Price Spikes in Salmon Prices: The Role Of Unexpected Yield Variations

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Introduction

- Salmon is a seasonally produced commodity.
- Little seasonality can be found in price levels:
  - This suggests a level of supply smoothing (Asche and Bjorndalen, 2011).
- *However*, in certain years seasonality will transmit from biomass to prices:
  - This leads to price bubbles/spiking.
  - Supply smoothing appears to fail and significant price premiums exist.

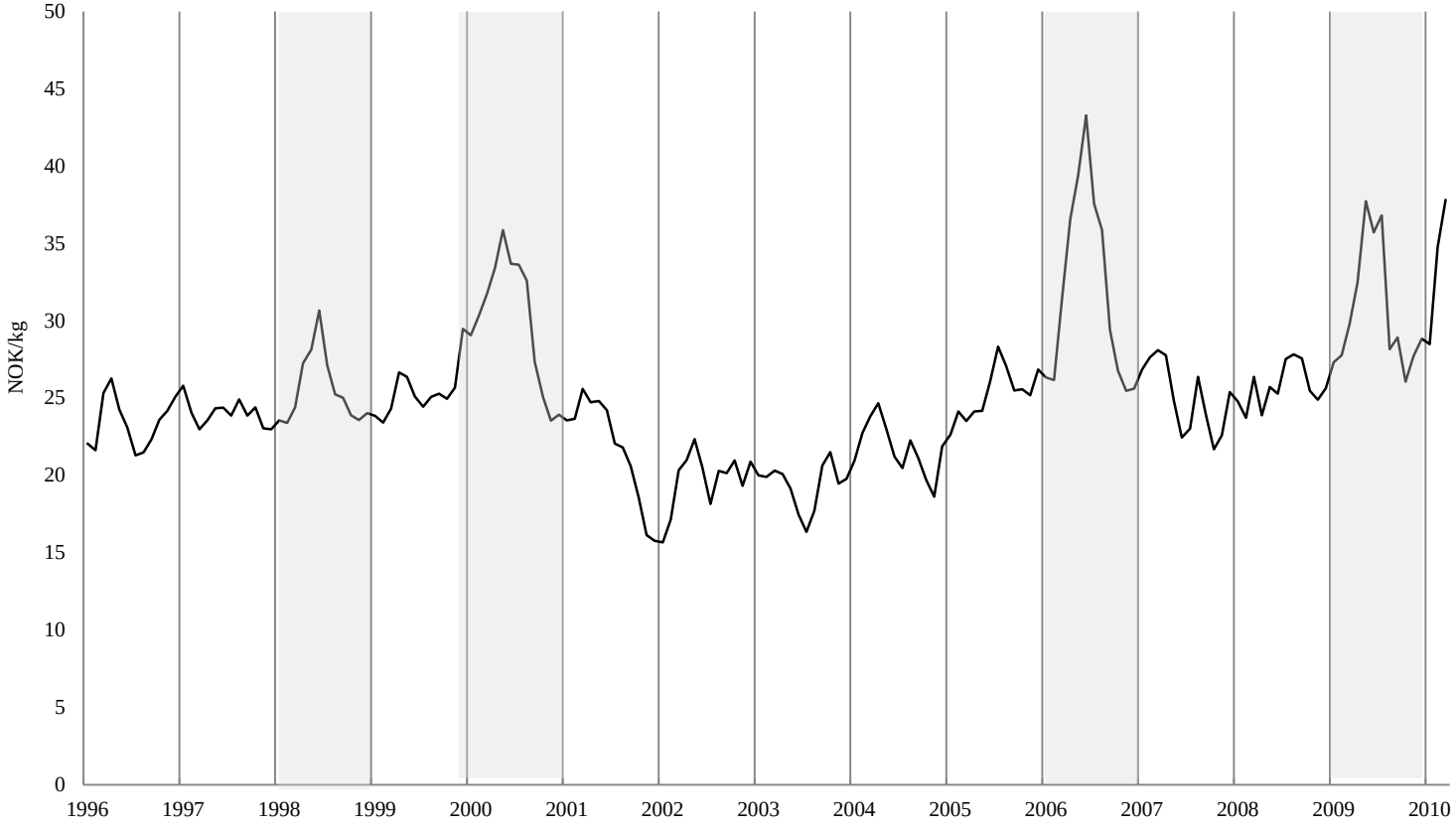
Introduction

- Prices in these ”spiking” years have a regular seasonal timing:
  - Prices increases in spring, peaks in early summer and declines in late summer/early fall.
- Prices peak when biomass and average fish weight is at its seasonal minimum
  - Suggests a cause can be found in the state of biomass.
- **Can we explain this phenomenon?**

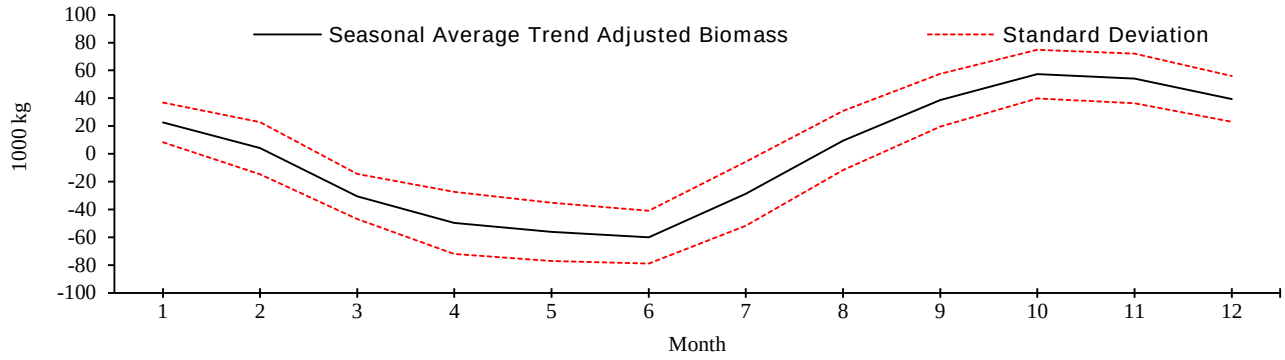
Norwegian Salmon Aquaclture

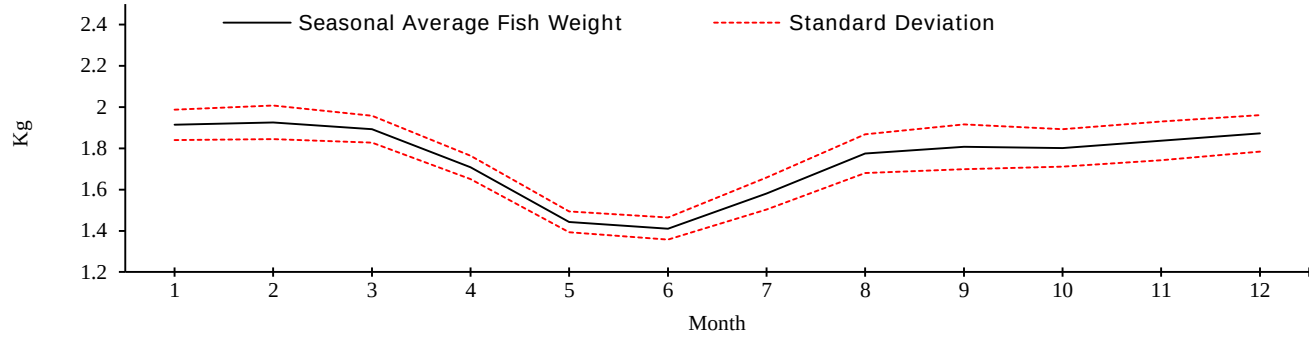
- Norway is the single largest producer of Atlantic Salmon
  - 940 000 tonnes sold in 2010.
- Salmon takes 16-24 months to grow and reach harvest ready weight.
- Markets exist for salmon of different weight-classes.
- Salmon growth is highly dependent on sea-water temperatures.

Salmon Price



Salmon Biomass/Average Weight





Biomass Management

- Adjusting biomass takes time
  - Fish takes 16-24 months to reach harvest ready weight.
  - Adjusting biomass in the short run can only be done by adjusting harvesting patterns => This is likely to have price effects.

- The main ”harvest” period of salmon is in late summer/fall.
  - Low alternative cost of harvesting

- Highest alternative cost of harvesting in spring/early summer
  - Expected yield is high
  - This is when prices peak.

Biomass Management

- **Proposed Explanation for price spiking:**
  - Lower than expected growth in months leading up to the main growth period (summer).

- **Lower than expected growth implies**
  1. Lower than expected biomass.
  2. Biomass skewed in favor of small fish.

- The coming high growth period becomes very valuable
  - Farmers can only readjust biomass by letting the small fish grow into larger fish.

- Alternative cost of harvesting becomes very large =>

  Prices must increase to compensate farmers for harvesting.

Relation to the Litterature

- **Commodity price dynamics** (Deaton and Laroque 1992; 1996, Wright and Williams, 1991; Pirrong, 2011)

- **Optimal stock management and cyclicality**
  - ***Cattle:*** Rosen, Murphy and Scheinkman, 1994; Aadland and Bailey, 2001; Hamilton and Kastens, 2000.
  - ***Hogs:*** Hayes and Schmitz 1993; Shonkwilder and Spreen 1986; Harlow 1960; Dean and Heady 1958; Chavas and Holt 1991; Chavas, 1999.
  - ***Timber:*** Prestemoen and Holmes (2000)

- **Price co-movements dependent on supply side factors** (Ai, Chatrath and Song, 2006)

Predictions from Proposed Explanation

- Price Volatility highest when expected growth is high (late spring/early summer).
  - This pattern is found in Oglend and Sikveland (2009)

- Correlation between different weight-class prices larger when expected growth is high.
  - High expected growth links smaller fish to larger fish.
  - Indications of this found using conventional correlation analysis.

- A measure of historical growth should provide explanatory power on price spiking.
  - **This is investigated further.**

The Role Of Unexpected Yield Variations

- Sea water temperature is used as a proxy for biomass growth.
- Temperature decomposed into a ”predicted” and ”residual” component.
- Allow lagged effects to capture consecutive periods of low growth.
  - Lag coefficients are restricted to decline geometrically to avoid overfitting .
- Linear, squared and cubed unexpected temperature variation effects allowed to capture non-linear effects.

Econometric Specification

$$price_t = \mu_t + \hat{x}_t + x_t + \varepsilon_t$$

- **Deterministic component:**

$$\mu_t = \beta_0 + \beta_1 t + \beta_2 t^2$$

- **Predicted Temperature Effect:**

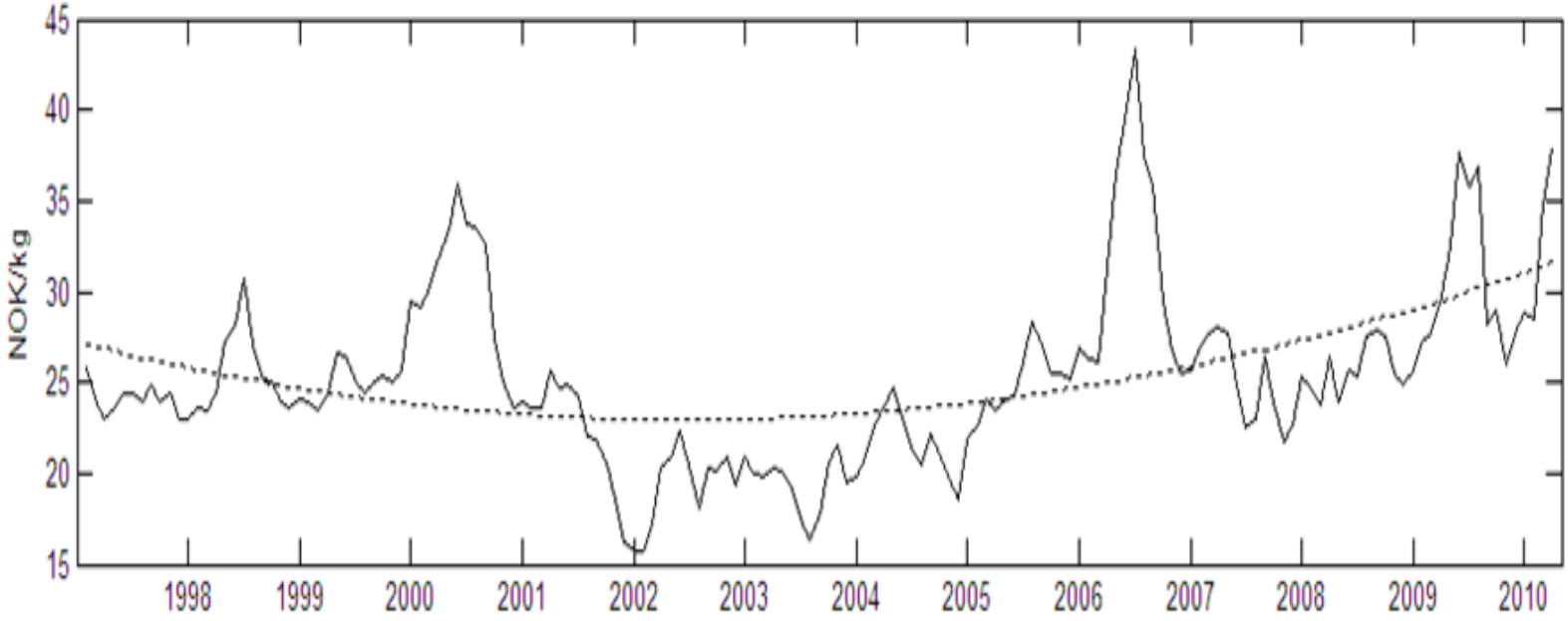
$$\hat{x}_t = \beta_3 tmp_{pred,t}$$

- **Residual Temperature Effect:**

$$x_t = \beta_4 tmp_{res,t} + \beta_5 \left(tmp_{res,t}\right)^2 + \beta_6 \left(tmp_{res,t}\right)^3$$

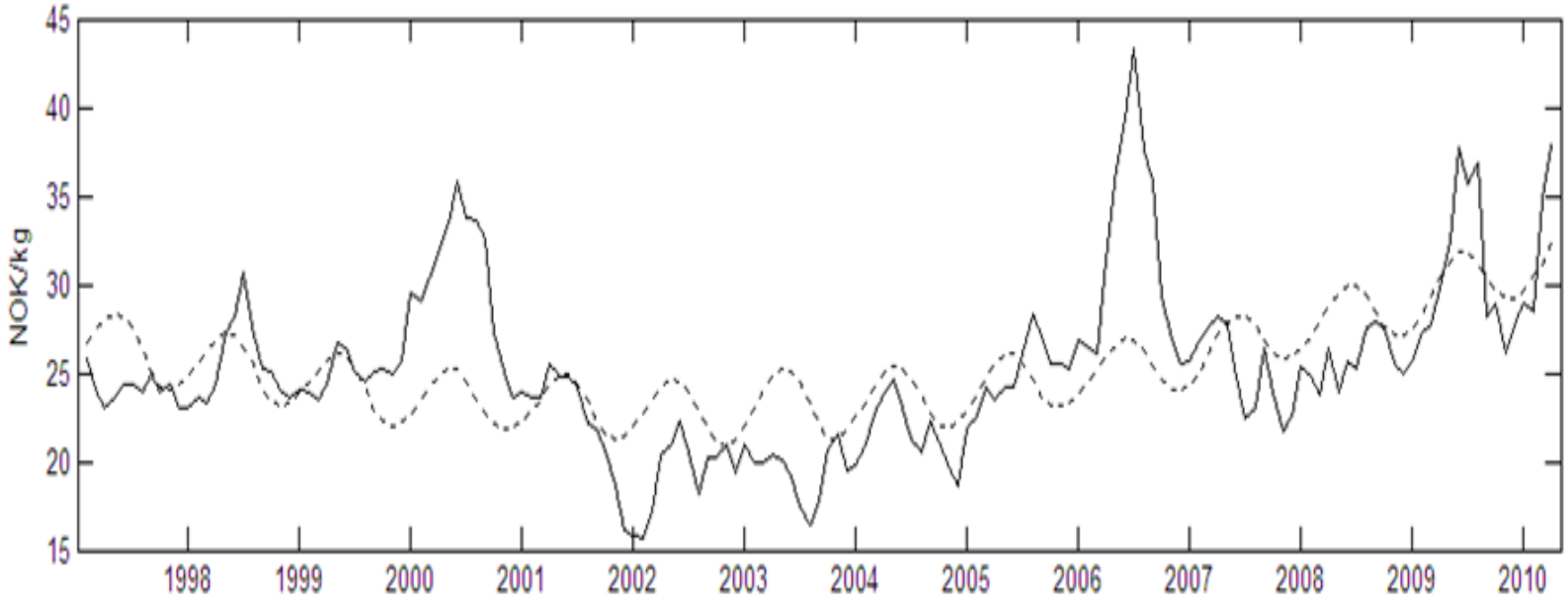
Econometric Results

- The effect of the deterministic component only



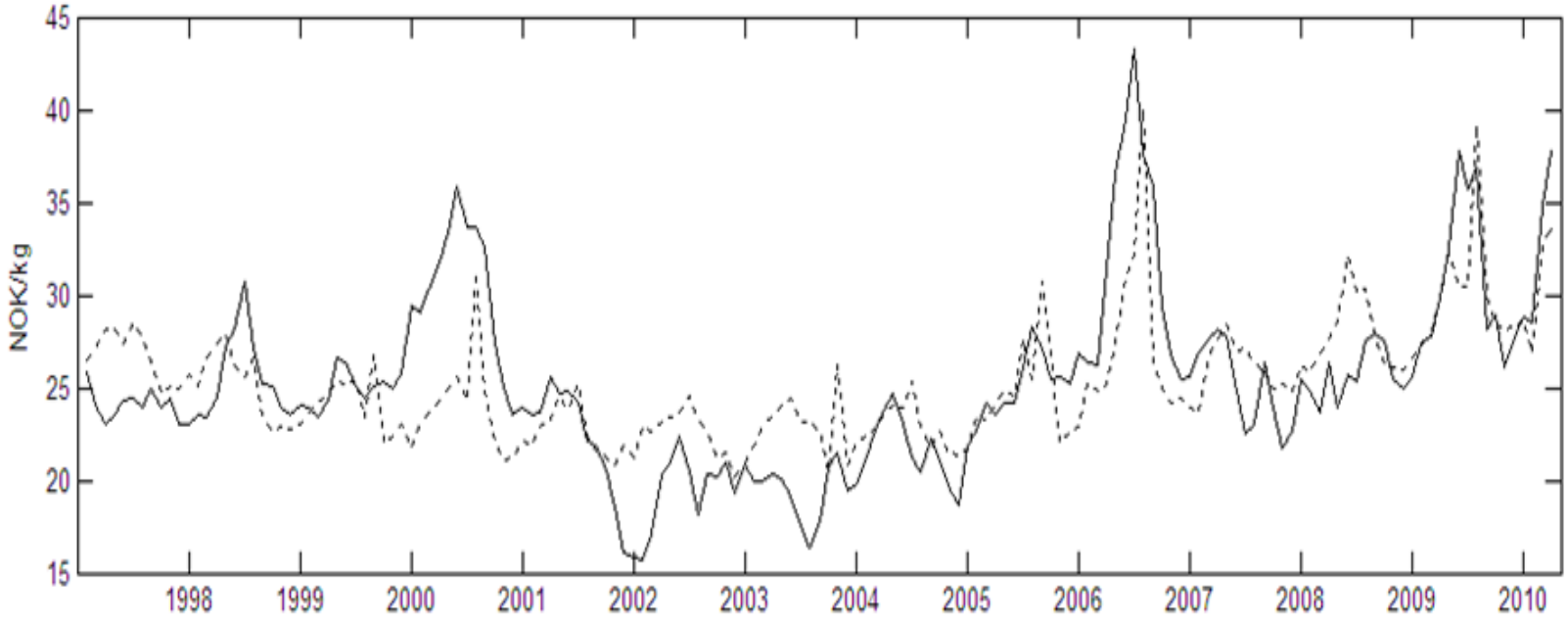
Econometric Results

- Adding the effect of Predicted Temperatures:
  - Significant negative effect on prices.
  - Adds seasonality to the series.



Econometric Results

- Full modell; adds the residual temperature effect.
  - Only non-linear effects significant.
  - ”Corrects” the seasonality in prices.



Discussion of Econometric Model

- The residual temperature effect can explain some of the price-spiking
  - Specifically the major 2006 bubble
- Model might suffer from overfitting
  - Needs to add squared and cubed effects to capture the spikes.
- More restrictive analysis is needed.

Conclusion

- We suggest spikes in salmon prices are the result of periods of lower than expected growth leading up to the major growth period.
- The high alternative cost of slaughtering in this period leads to high prices.
- We find some preliminary support for the hypothesis using sea water temperature as a proxy for growth