PREDICTING THE PRICE OF EXPORT LOGS

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EXECUTIVE SUMMARY

Since the 1960's, Washington forest landowners have enjoyed financial gains from the existence of a log export market to the Pacific Rim, especially to Japan. Gains to timber owners are embodied in the price premium for high quality logs paid by the export market. Trends in US environmental policy and overseas financial crises have thrown the export market into upheaval, which is manifested in erratic fluctuations of the price premium. The ability to predict the price for logs in the volatile export market aids forest landowners in decision making because they can predict revenues from timber harvesting operations.

I have developed two models to assist landowners in predicting export log prices for Douglas-fir timber in Western Washington. The first uses five exogenous variables, one lagged export price variable, and an autoregressive correction to explain the export price. The exogenous variables domestic log price, exchange rate between dollars and Japanese yen, Japanese wood housing starts, northern spotted owl listing as an endangered species, the Asian financial crisis are used, along with an autoregressive correction for time series autocorrelation. Regression coefficients explain how the export price will react to marginal changes in any of these variables.

The second uses four variables to forecast the actual export price per thousand board feet of Japan 12 sort Douglas-fir logs. These variables are domestic log price, one month and two month lagged Japan 12 price, and a correlation coefficient for autoregressive error.

Both of these models are useful for predicting the price of Japan 12 logs. R-squared value of the first model is 0.97. By using the first model, landowners can use domestic log price, exchange rates, Japanese wood housing starts, and previous month's export price to calculate an export price for any period. Also, landowners can accurately predict how a change in any of the right hand side variables will affect the export price. In addition, the second model provides a formula to forecast the price one month in advance.

PREDICTING THE PRICE OF EXPORT LOGS

THE MYSTERY

Since the 1960s, the State of Washington has essentially had two markets where forest landowners can sell timber, the domestic market and the export market. The domestic market includes all domestic processing facilities within the state and the export market sends raw logs by boat to the Pacific Rim, predominantly to Japan. Log exports have been a controversial issue in the past, primarily because exporters paid a price premium for high quality logs destined for overseas markets. Domestic industries complained that exporters were bidding up the price of logs and reducing supply available for Washington mills. On the other hand, timber owners were traditionally in favor of the export market, since they received a higher price if timber is sold for export. Lately, this argument has all but vanished since drastic reductions in timber supply, coupled with stagnated overseas demand, have resulted in industry restructuring and a drastic decline in log exports.

The State of Washington and the Federal government are prohibited by law from exporting timber from their lands in log form. Only private forest landowners are legally eligible to benefit from an export price premium at time of harvest. Declining log export markets have triggered declining export price premiums. Private timber owners are wondering if log prices will increase again before they harvest. The ability to predict the export price premium would provide timber owners with valuable information to assist their harvesting decisions. The goal of my research project is to devise a method to predict the price of export logs to help private forest landowners increase profits by capturing returns from export markets.

THE METHOD

The price premium for export logs is driven by the Japanese preference for high quality logs. Since log quality is not highly valued in domestic mills, a similar high quality log would not receive a premium price if it entered the domestic market. Log quality is determined by a process called “grading”, where each log is inspected and rated by quality criteria, such as straightness of grain and growth rings per inch. In the export market, the highest quality grade for a Douglas-fir log is a Japan 12 sort, or Japan 12. Logs are sorted by grade and measured for volume in units called board feet. A board foot is a square of wood 1 foot on each side and 1 inch thick. Timber is generally aggregated by "thousand board feet" and prices are generally quoted "per thousand". My hypothesis is the price of one thousand board feet of Japan 12 logs depends upon the price of the same volume of domestic logs, macroeconomic factors both in the United States and in Japan, and constraints on timber supply and demand.

Logs Lines is a private independent log price reporting service in the Pacific Northwest. Their reports contain monthly prices for various sorts, species, and destinations. I used monthly prices of Japan 12 and the analogous domestic grade, #2 Sawmill, from January 1989 through July 2002 for my analysis.

Domestic demand for timber is driven foremost by the US housing construction industry. Initially, I hypothesized that housing starts, both in the United States, and in Japan, would influence the price per thousand of export logs. To capture the effect of domestic housing starts, I gathered monthly seasonally adjusted US housing starts from the US Census Bureau. To reflect overseas demand for housing, I used the Japan Lumber Journal to obtain monthly Japanese housing starts, both total housing starts and total houses constructed from wood.

Currency exchange rates between the dollar and Japanese yen can also drive exports. A dollar that is strong against other currencies discourages exports; a weak dollar promotes exports. Therefore, the strength of the dollar vs. the Yen should be manifested in the price of export logs. Nominal and real monthly currency exchange rates were located on the Bank of Japan website.

In 1991, the listing of the spotted owl as an endangered species in the Pacific Northwest drastically reduced timber harvesting on Federal timberlands. National Forests in Washington are cutting a fraction of what they cut before the listing. Timber supply in western Washington decreased dramatically, resulting in the diversion of large volumes of export quality logs into domestic mills. I included a dummy variable for this event since the reduction of the total supply of logs available for export could impact export log prices.

Export log demand was severely impacted in 1997 - the beginning of the Asian Financial Crisis. This crisis sent Japan, the biggest importer of Pacific Northwest logs, into financial chaos from which it has not yet fully recover. Housing construction activity in Japan is depressed, and so is Japanese demand for Northwest logs. I included a dummy variable for the Asian Financial Crisis in my model, since I believe it has impacted the price of export logs. Therefore, I originally had seven right-hand side variables for my model to predict the price per thousand of Japan 12 logs.

THE TRAGEDY

Unfortunately, I was unaware of the pitfalls of time series analysis when I began my study. Once I learned about multicollinearity between right hand side variables, I could see it was obviously present in variables included to capture housing as a demand driver. Because there was no way to correct for the problem, I removed the variable "Japan Total Housing Starts" from my model. Subject area knowledge and E-Views regression output led me to infer the variable "Japan Total Wood Housing Starts" is more important than "Total Japanese Housing Starts" for explaining the Japan 12 price. In addition, the variable "US Housing Starts" exhibited signs of multicollinearity with "Domestic Price". This multicollinearity, along with strong evidence that the coefficient for "US Housing Starts" was not statistically significant while "Domestic Price" was highly significant led me to omit the variable "US Starts". Now, I have only five right hand side variables.

My model took another blow when I learned the cruel effects of serial correlation, which occurs when errors in the regression model are correlated with each other. Errors in the current month are correlated with errors in previous months, which distorts standard errors and makes test statistics on the coefficients invalid. Luckily, the AR(1) correction for serial correlation was significant, so I rejoiced with feelings of renewed hope.

Lastly, Mr. White's Test for Heteroskedasticity indicated that my model was indeed heteroskedastic, meaning the model's variance was not constant. Again, I was relieved to discover that E-Views easily corrects for heteroskedasticity.

In addition to the multitude of corrections, I also included lag variables for Japan 12, since it was probable that any period's price was significantly affected by prices in previous periods. I tried lagging two periods, but only one lag, Japan 12(-1), was statistically significant. The Breusch-Godfrey test for serial correlation verified these findings.

THE REDEMPTION

I ran an Ordinary Least Squares regression on my modified equation:

Japan12 = $b_0 + b_1$***(domestic) +** b_2***(exch) +** b_3***(jwoodstarts) +** b_4**(owl) +** b_5***(collapse) +** b_6***(japan(-1)) + AR(1).** My output from E-Views was the following:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	155.4323	111.1280	1.398678	0.1640
DOMESTIC	0.211453	0.100177	2.110788	0.0365
EXCH	-0.819669	0.586863	-1.396696	0.1646
JWOODSTARTS	0.306185	0.500669	0.611551	0.5418
OWL	28.87512	22.86017	1.263119	0.2085
COLLAPSE	-30.34618	15.65424	-1.938528	0.0545
JAPAN12(-1)	0.755673	0.080698	9.364181	0.0000
AR(1)	0.554193	0.106523	5.202546	0.0000
R-squared	0.974215	Mean dependent var		776.1226
Adjusted R-squared	0.972987	S.D. dependent var		203.7304
S.E. of regression	33.48416	Akaike info criterion		9.910255
Sum squared resid	164814.8	Schwarz criterion		10.06734
Log likelihood	-760.0448	F-statistic		793.4337
Durbin-Watson stat	1.938185	Prob(F-statistic)		0.000000
Inverted AR Roots	.55			

R-squared for my modified original model was 0.97, meaning that my variables explain 97% of the variation in the price per thousand of Japan12 logs. The lagged price and autoregressive correction were overwhelmingly statistically significant. Only two my original model variables, domestic price and collapse, retained some semblance of statistical significance. Overall, it appears the price of 1000 board feet of Japan 12 logs depends predominantly on the previous period's price, the domestic price, and the occurrence of the Asian Economic Collapse.

My second model is designed as an out-of-sample forecast the export log price. I ran a pared-down version of my original model using only domestic price, two periods of lagged Japan 12, and AR(1) to forecast future error terms of the Japan 12 price for June and July of 2002. The equation of the forecast model is:

Japan12 = $b_0 + b_1$***(domestic) +** b_2***(japan(-1)) +** b_3***(japan(-2))**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.19997	40.62556	0.595683	0.5523
DOMESTIC	0.275580	0.112819	2.442667	0.0158
JAPAN12(-1)	0.757433	0.162010	4.675229	0.0000
JAPAN12(-2)	0.034059	0.106466	0.319907	0.7495
AR(1)	0.622541	0.135679	4.588346	0.0000
R-squared	0.972223	Mean dependent var		775.5592
Adjusted R-squared	0.971467	S.D. dependent var		201.3791
S.E. of regression	34.01624	Akaike info criterion		9.923895
Sum squared resid	170094.4	Schwarz criterion		10.02336
Log likelihood	-749.2160	F-statistic		1286.291
Durbin-Watson stat	1.979950	Prob(F-statistic)		0.000000
Inverted AR Roots	.62			

E-Views forecast for June and July 2002:

Date	Actual Value ($/MBF)	Forecast Value ($/MBF)
January 2002	645.00	645.00
February 2002	648.00	648.00
March 2002	624.00	624.00
April 2002	596.00	596.00
May 2002	584.00	584.00
June 2002	580.00	589.28
July 2002	584.00	602.51

As I expected, the forecast value for June 2002 is close to the actual value, but the forecast value for July 2002 is very different from actual value. Since the second period lag of Japan 12 price was statistically insignificant, a reliable forecast can only be obtained one month in advance.

To conclude, I must say that had I known the treacherous nature of time series data, I might have selected a different topic. But then I wouldn't have learned as much!!!!