Exchange-Rate Dynamics
Chapter 5

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Sequential Trade Models

Outline:

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2. Exchange Rate Determination
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   ii. Learning from Trade
3. Exchange Rate Dynamics
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   ii. Market Efficiency and Volatility
4. Information Flows
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5.2 Exchange Rate Determination

Quotes and beliefs

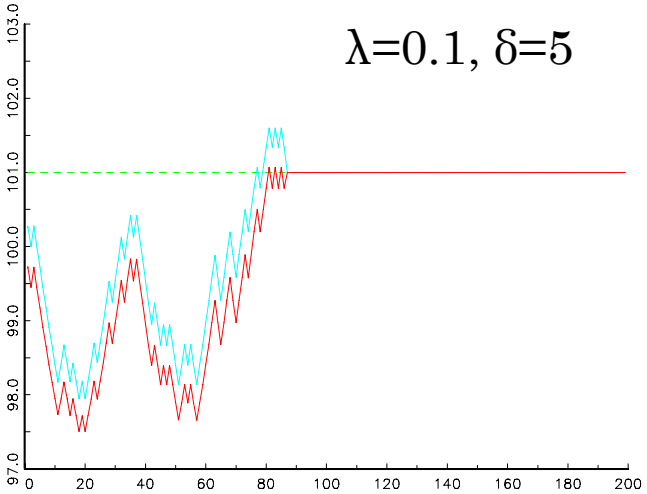
To complete the link between marketmaker beliefs and their spot rate quotes we now compute the trade probabilities.

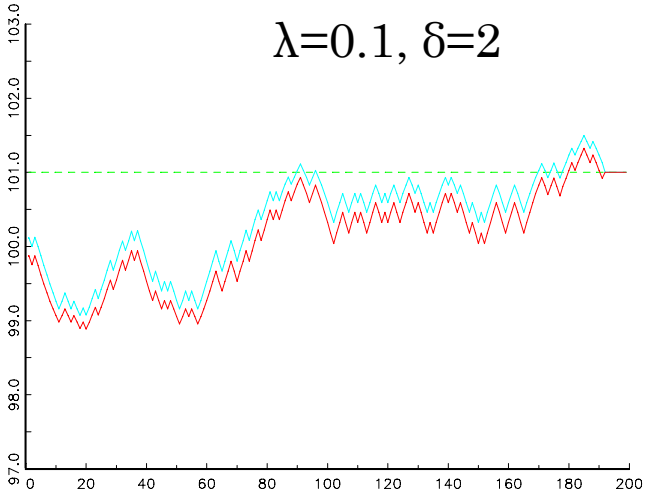
Table 1

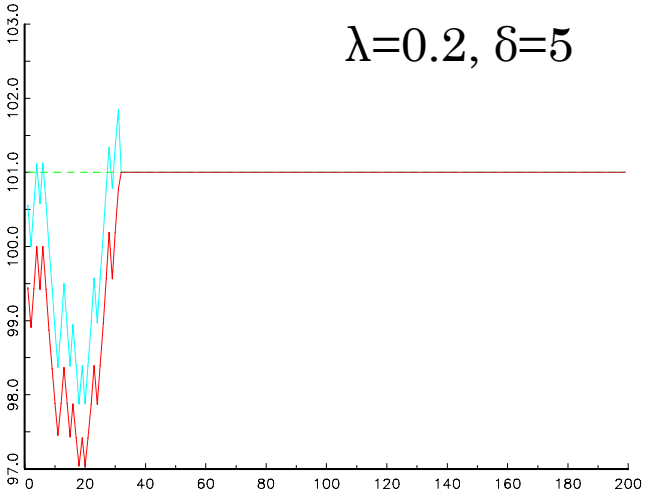
States	$Z=1$	$Z=2$	$Z=3$
	$F_t > S_t^A$	$S_t^A \geq F_t \geq S_t^B$	$S_t^B > F_t$
$\Pr(Z\|\Omega_t)$	$\overline{\Pi}(S_t^A)$	$1-\overline{\Pi}(S_t^A)-\underline{\Pi}(S_t^B)$	$\underline{\Pi}(S_t^B)$
Purchase Probabilities			
$\Pr(\mathbb{B}^I\|Z,\Omega_t)$	λ/N	0	0
$\Pr(\mathbb{B}^U\|Z,\Omega_t)$	$(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$
$\Pr(\mathbb{B}\|Z,\Omega_t)$	$\lambda/N+(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$
Sale Probabilities			
$\Pr(\mathbb{S}^I\|Z,\Omega_t)$	0	0	λ/N
$\Pr(\mathbb{S}^U\|Z,\Omega_t)$	$(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$
$\Pr(\mathbb{S}\|Z,\Omega_t)$	$(1-\lambda)/(2N)$	$(1-\lambda)/(2N)$	$\lambda/N+(1-\lambda)/(2N)$
Pass Probabilities			
$\Pr(\mathbb{P}^I\|Z,\Omega_t)$	0	λ/N	0
$\Pr(\mathbb{P}^U\|Z,\Omega_t)$	0	0	0
$\Pr(\mathbb{P}\|Z,\Omega_t)$	0	λ/N	0

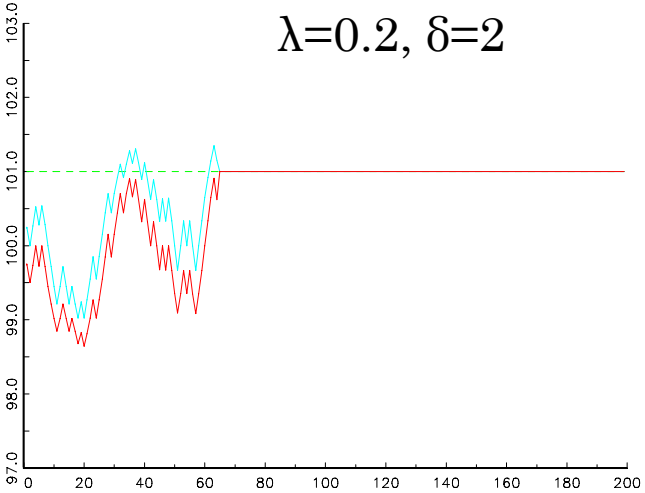
5.3 Exchange Rate Dynamics

Learning about fundamentals Case 1



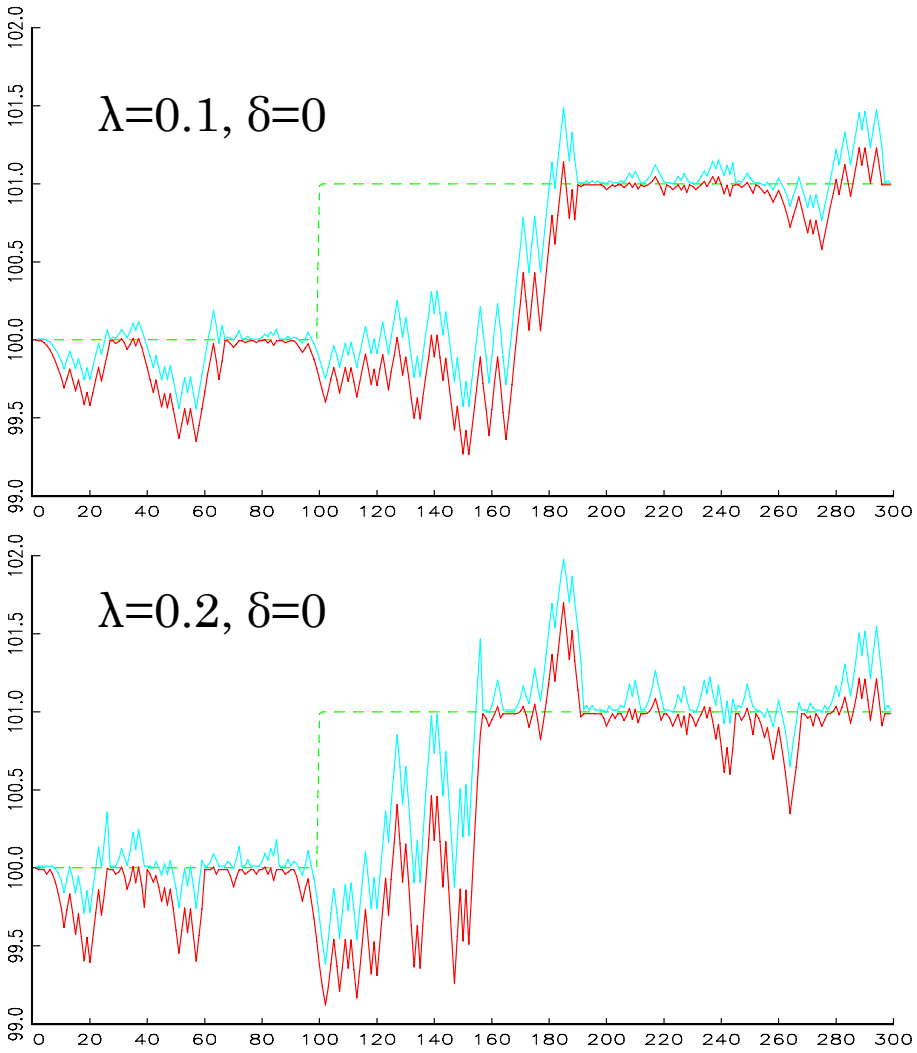






5.3 Exchange Rate Dynamics

Learning about fundamentals Case 2



Case 2: Learning about a one time change in Fundamentals

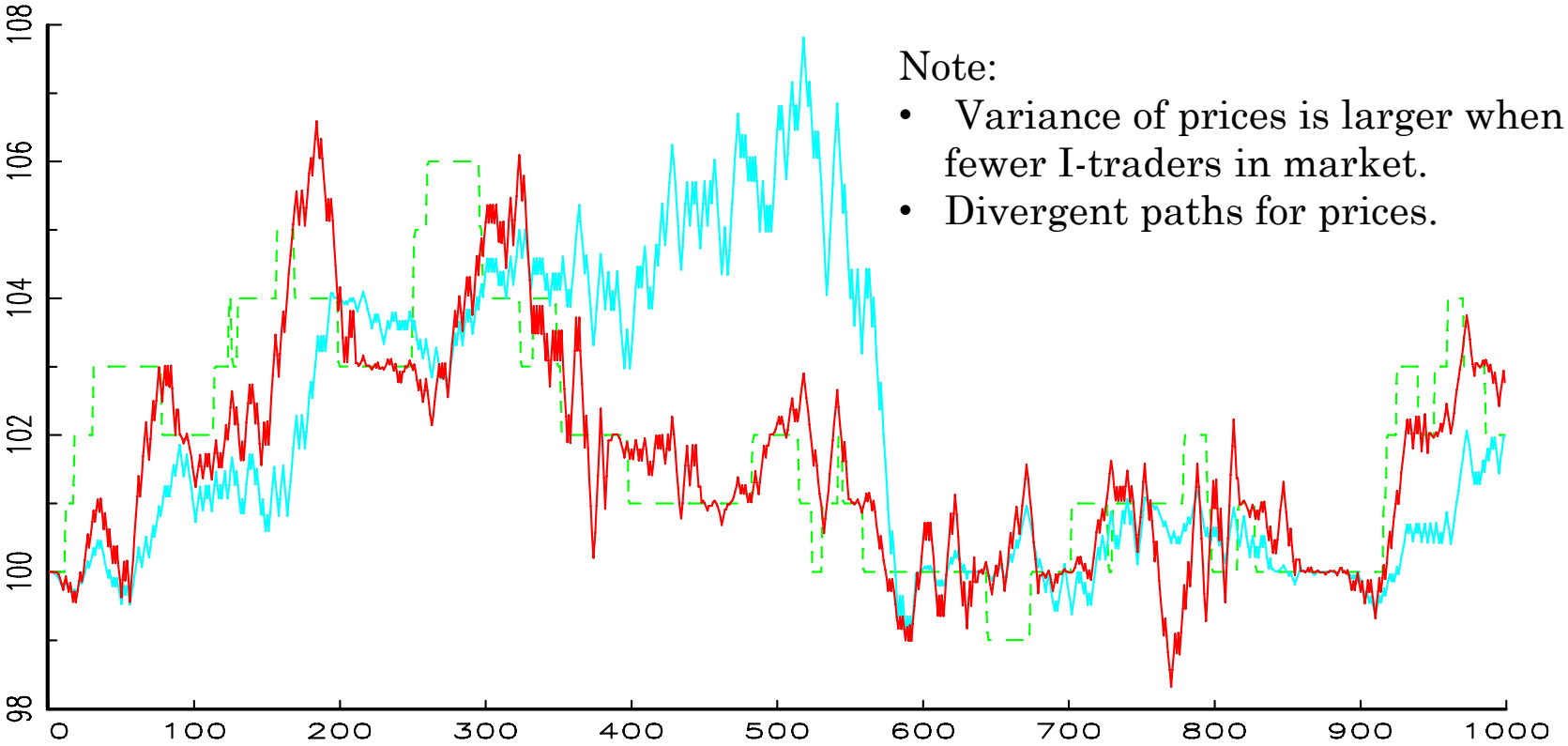
Note:

- It takes time for quotes to change.
- No monotonicity in adjustment path
- Quotes are revised away from fundamentals because $\alpha > 0$.

5.3 Exchange Rate Dynamics

Learning about fundamentals Case 3

Case 3: Learning about Dynamic Fundamentals: $\alpha = 0.1$



Note:

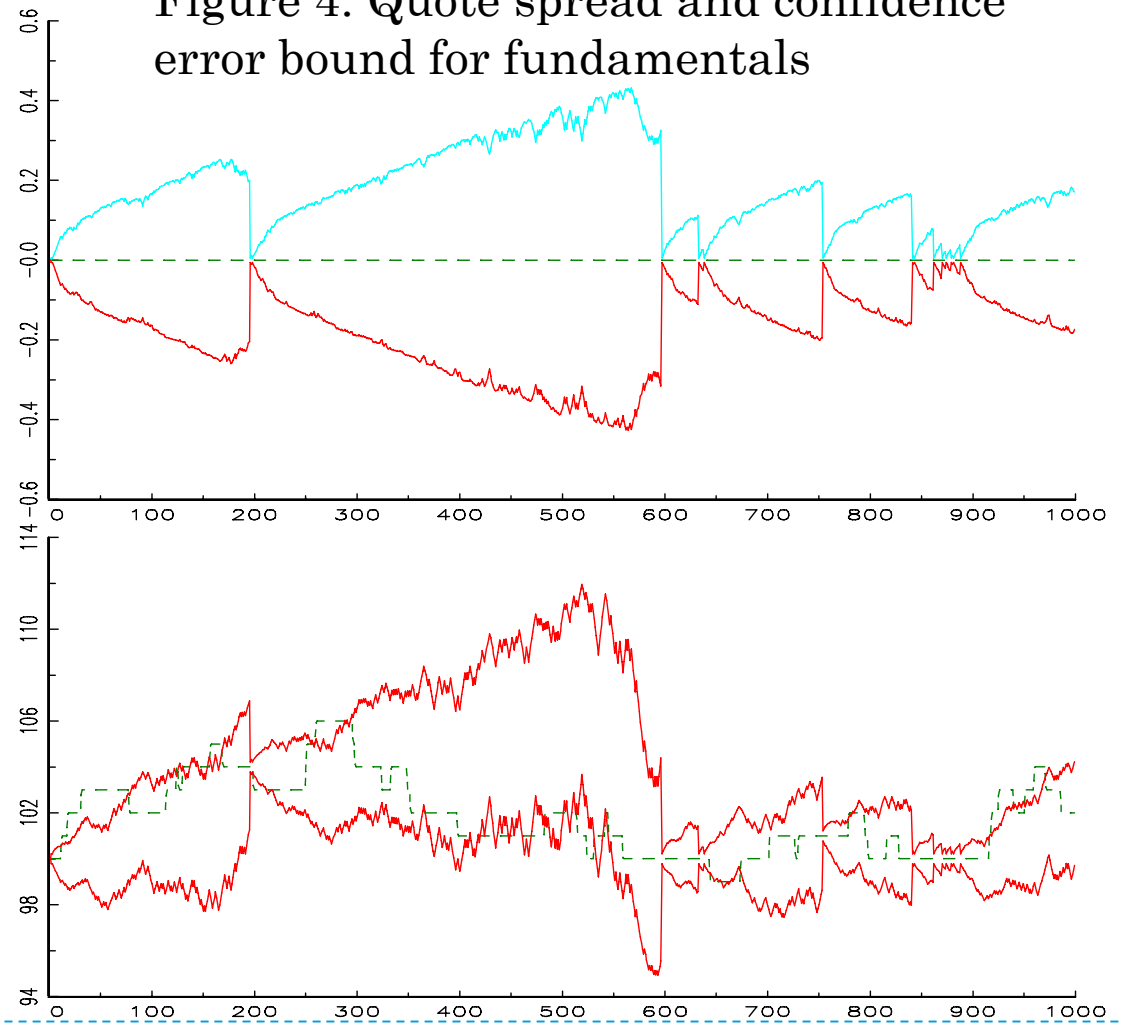
- Variance of prices is larger when fewer I-traders in market.
- Divergent paths for prices.

Key: Fundamentals Green; Transactions Prices; Blue (λ=0.1) Red (λ=0.2)

5.4 Information Flows

Interpreting the Quote Spread

Figure 4: Quote spread and confidence error bound for fundamentals



Note:

- The spread is highly correlated with confidence bound.
- The markups in the quotes are highly correlated
- Marketmakers learn about fundamentals in bursts of trading activity.
- The flow of information reaching marketmakers isn't constant.

5.4 Information Flows

Order Flow

The serial correlation properties of order flow are more complex and hold the key to understanding why the variable can be used to measure the flow of information. Consider the autocovariance for the order flow imbalance:

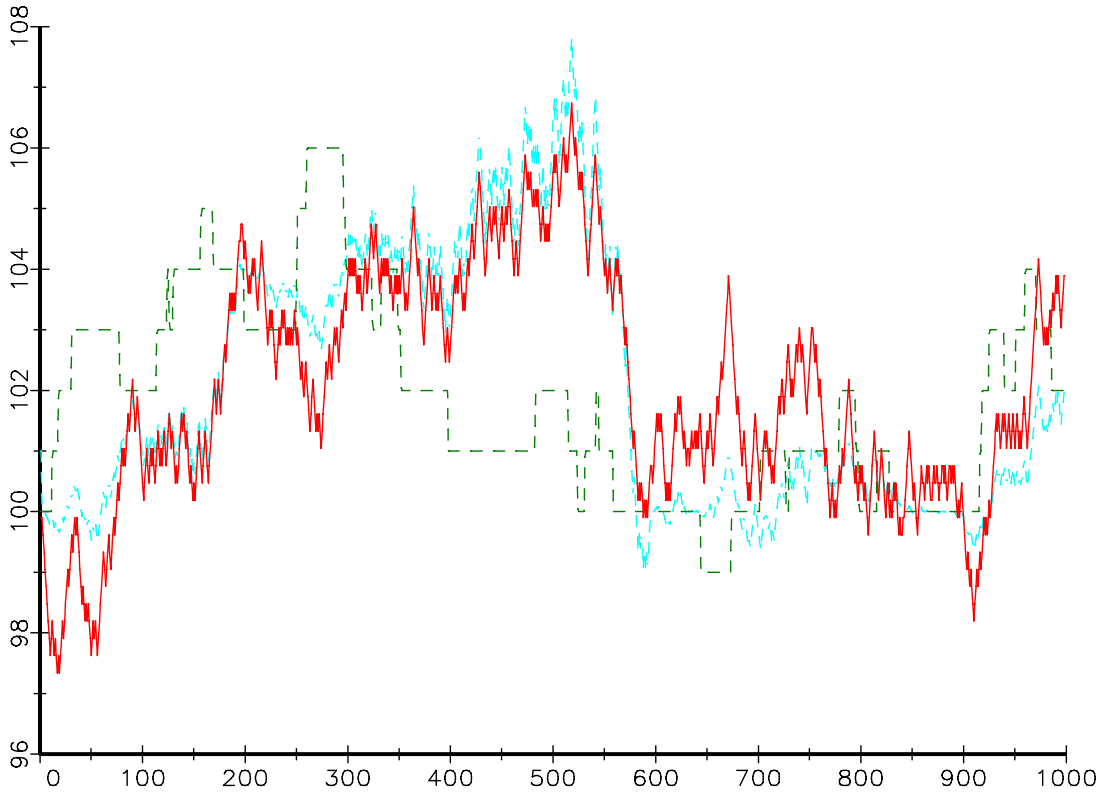
$\mathbb{CV}\left[\Delta\mathbb{X}_{t+1}\Delta\mathbb{X}_t \middle| Z_{t+1}, Z_t\right]$	$Z_t = 1$	$Z_t = 2$	$Z_t = 3$
$Z_{t+1} = 1$	$\frac{(N-1)^2\lambda^2}{N^4}$	0	$-\frac{(N-1)^2\lambda^2}{N^4}$
$Z_{t+1} = 2$	0	0	0
$Z_{t+1} = 3$	$-\frac{(N-1)^2\lambda^2}{N^4}$	0	$\frac{(N-1)^2\lambda^2}{N^4}$

The information conveyed by an individual trade depends, in part, on the history of preceding trades.

5.4 Information Flows

Order Flow

Figure 5: Fundamentals (dashed green), Transactions Prices (dashed blue) and Cumulated Order Flow (solid red) [scaled]



Note:

- The large and persistent movements in prices are closely matched by similar movements in cumulated order flow.
- Order flows account for the lags in price adjustment relative to changes in fundamentals.

5.4 Information Flows

Order Flow

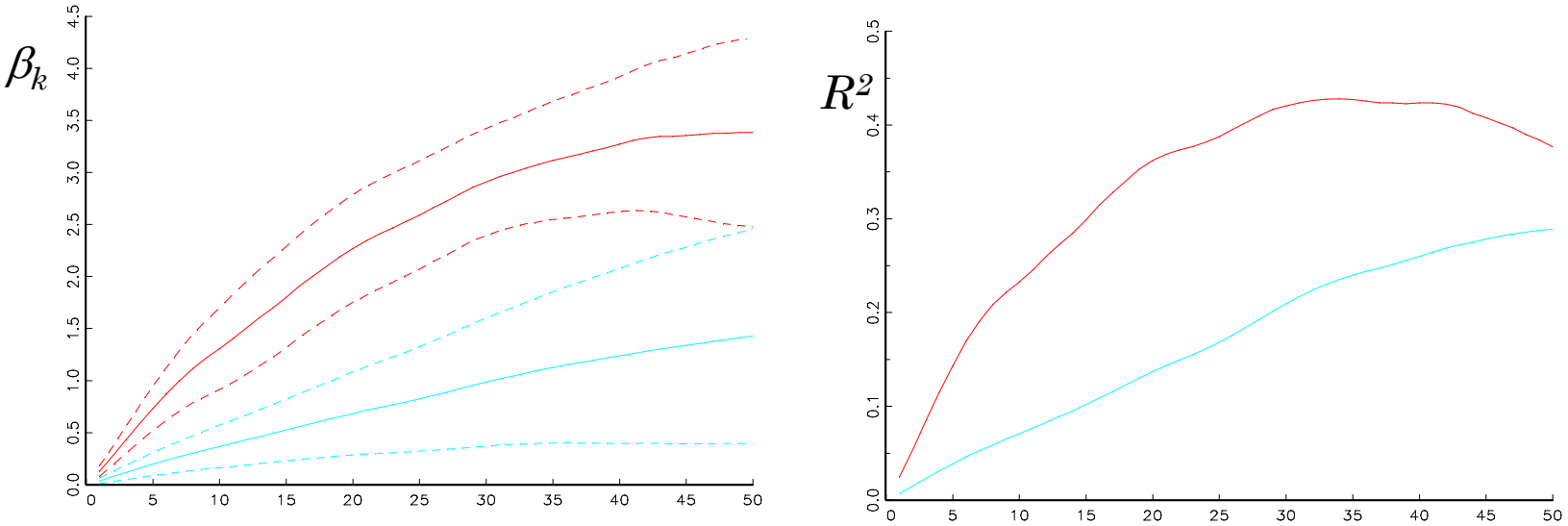


Figure 6: Regression results [λ=0.1 blue, λ=0.2 red]

Note:

- As time passes more information about the past value of fundamentals is reflected in the cumulated order imbalance between trader-initiated purchases and sales.
- A gap between fundamentals and spot rates induces a greater order imbalance when the faction of I-traders in the market is larger.

5.4 Information Flows

Order Flow

Now consider how price changes are related to the behavior of order flow with the regression:

$$S^{A}_{t+k} - S^{A}_{t} = \gamma_k (X_{t+k-1} - X_{t-1}) + \nu_{t+k}.$$

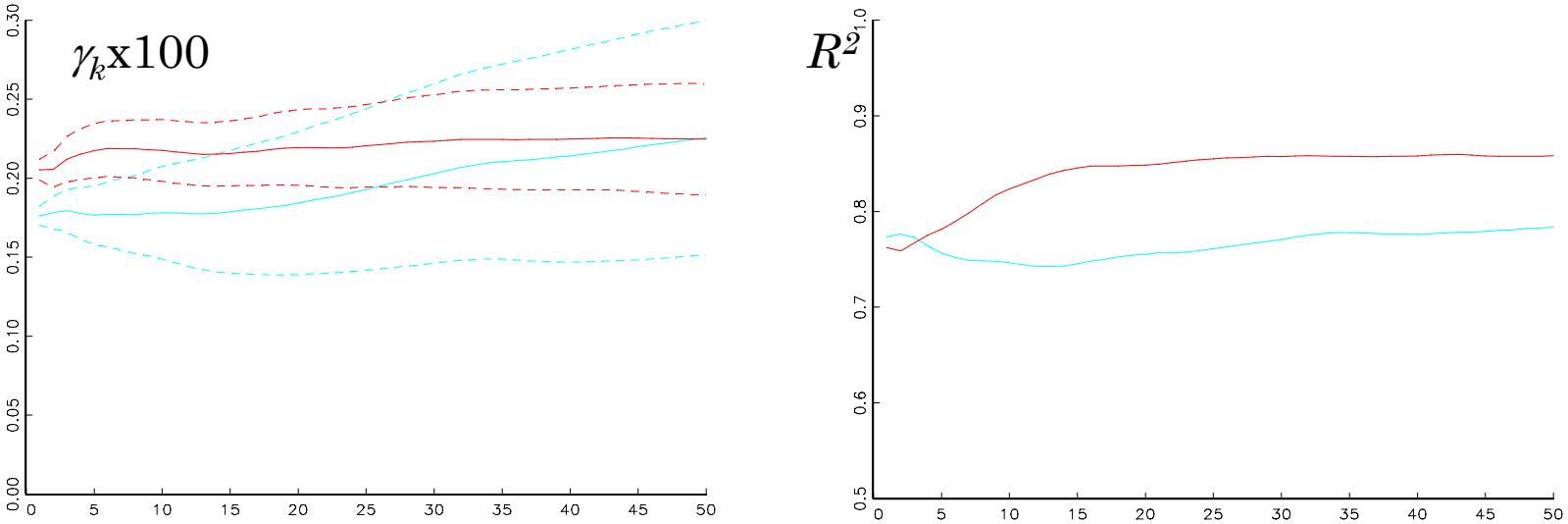


Figure 7: Regression results [λ=0.1 blue, λ=0.2 red]

Trader composition affects the pace at which information about fundamentals becomes embedded in the pattern of trading far more than it does the inferences marketmaker make from trades.

5.6 Uninformed Traders

Consider the trade profits from the simulation. Let z_t^J and $\hat{z}_t^J$ denote the number of dollars and foreign currency held by a J-trader at the end of period t. Profits are the dollar value of the closed-out position:

$$\Lambda_t^{\mathrm{J}} = z_t^{\mathrm{J}} + \begin{cases} S_t^{\mathrm{B}} \hat{z}_t^{\mathrm{J}} & \text{if } \hat{z}_t^{\mathrm{J}} > 0 \\ S_t^{\mathrm{A}} \hat{z}_t^{\mathrm{J}} & \text{if } \hat{z}_t^{\mathrm{J}} < 0 \end{cases}$$

Clearly:

- losses to U-traders are large
- information on fundamentals does not provide a guarantee of profitable trading in the short run.