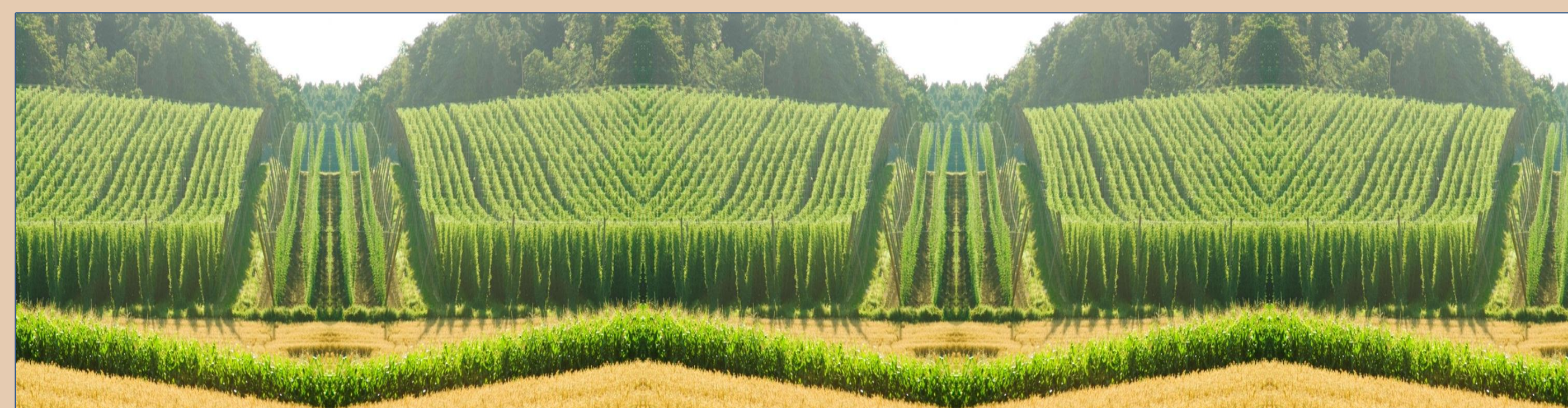


Price Formation of Hops in the United States

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

- Understand the nature of hop pricing
 - Increase efficiency of contracting
 - Assist growers to define and implement better strategies to deal with the price shocks

DATA

- Data were compiled from several sources for 1947 - 2009.
 - Time series data – from NASS/USDA
 - Quantity
 - Price
 - Stocks
 - The producer price index for farm products – from US Department of Labor – Bureau of Labor Statistics

METHODOLOGY

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.

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

$$h(P_t) = g(Q_t, S_t, Y_t)$$

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

where $h(P_t) = \frac{P_t^\lambda - 1}{\lambda}$ is the box-cox transformation specification.



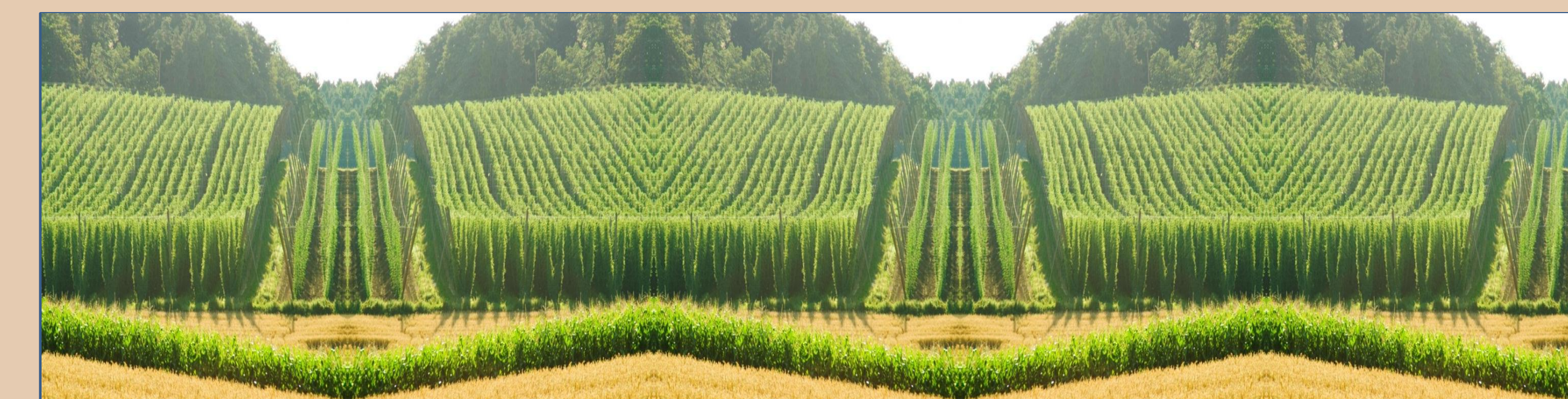
The price dependent reduced form equation is specified as

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

P_t Is the price of hops at time t

Q_t Is the production of hops at time t

S_t Is the amount of stocks of hops at time t



RESULTS

Variables	Estimates (SE)	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	
S_{t-3}	0.008*** (0.003)	0.41	0.08
Constant	-0.179** (0.086)		

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

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

CONCLUSIONS / WORK IN PROGRESS

- 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
- We estimate demand systems for the hops industry in the U.S using Seemingly Unrelated Regression with autoregressive corrections