MFE 409 Lecture 6 Liquidity Risk

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UCLA Anderson

LECTURE OBJECTIVES

- Market liquidity

- Funding liquidity

- How to measure them?

- Liquidity crises

LIQUIDITY

- Liquidity: ability to make payments when they are due

- Two dimensions to liquidity:
  1. **Market liquidity**, or trading liquidity

  2. **Funding liquidity**

- The two dimensions interact

Outline

Market Liquidity

- **Market liquidity**: Ability to sell an asset on short notice

- Price received for an asset depends on:
    - Mid-market price

MARKET LIQUIDITY

- **Market liquidity**: Ability to sell an asset on short notice

- Price received for an asset depends on:
    - ▶ Mid-market price

    - ▶ How much is to be sold

    - ▶ How quickly it is to be sold

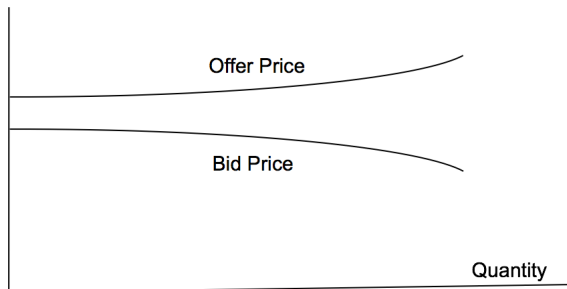   - ▶ The economic environment

Bid-Ask Spread

Ask > Bid

- Ask price (or offer price): price at which one can buy

- Bid price: price at which one can sell

limit orders

market orders

Prices

"Sell" orders

105
102

Ask — Mid-market

Bid — 98
95

"Buy" orders

order book
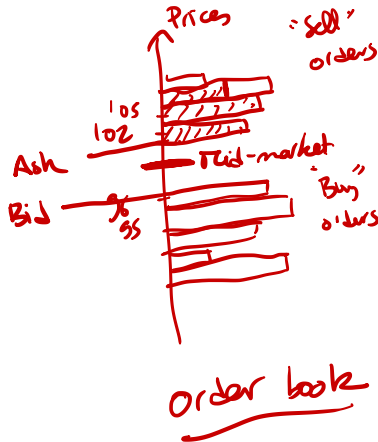
BID-ASK SPREAD

- Ask price (or offer price): price at which one can buy

- Bid price: price at which one can sell

- Role of *size*

COST OF LIQUIDATION

- Proportional bid-ask spread:

$$s = \frac{\text{Ask Price} - \text{Bid Price}}{\text{Mid-market Price}}$$

$$= \frac{Bid + Ash}{2}$$

Cost of Liquidation

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- Cost of liquidating a portfolio with positions α_i right now:

$$\sum_{i=1}^{n} \frac{1}{2} |\alpha_i| s_i$$

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- Stressed conditions: replace s_i by extreme historical value, e.g. 1% largest

- *Liquidity-adjusted VaR*: If portfolio is likely liquidated in extreme bad performance, add liquidation cost to VaR calculation

Role of Time

- Role of *time*
  - ► Example: selling a house tomorrow vs over the next month

- Trade-off for executing a trade:

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- Trade-off for executing a trade:
  - ► Selling slowly avoids large trading costs

  - ► Selling slowly increases the risk of adverse price movement

OPTIMAL EXECUTION

- You want to sell S shares over the next n days
- The bid-ask difference is $p(q)$ where q is the quantity sold on that day
- The daily standard deviation of ~~returns~~ *change in price* is σ
- Formalize the problem of optimal execution

$$\min_{\{q_t\}_{t=1}^{n}} \sum_{t=1}^{\hat{n}} p(q_t)|q_t| + \lambda \sqrt{\sum_{t=1}^{\hat{n}} x_t^2 \sigma^2}$$
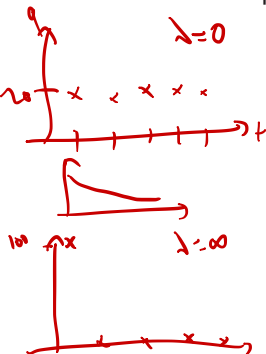
x_t: how much I hold at the beginning of date t

such that $\sum_{t=1}^{n} q_t = S$

$$x_1 = S$$

$$x_{t+1} = x_t - q_t$$

- Solve it for $p(q) = 0.1 + 0.05 \exp(0.03 \times q)$, $S = 100$, $n = 5$, $\sigma = 0.1$

Optimal Execution

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- The bid-ask difference is $p(q)$ where q is the quantity sold on that day
- The daily standard deviation of returns is σ
- Formalize the problem of optimal execution

$$\min_{\{q_t\}} \lambda \sqrt{\sum_{t=1}^{n} \sigma^2 x_t^2} + \sum_{t=1}^{n} \frac{1}{2} |q_t| p(q_t)$$

$$\text{such that} \sum_{t=1}^{n} q_t = S$$

$$x_1 = S$$

$$x_t = x_{t-1} - q_{t-1}$$

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Fire Sales

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- **Fire sale**: In periods of deep market distress, many investors might want to sell, and few are ready to buy, so the whole price is lower

- Fire sales are difficult to tell apart from justified low prices
  - ▶ Chodorow-Reich, Ghent, Haddad (2016): *Asset insulators*: Valuation of institutions that sit out the fire sale should not respond to the drop in prices

Outline

1. Market Liquidity

2. Funding Liquidity

3. Liquidity Crises

Funding Liquidity

- **Funding liquidity**: Ability to maintain sources of funding for running the firm's activities

- Sources of funding liquidity:

Funding Liquidity

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- Sources of funding liquidity:
    - Cash and Treasury holdings

    - Ability to borrow

    - Retail and wholesale deposits

    - Central bank borrowing

Quantifying Liquidity Risk

- Difficult to quantify liquidity risk

- Some measures from Basel III:
  - ▶ *Liquidity coverage ratio*: designed to make sure that the bank can survive a 30-day period of acute stress

  - ▶ *Net stable funding ratio*: a longer term measure designed to ensure that stability of funding sources is consistent with the permanence of the assets that have to be funded

OUTLINE

1 MARKET LIQUIDITY

2 FUNDING LIQUIDITY

3 LIQUIDITY CRISES
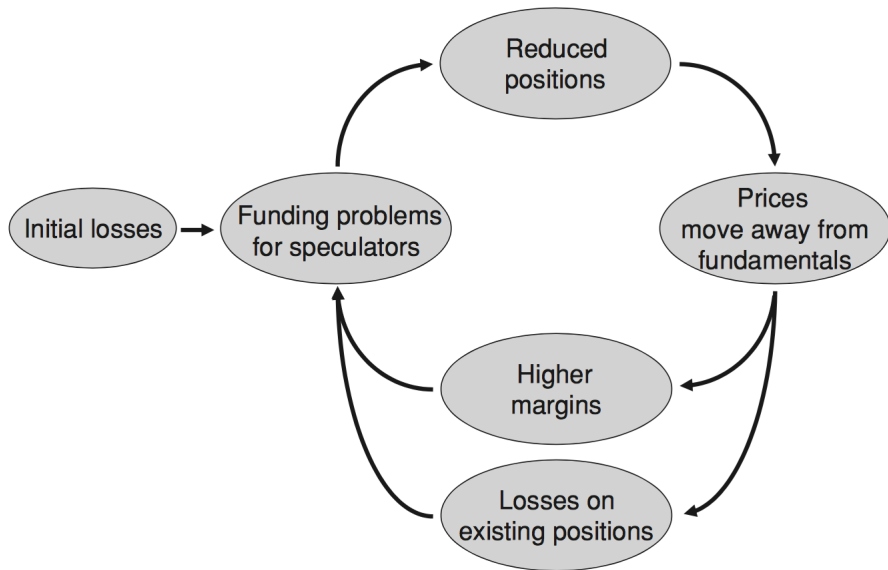
Liquidity Crises

- In a simple view of markets, trading stabilizes prices
  - ▶ If somebody gets in trouble and has to liquidate some assets ...

  - ▶ Somebody else sees this as a buying opportunity

  - ▶ *Negative feedback trading*: price drop creates buying, which pushes price up

Liquidity Crises

- In a simple view of markets, trading stabilizes prices
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  - ▶ Somebody else sees this as a buying opportunity

  - ▶ *Negative feedback trading*: price drop creates buying, which pushes price up
- But market frictions can lead to unstable prices: positive feedback trading
  - ▶ Remember LTCM

Liquidity Spirals

Preparing for Liquidity Crises

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- Some useful steps:
  - ▶ Plan for the lifetime of the strategy

  - ▶ Analyze correlation of strategy performance and funding conditions

  - ▶ Understand behavior of other participants in the markets: if everybody does the same thing, everybody will fall at the same time

Preparing for Liquidity Crises

- Fatalist view: when everything goes bad, there is nothing to do

- Some useful steps:
  - Plan for the lifetime of the strategy
  - Analyze correlation of strategy performance and funding conditions
  - Understand behavior of other participants in the markets: if everybody does the same thing, everybody will fall at the same time

- Even risk management regulations could generate liquidity crises!

Takeaways

- Liquidity problems can prevent ability to run a strategy or a business

- Stem from limited ability to:
  - ▶ Sell assets: market liquidity

  - ▶ Borrow to finance trade: funding liquidity

  - ▶ Both

- Liquidity risk is difficult to quantify …

- But being aware of sources of liquidity and market environment can help