The Price of Lobster
Forecasts and Simulation in a ARDL- Bounds Testing Framework

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Introduction

- Economists have long been interested in forecasting the price of staple commodities
- Moore's (1917) path breaking work on cotton.
- Sarle (1925) multivariate reduced form econometric modelling on hogs

- Many contributions; agriculture, fisheries, metals, electricity using both structural and reduced form econometric models and more recently univariate and multivariate time series models.

Objective

- Reduced form econometrics in forecasting the ex-vessel price of lobster on the east coast of Canada
- The reduced form model: Autoregressive Distributed Lag (ARDL) framework within an Error-Correction (EC)
- To estimate elasticities of interest and to measure the speed of adjustment to regain the equilibrium
- To simulate some alternative price scenarios
- Interest is policy driven; to generate accurate forecasts and turning points, support planning, management and predicting income and welfare effects of fishermen

- Why Lobster?

- Collapse of the groundfish fishery, crustaceans (particularly lobster) the most important fisheries in terms of export value, in Canada
- In 2008, groundfish accounted for only 9% of total value landed whereas, shellfish reached 78% of total value landed
- Lobster is the premier export fishery, $680.5 million, landed volume of 75 thousand tonnes, 2013

Literature

- Doll (1972) structural forecasting model studying a five-equation model of U.S. shrimp
- Gillig et al. (1998) structural approach to measure ex-vessel price flexibilities in the Gulf of Mexico shrimp fishery
- Gates and Richardson (1986) reduced form simulation model to examine prices in the American lobster fishery.
- Kellog & Wang (1988) reduced form model to determine the price impact from increases in minimum size for lobster.
- Greenberg et al. (1995) reduced form model to measure the price impact of increased harvest, the Alaska snow crab fishery

- Time series techniques used in fish price forecasting.

- Dupont (1993) ARIMA models to construct price forecasts that feed into a model of profit expectations on fishing location
- Oglend & Sikveland (2008) use ARCH and GARCH to examine the volatility of fish prices. Variance to measure market risk.
- Guttormsen (1999) price variation in farmed salmon. Classical Additive Decomposition model preformed well in predicting price but a VAR did well in predicting turning points

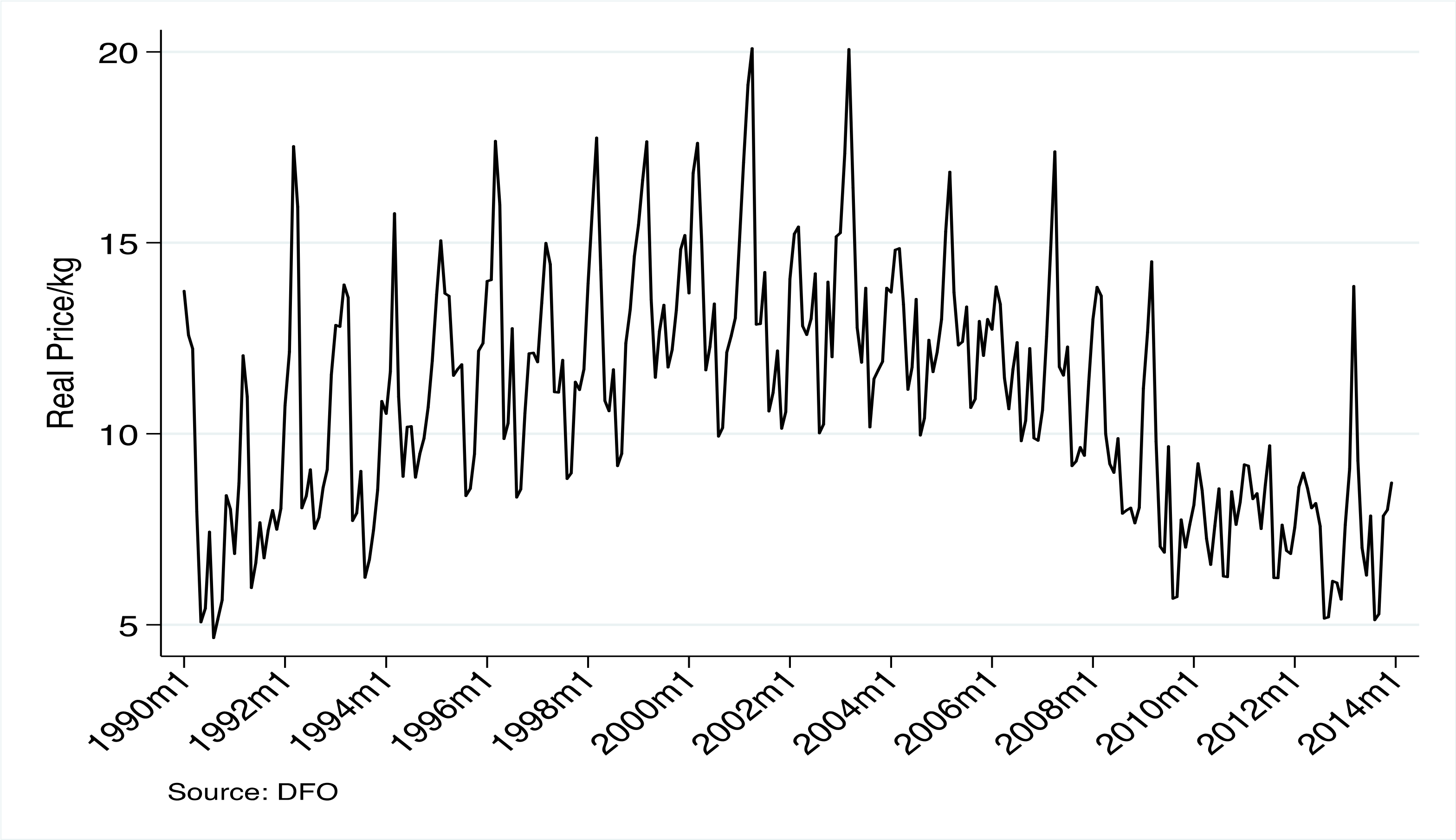
- The current research builds on this literature by modelling and forecasting the ex-vessel price of lobster.
- Based on the statistical stationary properties of the variables, an ARDL model is used for empirical purposes
- An inverse demand curve within an EC framework to model both short- and long-rung positions in the fishery.

THE LOBSTER FISHERY

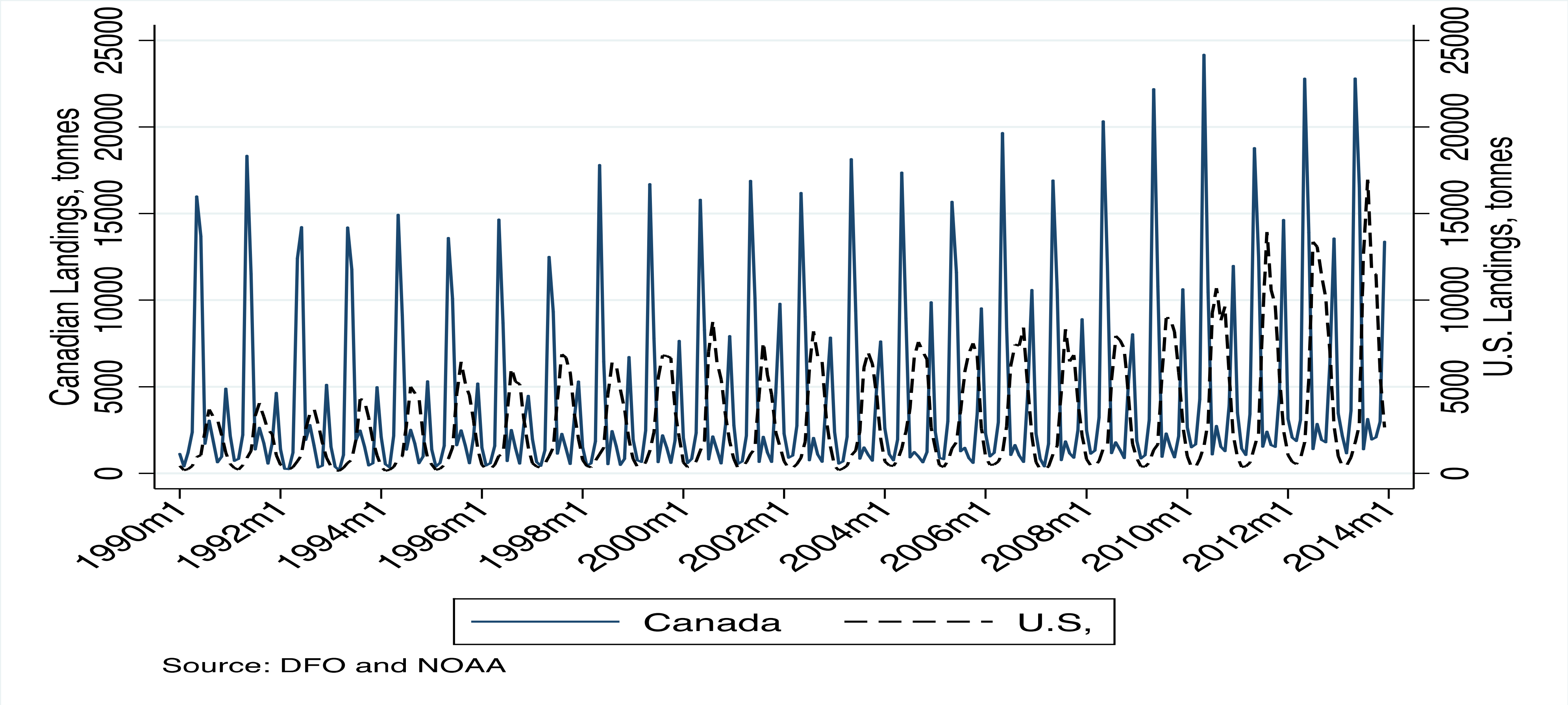
- Lobster high value fishery, 78% exported to the United States
- Management 45 in-shore lobster areas with some 10,000 licensed fishermen
- Management input controls; limits number of traps, seasonal closures, restrictions on size and harvesting egg-bearing females
- Off-shore fishery small and regulated with TAC
- Econometric implications? No major policy shocks of interest.
- Harvest endogenous and may be correlated with error term

$$P_t = f(LQ_t, Ex_{jCt}, GDP_{jt}, \varepsilon_t) \tag{1}$$

- *P* is real landed price of lobster in Canadian dollars, *LQ* is landed quantity, *Ex* is exchange rate, *GDP* is real gross domestic product U.S.and *ε* is a stochastic error term that gathers up all other factors that impact the real average landed price.



- Real Price Canadian Lobster: monthly 1990-2013



- Canadian and U.S. Landings Lobster, monthly 1990 – 2013

Optimal Lag Structure Under Three Alternative Statistics

Variable	AIC	BIC	MAIC	
Price[a]	4	4	12	
Landings Can[b]	4	4	12	
Landings US[c]	4	4	13	
Ex[d]	2	2	1	
U.S. GDP	4	4	3	
Observations	284			

Alternative Tests for Variable Stationary in Distribution

Variable	DF	glsDF	PP	KPSS
Ex-vessel Price	Level[e] First-Diff	Level[e] First-Diff	Level	First-Diff[e] First-Diff
Quantity Can	Level First-Diff	Level First-Diff	Level	Level First-Diff
Quantity US	Level First-Diff	Level First-Diff	Level	Level Level
EX	First-Diff First-Diff	First-Diff First-Diff	First-Diff	First-Diff First-Diff
GDP US	First-Diff First-Diff	First-Diff First-Diff	First-Diff	Level First-Diff

- Long run
- $P_t = f(LQ_{c_t}, LQ_{us_t}, Ex_{usc_t}, GDP_{u_t}, \varepsilon_t)$

- Critical assumption: Causality runs from the exogenous or independent right-hand-side variables to ex-vessel price
- Individually the right-hand-side variables are not correlated with the error term, test Canadian Landings
- Apply cointegration tests and, it turns, out that there are at least two conitegrating vectors

Unrestricted ARDL error correction model

- $\Delta P_t^c = \sum_{i=0}^{I} \alpha_{c_i} \Delta LQ_{t-i}^{c} + \sum_{j=0}^{J} \alpha_{us_j} \Delta LQ_{t-j}^{us} +$
- $\sum_{k=0}^{K} \alpha_{ex_k} \Delta Ex_{t-k}^{us,c} + \sum_{s=0}^{S} \alpha_{gdp_s} \Delta GDP_{t-s}^{us} +$
- $\gamma \, (P_{t-1}^{c} - \beta_o - \beta_c \cdot LQ_{t-1}^{c} - \beta_{us} \cdot LQ_{t-1}^{us} - \beta_{ex} \cdot$
- $Ex_{t-1}^{us,c} - \beta_{gdp} GDP_{t-1}^{us}) + \vartheta_t$

- The speed of adjustment $-1 \leq \gamma \leq 0$ and the closer to -1 the more rapid the recovery from short-run shocks.

Testing Endogeneity

- Boswijk and Urbain (1997) suggest a modified application of the Hausman test for weak exogeneity
- Distributed lag model in Landed Quantity Canada

- $\Delta LQ_t^c = \ \delta_o + \sum_{j=1}^{I} \delta_j \Delta LQ_{t-i}^c + \sum_{i=1}^{I} \delta_i \Delta P_{t-i}^c +$
- $\sum_{k=1}^{K} \delta_k \Delta LQ_{t-k}^{us} + \sum_{s=1}^{S} \delta_s \Delta Ex_{t-s}^{usc} + \sum_{v=1}^{J} \delta_j \Delta GDP_{v-j}^{us} + \epsilon_t$

Testing Endogeneity

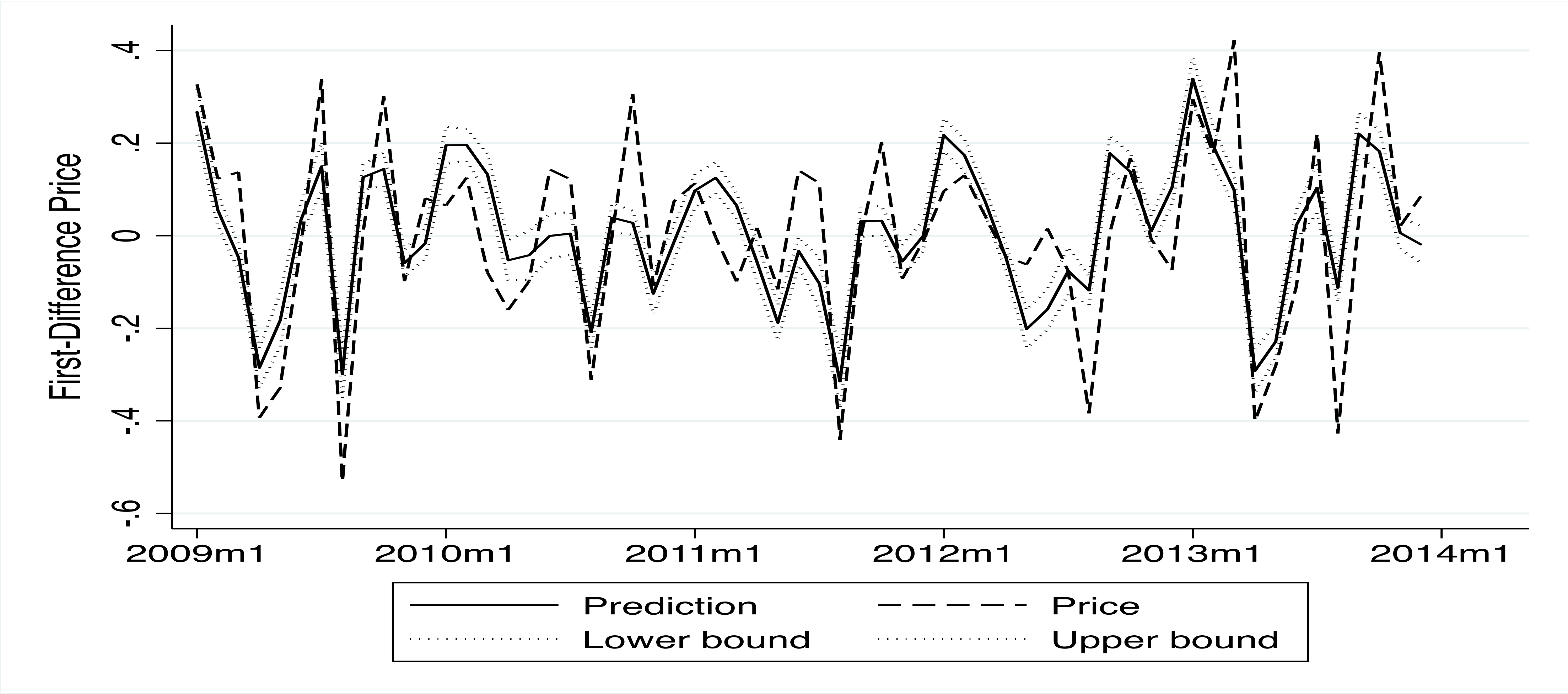
- Long Run sense, add lagged error term from cointegration equation to DL model
- Short Run Sense, add error from DL to ARDL-EC

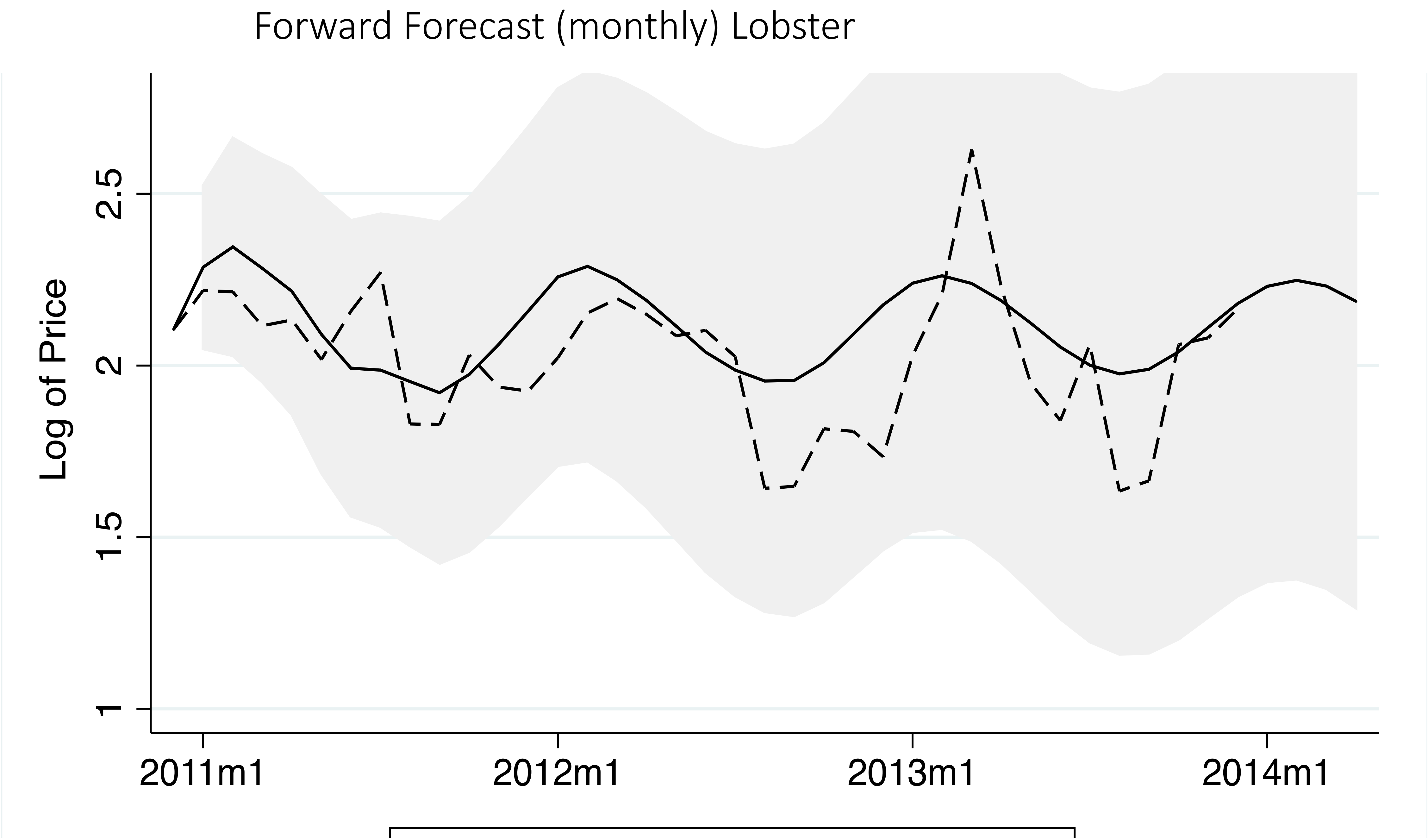
- Follow standard practice in forming DL model in setting lag length and find that we need second order terms to Not reject correct speciation.
- Not reject weak exogeneity, why?

Some Results

Short- Long-run Elasticities : Speed of Adjustment	
Short- Landed Can	-0.0811 (0.00)
Landed US	-0.091 (0.00)
Long- Landed Can	-0.90 (0.00)
Landed US	-1.126 (0.00)
Speed of adjustment	-0.414 (0.00)

Out-of-sample Forecast (monthly) Lobster





Forward Forecast (monthly) Lobster
Log of Price
2.5
2
1.5
1
2011m1
2012m1
2013m1
2014m1

Summary

- The purpose of this report was to model and forecast trends and turning points in ex-vessel price series for lobster, northern shrimp and snow crab. Both annual and monthly data are used in estimation. The main econometric model relies on the error-correction framework of Granger and Johansen using a vector autoregressive (VEC) estimation procedure.
- The forecasting results for lobster using both annual and monthly data are very promising. The results based on the dynamic VEC model capture trend and turning points in the data and should serve as a reasonable forecasting tool for policy and management.