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High Frequency Asymptotics for the Limit Order Book

We study the one-sided limit order book for sell (or buy) orders and model it as a measure-valued process. Limit sell (or buy) orders are offers to sell (or buy) an equity at a price determined by the seller (or buyer). Market buy (or sell) orders are orders to buy (or sell) an equity at the best, that is, least expensive (most expensive, in case of sell market orders) price offered by previous limit sell (or buy) orders. Limit and market orders arrive to the book according to two independent Poisson processes, and limit orders are placed on the book according to a distribution which varies depending on the current best price. We consider the order book in a high frequency regime in which the rates of incoming limit and market orders are large, and traders place their limit sell orders close to the current best price. We provide weak limits for the price process, the scaled volume, and the scaled measure-valued order book process in the high frequency regime. We then provide an analysis of the long-run behavior of the limiting price process.