Market Microstructure

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Prices in the Walrasian model

Price are such that supply=demand

Prices can reveal informaton

Price formation is a ‘black box’

Mark Garman, 1976: ‘Market Microstructure’

‘We depart from the usual theory of exchange by (1) making the assumption of asynchronous, temporal discrete market activities on the part of market agents and (2) adopting a viewpoint which treats the temporal microstructure, i.e., moment-to-moment aggregate exchange behavior, as an important descriptive aspect of such markets’

How does the trading mechanism matter?

Where do prices come from?

How is supply matched with demand?

How does information get into prices?

What drives transactions costs?

What drives liquidity?

What are ‘optimal’ ways to trade?

Liquidity is empirically important for asset prices

In the time-series

In the cross-section: 9% spread in average returns for sensitivity to aggregate liquidity

Puzzling

Ingredients in Microstucture Models

The rules of the mechanism: who sees what, how do actions map into prices and allocations

The traders' goals

The traders' information sets

The traders' constraints

One period, trade-by-trade environment

One risky asset, one risk free asset

Final risky asset value: v, v_0 expectations

v is a a random variable

Different traders can have different information about v

Liquidity demanders

Purposeful

May have a signal s about v

Private value reason for trading: L, driven by endowments and risk-aversion

Submit an order of Q(s,L) shares

Pays a price P*(Q(s,L);Rules)

N Liquidity suppliers

'compete' to fill order

Costs c(q,N) to fill order: order processing costs, inventory costs

As N increases, inventory costs drop

Infer information from quantity

Different trading mechanisms imply different information, and P*(Q(s,L);Rules)

Trading mechanisms

Uniform price

Discriminatory price

Limit order markets: liquidity suppliers post limit orders, and the liquidity demanders quantity determines price

Example

1 share offered for sale at $15

1 share offered for sale at $15.50

Order for two shares arrives

Uniform price: both shares trade at $15.50

Discriminatory price: first share trades at $15, second share trades at $15.50

Competitive dealers

No information asymmetry

Uniform pricing

Suppliers cost function: $(c/2)q^2$ to trade q shares

Inventory cost function

Buy price for Q shares: $v_0+(c/N)Q+$ inv cost

Strategic dealers or market power influence prices

Dealers charge more than marginal cost

Empirical Example: The Municipal Bond Market

from Green, Hollifield, Schuerhoff, 2007

Data from US Municipal bond market: 4.5 M transactions, 2001-2004

Large and economically important market

Use stochastic frontier model to estimate cost function

Dealers have market power

Average bond has about a 5% yield, but markups are on the order of 2%

Markups decreasing in quantity

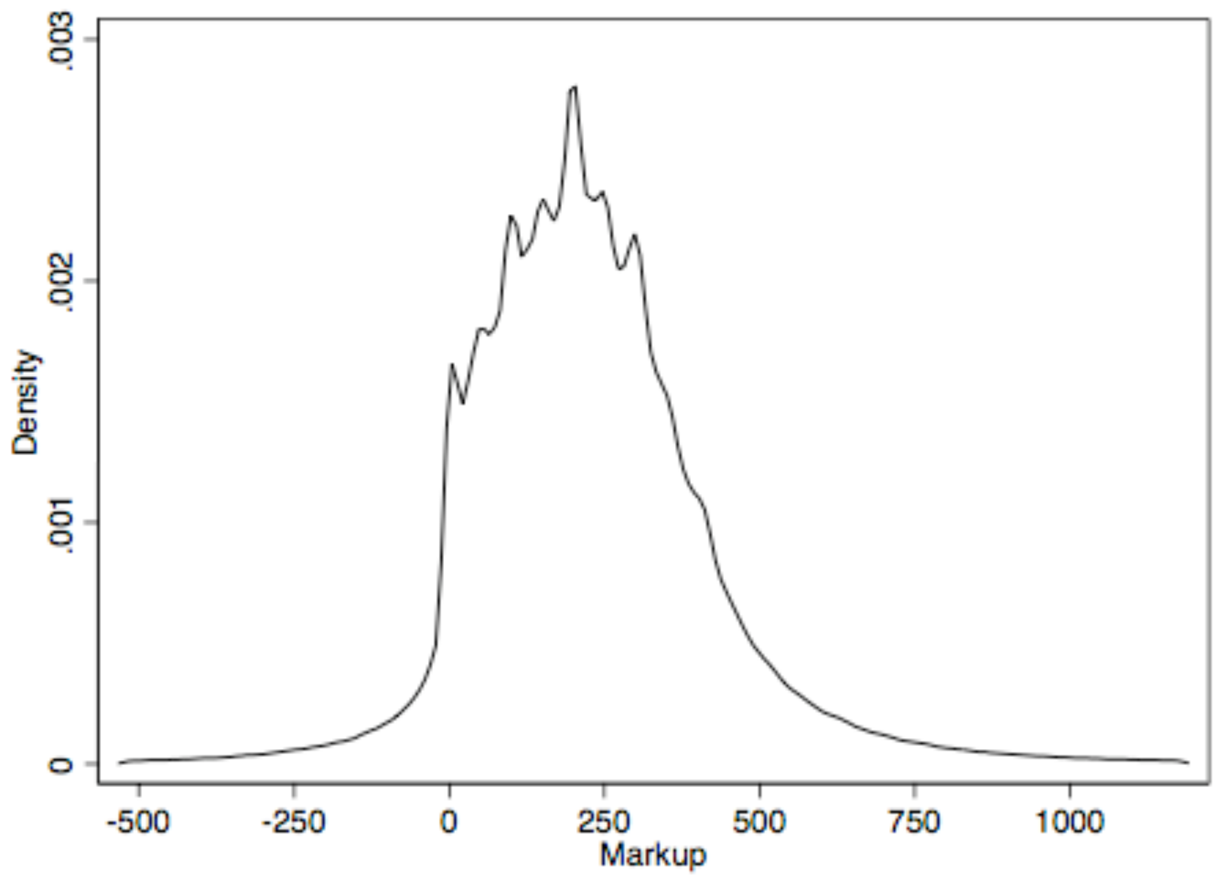
Informational asymmetry?

Very little time in dealer's inventory

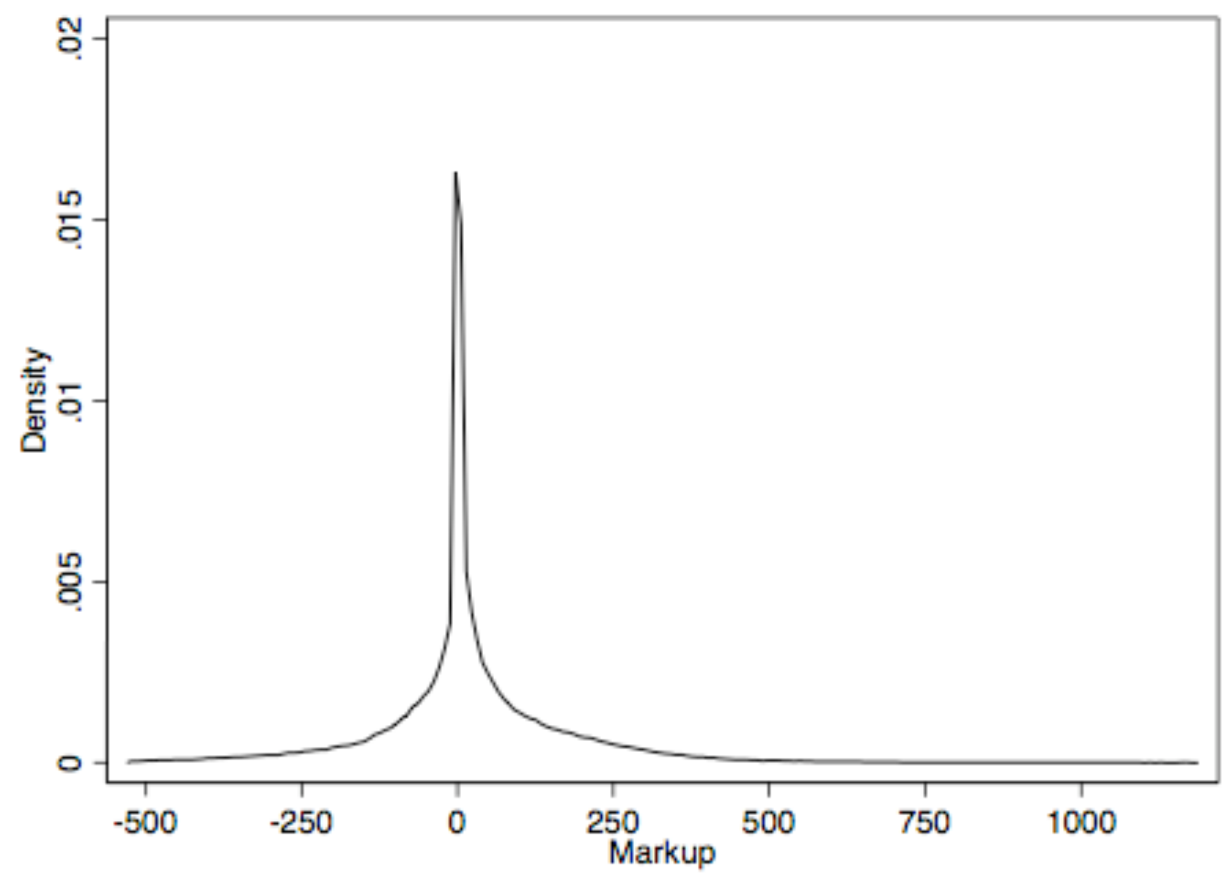
Much higher markup for smaller trades

Striking asymmetry in price reactions to Treasuries

Markups conditional on trade size



(a) $Par \in (0, 100k)$



(c) $Par \in [500k, \infty)$

Information asymmetry

With uniform pricing, buy prices are:

$P^*(Q)=E[v|Q(s,L)=Q]+\text{costs} + \text{markup}$

Markup goes to zero as the number of liquidity suppliers increases

Limit Orders-example

Liquidity demand can be one or two units

1 limit order at p_1, 1 limit order at $p_2 \geq p_1$

When does order at p_1 transact? If either one or two units is demanded...

Payoffs:

$$\text{Prob}(Q=1)\{p1-E[v|Q=1]\}+\{\text{Prob}(Q=2)-E[v|Q=1]\}$$

$$=p_1-E[v|Q\geq 1]$$

Limit Order Book Condition

Based on Glosten (1994)

Marginal buy prices satisfy

$E[v|Q>q]+\text{markup}$

Markup goes to zero as the number of liquidity suppliers increases

Sandas (2001)

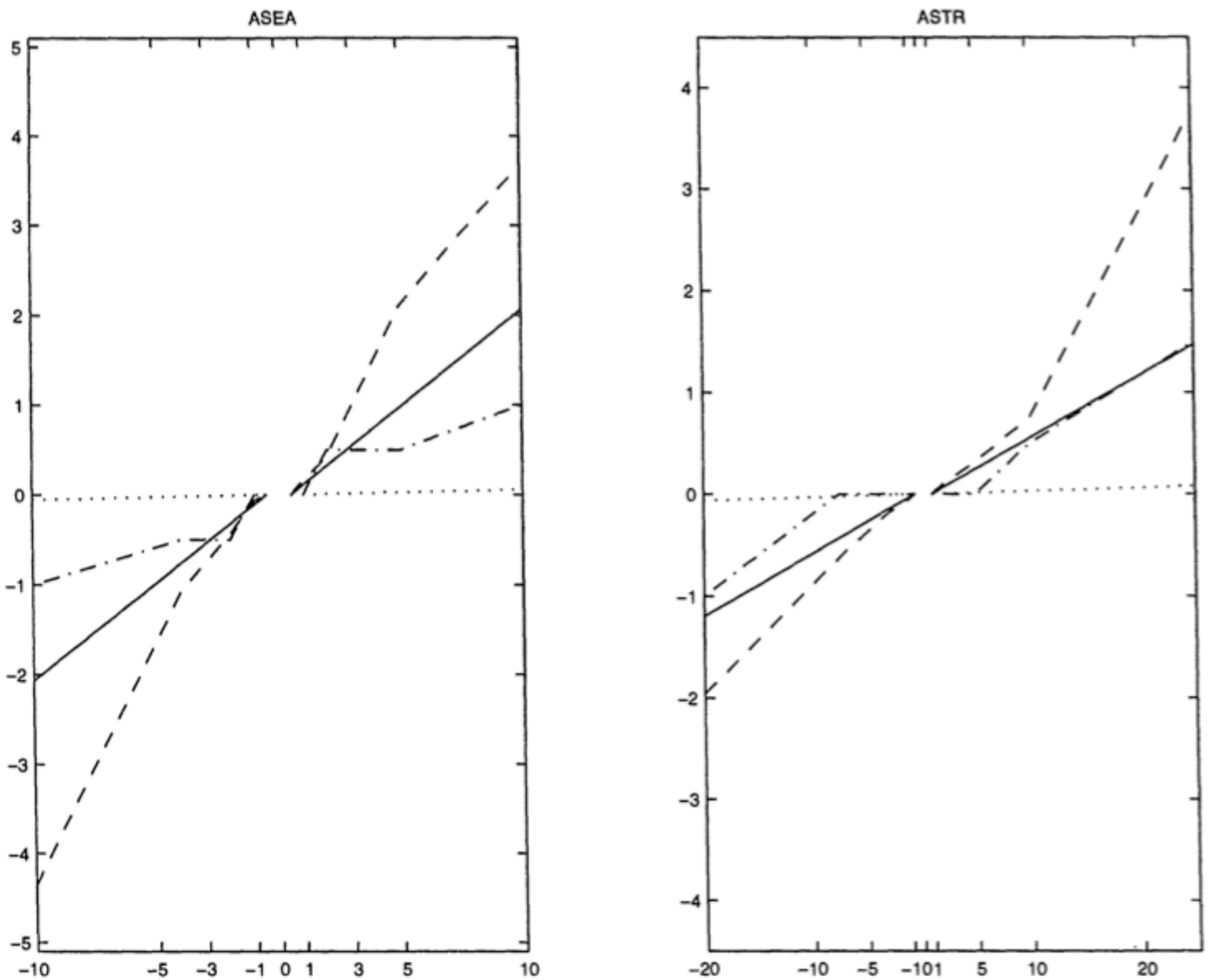


Figure 2
Comparison of Implied (Model) and Observed Price Schedules

But any trader can submit limit or market orders

Optimal strategies: Hollifield, Miller and Sandas (2004)

Goettler, Parlour, and Rajan (2005), (2008), Foucault (1999)

Traders arrive sequentially, with one chance to submit an order and a ‘horizon’

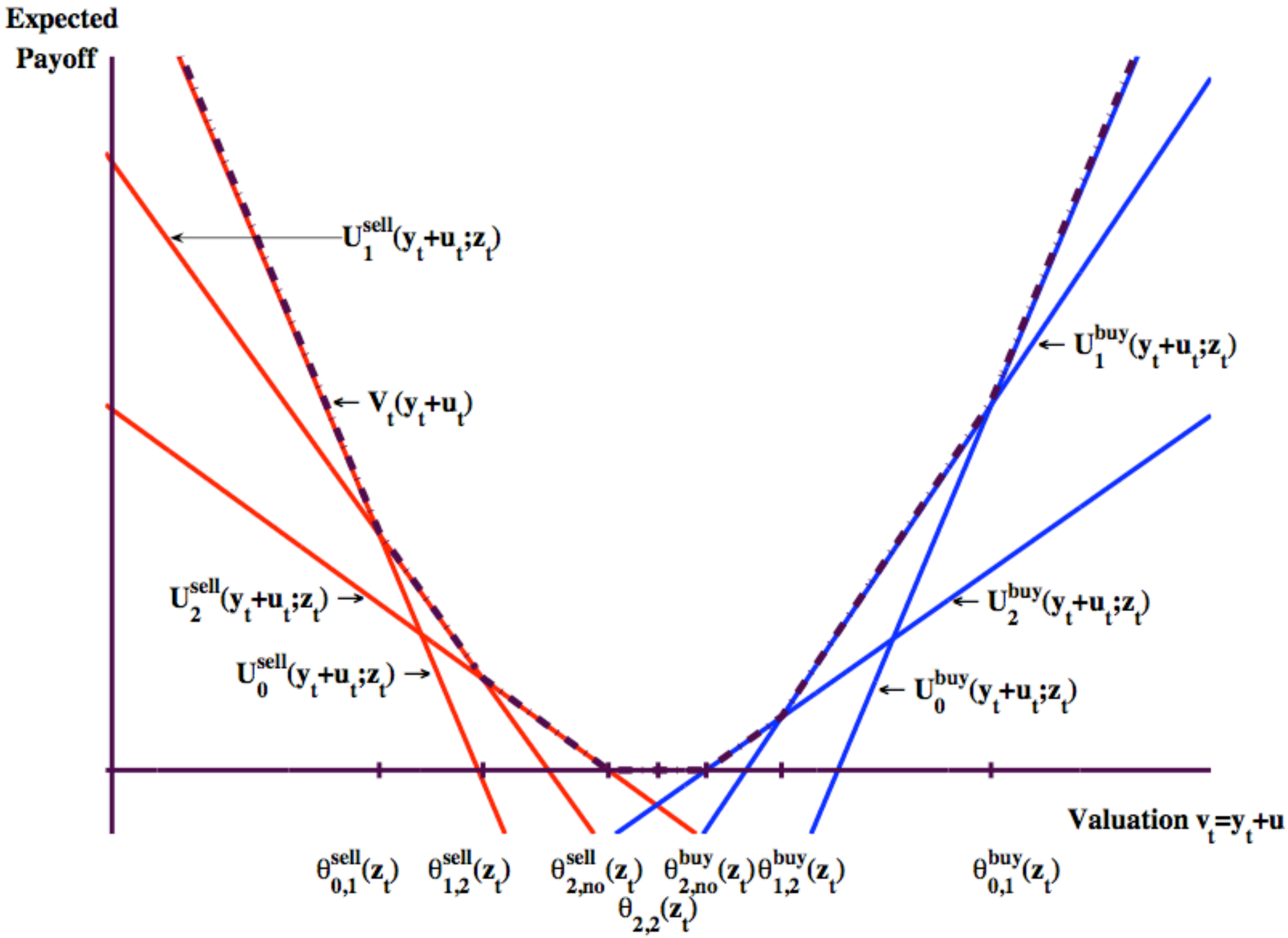
Stochastic valuations per share: y_t+u_t

y_t: common value, u_t: private value (reason to trade)

Payoffs from order submissions

$$U_b^{buy}\left(y_t + u_t; z_t\right) = \psi_b^{buy}\left(z_t\right)\left(y_t + u_t - p_{t,b}^{buy} - c_e\right) + \xi_b^{buy}\left(z_t\right) - c_o$$

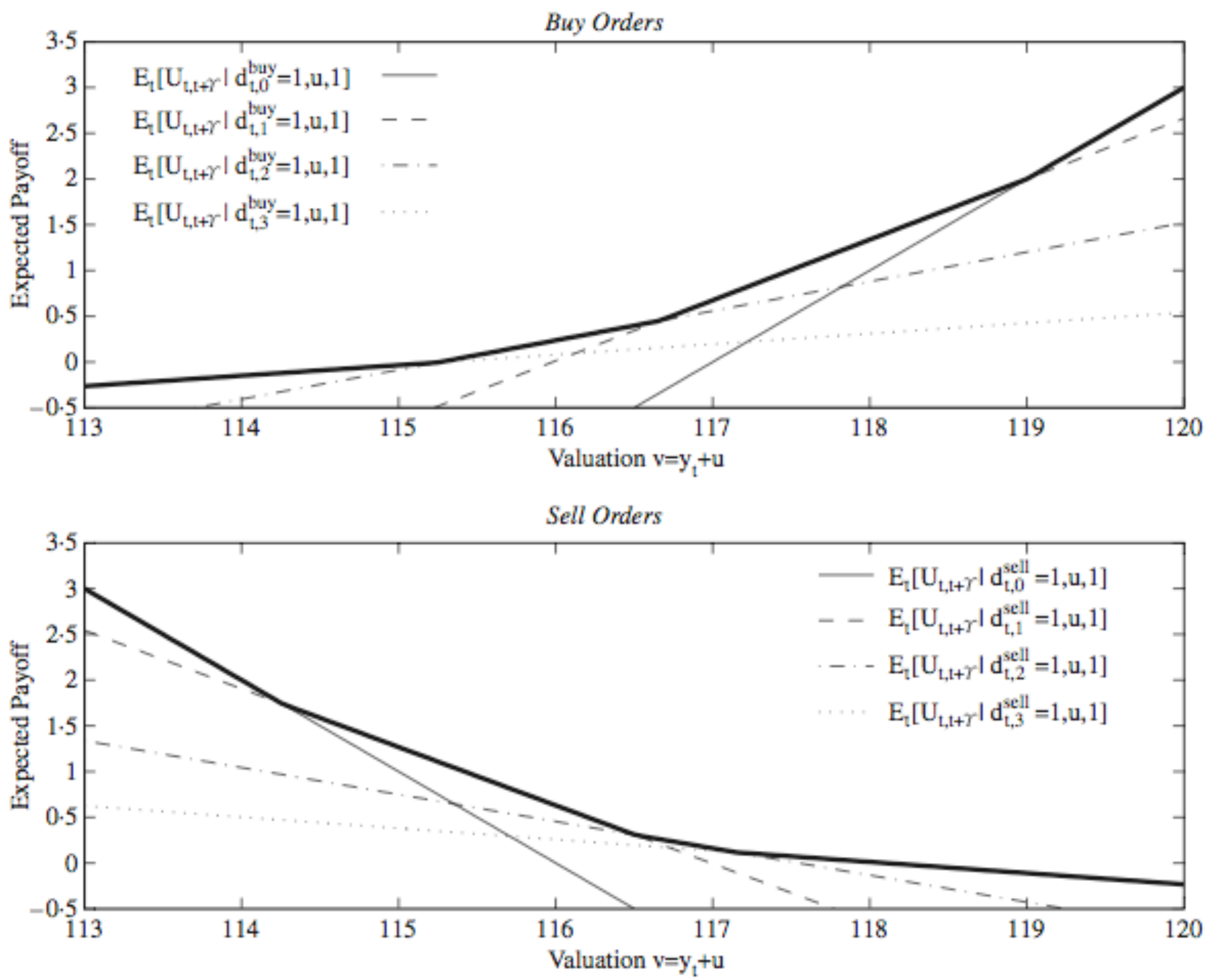
Optimal strategy



A test of optimality

Are the thresholds monotone?

Patient traders are not submitting orders optimally



Issues

No asymmetric information, at a point in time

In the model, strategies are static

Cancelations/resubmissions

What are optimal dynamic strategies?

Theoretical solutions for very specific environments: uninformed traders (Almgren and Chriss (1999), Obizhaeva and Wang (2007))

What is the trader trying to accomplish?

How quickly does the book replenish?

Does the trader have information?

Empirical Issues

Algorithmic trading

Seems to have an impact on transactions costs (Hendershott, Jones and Menkveld (2008)

The seem be an empirical aggressiveness/risk tradeoff (Engle, Furstenberg and Russell (2008))

Learning