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The transmission of price changes between wholesale and ex-vessel markets in the Alaska shoreside pollock fishery

Ben Fissel

NAAFE

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Transmission of prices through the supply chain

- Theory of derived demand: prices of goods should be linked (transmitted) through the supply chain (Gardner (1975) farm-retail price spreads).
  - demand/supply elasticities drive price variation
  - Fisheries example: Asche *et al. (2007) horizontal and vertical (wholesale-retail) price integration in European salmon markets.*
- This research considers the *vertical* transmission of prices between the ex-vessel (pre-processed) and first-wholesale markets (post-processed)

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Asymmetric price transmission

Imperfections in the markets at different levels of the supply chain can result in asymmetries in transmission of prices.

- Linkage between markets is different depending on the state of some other variable. Examples:
  - Price decreases are transmitted more than increases
  - Price decreases are transmitted fully and increases are transmitted partially.

Causes typically attributed to frictions or imperfection in markets (e.g., menu costs, market power).

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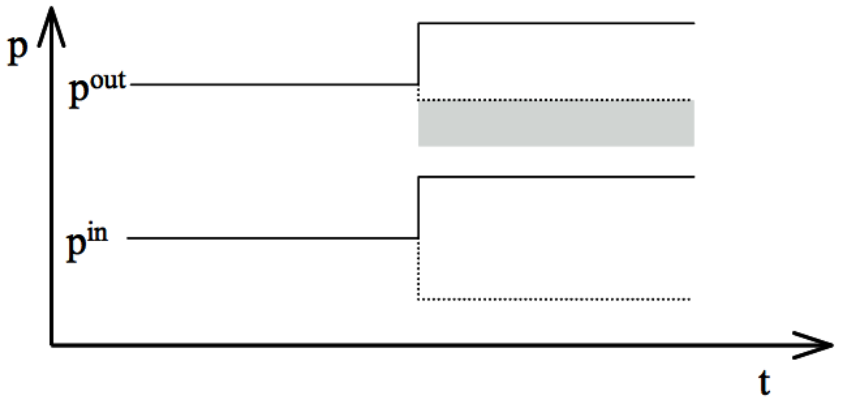
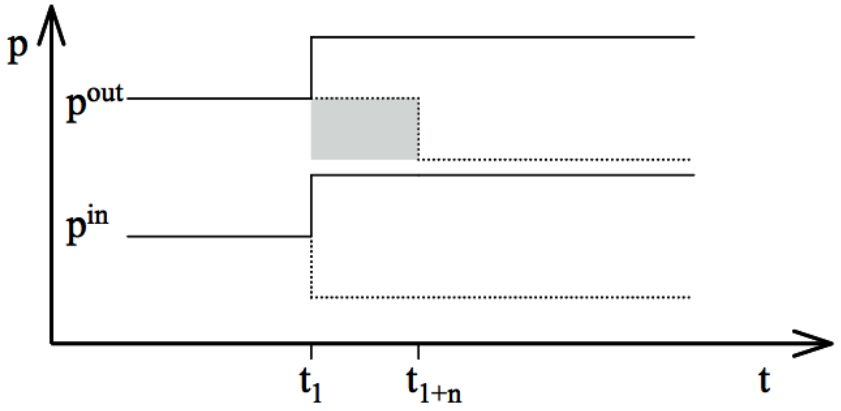
Examples of asymmetric price transmission (APT)

a): Magnitude



b): Speed



Meyer and von Cramon-Taubadel (2004) JAE 55:3

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The Literature on Asymmetric Price Transmission

APT researched extensively in agriculture

- Balke et al. (1998), Abduli (2002), Meyer & von Cramon-Taubadel (2004), Goodwin & Harper (2000), vCT (1998)
- Fisheries applications include: Jaffery (2005), Nakajima *et al.* (2011) Simioni *et al.* (2013), Guillen & Franquesa (2015).

APT is a subset of the more general literature on "Threshold Cointegration" (extension of TAR)

- TAR: Chan et al. (1985) Tsay (1989), Tong (1990), Chan (1993)
- TVECM: Balke & Fomby (1997), Enders & Granger (1998), Enders & Silko (2001)

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Modeling asymmetries and thresholds in the price relationship

Maintain the long-run equilibrium: $p_t^e - \alpha_0 - \alpha_1 p_t^w = u_t$

Adjustment to equilibrium is allowed to differ

$$du_t = \rho^+ I^* u_{t-1} + \rho^- (1 - I^*) u_{t-1} + \lambda du_{t-1} + e_t$$

$$I^* = 1, \text{ if } du_{t-1} \geq \tau \qquad I^* = 0, \text{ if } du_{t-1} < \tau$$

Momentum Threshold AR process

Threshold error corrections model describe short-run

$$dp_t^e = \beta_1^+ I^* u_{t-1} + \beta_1^- (1 - I^*) u_{t-1} + \gamma_{11} dp_{t-1}^e + \gamma_{12} dp_{t-1}^w + \varepsilon_{1,t}$$

$$dp_t^w = \beta_2^+ I^* u_{t-1} + \beta_2^- (1 - I^*) u_{t-1} + \gamma_{21} dp_{t-1}^e + \gamma_{22} dp_{t-1}^w + \varepsilon_{2,t}$$

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Market levels in the supply chain

Alaska shoreside pollock (2001-2014)

Ex-vessel market:

- Transaction between catcher-vessels (n=556) that deliver their harvest to shoreside processors (n=34)

First-wholesale market:

- Shoreside processors in-turn sell processed products (fillets, surimi, roe, H&G) on the “global” market.
- A large share of products are exported: 70% of fillets, 90% of surimi, 90% of roe, 90% of H&G

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Data

Analysis is restricted to major ports, near Dutch Harbor, on the AK peninsula and on Kodiak island. Product types is restricted to products/deliveries fit for human consumption (in particular this exclude meal).

Monthly ex-vessel prices are derived from ADFG fish tickets.

Wholesale data from COAR data is annual. Monthly wholesale prices are interpolated from monthly export prices using the Chow-Lin method.

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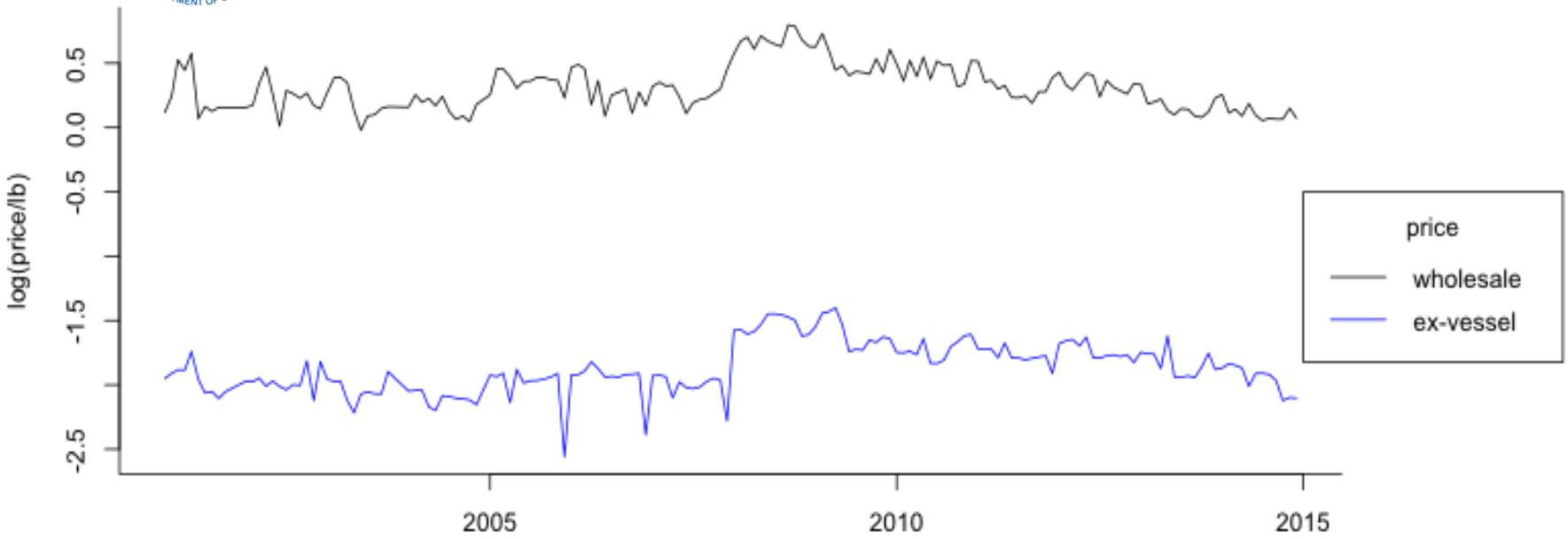
Shoreside pollock prices



Average wholesale price/lb = $1.389
Average ex-vessel price/lb = $0.158

Unit root tests confirm non-stationary prices

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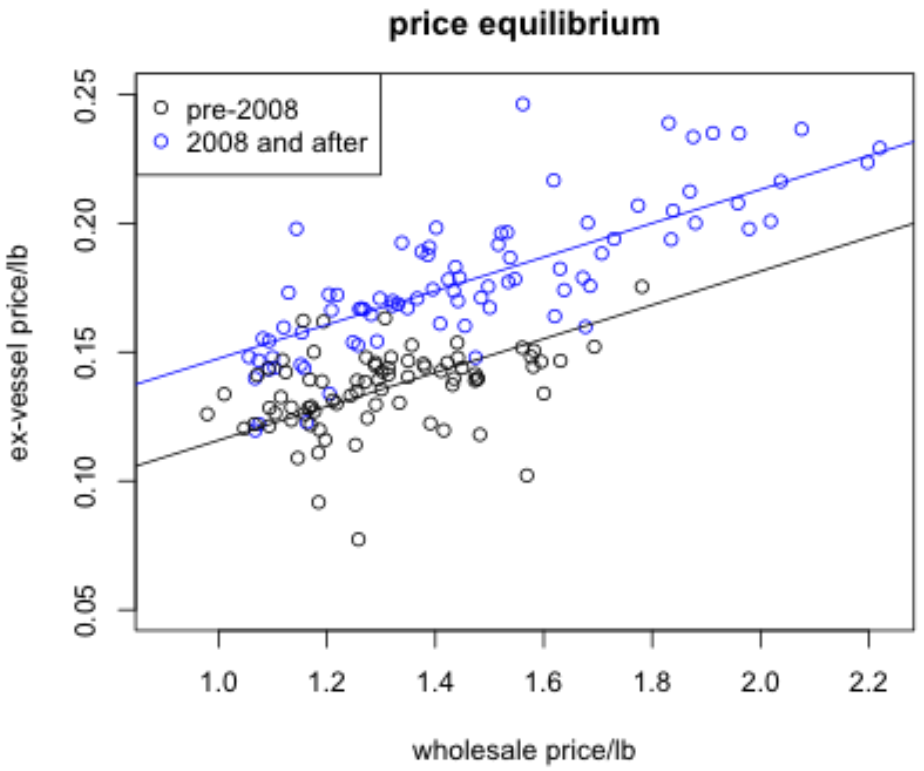
Long-run price equilibrium

$$p^e = \underset{\text{(-120.8)}}{-2.15} + \underset{\text{(10.8)}}{0.55}\ p^w + \underset{\text{(11.7)}}{0.21}\ I(year \geq 2008)$$

R-squared: 0.697

The dummy indicates a structural break in the long-run relationship between prices.

The margin between prices has decreased about $0.04



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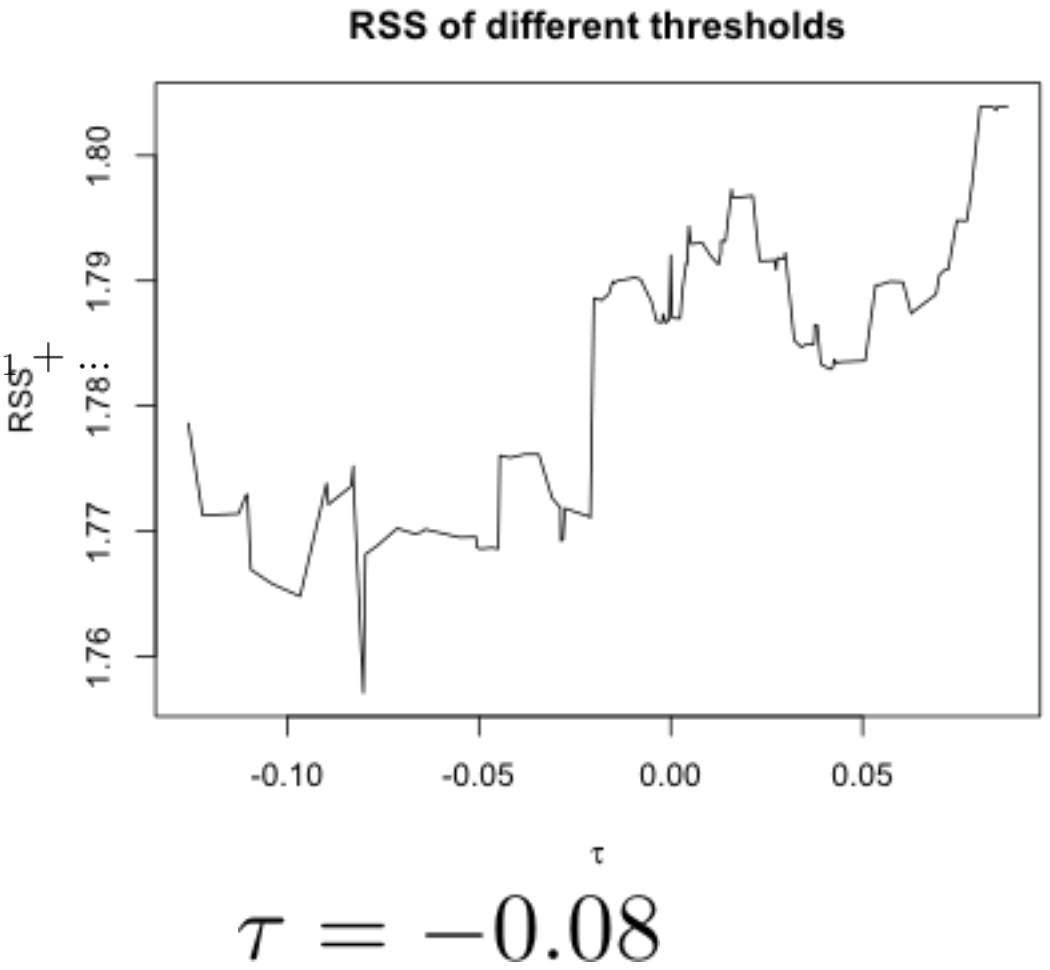
Determining the optimal threshold

RSS of the equilibrium adjustment process

$$du_t = \rho^+ I^* u_{t-1} + \rho^- (1 - I^*) u_{t-1} +$$

model indicates that negative thresholds provide the best description of the data.



$$\tau = -0.08$$

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Long-run adjustment process

$$du_t = \underset{(-5.94)}{\overset{\rho^+}{-0.650}} I^* u_{t-1} + \underset{(-8.81)}{\overset{\rho^-}{-0.969}} (1 - I^*) u_{t-1} + e_t \qquad \begin{array}{l} I^* = 1, \text{ if } du_{t-1} \geq -0.08 \\ I^* = 0, \text{ if } du_{t-1} < -0.08 \end{array}$$

Large negative deviation adjust to equilibrium faster than positive deviations

Reject the null of insignificance

$$H0 : \rho^+ = \rho^- = 0 \quad \text{F-stat: } 56.5 \quad \text{p-value } < 2e-16$$

Reject the null of symmetry

$$H0 : \rho^+ = \rho^- \quad \text{F-stat: } 4.24 \quad \text{p-value } < 0.04$$

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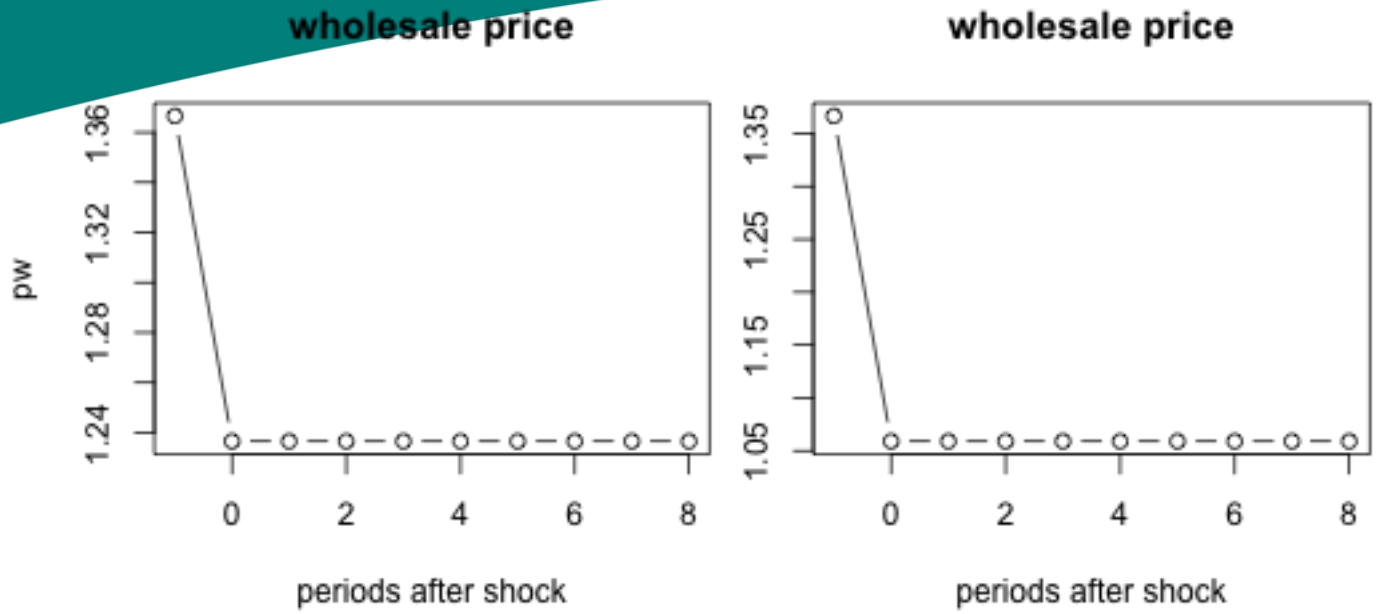
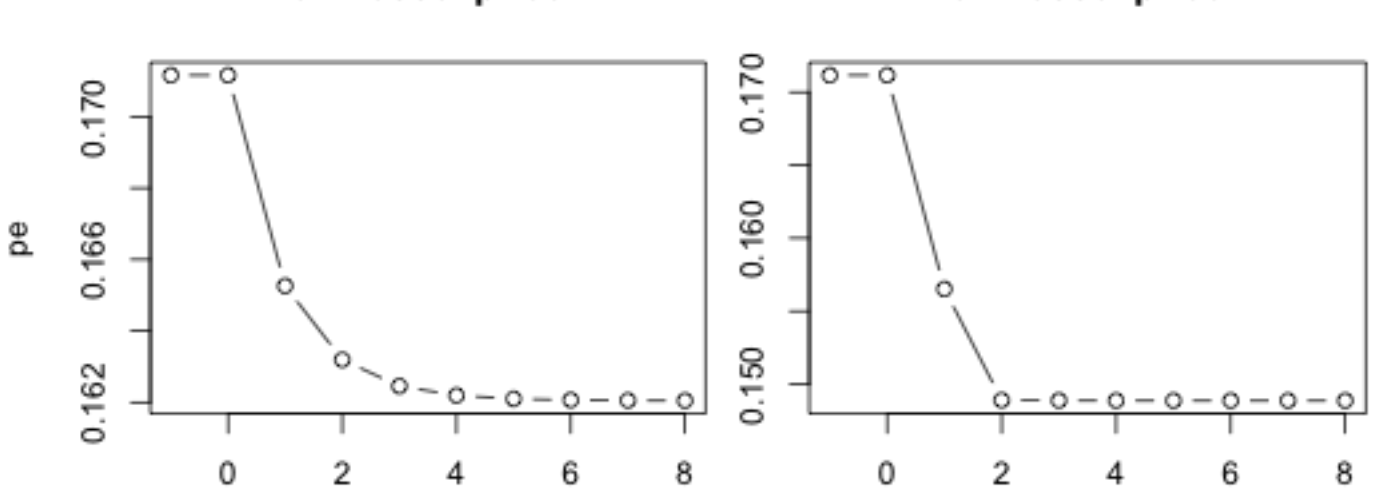
Stylized depiction of price dynamics after a shock to wholesale prices



Small shock

Big shock



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Short-run dynamics

$$dp_t^e = \beta_1^+ I^* u_{t-1} + \beta_1^- (1 - I^*) u_{t-1} + \gamma_{11} dp_{t-1}^e + \gamma_{12} dp_{t-1}^w + \varepsilon_{1,t}$$

$$dp_t^w = \beta_2^+ I^* u_{t-1} + \beta_2^- (1 - I^*) u_{t-1} + \gamma_{21} dp_{t-1}^e + \gamma_{22} dp_{t-1}^w + \varepsilon_{2,t}$$

Ex-vessel price equation Wholesale price equation

$$\begin{matrix} \\ \beta_1^+ \\ \beta_1^- \\ \gamma_{11} \\ \gamma_{12} \end{matrix} \begin{bmatrix} & & \\ -0.5 & (-3.92) \\ -1.11 & (-8.04) \\ -0.03 & (-0.40) \\ -0.14 & (-1.60) \end{bmatrix} \begin{bmatrix} & & \\ 0.28 & (2.24) \\ -0.16 & (-1.14) \\ -0.01 & (-0.09) \\ -0.20 & (-2.43) \end{bmatrix} \begin{matrix} \\ \beta_1^+ \\ \beta_1^- \\ \gamma_{21} \\ \gamma_{22} \end{matrix}$$

H0₁ *H0₂*

Granger causality tests indicate that price shocks flow downstream

$H0_1$: p^w does not Granger cause p^e	F-stat: 2.99	p-value 0.086
$H0_2$: p^e does not Granger cause p^w	F-stat: 0.01	p-value < 0.93

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Summary of the model results

There exists an equilibrium between wholesale and ex-vessel prices:

- Structural break in the equilibrium relationship in 2008 that reduced the margin between prices.

Evidence of Asymmetric price transmission:

- Find that large negative deviations (>8%) are transmitted to the more quickly.

- Find that price shocks flow downstream through the supply chain (wholesale -> ex-vessel).

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Final remarks

Identification of APT does not assign a causal mechanism (methods lacking in this regard)

- Lack the data to investigate whether the asymmetries can be attributed to adjustment costs by processors
- A better understanding of the contractual relationships between harvester and processors is needed.
  - Investigate differences in the contractual relationships for AFA pollock vessel in the EBS and GOA pollock vessels.
- Herfindahl indices show some increased concentration of deliveries after 2008 & many vessels deliver to only a single company (>70%). Suggesting potential for market power.
- The reduction in the margin starting coinciding in 2008 runs contrary to the notion of market power as a sole cause.

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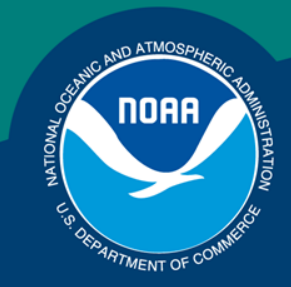

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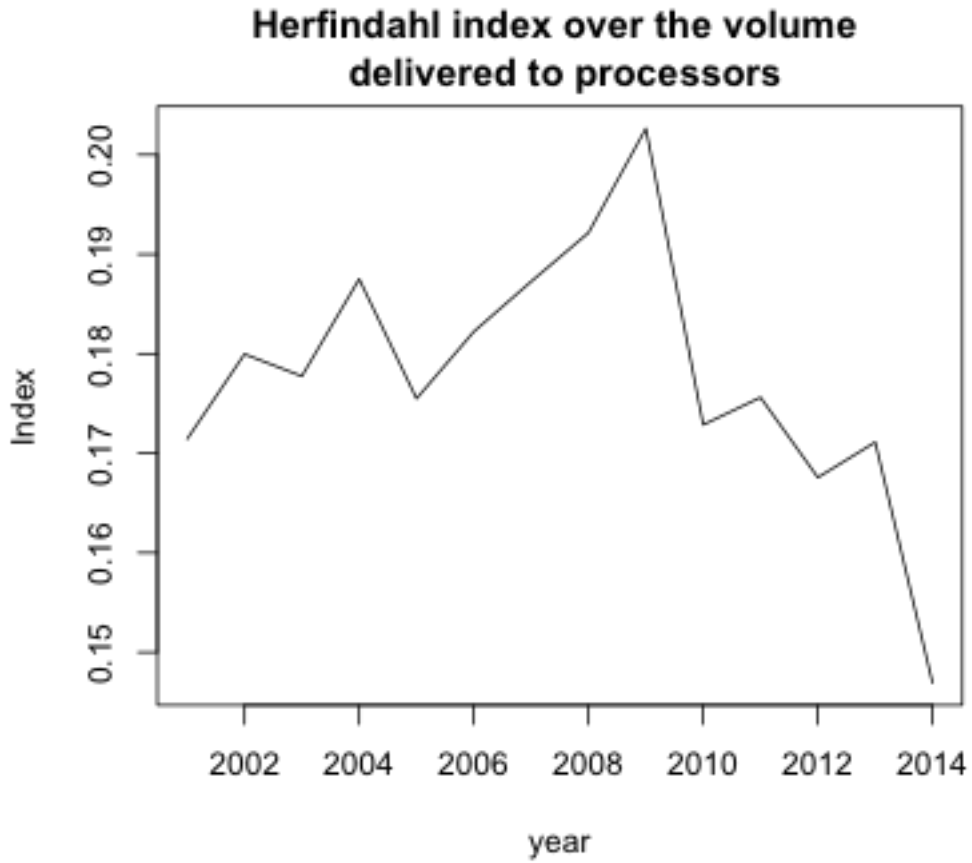
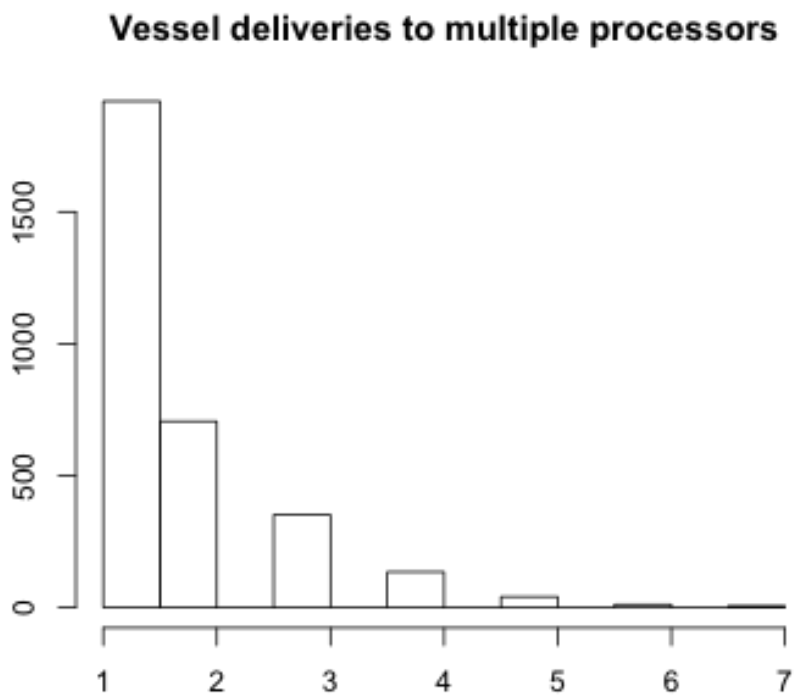
Concentration in the ex-vessel market





1	2	3	4	>4
60%	22%	11%	4%	2%

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Final remarks

The identification of APT does not assign a causal mechanism (methods lacking in this regard)

- We lack the data to investigate whether the asymmetries can be attributed to adjustment costs by processors
- A better understanding of the contractual relationships between harvester and processors is needed

The concentration of deliveries to processors starting in 2008 play role.

- The reduction in the margin starting coinciding in 2008 runs contrary to the notion of market power as a sole cause.
- Given that 30%-40% of vessels deliver to multiple processors this may provide sufficient competition.

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Estimating the Asymmetric price transmission model

1. Estimate the long-run relationship between prices
2. Test if the relationship forms an equilibrium
3. Estimate the equilibrium adjustment process and associated threshold
   - Test the validity of the threshold
4. Test

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Connection Between Markets

In a friction-less, sufficiently competitive economic world the difference between first-wholesale and ex-vessel prices would be the value-added by processing.

=> Fluctuations in prices across markets coupled.

$$p_t^{wsl} - \alpha_0 - \alpha_1 p_t^{exv} = u_t$$

The dynamic relationship between these market can be modeled through an error-corrections model.

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Modeling relationships between prices (The symmetric case)

Long-run equilibrium relationship

$$p_t^e - \alpha_0 - \alpha_1 p_t^w = u_t$$

Adjustment to the equilibrium modeled as AR process

$$du_t = \rho u_{t-1} + \lambda du_{t-1} + e_t$$

Error corrections model describes the short-run dynamics

$$dp_t^e = \beta_1 u_{t-1} + \gamma_{11} dp_{t-1}^e + \gamma_{12} dp_{t-1}^w + \varepsilon_{1,t}$$

$$dp_t^w = \beta_2 u_{t-1} + \gamma_{21} dp_{t-1}^e + \gamma_{22} dp_{t-1}^w + \varepsilon_{2,t}$$

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Pollock's global market position

Global whitefish & other groundfish: 74,004,976 mt

Global wild white fish 2013 (capture): 9,198,320 mt

Global pollock harvest 2013: 3,247,621 mt

Total AK pollock harvest 2013: 1,370,100 mt

Pollock competes in a global market for whitefish products. Export prices should serve a good proxy for first wholesale prices. Price changes at the wholesale level are largely exogenous by the larger global market for whitefish products.

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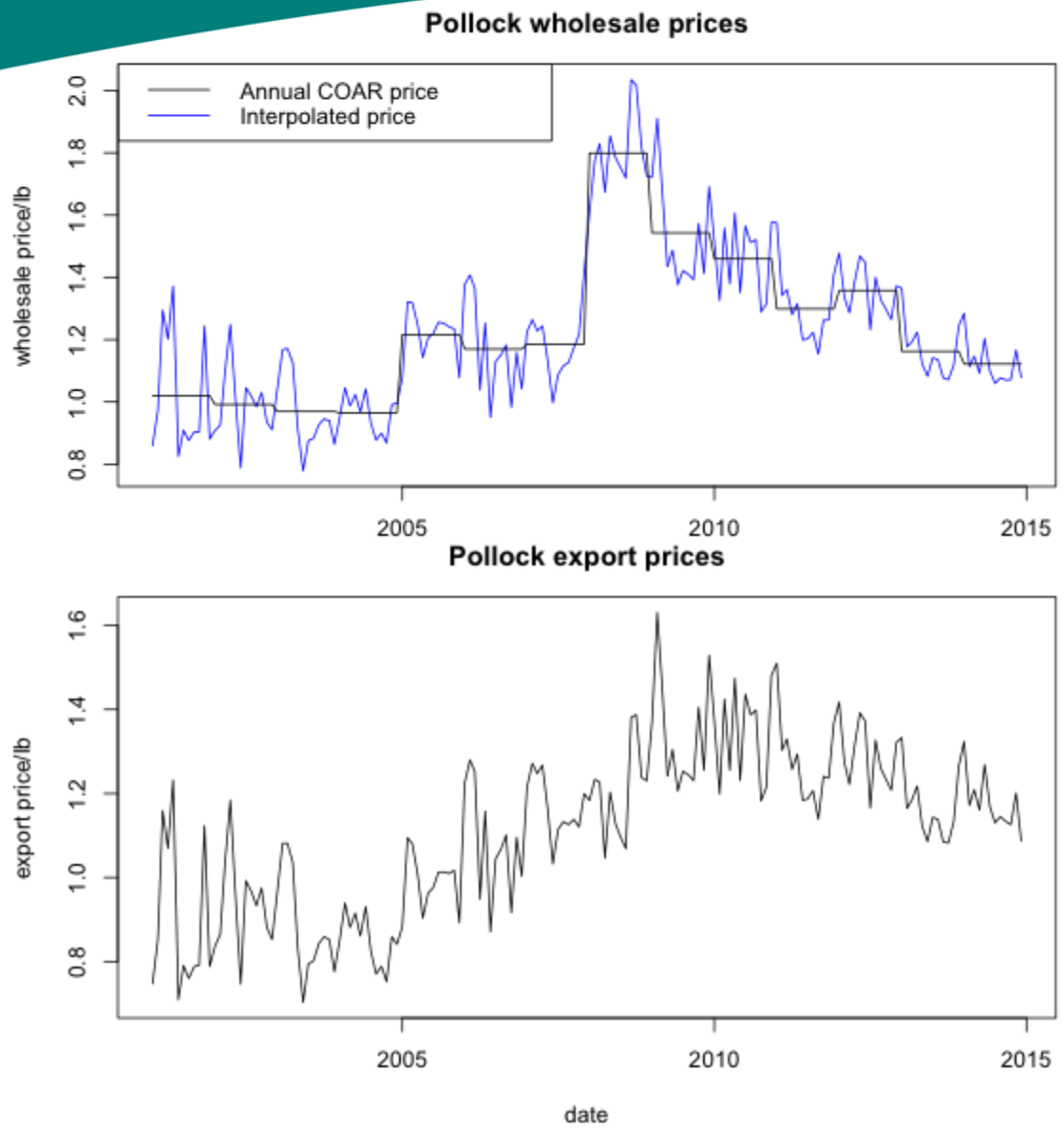
Chow & Lin (1971) interpolation:

- Based on estimation of the low-frequency relationship between prices.
- Adjustments so that annual average of the monthly price is equal to the annual price.



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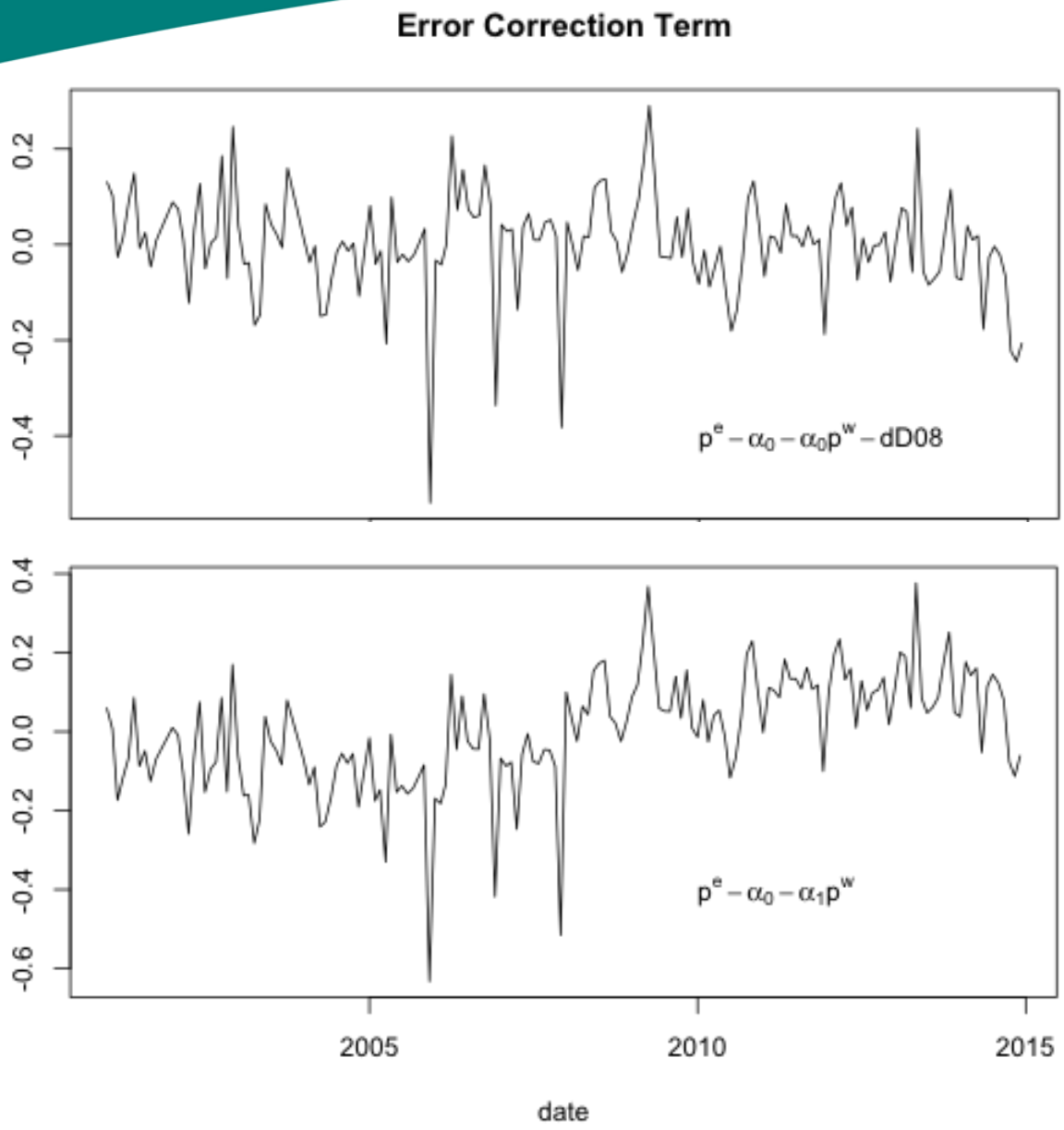
Structural break in the equilibrium relationship between ex-vessel and wholesale prices in 2008.



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Testing the price equilibrium

Price tend to be non-stationary => no long-run mean

H0: Unit Root present (i.e. price are non-stationary)

	ADF Test (lags)		DF-GLS Test (lags)	
log wholesale price/lb	-1.98	(3)	-1.9	(3)
log ex-vessel price/lb	-1.63	(12)	-1.53	(12)
	1pct 5pct 10pct		1pct 5pct 10pct	
Critical values	-3.46 -2.88 -2.57		-2.58 -1.94 -1.62	

Conclusion: prices are non-stationary

If the estimate relationship is stationary the prices are coupled over time (i.e., there's an equilibrium relationship)

Residual ($\hat{u}_t$) stationary ADF: -7.09*** DF-GLS= -4.35***

Conclusion: there exists an equilibrium between prices