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Information Contagion and Financial Prices

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Objective

- To show that social interaction and information contagion:
  - contributes to high levels of, and persistence in, volatility seen in financial prices (the focus of today's presentation).
  - can offer some insight into the momentum effect that is the generally rising or falling market commonly referred to as bull and bear markets.
  - Can not explain the formation of bubbles in financial markets.

- The models consist of a series of equations that attempt to mirror trading strategies of different classes of agent.

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The Sentiment Investor

- Bowden and McDonald (2006) examined information flows between agents within a small world network.

- Agents receive a private binary signal $x \in X = \{0,1\}$ on the state of the world $v \in V = \{0,1\}$ where $P(x = 1 | v = 1) > 0.5$.

- Social learners then adjust their beliefs following discussions with neighbors using Bayesian Updating.

- Experts followed their own signal.

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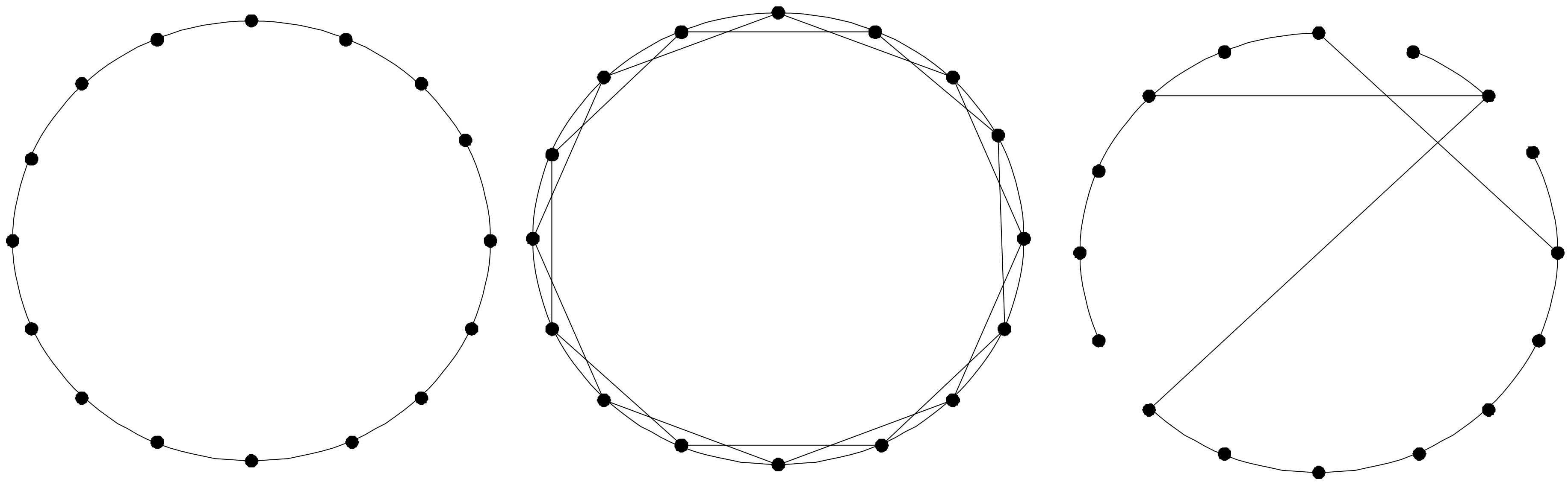
Ring Lattice and Small Worlds



k = 2 and pr = 0   *k = 4 and p = 0*   *k = 2 and pr > 0*

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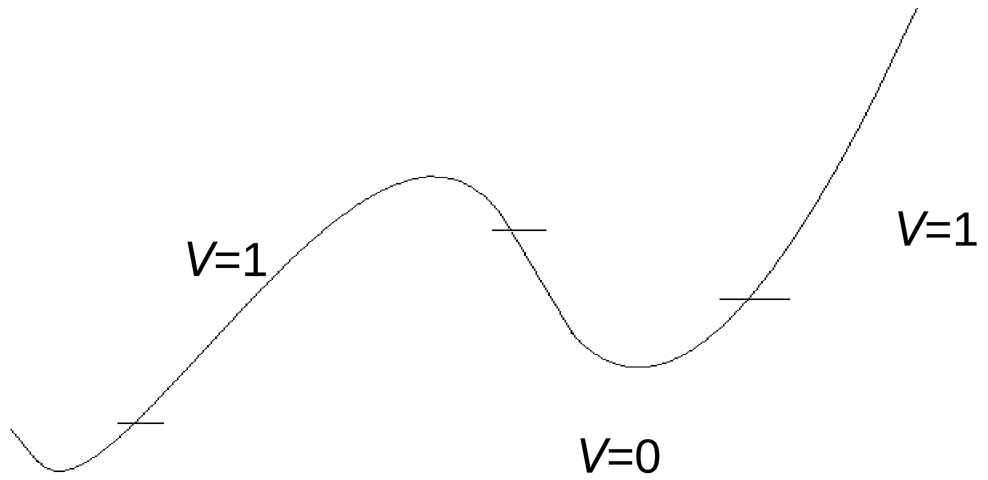
State of the World

- $V = 1$ if $p_{t-1} > p_{t-1-h}$ and $=0$ if $p_{t-1} < p_{t-1-h}$ (otherwise toss coin)



- The SoW is a sentiment indicator so investors trade on sentiment not on strict charts rules

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Demand of the Sentiment Investor

- Let *N* be the total number of sentiment investors, n_t^+ the number of these investors that believe that *V* = 1 and n_t^- be the number that believe that *V* = 0.

- When an investor that was previously bullish turns bearish they sell with the converse true.

For $n_t^+ > n_{t-1}^+$ then $n_t^+ - n_{t-1}^+$ Net buyers

$n_t^- > n_{t-1}^-$ then $n_t^- - n_{t-1}^-$ Net sellers

$$D_S = T_S \cdot \left(n_t^+ - n_{t-1}^+\right)$$

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Sentiment Investors Only

- What effects $\left(n_t^+ - n_{t-1}^+\right)$?

- From Bowden and McDonald (2006) we know that the following variables effect the volatility in the mean level of agent expectations as well as the speed at which agents learn of changes in the SoW:

  – The number of experts in the social network;
  – The number of connections from these experts to sentiment investors;
  – The small world properties of the network '*pr*'; and
  – The number of connections between agents '*k*'

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Fundamental Traders

- Fundamental traders are aware of the fundamental value and buy (sell) if the price is below (above) this value. They care about relative not absolute return.

$$D_F = T_F \cdot \frac{\left(p_{t-1}^f - p_{t-1}\right)}{p_{t-1}^f}$$

  – Fundamental traders have deep pockets but only trade heavily if expected profits are high.

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Evolution of the Fundamental Value

- Volatility is defined as the daily percentage return

$$\eta_t = \frac{\left(p_t^f - p_{t-1}^f\right)}{p_{t-1}^f} \qquad \text{or} \qquad p_t^f = p_{t-1}^f \cdot \left(\eta + 1\right)$$

- Three processes for *η* are analysed in this paper:
  - Drift: $\eta = 0.1/260$
  - Random walk: mean of 0 and Variance of 0.01
  - Random walk with drift
  - Approximate Daily Returns

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Market Maker

- The market maker matches supply and demand by adjusting prices in the usual way.

$$p_t = p_{t-1} + \beta \cdot \left(D_S + D_F\right)$$

- β set to 1. Market Maker does not smooth price volatility and accepts no risks. But simplifies analysis.

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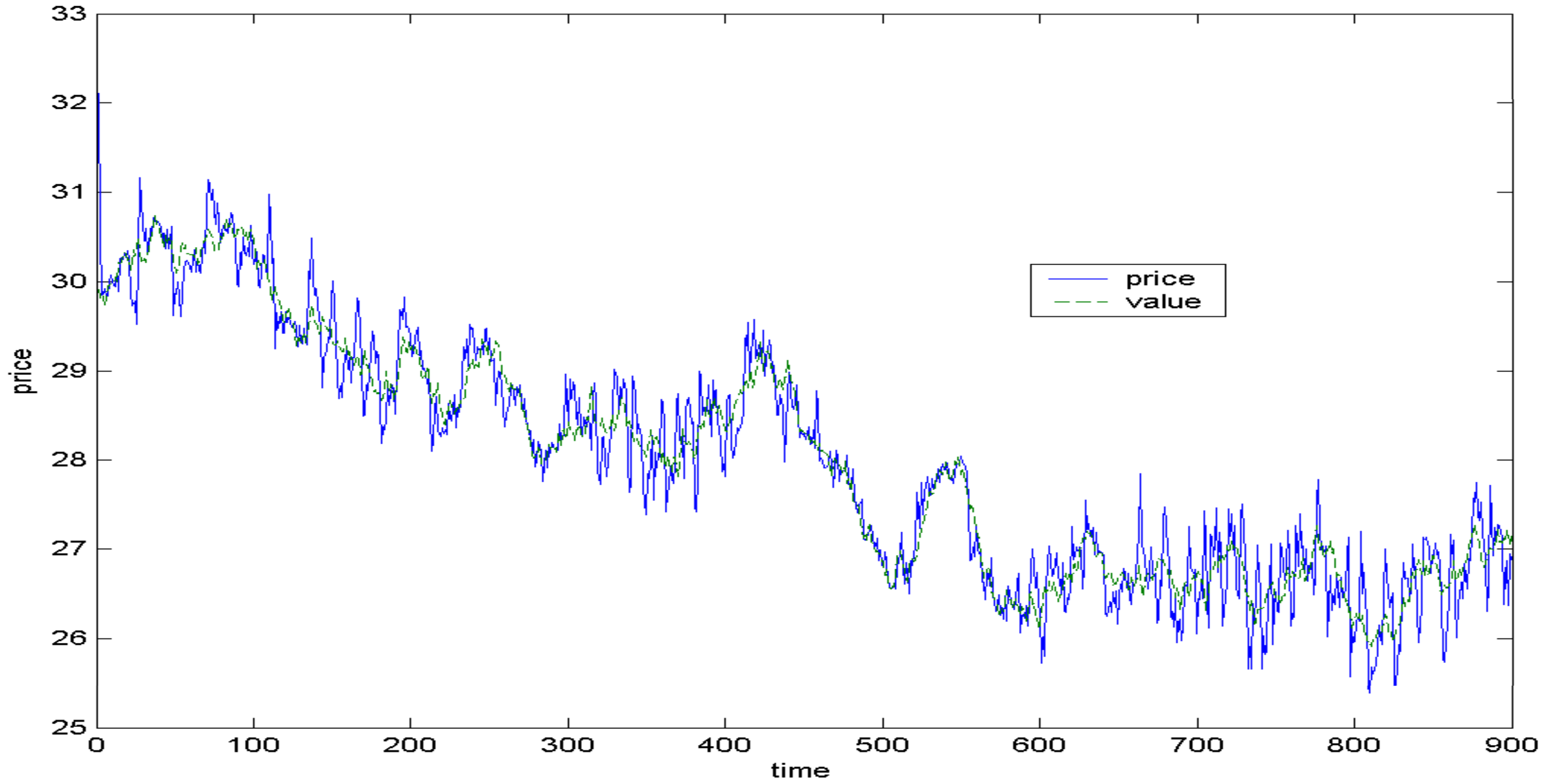
Multi-Agent Model-RW



pr = 10%; 5% of agents are experts;
$T_S = 0.01$; $T_F = 25$

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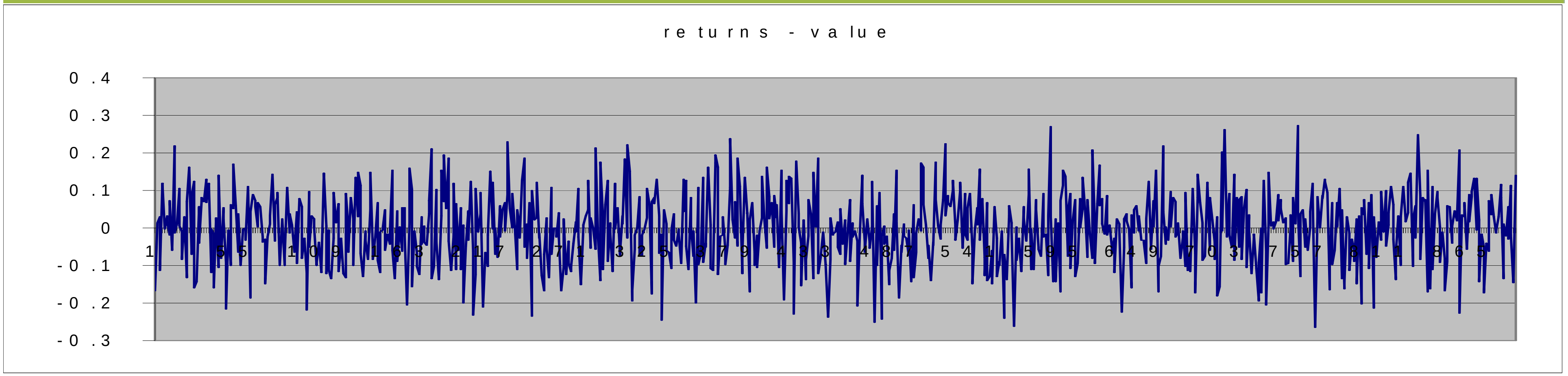
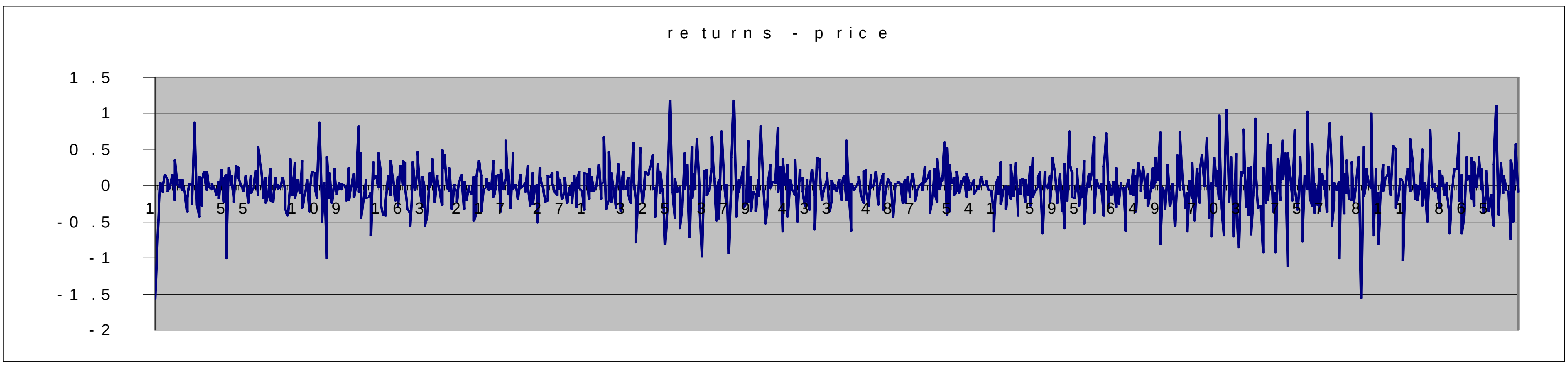
Returns value vs price – Base Case





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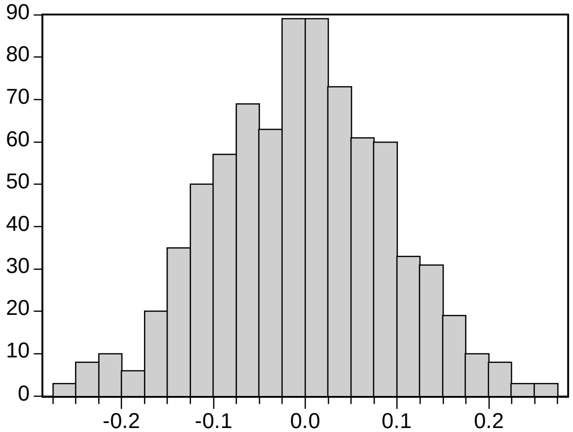
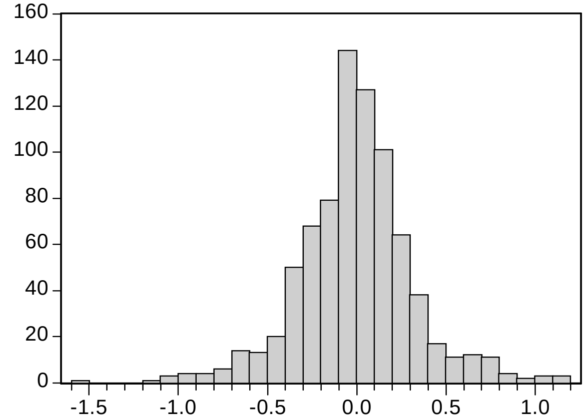
Distribution of Returns and (v-p) – Base Case



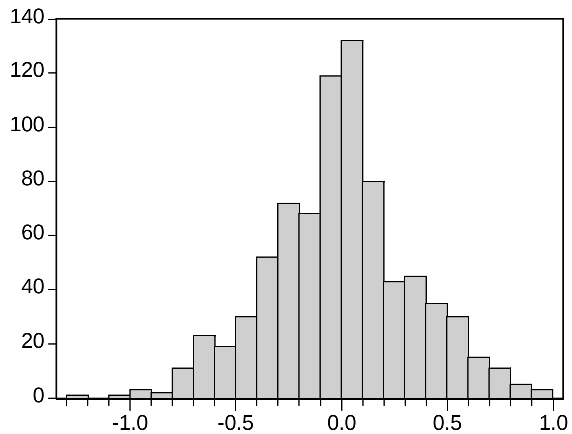
Series: RV	
Sample 1 800	
Observations 800	
Mean	-0.004117
Median	-0.001795
Maximum	0.273164
Minimum	-0.264422
Std. Dev.	0.095496
Skewness	-0.009416
Kurtosis	2.886451
Jarque-Bera	0.441602
Probability	0.801876

value



Series: RP	
Sample 1 800	
Observations 800	
Mean	-0.004166
Median	-0.009024
Maximum	1.189805
Minimum	-1.556358
Std. Dev.	0.324939
Skewness	0.007409
Kurtosis	4.986050
Jarque-Bera	131.4871
Probability	0.000000

price



Series: P_V01	
Sample 1 800	
Observations 800	
Mean	-0.005001
Median	-0.001620
Maximum	0.957909
Minimum	-1.209644
Std. Dev.	0.338187
Skewness	-0.015458
Kurtosis	3.238597
Jarque-Bera	1.929473
Probability	0.381084

v-p

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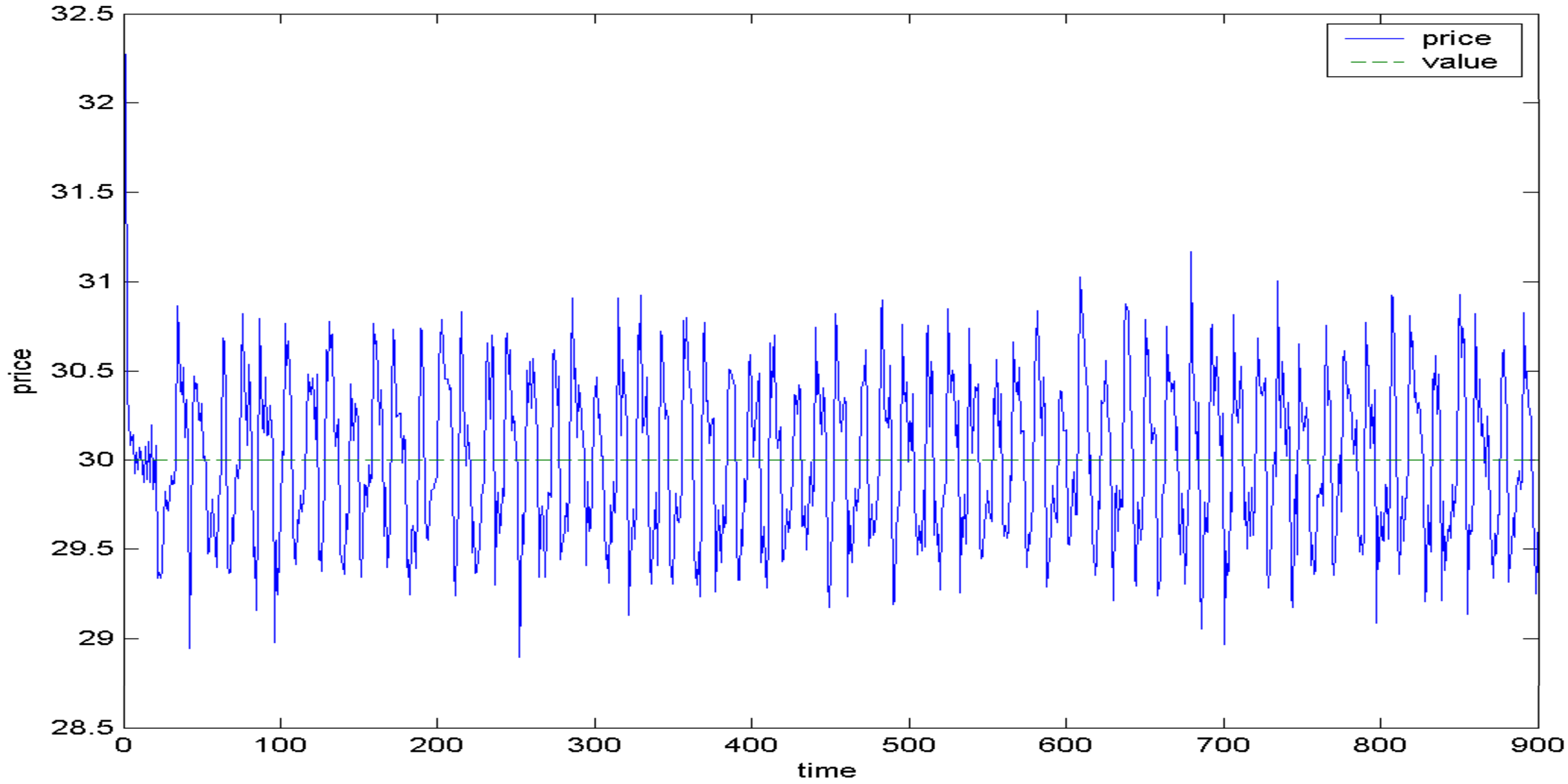
Multi-Agent Model-constant value



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pr = 10%; 5% of agents are experts;
$T_S = 0.01$; $T_F = 25$

Distribution of Returns– Base Case

$\left(n_t^+ - n_{t-1}^+\right)$	$r_t = \delta + \beta_1 \cdot r_{t-1} + \varepsilon_t + \alpha_1 \varepsilon_{t-1}$	Garch Errors
P_f is fixed	$r_t = \sum_i \beta_i \cdot r_{t-1} + \varepsilon_t$	No Garch Errors
P_f follows RW	$r_t = \sum_i \beta_i \cdot r_{t-1} + \varepsilon_t$	Garch Errors

- No drift term in prices

Garch Errors are $\varepsilon_t = \mu_t \sqrt{\sigma_t} = \mu_t \sqrt{\gamma_0 + \tau_1 \cdot \sigma_{t-1} + \gamma_1 \cdot \varepsilon_{t-1}^2}$

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%experts; ‘*p*’ and Connections from Experts

	Std Deviation	Kurtosis
pr1	0.2328	4.770
BC	0.2575	4.635
pr20	0.2797	4.393
pr50	0.2811	4.191

	Std Deviation	Kurtosis
e1	0.2076	4.239
BC	0.2575	4.635
e10	0.3260	4.430
e20	0.4216	4.903

	Std Deviation	Kurtosis
BC	0.2575	4.635
NoC2	0.2941	4.724
NoC5	0.3283	3.911
NoC10	0.3744	3.741

pr = 10%; 5% of agents are experts;
Experts have no extra connections
$T_S = 0.01$; $T_F = 25$

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Conclusions

- When both fundamental and sentimental traders are in the market you find increased volatility and kurtosis in prices.

- The level of volatility depends on whether the value is surging or meandering resulting in the emergence of GARCH properties.

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