



Domestic and Export Price Formation of U.S. Hops

Gnel Gabrielyan and Thomas L. Marsh



INTRODUCTION

- Hops are one of the four main ingredients used in the brewing process to add bitterness and keep freshness
- Huge price volatility in the recent years
- The U.S. is the second largest producer of hops (30% in 2010)
 - Washington State is the largest producer in the U.S. (80% in 2010)
 - Washington State has 24% share of the world market
- To the extent of our knowledge this is a topic that has received almost no attention in the economic literature.
- It is a surprising observation given that hops are a primary ingredient in a favorite beverage of consumers across the world – beer.

OBJECTIVES

- Identify and quantify factors that determine domestic and international (i.e., export) hop prices
- Increase efficiency of contracting
 - Assist growers to define and implement better strategies to deal with the price shocks

DATA

Domestic Price

- Annual time series data – from NASS/USDA for 1947 – 2009
 - Quantity
 - Price
 - Stocks
- The producer price index for farm products – from US Department of Labor – Bureau of Labor Statistics

Export Prices

- Quarterly time series data – from FAS/USDA for 1988 – 2011
 - Quantity of exports,
 - Unit values

METHODOLOGY

Domestic Price Analysis

Because of data limitations and the simultaneous nature of production, demand, and storage of hops, we rely on reduced form modeling techniques to estimate hop prices.

$$Q_t = f(P_t, X_t)$$

$$h(P_t) = g(Q_t, S_t, Y_t) \quad \text{where } h(P_t) = \frac{P_t^\lambda - 1}{\lambda} \text{ is the box-cox transformation specification.}$$

$$S_t = \phi(P_t, Q_t, Z_t)$$

The price dependent reduced form equation is specified as

$$\ln P_t = \beta_0 + \beta_1 Q_t + \beta_2 Q_{t-1} + \beta_3 Q_{t-3} + \beta_4 \ln P_{t-1} + \beta_5 \ln P_{t-2} + \beta_6 S_{t-2} + \beta_7 S_{t-3} + \varepsilon_t$$

Export Price Analysis

Inverse translog model is applied for hop export price analysis

$$w_i = \frac{\alpha_i + \sum_{j=1}^4 \alpha_{ij} \ln(q_j)}{1 + \sum_{j=1}^4 \sum_{i=1}^4 \alpha_{ij} \ln(q_j)} + \varepsilon_i$$

Homogeneity in quantities and symmetry restrictions, imply

$$\sum_{i=1}^4 \alpha_i = 1, \sum_{i=1}^4 \alpha_{ij} = 0, \alpha_{ij} = \alpha_{ji}$$

RESULTS (DOMESTIC PRICES)

Variables	Estimates (SE)	Standard errors	Flexibilities (Short run)	Flexibilities (Long run)
Q_t	0.005*	0.003	0.28	
Q_{t-1}	-0.006**	0.003	-0.33	1.02
Q_{t-3}	0.005**	0.002	0.29	
P_{t-1}	1.084***	0.153	0.34	
P_{t-2}	-0.324*	0.178	-0.10	
S_{t-2}	-0.007***	0.003	-0.39	0.08
S_{t-3}	0.008***	0.003	0.41	
Constant	-0.179**	0.086		

$R^2 = 0.85$, $RMSE = 0.096$

* - significant at 10% ** - significant at 5%, *** - significant at 1% levels,



RESULTS (EXPORT PRICES – FLEXIBILITIES)

Variable*	Mean	Std. Dev.	Min	Max
f11	-0.214	0.315	-26.583	6.518
f12	-0.063	0.013	-0.332	1.114
f13	-0.113	0.036	-0.884	2.997
f14	-0.609	0.266	-6.301	21.472
f21	-0.077	0.004	-0.186	0.155
f22	-0.083	0.124	-6.650	4.084
f23	-0.108	0.010	-0.446	0.437
f24	-0.732	0.112	-4.452	5.114
f31	-0.231	0.075	-7.292	0.339
f32	-0.174	0.052	-5.063	0.239
f33	0.026	0.500	-3.128	47.310
f34	-0.621	0.374	-35.956	1.550

– i,j = 1 – Brazil, i,j = 2 – Canada, i,j = 3 – Germany, i,j = 4 – ROW

CONCLUSIONS / WORK IN PROGRESS

➤ Domestic Price Analysis

- Preliminary results show that lagged stocks for two and three periods have significant impact on prices.
- Current production and lagged productions for one and three years also significantly impact the prices of hops.
- The significance of lagged variables is consistent with the typical contract length between hops growers and dealers

➤ Export Price Analysis

- There is a negative relationship between prices and quantities of hop exports to Brazil and Canada, and a positive relationship between hop prices and exports to Germany
- When Germany increases the volume of imports of U.S. hops, producers in the U.S. are willing to supply more hops at higher prices