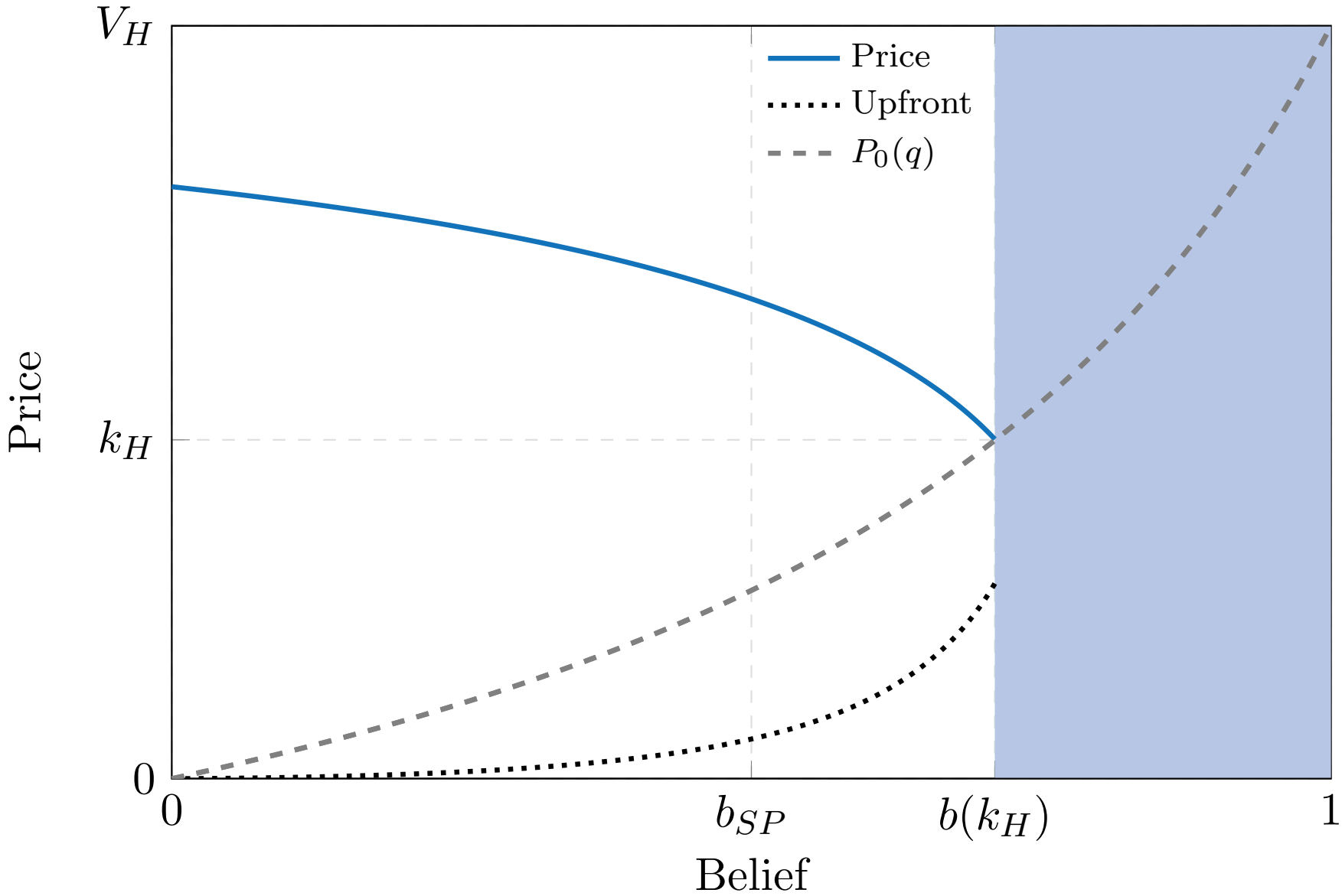
- The constraint ensures the acquirer make a non-negative profit

Clearly, the constraint binds at the solution, thus the HTO solves

$$\max_{P} F_H(q_0|P) + F_B(q_0|P)$$

- NB: not surplus maximization.

Solution: HTO contract



Takeaways: HTO Equilibrium

- High-type optimal price is strictly greater than P_{SP}
  $\Rightarrow$ Acquirer too diligent compared to social optimum (again!)

- High-type trade-off: maximizing total surplus vs extracting rent from the low type

- Rent extraction less important as beliefs go up $\Rightarrow$ price decreasing in q

Extensions

- When X is contractible
  - Can approximate first-best
  - Mirleesian existence problem
- Common knowledge of gains from trade
  - Seller might prefer due diligence even though it's socially inefficient
  - Seller prefers dynamic bidding
- Costly due diligence
  - Two threshold policy: execute above b, exit below a
  - Acquirer drops out too early relative to social optimum
- Endogenous due diligence effort $\Rightarrow$ more effort closer to completion

Conclusions

Most transactions involve a period of due diligence after terms are reached. This implies that:

- Acquirer "wins" a real option
  - facilitates surplus extraction
- Sellers do not always prefer a higher price
- Acquirer is too diligent relative to social optimum
- Upfront payments (or break-up) fees can mitigate the distortion
  - But distortions persist with private information