High Frequency Market Making

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1. A Model of HFMM

- Premise: Compared to traditional market makers
  - HFMMs are better informed than their counterparties: able to extract signals about the direction of the order flow
  - And are faster
- What can we expect when HFMMs become the primary providers of liquidity?

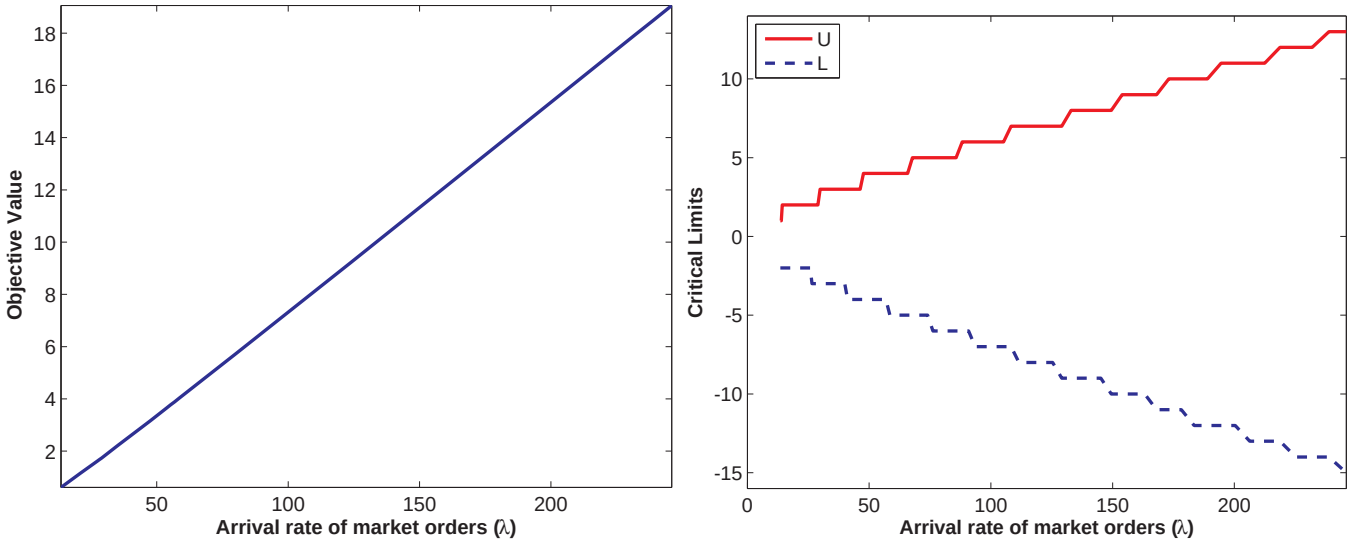
- Inventory discipline is the primary means of risk control by the HFMM who is risk-neutral, but penalized for holding inventory
- LFTs are randomly arriving noise traders submitting market orders.
- The HFMM posts quotes and aims to capture the spread as often as possible.
- The HFMM receives a signal that is informative, but not perfect, about the sign of the incoming market order from LFTs.
- Optimal Policy: HFMM always quote unless inventory thresholds are exceeded.
- When deciding whether to quote or not, the HFMM is constantly weighing the potential of capturing the spread vs. the cost of increasing his inventory.

2. Predictions of the Model

- Objective value and optimal inventory limits as a function of model parameters
  - the arrival rate of the LFTs, λ
  - the arrival rate of the HFMM's signal, μ
  - the accuracy of the signal, p
  - the bid-offer spread, c
  - the coefficient of inventory aversion, γ

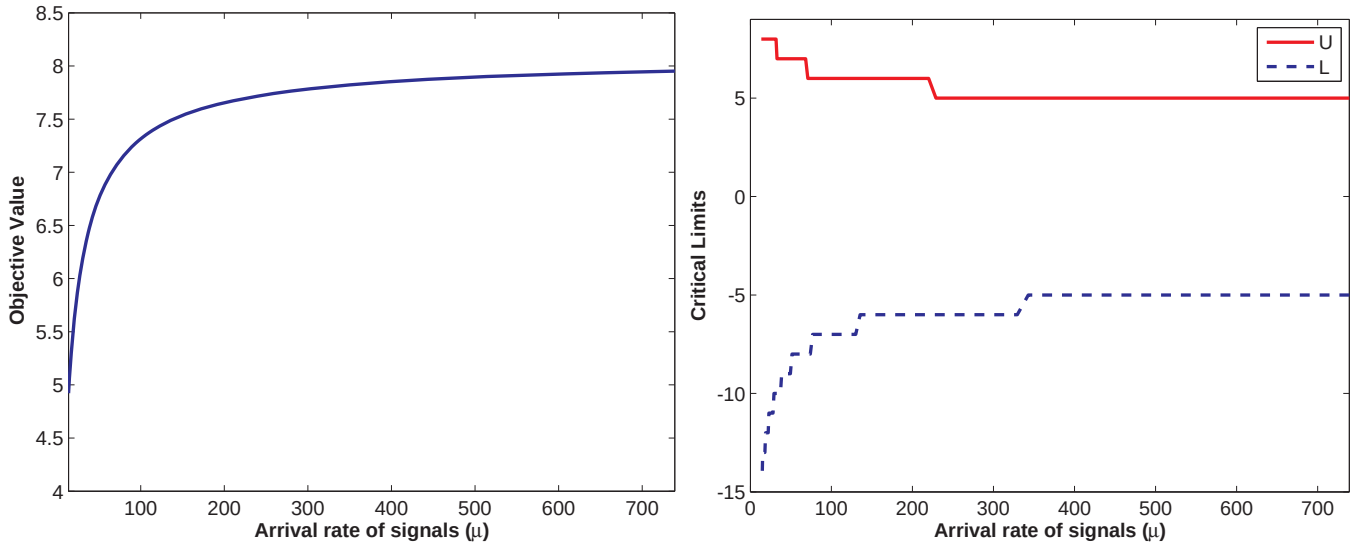
2.1. LFTs' Market Orders Arrival Rate

Optimal value and inventory trading limits



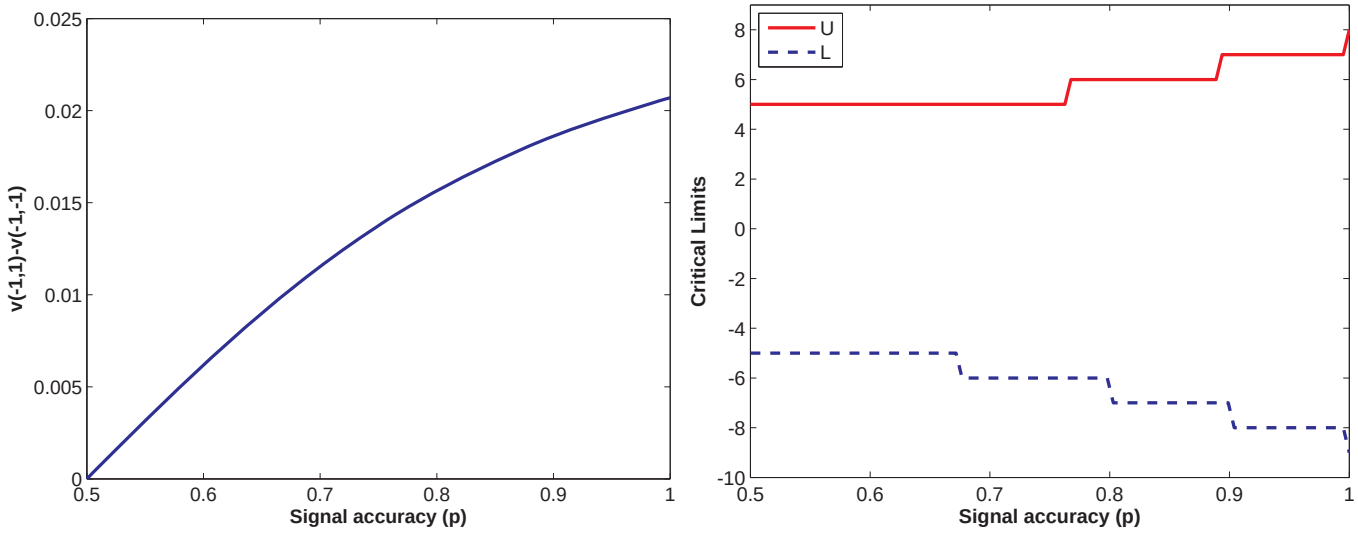
2.2. HFMM's Signal Arrival Rate (or Latency)

Optimal value and inventory trading limits



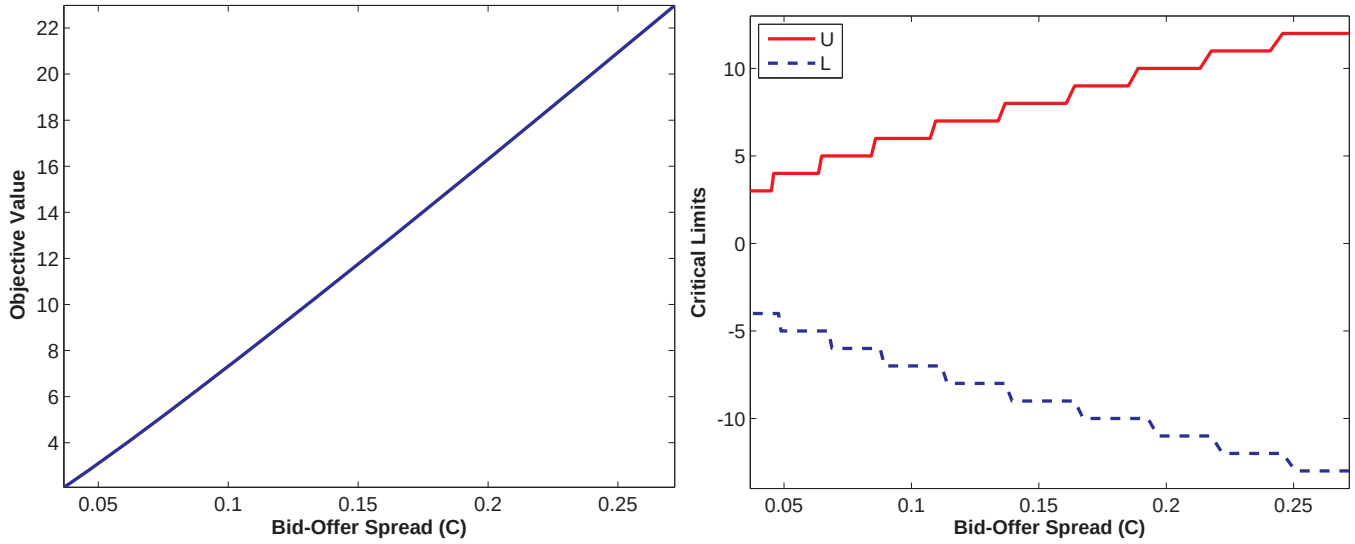
2.3. Signal Accuracy

Optimal value and inventory trading limits



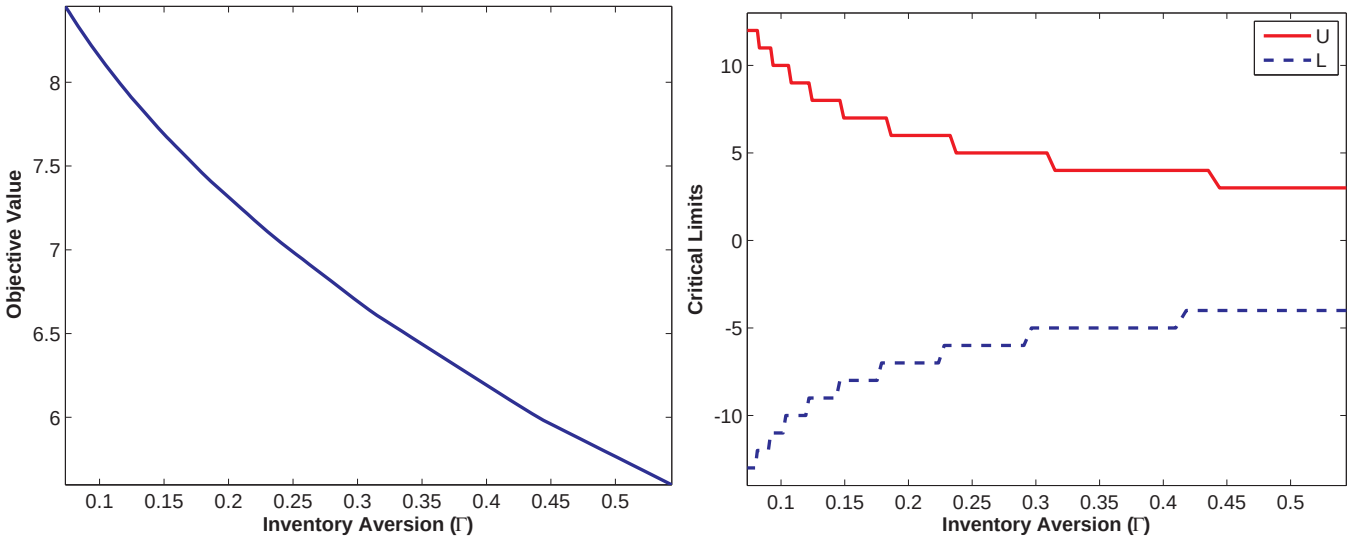
2.4. Bis-Ask Spread

Optimal value and inventory trading limits



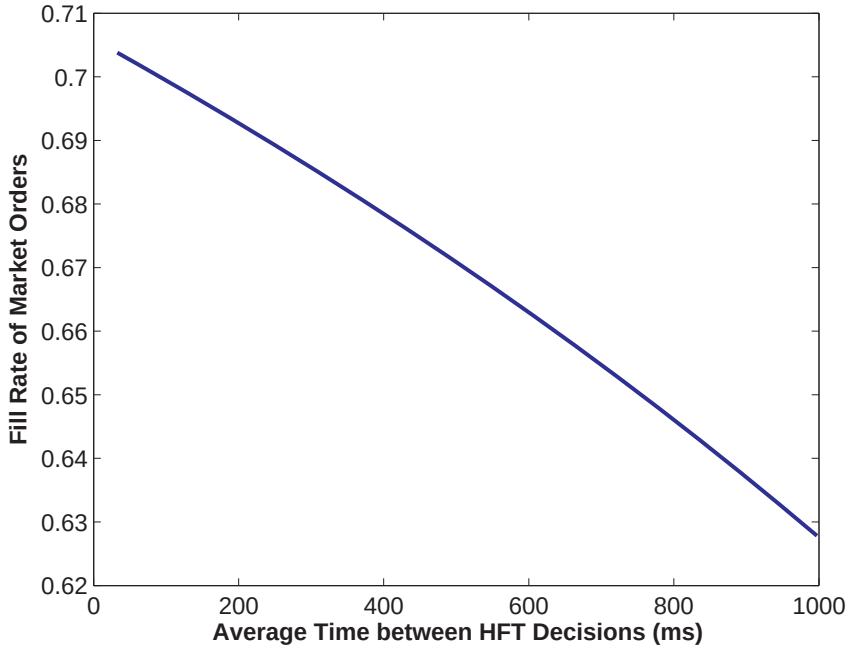
2.5. Inventory Aversion

Optimal value and inventory trading limits



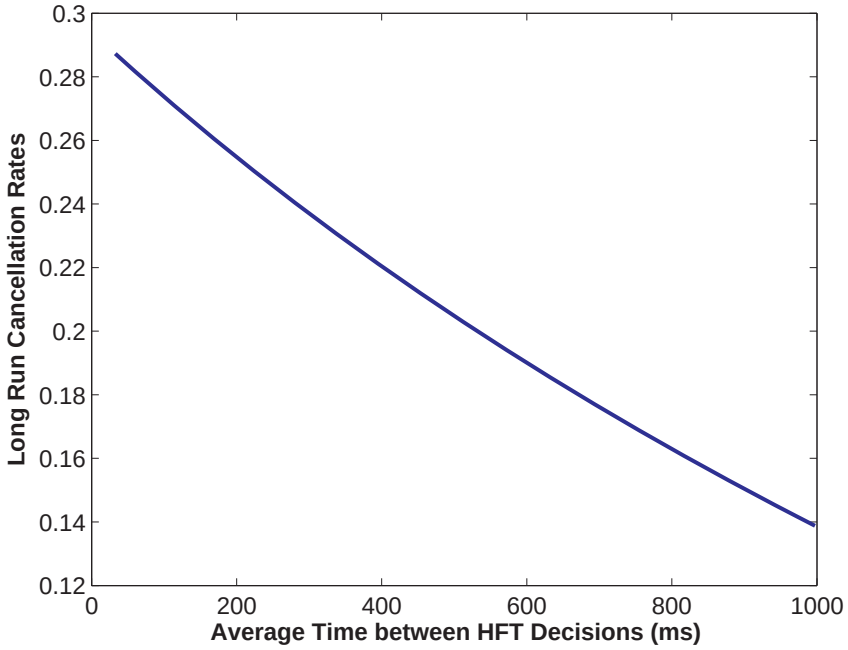
2.6. Provision of Liquidity by the HFMM

Long-run Probability of LFTs' Orders Being Filled by the HFMM



2.7. Endogenous Cancellations by the HFMM

Long-run probability of an existing quote being canceled by the HFMM



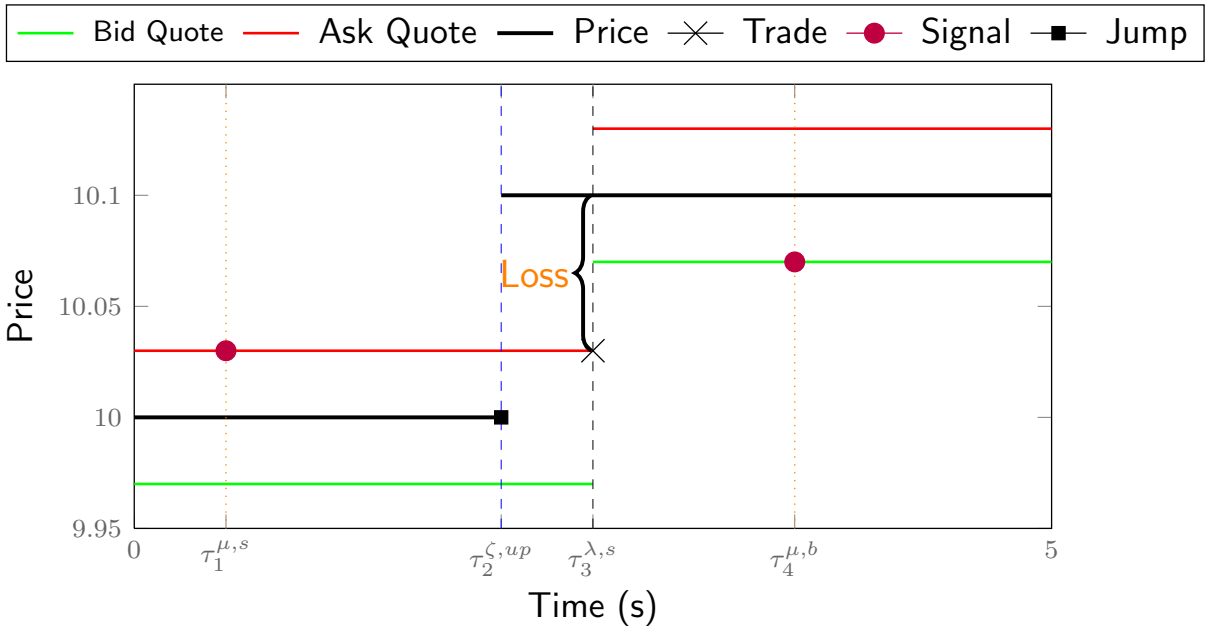
3. Price Volatility

- Add price variability in the form of jumps in the asset's fundamental value.

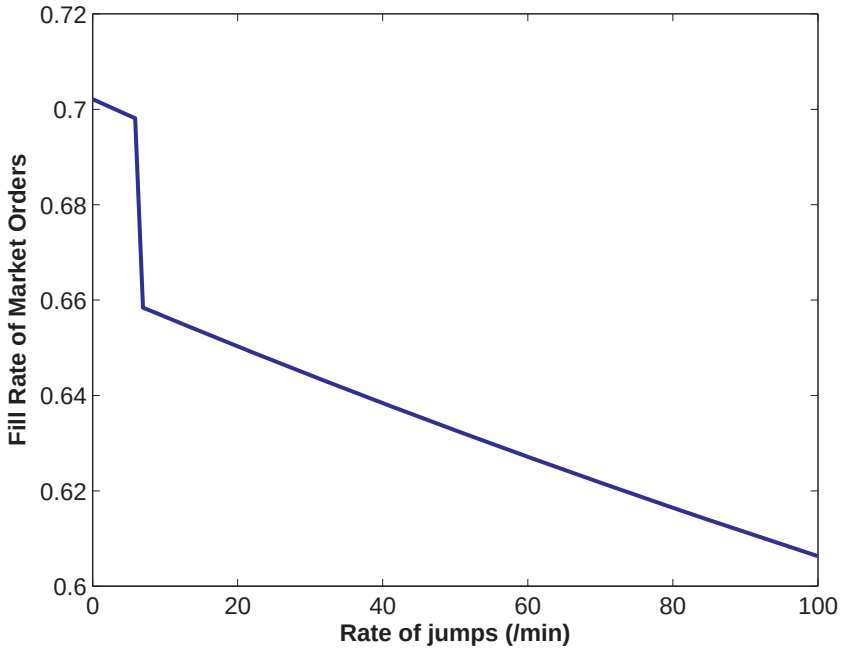
- The HFMM has no informational advantage regarding these price movements; his only signal is about the likely direction of the order flow.

- Volatility introduces adverse selection: the HFMM may get stuck with stale quotes that can be sniped by another HFT

Example: A Simulated Path with Volatility



Long-run probability of quoting as a function of the price jump arrival rates



- When the price is more volatile, the likelihood that the HFMM will provide liquidity decreases.

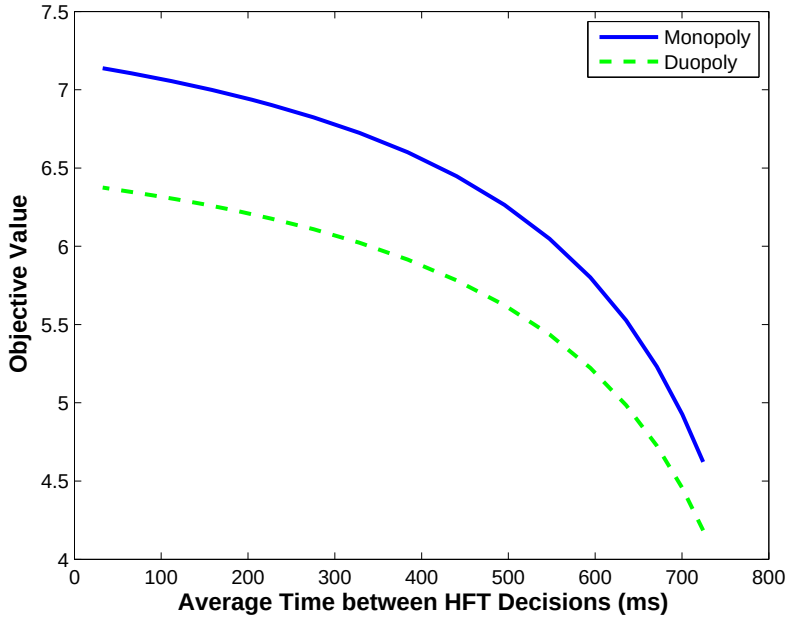
- This is because this volatility introduces a new source of risk for the HFMM (excess inventory) that is not compensated for and for which he holds no advantage (no signal).

- So while the HFMM provides plenty liquidity in normal times, it is optimal for the HFMM to withdraw when the market needs that liquidity the most...

4. Competition Among HFMMs

- Duopoly: Splitting the Rent

Optimal value achieved by the HFMM: Monopoly vs. Duopoly



- The rent extracted from LFTs gets split between the two market makers.

- The faster the HFMM, the more of the rent he is able to capture: there are benefits to becoming faster among HFMMs.

- LFTs are better off when market makers compete compared to the monopolistic HFMM situation.

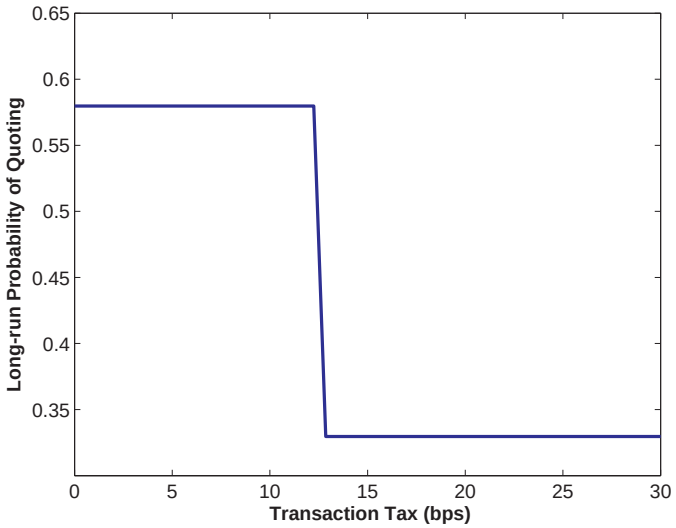
5. Comparing Different HFT Regulations

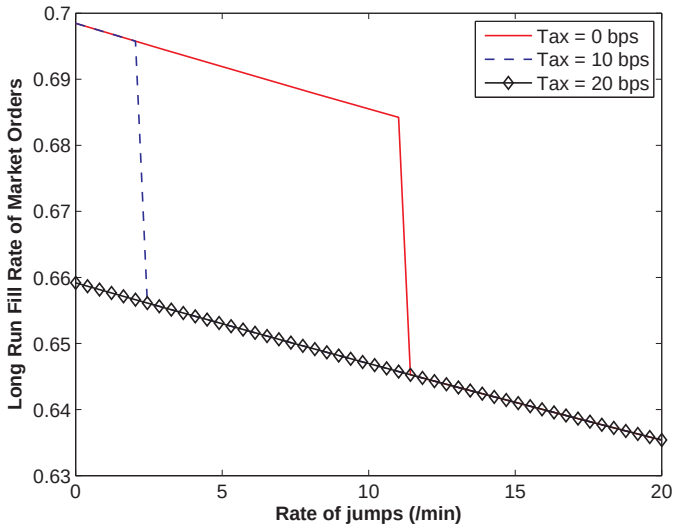
- Three policies in the context of the model: imposing a transaction tax on each trade, setting minimum rest times on limit orders and taxing cancellations of limit orders.

- Objective: induce the HFMM to provide liquidity that is more resilient to increases in volatility = procyclical with respect to volatility
  - We find that none of the three policies result in an improvement compared to doing nothing.
  - Transaction taxes result in less liquidity both in low and high volatility environments.
  - Both minimum rest times and a cancellation tax result in more liquidity in good (low volatility) environments but less in bad (high volatility) environments = countercyclical.

5.1. Tobin Tax: Taxing Transactions

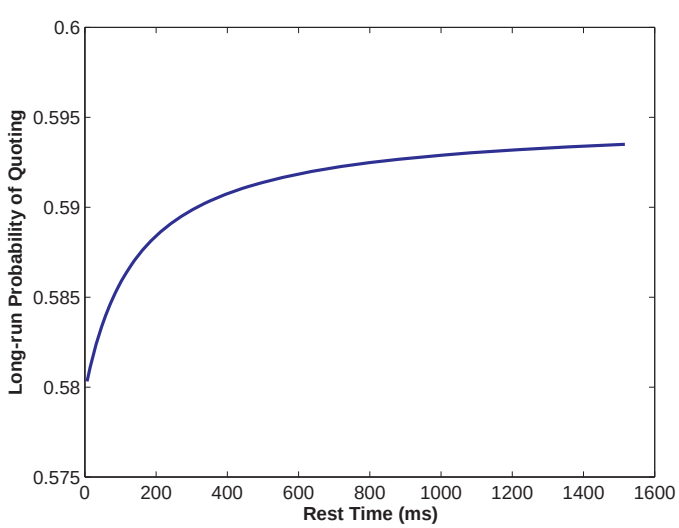
- Equivalent to a reduction in the spread. Transaction taxes reduce the incentive to quote.

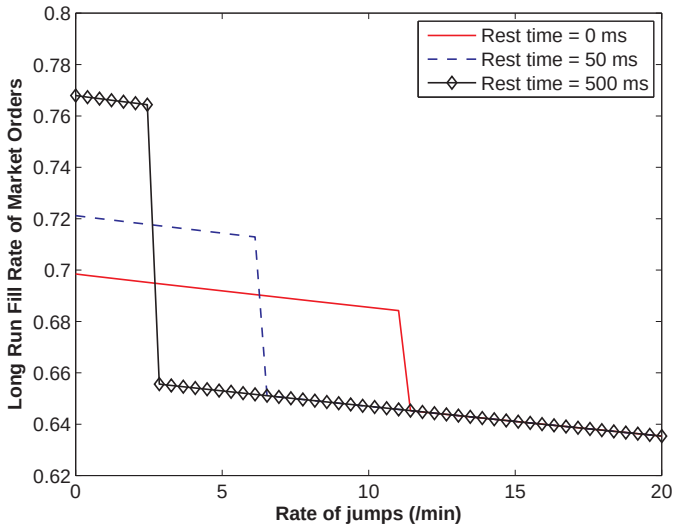




5.2. Minimum Rest Time

- Mandatory rest times increase the provision of liquidity when volatility is low, but decrease it when volatility is high

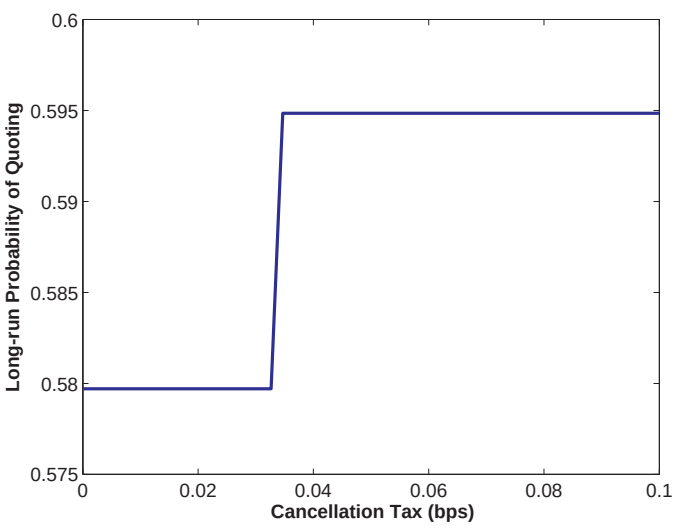


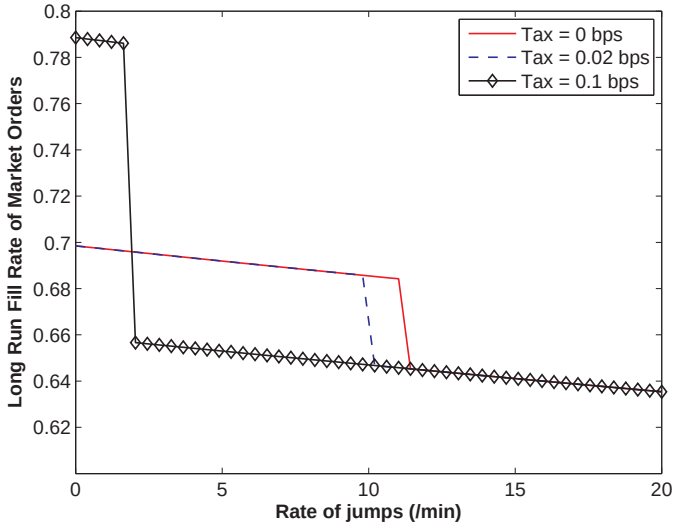


5.3. Taxing Order Cancellations

- Tax the HFMM whenever an existing quote is cancelled.

- Cancellation taxes encourage the HFT to quote more when volatility is low but less when it is high.





6. Conclusions

- The latency advantage of a HFT can be quantified in a fully optimizing model.
- Predictions of the model:
  - The HFMM trades often, carries little inventory, captures the spread from LFTs.
  - Lower latency is beneficial to the HFMM.
  - Order cancellations occur endogenously in the model.
  - In good times, the HFMM improves liquidity. But when price volatility increases, the HFMM decreases his liquidity provision.
  - Competition among HFMMs lead to splitting the rent and benefits LFTs.

- Regulations?
  - Taxing transactions is ineffective: it uniformly reduces the provision of liquidity
  - Mandatory rest times and cancellation taxes increase the provision of liquidity when volatility is low
  - But decrease it when volatility is high
  - So both fail to encourage countercyclical liquidity provision.

- Details?

  http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2331613