Domestic and Export Price Formation of U.S. Hops

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INTRODUCTION

According to USDA report/data (USDA/NASS) U.S. hop prices have changed dramatically in the last 2 decades. For example, prices increased by 35% (20% in real terms) from 2007-2008 and decreased by 11% (20% in real terms) from 2009-2010. The price increase in 2008 coincided with an oversupply of hops in 2008 and 2009, which led to lower prices in 2009. By 2010 the production of hops decreased by 30%. In this paper, our interest is examining domestic and export price formation of hops. To the extent of our knowledge this is a topic that has received almost no attention in the economic literature.[1] It is a surprising observation given that the U.S. is a primary supplier of hops in the world market and hops are a primary ingredient in a favorite beverage of consumers across the world – beer.

Hops are one of the four main ingredients used in the brewing process to add bitterness and keep freshness in production of beer (Tremblay and Tremblay, 2005). Moreover, the U.S. plays a vital role in domestic and international trade of hops. According to Barth report (2011) the U.S. is the second largest producer of hops with 29.7% share of the world market in 2010. Germany was the leader in hop production with 34.27% share of world production of hops in 2010. In the U.S. the three main hops producing states are Washington, Oregon, and Idaho. Washington State is by far the largest producer of hops, growing up to 80% of the total U.S. hop production in 2010 (USDA/NASS). Nearly all hops are raised and sold under a contract with a dealer (Hop Growers of Washington, 2008).

[1] Kuhlman and Fore (1939) studied how the hop production costs are derived in Oregon. They found labor, materials and equipment operation, and interests and depreciation on the hop investment where that main drivers of the production costs of hops.

The objective of the current study is to identify and quantify factors that determine domestic and international (i.e., export) hop prices. For example, we hypothesize that stocks, production and lagged variables affect domestic prices, while exported quantities affect U.S. export prices of hops. Understanding the nature of hop pricing may increase efficiency of contracting between growers and dealers, assist growers to define and implement the strategies that mitigate price shocks during periods of under or over supply.

Two modeling strategies are followed. To analyze domestic hop prices we develop a reduced form model because data are limited and only available for annual observations. Kalaitzandonakes and Shonkwiler (1992) argue that, commonly, data scarcity results to a single reduced form equation. To analyze international prices, we focus on a richer data set of quarterly exports and use an inverse translog demand system (Christensen et al., 1975). It is maintained that a demand system framework provides a relevant market setting to posit and test economic hypotheses and to efficiently estimate own- and cross-effect measures of price and substitution flexibilities (Marsh, 2005).

The export data are richer and, as a result, allow us to extend the insights of price formation across countries. Hop pricing at international level will help us to understand the nature of the U.S. hop exports; how prices adjust to clear international markets. We also calculate own and cross-price flexibilities of the U.S. hop exports, which maybe a useful tool for policymakers (i.e., quantifying substitutability and responses across countries).

The reminder of the paper will be in the following order; in the Data section we present the data, which is followed by the methodology section. Then we present results and make conclusions.

DATA

Domestic Prices

For the domestic price analysis, data are limited. Historical data are available from the National Agricultural Statistical Service, USDA, which provides annual hop prices, production and stocks (NASS, USDA 2011). Real prices, aggregate production quantities and stocks data are constructed and used for the domestic price analysis. The study period is from 1947 to 2009.

Descriptive statistics are presented in Table 1. Prices are calculated as a weighted average of all hops reported by dealers.[2] Prices are deflated using the product price index for farm products published by Bureau of Labor Statistics (2011). The average real price for the years 1947-2008 is $ 1.42 per pound in 1982 U.S. dollars. Average hop production is 56.94 million pounds yearly. Stocks include both domestic and international contributions, and are the amount of hop stocks held by growers, dealers, and brewers. The stocks were reported twice per year March 1st and September 1st (NASS, 2010). We used the average yearly stocks number for the analysis. The mean stocks value is 52.7 million pounds annually.

Export Prices

For the export price analysis, we use quarterly time series data from the Foreign Agricultural Service, USDA (2012), which gives historical data of hop exports (quantity and value) from the U.S. to other countries during the years 1988 to 2011. Unit values are calculated from the value and quantity of the exported hops, and are used as proxies for prices.

Descriptive statistics for prices (i.e., unit values), export shares, and exchange rates are reported in Table 2. Exports of hops are presented in thousands of pounds. Exports to three main countries and rest of the world are presented in the table. On average, the largest amount of hops was

[2] USDA-NASS constructs domestic hop prices by sampling on an annual basis a small number of hop merchants, which market a majority of hops produced (personal communication).

exported to Brazil with 947,000 pounds quarterly followed by Germany and Canada with 802,000 and 780,000 pounds respectively. The shares of the values of exports to individual countries on total value of exports are also reported. Again, Brazil, on average, has the highest share of all with coefficient 12.3% of the value of all exports. Shares of values of quarterly exports to Canada and Germany, on average, are 9.8% and 11.8% respectively. Values of exports to these three countries represent 34% of the value of all the exports from the U.S. On average, exports to Germany have the highest real unit value with $5.1 per pound. Real unit values of exports to Brazil and Canada are 3.7 and 3.1 $/pound, respectively.

METHODOLOGY

Domestic Price Analysis

The model for domestic price analysis is conceptualized to include hop production, farm level inverse demand, and storage. Because of data limitations and the simultaneous nature of production, demand, and storage of hops, we rely on reduced form modeling techniques to estimate domestic hop prices. It is common in research to use reduced form models because of simultaneity problems, first described by Haavelmo (1943), and scarcity of data (Kalaitzandonakes and Shonkwiler, 1992). Reduced form equations are often used for estimating different attributes of agricultural commodities (French, 1987; Jordan et al., 1985; Fox, 1954). Park and Lohr (1996) use reduced form equations to evaluate the supply and demand factors of organic broccoli, carrots and lettuce.

Storage of hops, like other agricultural commodities, is likely to be an important factor in the changes of domestic hop prices, volatility, and price spikes. When stocks decline to a minimum feasible level, prices can become hypersensitive to shocks in the market (Wright, 2009). Thus it is important to understand the relationship between prices and stocks. Stocks also dampen the volatility of exports and imports, decreasing the effect of price shocks in the other parts of the world. From the plot of real hop prices and stocks (Figure 1) we observe that prices and stocks move opposite directions. This happens because stock holders benefit from selling the stocks when prices are high, and the accumulate stocks when prices are low.

French (1987) is using per capita carry-in stocks of the commodity as a exogenous variable for estimating farm prices of processed food and vegetables. The use of lagged variables, commonly used in the literature can be partially explained by the extensive use of contracts in the agricultural production (Holt, 2002; Holt and Goodwin, 1997). A typical contract length between hop growers and dealers is 3 to 5 years. MacDonald et al. (2004) and MacDonald (2006) show that agricultural contracting in crop productions has been increased from 12 % in 1969, to 28 % in 1991 and 36 % in 2001.

For the empirical analysis of domestic hops we first conceptualize supply, price determination, and stock equations:

$$Q_t = f(P_t, P_{t-i}, X_t) \tag{1}$$

$$h(P_t) = g(Q_t, S_t, Y_t) \tag{2}$$

$$S_t = h(P_t, Q_t, Z_t) \tag{3}$$

Here Q_t is the quantity produced at time *t*; P_t and P_{t-i} are the real prices of hops at time *t* and lagged prices at *t*-*i*; S_t is the stocks of hops at time *t*; and X_t, Y_t, and Z_t are other exogenous variables affecting the production, prices and stocks of the hops, respectively. To generalize the functional specification of price, $h(P_t) = \frac{P_t^{\lambda} - 1}{\lambda}$ is assumed to be a Box-Cox transformation in (2).

To specify the reduced form model the exogenous or predetermined variables in equations (1)-(3) are used as independent variables to regress on price. The price dependent reduced form equation is specified as

$$h(P_t) = \beta_0 + \beta_1 Q_t + \beta_2 Q_{t-1} + \beta_3 Q_{t-3} + \beta_4 \ln P_{t-1} + \beta_5 \ln P_{t-2} + \beta_6 S_{t-2} + \beta_7 S_{t-3} + \varepsilon_t \qquad (4)$$

where P_t is the real price of hops at time ***t***, P_{t-1} and P_{t-2} are lagged prices for one and three years, Q_t is the produced quantity at time t, Q_{t-1} and Q_{t-3} are lagged quantities for 1 and 3 years, S_{t-2} and S_{t-3} are lagged stocks for 2 and three periods. In (4) ε_t is the residual variable, which encompasses other effects that the model cannot capture. For example, weather conditions that might affect the price of the hops, or international prices and demand of hops. Generally speaking, given the nature of the reduced form model, we have no a priori expectations on the signs of the unknown parameters β_i 's.

The Box – Cox transformation (Box and Cox 1964) is applied to the dependent variable of the inverse demand equation, as suggested by Greene (2003). The result of Box – Cox test is given in the table 3. We can see that at 10% significance level we reject the null hypothesis that $\lambda = -1$ and $\lambda = 1$. But we cannot reject that $\lambda = 0$. This supports log (prices) as a dependent variable. Based on the result it is determined that the price is appropriately modeled with a natural log transformation.

Several specification tests were completed to arrive at a preferred model. Quantity produced is likely predetermined in the model because of the biological nature of hop production process. Therefore, it was hypothesized not to be endogenous with prices of hops. To test this hypothesis statistically, we perform Hausman – Wu endogeneity test (Hausman, 1978 and Wu, 1973). We couldn't reject the null hypothesis at 10% level that quantity is exogenous.

A variety of other statistical tests were performed to check different properties of our data. The results of those tests are presented in the table 3. Shapiro – Wilks (1965) test is performed to check whether the residuals are normally distributed with the null hypothesis that the residuals are normally distributed. We couldn't reject the null hypothesis at 10 % level. To check if the residuals are iid randomly distributed we perform a nonparametric Wald – Wolfowitz (1940) test. We cannot reject the null hypothesis at 10% significance level that the residuals are randomly distributed. We use augmented Dickey – Fuller (1970) test to check whether the data is stationary. The result supports that the time series data doesn't have unit root. Therefore, it is stationary. A Durbin – Watson (1951) test is performed to test the presence of autocorrelation in the residuals. The result of Durbin – Watson (1951) test, 2.09, suggests that there is no correlation of the residuals (consistent with the Wald-Wolfowitz test).

Export Price Analysis

Export demand equations are conceptualized following Diewert and Morrison's (1986) production theory approach. Econometric specifications for price dependent models include but are not limited to the linear inverse demand system (e.g., Moschini and Vissa 1992) and the inverse almost ideal demand system (Eales and Unnevehr, 1994)[3]. For the hop export price analysis we apply the inverse translog model developed by Christensen et al. (1975)[4].

The inverse share equation is specified as the following

[3] It is dual to the almost ideal demand systems (Deaton and Muellbauer, 1980).

[4] Preliminary analysis indicates that the inverse demand model (prices adjusting to clear the market) outperforms (e.g., predicts the shares of exports more accurately and exhibits better overall statistical significance) the standard demand systems model (quantities adjusting to prices). This is consistent with quantities being predetermined by the hops production process.

$$w_i = \frac{\alpha_i + \sum_{j=1}^{4} \alpha_{ij} \ln(q_j)}{\sum_{i=1}^{4} \alpha_i + \sum_{j=1}^{4} \sum_{i=1}^{4} \alpha_{ij} \ln(q_j)} + \varepsilon_i \tag{5}$$

The index i is defined as i = 1 – Brazil, i = 2 – Canada, i = 3 – Germany, and i = 4 – Rest of the World. In (5), w_i are the factor shares of the value of the exports to country ***i*** to the total value of all hop exports from the U.S ($w_i = \frac{p_i q_i}{\sum_{i=1}^{4} p_i q_i}$) and the p_i are real unit values of exports to the country ***i***. The quantities of the exports to country j are defined by q_j. We normalize $\sum_{i=1}^{4} \alpha_i = 1$ so that

$$w_i = \frac{\alpha_i + \sum_{j=1}^{4} \alpha_{ij} \ln(q_j)}{1 + \sum_{j=1}^{4} \sum_{i=1}^{4} \alpha_{ij} \ln(q_j)} + \varepsilon_i \tag{6}$$

Homogeneity in quantities and symmetry restrictions, imply

$$\sum_{i=1}^{4} \alpha_i = 1, \; \sum_{i=1}^{4} \alpha_{ij} = 0, \;\; \alpha_{ij} = \alpha_{ji} \, . \tag{7}$$

Flexibilities are given as (Moschini and Vissa 1992)

$$f_{ij} = \frac{\alpha_{ij} - s_i (\sum_k \alpha_{kj})}{\alpha_i + \sum_k \alpha_{ik} \ln(q_k)} \; for \, all \, i, j, i \neq j \tag{8}$$

$$f_{ii} = \frac{\alpha_{ij} - s_i (\sum_k \alpha_{kj})}{\alpha_i + \sum_k \alpha_{ik} \ln(q_k)} - 1, \; for\ all\ i \qquad (9)$$

To test residuals in (6) for autocorrelation, we follow Berndt and Savin (1975).

PRELIMINARY RESULTS / DISCUSSIONS

Domestic Prices

The results of domestic price formation are presented in the Table 4. Current period quantity is significant at 10% level and has positive impact on prices. The coefficients of lagged quantities Q_{t-1} and Q_{t-3} are also significant at 5% level. They have negative and positive impact on prices respectively. The long run own – quantity flexibility equals to 1.02. This indicates that if the quantity of production increases by 1%, in the long run, prices will increase by1%. The long run own – quantity flexibility is different than the short run flexibility. A reason for this that production contracts are from 3 to 5 years. The quantities in the short run have very small impact on the prices because they are specified by the contracts. In the long run, however, the prices can be renegotiated and the produced quantities will have larger impact on the market prices of hops.

Lagged prices for 1 and 2 periods are also significant at 1 and 10 % respectively. Last period's prices have positive impact on prices in this year. But the prices two periods ago have negative affect on this period's prices.

Coefficients of lagged stocks are significant at 1% level. They also have different impact on prices. While the coefficient of lagged stocks for 2 periods have negative impact on prices this period, the coefficient of lagged stocks for three years have a positive impact on prices at time t. Long run flexibility of stocks equals 0.08.

The composition and collection process of the available data create some limitations for our analysis. First of all we estimate a reduced form model to analyze domestic prices of hops. Hence, it restricts interpretation of structural effects (i.e., the positive relationship between quantities produced and hop prices in the long-run). Another issue is the availability of only aggregate annual data on prices, stocks and quantities of total production, which excludes the seasonal fluctuations, as well as limits the information about the quantities and prices of different varieties of hops produced. The reported prices may not represent the real variation of prices in the market.

It is also possible that other market forces have pushed both quantities produced and prices of hops up over time. From the Figure 1 it is clear of the long run that prices and quantities of hops produced have gradually increased since 1960s. In the short-run we find a negative relationship between lagged quantities of one year and the current prices. This explains that, at least in the short-run we observe traditional negative relationship between quantities and the price of hops.

Export Prices

For estimation of export price analysis we use iterated seemingly unrelated regression with restrictions in (7).[5] We drop the rest of the world equation from the system of equations, as the shares of values of exports to individual countries sum up to one. Likelihood ratio tests are performed to test for autocorrelation in the residuals and analyze the order of autocorrelation. The result implies that there is significant autocorrelation of the first order. Therefore, the reported model is estimated with first order autoregressive correction (see Table 5).

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[5] Curvature conditions are not imposed for initial data exploration in the preliminary analysis. Further identification and investigation of the model will be completed to determine a final, preferred model.

To quantify and interpret the results we calculate own-price and cross-price flexibilities which are reported in Table 6. From the calculated flexibilities we can see negative own-quantity flexibilities for Brazil and Canada, which are in accordance with the law of demand. This implies that if quantities of exports go up by one percent then the price of hops to Brazil and Canada decrease by 0.21% and 0.083%, respectively. However, we have positive own-quantity flexibility for Germany. If the exported quantities to Germany increase by one percent then the price of hops increases by 0.026%. We provide a plausible explanation, which needs further exploration, why there is a sign difference between own-quantity flexibilities among the countries. For Brazil and Canada imports of U.S. hops can be substituted by imports from different countries, e.g. Germany. On the other hand, Germany is the largest producer of hops in the world. Therefore, when Germany demands more hops from the U.S., domestic producers in the U.S are willing to supply more hops to Germany at higher prices.

Cross-price flexibilities are negative as well, indicating the complementarity of the U.S. hops for different countries. These results indicate that unit prices of exports are negatively related to the exported quantities to different countries. However, from the parameter estimates (see Table 5), we point out that exports to Brazil and Canada don't have significant impact on the shares of values of other exports. Meanwhile, exports to Germany have marginally significant impact on the unit prices of hop exports to Brazil and Canada. This may be because of market power that Germany has in the international hop markets. We also notice that the exports to the rest of the world have the most impact on the unit prices of exports to individual countries. These results are not surprising considering that exports to the rest of the world make up more than half of the total hop exports from the U.S.

Reported results show high R-squares and adjusted R-squares for all the three equations (Table 7).The predicted values also show that the model adequately captures the variation of the shares of values of exports to all three countries; Brazil, Germany, and Canada (Figures 2, 3, and 4). High goodness of fit measures indicate that the exported quantities explain more than 70% of the volatility of shares of values of exports for each estimated equation. Because of the model specification we can conclude that the model explains well shares and, hence, price formation of hops at the export level.

We detect some similarities and differences between domestic and international price formations of hops. Although long-run own-quantity flexibilities are positive in domestic price analysis we have negative short-run own-quantity flexibilities. We observe similar negative relationship between unit prices and export quantities to Brazil and Canada. When exports of hops to those countries increase the unit prices go down. In contrast, we have positive own-quantity flexibilities for the Germany. We speculate that Germany's market power in hop production in the world plays a vital role in that relationship.

CONCLUSIONS

Considering the facts that hops are one of the major ingredients in beer production and the U.S. is the second producer of hops in the world, it is surprising no study was done to analyze the price formation of hops. The purpose of our study is to determine what factors affect the price of hops at domestic and international levels. We analyze reduced form model and inverse translog model for the domestic and export hop analysis respectively.

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 hop growers and dealers. The empirical model in the paper provides insights into price formation; the mechanisms of how the hop prices are determined and how the current production and previous production lags and stocks of hops are affecting prices.

Preliminary analysis of hop export prices show that there is negative relationship between prices and quantities of hop exports to Brazil and Canada, and positive relationship between hop prices and exports to Germany. For Brazil and Canada we find an inverse demand situation, if the quantity demanded increases, then prices go down. For Germany we find a different situation. Germany is the world's largest producer of hops, thus, they have potential market power compared to any other country importing U.S. hops. 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.

To better describe the relationship between hop exports and prices we are planning future extensions of the current work to (1) examine more flexible models; (2) explore more carefully identification and market power issues; (3) testing and imposing curvature restrictions; and (4) expanding the empirical analysis using Monte Carlo simulations. This will give us more information to interpret and understand price formation of hops on domestic and international levels.

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Table 1. Descriptive Statistics – Domestic Price Analysis

Variable	Mean	Standard Deviation	Min	Max
Real prices in $/pound	1.42	0.34	0.94	2.50
Production (1000 lbs.)	56940.85	11387.82	35454.00	80630.10
Stocks (1000 lbs.)	52707.70	16791.06	24130.00	84198.00

Table 2. Descriptive Statistics – International Price Analysis

Variable	Mean	Std. Dev.	Min	Max
Exports to Brazil (000 lbs.)	947.469	776.730	99.869	4482.438
Exports to Canada (000 lbs.)	779.146	449.502	78.264	3554.732
Exports to Germany (000 lbs.)	802.232	692.999	26.896	3634.540
Exports to rest of the world (000 lbs.)	3812.653	1500.691	756.185	7866.752
Share of value of exports to Brazil	0.123	0.090	0.027	0.508
Share of value of exports to Canada	0.098	0.060	0.025	0.351
Share of value of exports to Germany	0.118	0.064	0.004	0.365
Share of value of exports to rest of the world	0.661	0.122	0.227	0.886
Real unit value of exports to Brazil in $/lb.	3.696	1.669	1.489	12.500
Real unit value of exports to Canada in $/lb.	3.055	0.570	1.601	5.226
Real unit value of exports to Germany in $/lb.	5.097	2.778	1.189	17.983
Real unit value of exports to rest of the world in $/lb.	4.752	1.129	2.447	7.812

Table 3: Statistical tests and the results

Problem	Name of the test	H_0: Null hypothesis	Critical value
Model specification	Box – Cox transformation	$\lambda = -1$	38.80*
		$\lambda = 0$	39.86
		$\lambda = 1$	33.41***
Endogeneity	Hausman – Wu	The variable is exogenous	0.056
Normality of residuals	Shapiro – Wilk	Residuals are normally distributes	0.987
IID random sample	Wald – Wolfowitz	Residuals are IID; randomly distributed	-1.180
Unit root	Dickey – Fuller	Stationary data	-1.659
Autocorrelation	Durbin Watson	Autocorrelation in the residuals	2.09

* – significant at 10% level
** – significant at 5% level
*** – significant at 1% level

Table 4: Results (P_t) – Domestic Price Analysis

Variables	Estimates (SE)	Flexibilities (Short run)
Q_t	0.005* (0.003)	0.28
Q_{t-1}	-0.006** (0.003)	-0.33
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
Constant	-0.179** (0.086)	

R^2 = 0.85, RMSE = 0.096

* - significant at 10% level,

** - significant at 10% level,

*** - significant at 10% level,

Table 5: Results – International Price Analysis

Parameter	Estimate	Std. Err	t-value	P-value
Dependent variable: Share of Values of Exports to Brazil				
Intercept	0.195	0.014	14.200	<.0001
Log exports to Brazil	0.072	0.006	12.710	<.0001
Log exports to Canada	0.001	0.003	0.160	0.874
Log exports to Germany	-0.006	0.003	-1.680	0.096
Log exports to rest of the world	-0.066	0.007	-9.570	<.0001
Dependent variable: Share of Values of Exports to Canada				
Intercept	0.167	0.010	17.480	<.0001
Log exports to Brazil	0.001	0.003	0.160	0.874
Log exports to Canada	0.062	0.005	13.340	<.0001
Log exports to Germany	-0.004	0.002	-1.500	0.137
Log exports to rest of the world	-0.059	0.005	-12.010	<.0001
Dependent variable: Share of Values of Exports to Germany				
Intercept	0.159	0.009	17.400	<.0001
Log exports to Brazil	-0.006	0.003	-1.680	0.096
Log exports to Canada	-0.004	0.002	-1.500	0.137
Log exports to Germany	0.047	0.003	14.580	<.0001
Log exports to rest of the world	-0.038	0.005	-8.180	<.0001

Table 6: Flexibilities of ITL model with AR (1) corrections

Variable*	Obs	Mean	Std. Dev.	Min	Max
f11	96	-0.214	0.315	-26.583	6.518
f12	96	-0.063	0.013	-0.332	1.114
f13	96	-0.113	0.036	-0.884	2.997
f14	96	-0.609	0.266	-6.301	21.472
f21	96	-0.077	0.004	-0.186	0.155
f22	96	-0.083	0.124	-6.650	4.084
f23	96	-0.108	0.010	-0.446	0.437
f24	96	-0.732	0.112	-4.452	5.114
f31	96	-0.231	0.075	-7.292	0.339
f32	96	-0.174	0.052	-5.063	0.239
f33	96	0.026	0.500	-3.128	47.310
f34	96	-0.621	0.374	-35.956	1.550

* f_{ij} – i,j = 1 – Brazil, i,j = 2 – Canada, i,j = 3 – Germany, i,j = 4 – the rest of the world

Table 7: Goodness of fit measures

Equation	SSE	MSE	Root MSE	R-Square	Adjusted R-Square
Value of exports to Brazil	0.255	0.003	0.052	0.688	0.665
Value of exports to Canada	0.077	0.001	0.027	0.804	0.790
Value of exports to Germany	0.119	0.001	0.036	0.704	0.683

The results with AR (1) process

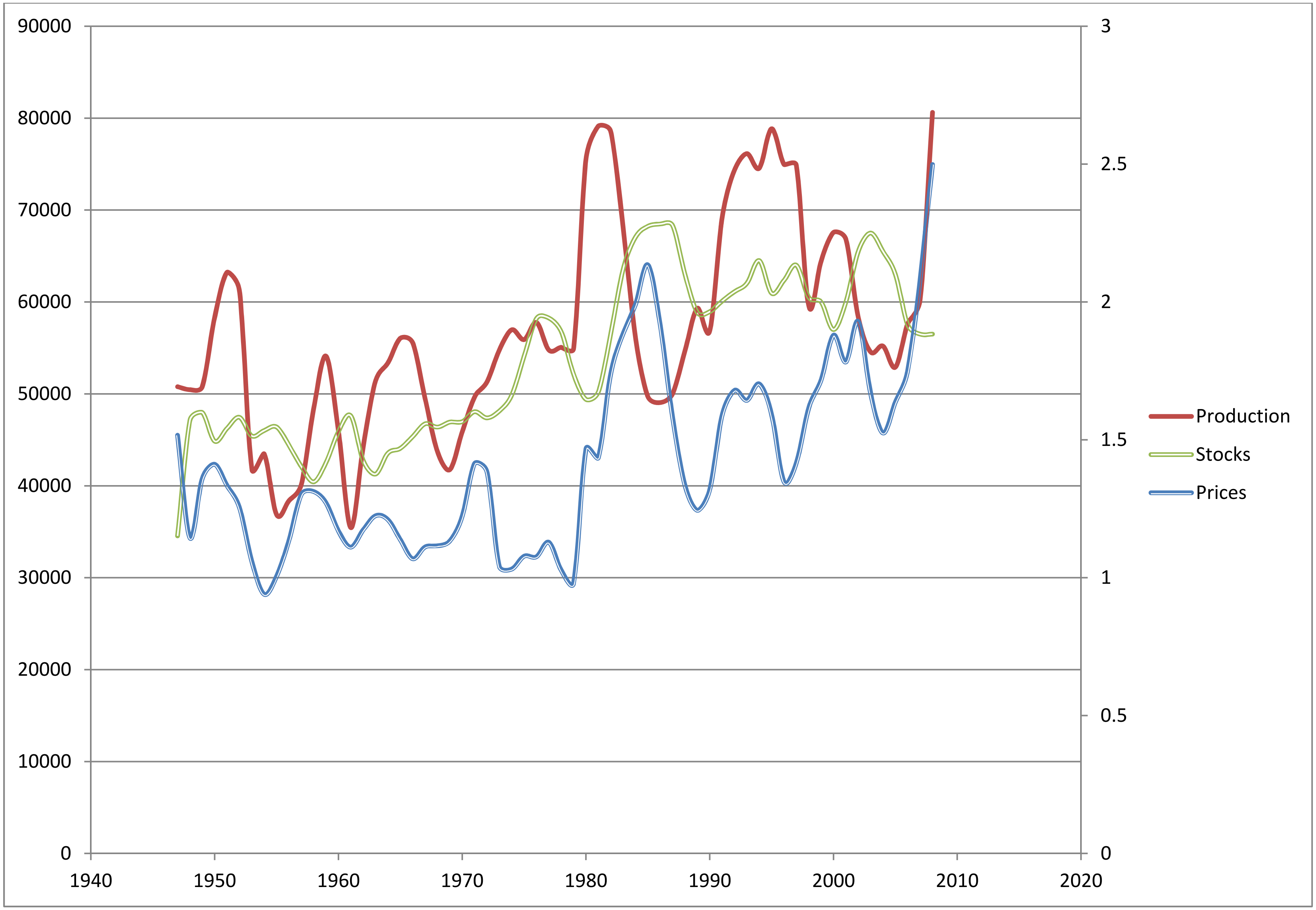

Figure 1: Real Prices ($/lb), Production (million lbs.), and Stocks (million lbs.) of Hops in the U.S.

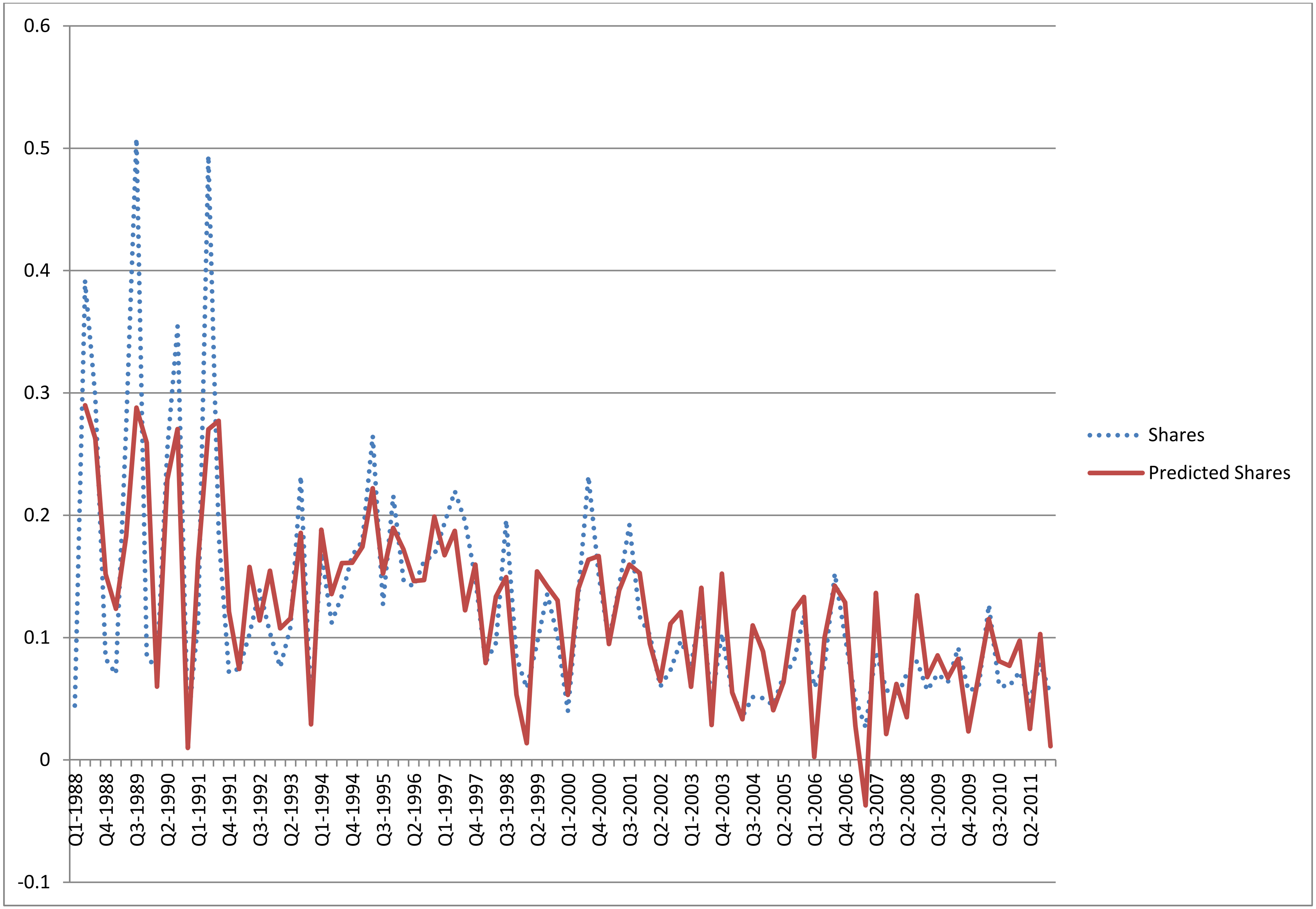

Figure 2 - Predicted vs Real Shares of Values of Exports to Brazil

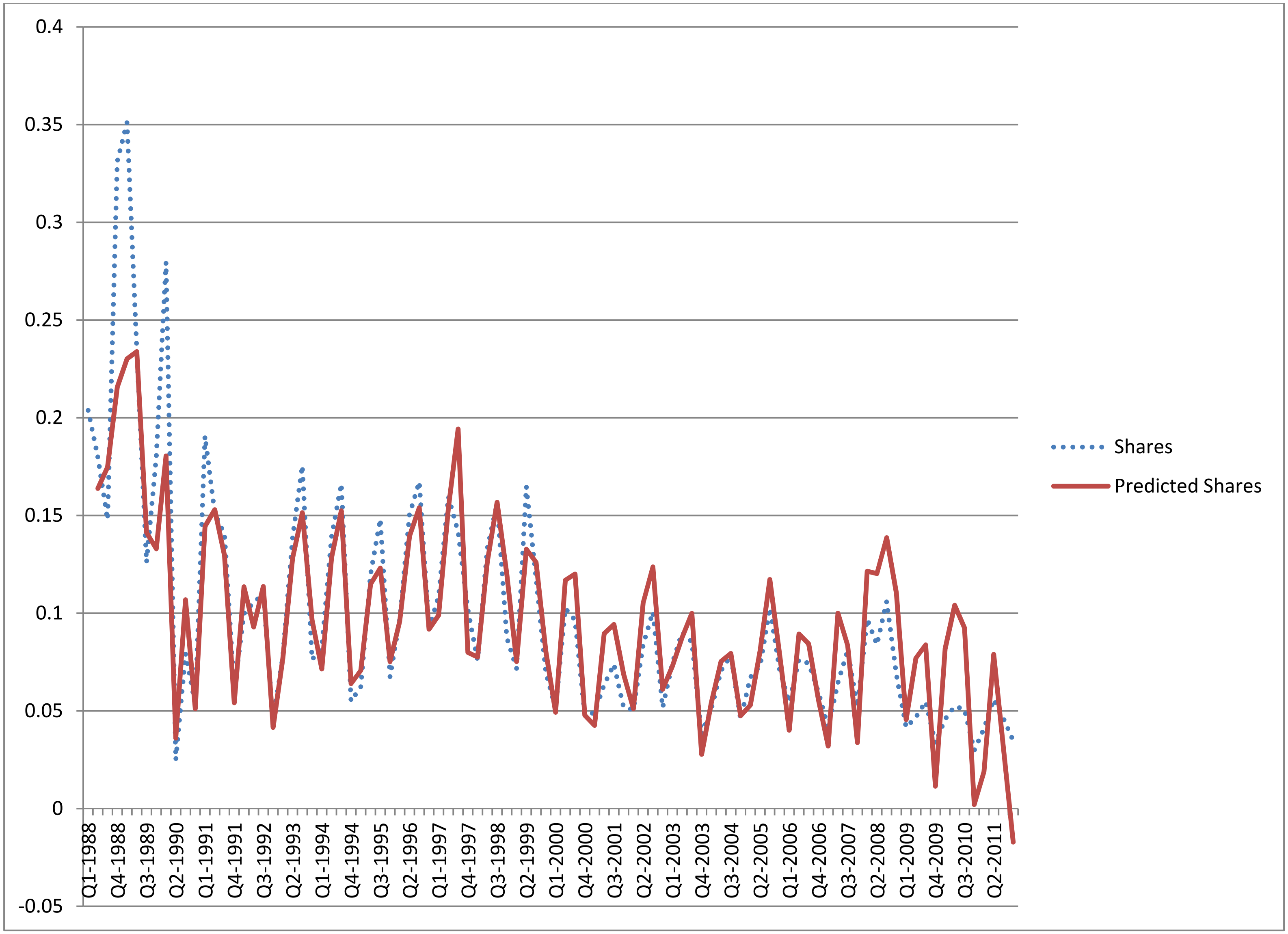

Figure 3 - Predicted vs Real Shares of Values of Exports to Canada

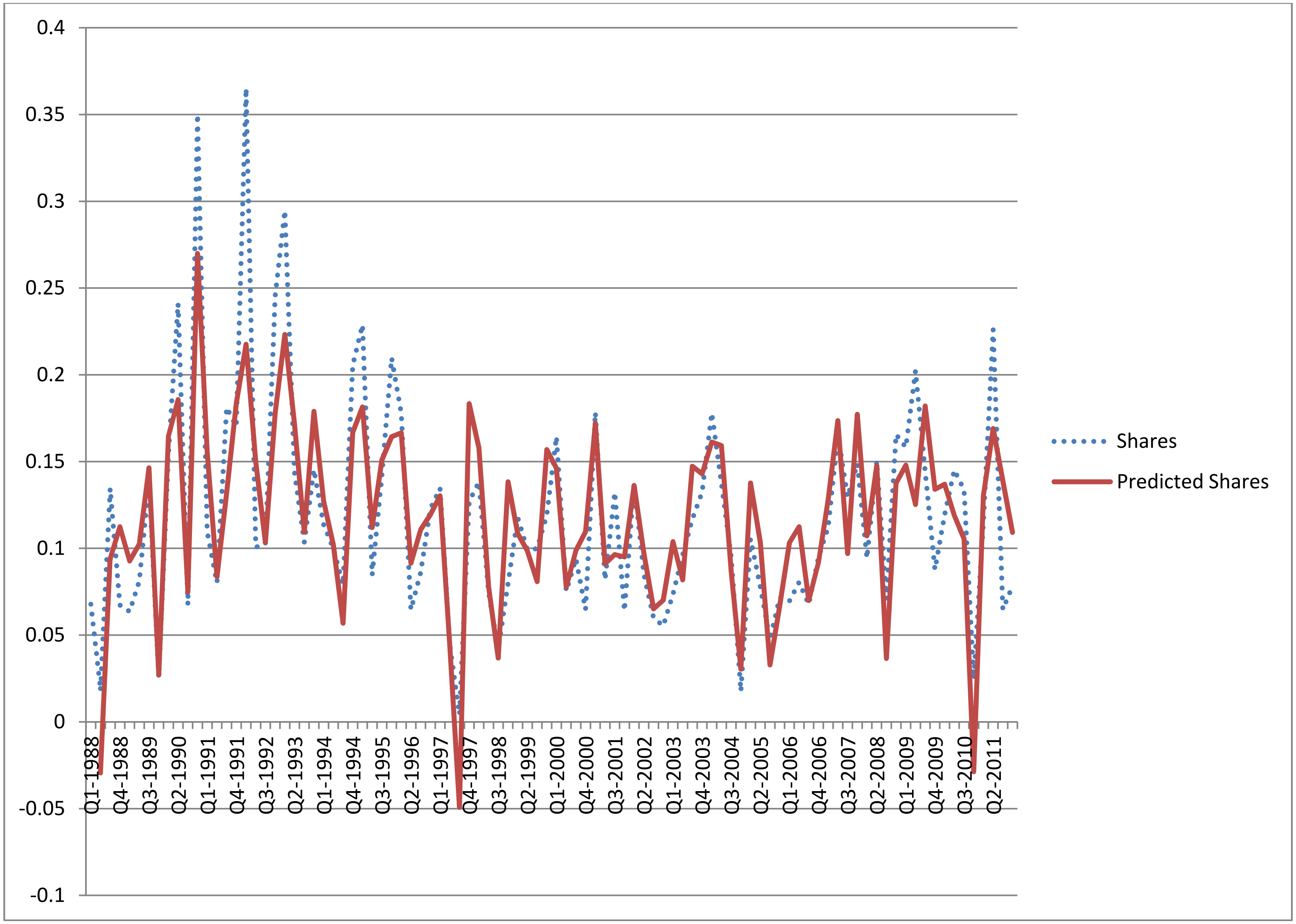

Figure 4 - Predicted vs Real Shares of Values of Exports to Germany