Masters Hypothesis and Market Efficiency - Insights from Multifractal Models

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- Masters and White (2008): introduction of (speculative) position limits
  - "The case for position limits therefore lacks a logical or empirical basis. As a result, such limits are highly unlikely to lead to more efficient pricing in commodity markets." (Pirrong, 2010)
Market efficiency

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- Serial correlation of asset returns as sign of predictability and, thus, market inefficiency
Empirical approach

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- Measure of degree of market efficiency (Campbell et al., 1997)
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- Estimation using rolling sample windows
Related literature

- Kilian and Murphy (2013): The 2003-2008 surge was caused by unexpected increases in world oil consumption driven by the global business cycle.
- Juvenal and Petrella (2014): Global demand shocks account for the largest share of oil price fluctuations, speculative shocks are the second most important driver.
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- Juvenal and Petrella (2014): Global demand shocks account for the largest share of oil price fluctuations, speculative shocks are the second most important driver.
- Buhuksayin and Harris (2011): Position changes of commercial, non-commercial, and swap dealers do not Granger cause oil price changes.
- Irwin and Sanders (2012): Relationship between index positions and returns as well as volatility - no empirical support for the Masters Hypothesis
Multifractality

- Returns with different time periods differ in their probability distribution
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- Interrelation between returns and sampling intervals: Multifractility
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- Interrelation between returns and sampling intervals: Multifractility
- Absolute moments of returns vary as a power of the return period, with non-linear exponent as a function of the moment order
Multifractal random walk

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- Three parameters: error term variance $\sigma^2$, correlation lag $T$, intermittency coefficient $\lambda^2$
- $\lambda^2$: measure of strength of interrelation between returns and sampling intervals
- $\lambda^2$ serves as measure of market efficiency (Sattarhoff, 2011; Sattarhoff, 2012)
Multifractal random walk

This paper: log-normal model version

\[ X(t) = \lim_{l \to 0^+} \int_0^t e^{\omega_l(u)} dB(u) \]  

(1)

where \( dB(u) \) is Gaussian White Noise, and \( \omega_l(t) \) is a stationary Gaussian process independent of \( dB(u) \), with mean

\[ E(\omega_l(t)) = -\lambda^2 \left( \ln \frac{T}{l} = 1 \right) \]  

(2)

and autocovariance function

\[ \gamma_{\omega_l}(h) := \text{Cov}(\omega_l(t), \omega_l(t + h)) \]

\[ \gamma_{\omega_l}(h) = \begin{cases} 
\lambda^2 \left( \ln \left( \frac{T}{l} \right) + 1 - \frac{h}{l} \right) & 0 \leq h < l \\
\lambda^2 \ln \left( \frac{T}{h} \right) & l \leq h < T \\
0 & h \geq T 
\end{cases} \]  

(3)

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$\lambda^2$ estimates for other markets (Sattarhoff, 2012)

<table>
<thead>
<tr>
<th>Index</th>
<th>$\lambda^2$</th>
<th>Sample period</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAX</td>
<td>0.0362</td>
<td>2003-2007</td>
</tr>
<tr>
<td>FTSE</td>
<td>0.0190</td>
<td>2003-2007</td>
</tr>
<tr>
<td>Dow Jones</td>
<td>0.0157</td>
<td>2003-2007</td>
</tr>
<tr>
<td>DAX</td>
<td>0.0273</td>
<td>2007-2011</td>
</tr>
<tr>
<td>FTSE</td>
<td>0.0351</td>
<td>2007-2011</td>
</tr>
<tr>
<td>Dow Jones</td>
<td>0.0492</td>
<td>2007-2011</td>
</tr>
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Preliminary results

Figure 1: Near month crude oil futures returns

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Oil futures market: $\lambda^2$ estimates

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<tr>
<td>0.0225</td>
<td>Full sample</td>
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<tr>
<td>0.0214</td>
<td>Pre 2002</td>
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$H_0 : \lambda^2 = 0$ rejected for all sample periods
Preliminary results

Figure 2: $\lambda^2$ estimates, rolling window, 2000 observations

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