

# Analysing the effects of latency arbitrage on fragmented markets using discrete event simulation

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## Quick Points

- Simulating multiple markets and the latency between them
- Initially starting with two markets
- Latency arbitrageur has fast access to both markets
- Background investors have fast access to their primary market but delayed information about the other one

### Investigations of market efficiency:

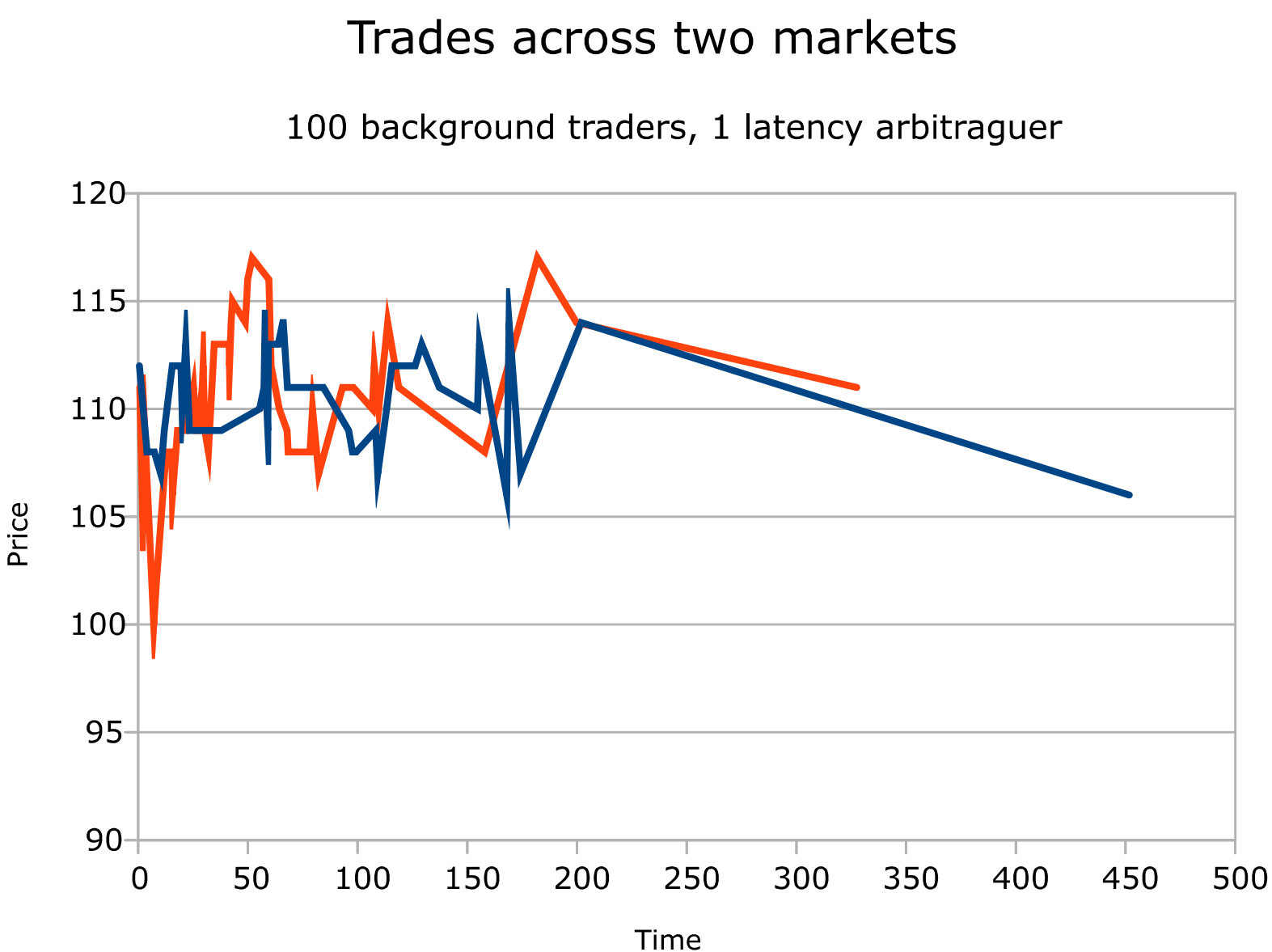
- Does presence of arbitrageur affect efficiency?
- What is the effect of more than two markets?
- What is the effect of new market rules?

## Introduction

This project aims to initially replicate and then extend the work of Wah and Wellman<sup>[1]</sup> that looks at the effect of latency arbitrage on a two market model, measured using total surplus. To do this I am building a new simulator using discrete event simulation.

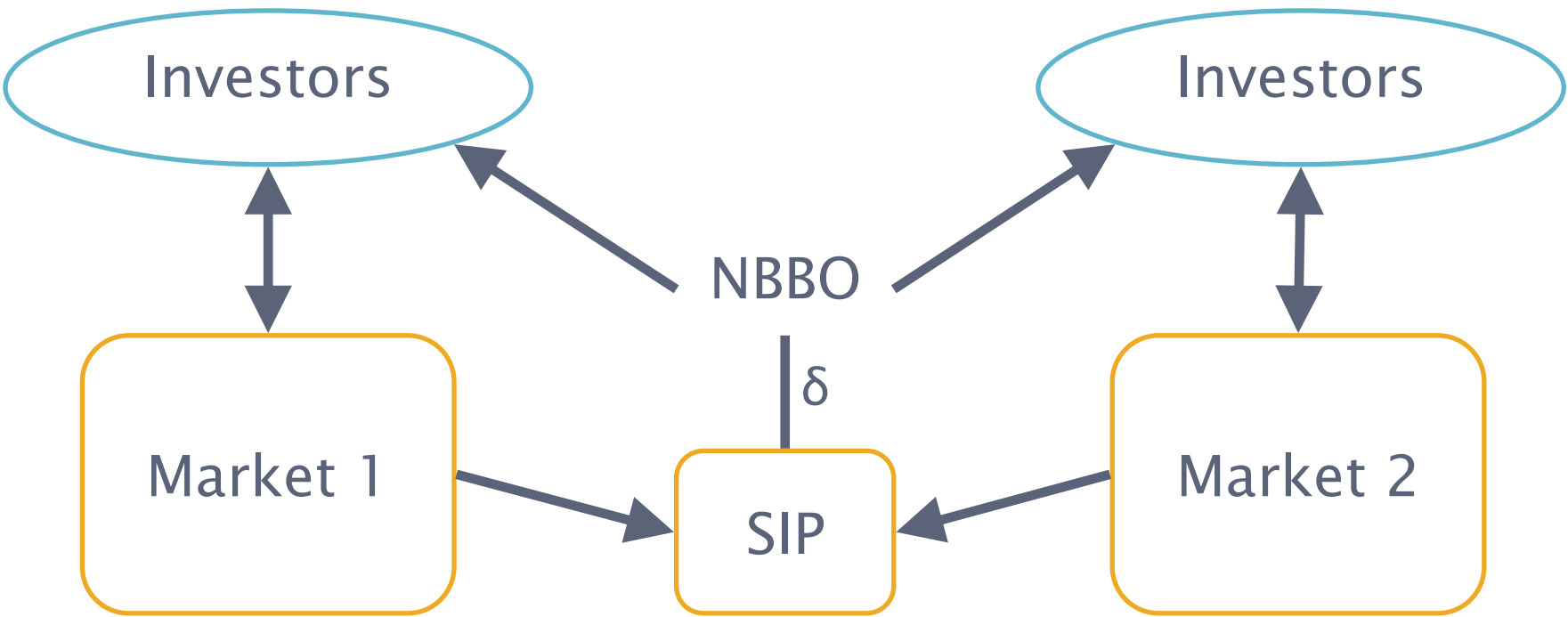
## The Simulator

I am building a simulator in Java using a discrete event simulation framework called DESMO-J<sup>[2]</sup>. Discrete event simulation is a way of representing the state changes of a system as an ordered sequence of events, each of which takes place at a specific point in time. In my simulator, orders being sent and received between traders and exchanges are represented as events.



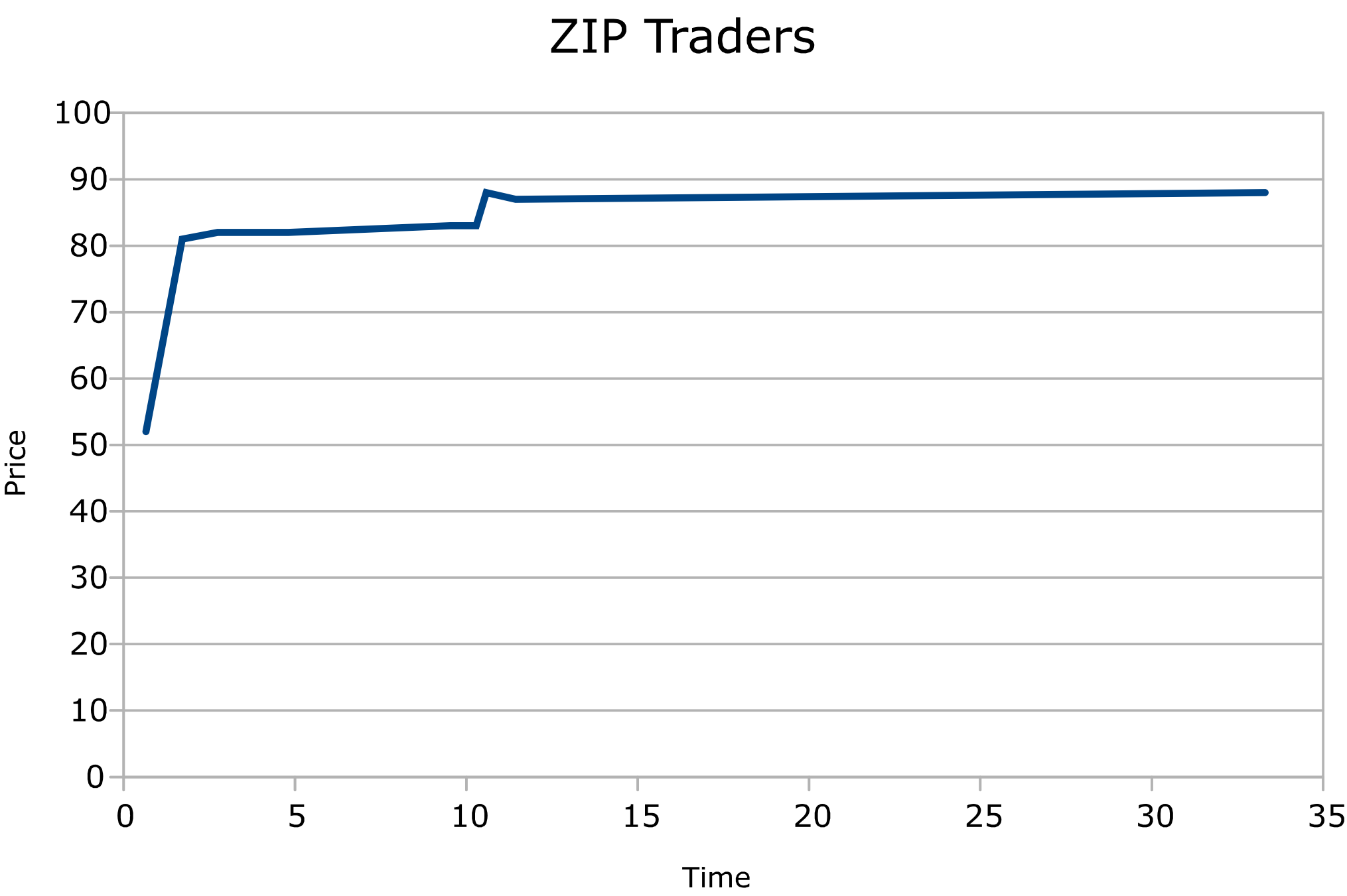
A time series showing trades taking place on two exchanges on the simulator. As time progresses the frequency of trades decreases as orders are fulfilled.

The two market model used in the Wellman paper



## Securities Information Processor (SIP)

The SIP is an entity that collates best bid and offer prices from different markets and calculates the National Best Bid Offer (NBBO). This gives investors the best price available across multiple exchanges. It takes a short time ( $\delta$ ) to calculate though and if the arbitrageur can calculate it earlier they have more information than the investors about the best prices.



A homogeneous group of 25 Zero Intelligence Plus (ZIP) traders being simulated on a single exchange. They converge towards the equilibrium price of 100.

## Latency Arbitrage

Arbitrage in general is the practice of taking advantage of disparities in prices of goods between different markets in order to secure a profit. Latency arbitrage exploits arbitrage opportunities that exist over short timescales due to delays in dissemination of information. For example, at a point in time it may be possible to buy at 90 in one market and sell at 100 in another, guaranteeing a profit of 10. Only agents with a speed advantage are able to capitalise on these opportunities.

[1] Wah, Elaine and Michael P. Wellman. “Latency arbitrage, market fragmentation, and efficiency: a two-market model.” EC (2013).

[2] <http://desmoj.sourceforge.net/home.html>