1 Introduction

Many financial markets around the world, including the Paris, Stockholm, Shanghai, Tokyo, and Toronto stock exchanges, are organized as limit order books. In a market system, a limit order to buy means one has to specify how much of something you want and the most you are willing to pay for it. A sell order exactly determines one’s individual supply function. Any combination of limit orders at the same place and time gives a limit order only interrupted market, where orders are matched up for execution. The process will always give the highest bid (if there are no sell orders) a lowest offer (if there are no buy orders), a quote (bid and offer but no transaction), or a transaction at a unique price. After the transaction of the appropriate size has been executed, there then remains, if the orders are not withdrawn, a bid and an offer. The actual operation of the limit order market is mechanical: the market sorts buyers and sellers by willingness to buy or sell, applies an ambiguity rule to the nearest unit, and notify those customers if a transaction was or was not made. When orders are of the same size, one applies a ‘first come first served’ priority rule on buyers, then sellers.

A limit order only market assures that all market participants have the same information.

Definition 1 (Limit Order) A limit order is an instruction to trade a specific quantity of an asset at a specified price, or a better price. The order is an ex-ante precommitment \((t, j, x, p)\) made on a date \(t\) to trade up to a given amount \(x\) of an asset \(j\) at a prespecified limit price \(p\). The order is in force until filled or cancelled, so unfilled orders accumulate in an limit order book \([2]\).

Definition 2 (Limit Order Book) The limit order book is characterised by a discrete set of prices at which traders may submit orders. The tick size, or distance, between any consecutive prices, is normalised to one. A backlog is associated with each price at any time. The backlog is the depth of the market at that price. The Limit order book is the vector of outstanding orders at any point. Given a limit order book, the bid price or quote is determined by the highest price at which a limit buy order exists, and the ask price or quote is the lowest price at which there is a limit sell order on the book. The book can, of course, be empty—then no market exists at all.
Limit orders are executed according to time and price priority, meaning orders submitted earlier are placed further ahead in the queue. Buy orders at higher prices and sell orders at lower prices get priority. An order will execute if no other orders have priority, and a trader arrives who wants to buy at some price. All trades execute instantly at the ask, and that order becomes the *market order* at this point.

Limit orders differ from standard market orders, which are requests to trade immediately at the best available price in the market. In a limit order setting the order execution is always filled at the limit price set by the buyer or seller. In limit orders, price priority holds, which means the limit orders offering better terms of trade (buyers buying higher, sellers selling lower) execute ahead of limit orders at worse prices. Time priority can also hold, where at each price \( p \), older limit orders are executed ahead of newer ones in a queuing system which thus rewards first movers who give up liquid positions to allow the LOOM to work more effectively. The price and time priorities may be taken together to define a probability distribution over execution timing. The notion of equilibrium in limit order markets is different to other continuously clearing markets, because buyers arrive and trade asynchronously in a limit order market, so there is no unique market-wide ‘market-clearing’ price, except in degenerate cases. Rather, there is a sequence of bilateral transaction prices at which endogenously matched pairs of investors choose to trade over time.

**Example 1 (Limit Orders in motion.)** A limit order to buy 100 shares can be filled at \( \$47.50 \) or below. A limit order to sell at \( \$50.25 \) can be filled at \( \$50.25 \) and above. The existence of the limit order is independent of having anyone to actually trade to fulfil the order. As time passes, one might not be able to fill the order. There several advantages to limit order markets. The first is the ability to obtain a better price. The second is the discrete nature of each trade: a limit order to buy simply means you specify how much of something you want, and how much you are willing to pay for it, and vice versa for the supplier. Both demand and supply are discrete functions of price. Any combination of these orders in a specific time and place gives rise to a limit order only interrupted market where the orders are matched up for execution ([3, Chapter 2] is the classic exposition of LOOM). [1] contains more up to date references.

The execution of a simple market algorithm will always generate either a highest bid (if there are no sell orders), a lowest offer (no buy orders), a quote, (bid and offer but no transaction) or a transaction at a unique price. The only requirement is the orders have finite price limits on them. The market algorithm puts the orders to buy and sell in ranks, applies an ambiguity rule to ensure there is a unique price.

**References**


Introduction.

Finance is the applied wing of economics. This course is about introducing students to the economics of finance via the study of several canonical models. 1.1

Overview of the course. We will begin with data. First, we'll describe the categories within which financially important variables exist, and develop ways to encapsulate them using simple statistics drawn from the study of simple probability distributions. We will develop graphical tools to analyse market movements in the lectures. Financial economics is the branch of economics characterized by a "concentration on monetary activities", in which "money of one type or another is likely to appear on both sides of a trade". Its concern is thus the interrelation of financial variables, such as prices, interest rates and shares, as opposed to those concerning the real economy. It has two main areas of focus: asset pricing and corporate finance; the first being the perspective of providers of capital, i.e. investors, and the second of FINANCIAL ECONOMICS is a highly empirical discipline, perhaps the most empirical among the branches of economics and even among the social sciences in general. This should come as no surprise, for financial markets are not mere figments of theoretical abstraction; they thrive in practice and play a crucial role in the stability and growth of the global economy. Therefore, although some aspects of the academic finance literature may seem abstract at first, there is a practical relevance demanded of financial models that is often waived for the models of other comparable disciplines.