Investigating salmon price volatility

Marius Sikveland
Atle Øglend

University of Stavanger, Norway
Introduction

• Salmon prices: Volatility in volatility
  – Stochastic production
  – Little information concerning future supply
  – Poor long-term predictability

• Undesirable volatility
  – Large volatility poses a strain on the value chain of salmon
Research Idea

• Can the salmon price volatility contain valuable information on the price structure?
  – Higher power correlations of prices
  – Clustering of volatility
  – Non-independent volatility

• Revealing such dynamics could offer valuable information for risk averse market participants
Importence of studying volatility


Salmon price and other agricultural goods

Divergence from linear trend/%

Year

Sd(beef) = 11.85

Source: Norwegian Seafood Export Council, USDA
Salmon price and other agricultural goods

Source: Norwegian Seafood Export Council, USDA

Sd(beef)=11.85  Sd(Pork)=24.89

Source: Norwegian Seafood Export Council, USDA
Salmon price and other agricultural goods

Source: Norwegian Seafood Export Council, USDA

Sd(beef)=11.85  Sd(Pork)= 24.89  Sd(Cod)=13.97

Source: Norwegian Seafood Export Council, USDA
Salmon price and other agricultural goods

Source: Norwegian Seafood Export Council, USDA

Sd(beef)=11.85  Sd(Pork)= 24.89  Sd(Cod)=13.97  Sd(Salmon)= 14.9
Weekly salmon prices and traded volume

Source: Norwegian Seafood Export Council
Measures of volatility

![Graph showing measures of volatility with standard deviation over years from 1995 to 2007.](image-url)
Measures of volatility

![Graph showing measures of volatility over the years 1995 to 2006. The graph includes standard deviation and moving average standard deviation lines.](image-url)
Measures of volatility
Measures of volatility

![Graph showing measures of volatility over years with standard deviation on the y-axis and years from 1995 to 2006 on the x-axis. The graph compares log return standard deviation without drift and with drift.]
Preliminary indications

• No significant long term trend in nominell prices

• Spiking and clustering of volatility
  – Volatility seems to be connected in certain periods

• Volatility as a stochastic process in the price structure
The GARCH-model

• Formalising the analysis by applying the GARCH model

• GARCH model, Bollerslev (1986)
  – The GARCH model allows for heteroskedasticity by modelling the price variance as being dependent on the lagged price variance and error-term of the price process.

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j}$$
The GARCH-model

• GARCH opens for non-independent volatility

• Volatility clustering
  – Variance dependent on lagged variance and lagged squared error-term.
  – Allows for higher power correlations.
  – As so the price structure can reveal connections other than the linear correlations of prices
The GARCH-model

- Normality test indicates non-normality
- Robust standard errors are calculated
- Estimated using Maximum Likelihood
  - Student t-distributed error term
- Number of lags determined by significance
  - Adding more lags did not change Akaike’s information criteria significantly
The GARCH-model

- By including significant values our price structure function takes the following form

\[
\ln \frac{p_t}{p_{t-1}} = \mu + \eta_1 \ln \frac{p_{t-1}}{p_{t-2}} + \eta_2 \ln \frac{p_{t-5}}{p_{t-6}} + u_t \tag{1}
\]

\[
h_t = \alpha_0 + \gamma \ln \frac{q_{t-1}}{q_{t-2}} + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1} \tag{2}
\]
## Model results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>Estimate</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>$\mu$</td>
<td>-0.0002</td>
<td>0.749</td>
</tr>
<tr>
<td>Return t-1</td>
<td>$\eta_1$</td>
<td>0.33</td>
<td>0.000</td>
</tr>
<tr>
<td>Return t-5</td>
<td>$\eta_2$</td>
<td>0.09</td>
<td>0.003</td>
</tr>
<tr>
<td>Constant</td>
<td>$\alpha_0$</td>
<td>0.0002</td>
<td>0.006</td>
</tr>
<tr>
<td>Vol. change</td>
<td>$\gamma$</td>
<td>-0.0004</td>
<td>0.037</td>
</tr>
<tr>
<td>Sq. error t-1</td>
<td>$\alpha_1$</td>
<td>0.45</td>
<td>0.001</td>
</tr>
<tr>
<td>Variance t-1</td>
<td>$\beta_1$</td>
<td>0.36</td>
<td>0.005</td>
</tr>
</tbody>
</table>
Results cont.

- The results indicates a GARCH(1,1) model describes the volatility process
  - Thus previous week’s volatility has some predictive power on this week’s volatility
- Lag 1 and lag 5 of log-returns are significant on this week’s log return
- The difference in previous week’s volume traded has a statistical significant negative effect on this week’s volatility
- The half-life of a volatility shock (Enders 2003) is estimated to 3,2 weeks.
Concluding remarks

• So what does this mean for the market participants?
  – The analysis indicates that volatility is not independent, and does display some predictive powers.
  – Risk-averse firm’s can avoid trading next week if volatility is large this week.
  – Lag 1 and lag 5 offers some predictive power on log-returns.
  – Following a shock the volatility halves in an estimated 3,2 weeks.