

**An Analysis of the Effects of Sale Attributes on the Timber
Sale Value of Washington Department of Natural Resource
Timber Sales Occurring in Western Washington**

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Study Focus:

- Timber sale history of lump-sum sales of Western Washington.
- State timber lands in Washington are managed by the Washington Department of Natural Resources (DNR).
- Western Washington is defined as all counties located west of the crest of the Cascade mountains.
- The DNR manages 2.1 million acres of forested land in Washington State, 1.4 million acres in Western Washington.



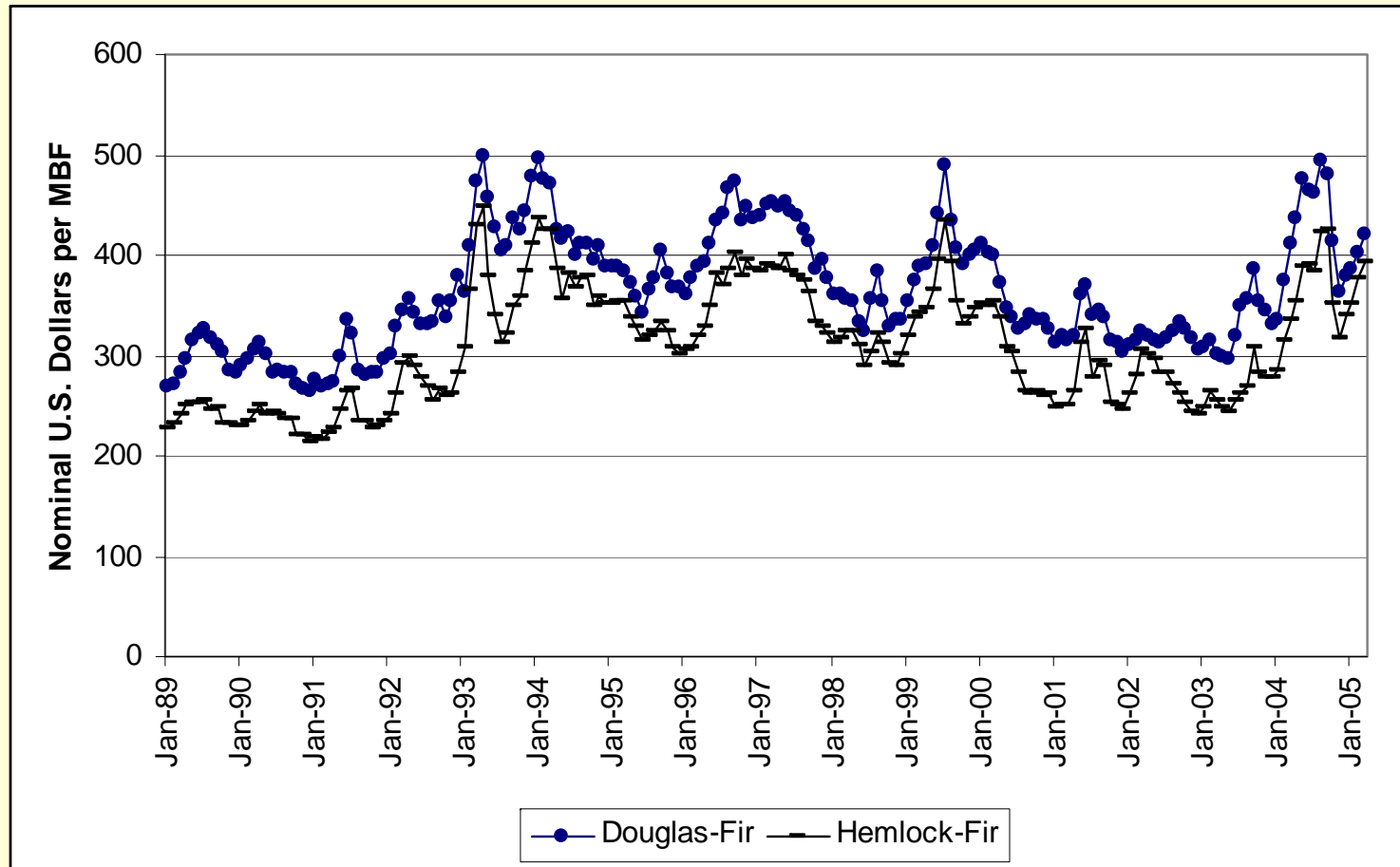
The Dataset:



- DNR timber sales from January of 1989 through September of 2005.
- Contained inventory, harvest cost, and final sale detail.
- The dataset was pared for statistical analysis of lump-sum board sales auctioned by sealed bid.
- The final data used for empirical analysis contained 2193 timber sales.
- The WWPA Hemlock-fir price index, volumes of softwood lumber imported from Canada, and US housing starts were all added to the monthly data.

Lumber price index for Douglas-Fir and Hemlock-Fir

Source: WWPA



A Variable for Diversity:

- A diversity index was added to each timber sale.
- Calculated with the Shannon-Wiener Index.
- It is a measure of the distribution of volume among species and grade of timber in the dataset.

$$D_{mn} = -\sum_{m=1}^n p_{(ij)} \ln p_{(ij)}$$

Where,

$P_{(ij)m}$ = The proportion of volume in the i^{th} grade occurring in the j^{th} species relative to the total sale volume in sale m .

n = The number of possible species multiplied by possible grades = 40.

D_{mn} = The diversity index of sale m , for n .

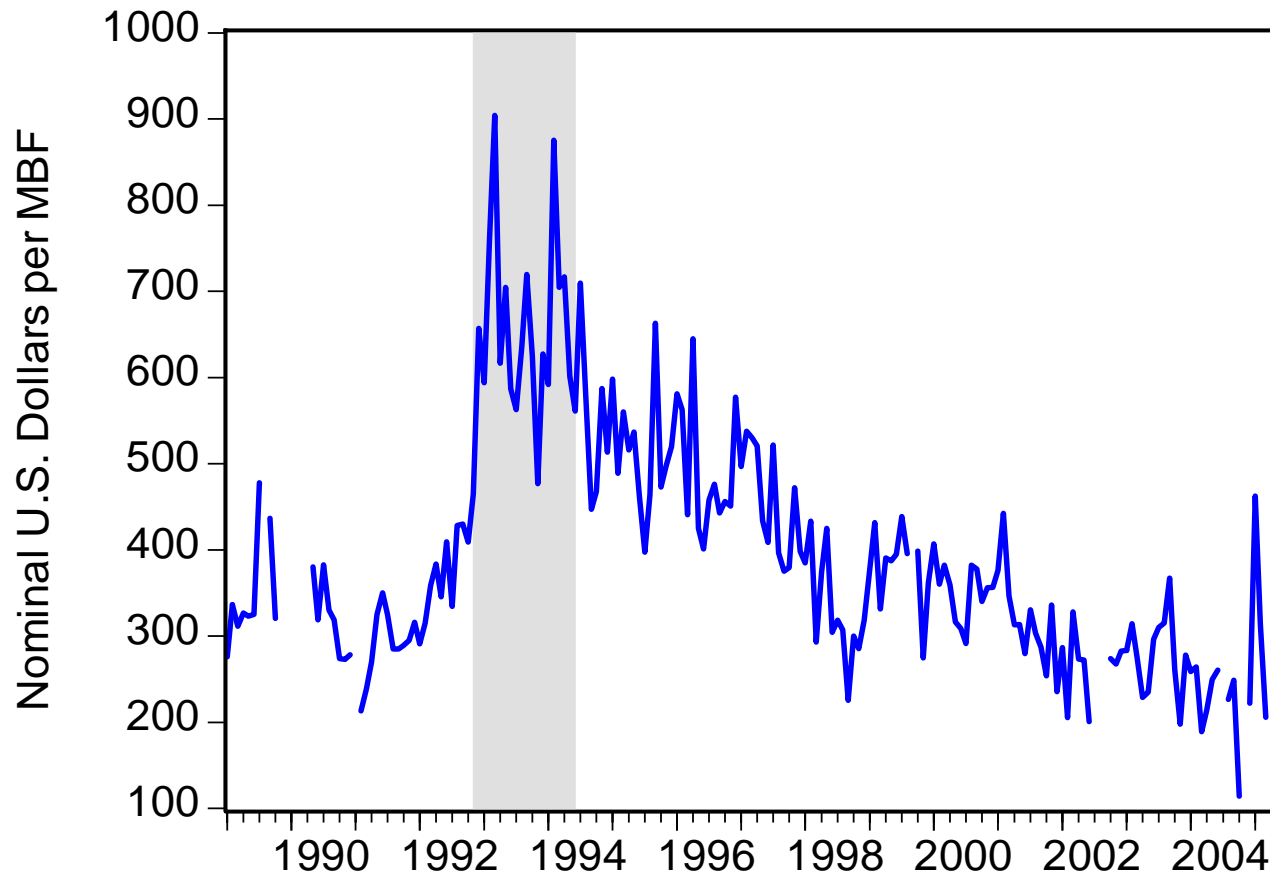
Theoretical Model:

- A hedonic model was created to examine the effect of sale attributes on the final sale value.
- This method was chosen based on prior research that had shown that timber sales could be described as differentiated factors of production associated with products produced by timber.
- Timber sales are heterogeneous inputs that vary in many attributes such as area, species mix, quality class, total volume, accessibility, etc.
- The simple form of the hedonic price equation representing the sale price of a given timber sale is as follows,

$$P = P (V_1, V_2 \dots V_n)$$

The Dependent Variable: Final Timber Sale Value

Source: WADNR

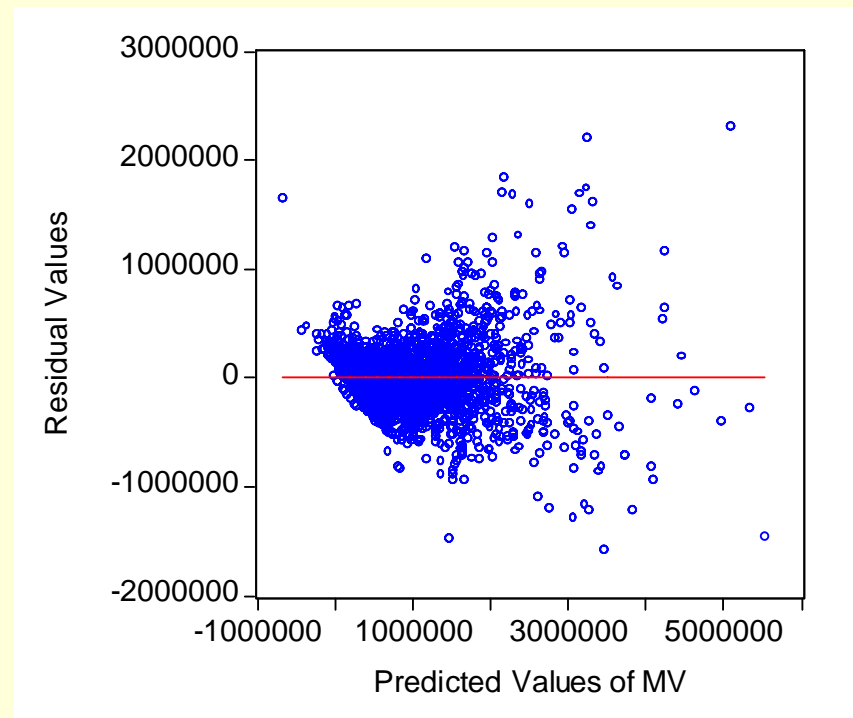


Independent Variables:

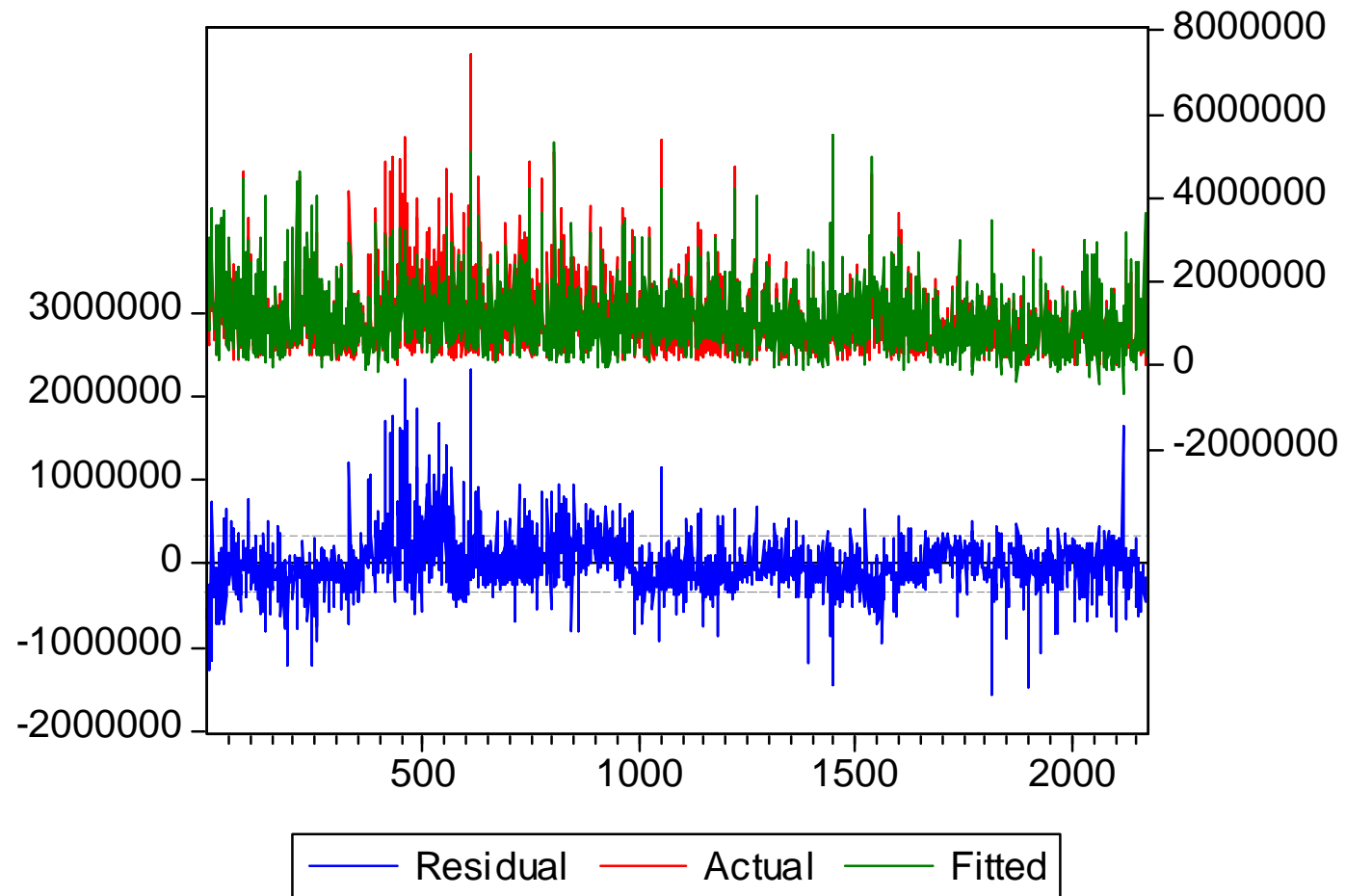
Independent Variables	Definition	Hypothesis
NBID	The number of firms bidding on a given timber sale.	+
DIVERSITY	The diversity index as previously described.	-
ACRES	The total acreage involved in a given timber sale.	+
CL	The contract length in months.	+
RDCON	The miles of mandatory road construction.	-
RDRECON	The miles of mandatory road reconstruction.	-
VS1DF	Thousand board feet of Douglas fir in the high grades (P, 2P, 3P, SM, #1S)	+
VS2DF	Thousand board feet of Douglas fir in #2S.	+
VS3DF	Thousand board feet of Douglas fir in #3S.	+
VS1WH	Thousand board feet of Western Hemlock in the high grades.	+
VS2WH	Thousand board feet of Western Hemlock in #2S.	+
VS3WH	Thousand board feet of Western Hemlock in #3S.	+
OTHERVOL	Thousand board feet of other volumes.	+
LUMBERPRICE	Monthly lumber price index for Hemlock-fir produced by WWPA.	+
SLIMPORTCAN	Million board feet of softwood lumber imported by the U.S. from Canada.	-

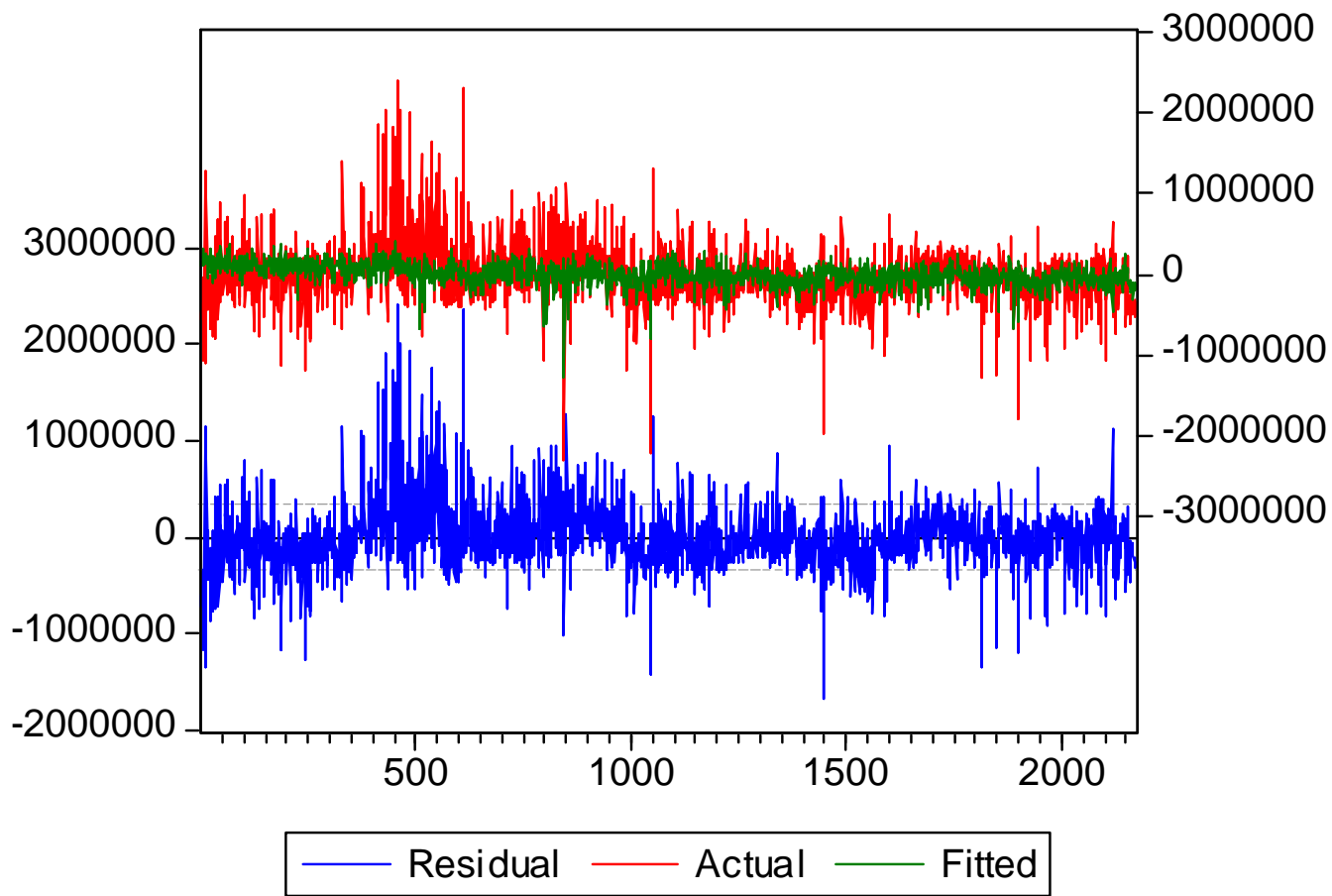
Results of the Initial Estimation:

- All independent variables showed significance at the 5% level with the exception of contract length.
- Evidence of heteroscedasticity was found in the dataset when a White's test was conducted.
- The cause is believed to be related to increasing variance as sale size increases.
- This issue was corrected using Feasible Generalized Least Squares.



Residual Graphic of Weighted Model





What is the Diversity Variable Really Measuring?

Model 1	t-Statistic	Model 2	t-Statistic	Model 3	t-Statistic
NUMBERBIDDERS	129.28	NUMBERBIDDERS	82.93	NUMBERBIDDERS	109.21
DIVERSITY	-35.02	PRODD	-15.19	SPECIESD	-46.54
ACRES	-72.86	ACRES	-68.51	ACRES	-55.70
RDCON	-119.14	RDCON	-55.85	RDCON	-63.00
RDRECON	-32.45	RDRECON	-55.88	RDRECON	-31.93
VS1DF	85.14	VS1DF	81.40	VS1DF	76.22
VS2DF	394.32	VS2DF	269.97	VS2DF	404.33
VS3DF	188.26	VS3DF	155.11	VS3DF	112.31
VS1WH	27.50	VS1WH	41.21	VS1WH	18.90
VS2WH	97.17	VS2WH	64.47	VS2WH	135.25
VS3WH	57.69	VS3WH	48.46	VS3WH	68.80
OTHERVOL	312.93	OTHERVOL	235.62	OTHERVOL	331.80
HFP_NOM_	395.32	HFP_NOM_	270.25	HFP_NOM_	589.13
SLIMPORTCAN	-51.24	SLIMPORTCAN	-36.73	SLIMPORTCAN	-58.06
C	-259.18	C	-134.89	C	-221.54

Findings:

- Of the hypotheses regarding the independent variables of the regression model, only the hypothesis for the effect of total acreage was rejected.
- The various representations of heterogeneity in volume of both species and grade showed evidence of a negative effect on the market value of timber sales in the dataset.
- Empirical analysis pointed to species diversity as having a stronger negative effect on final sale value than diversity among grade classifications.

Importance:

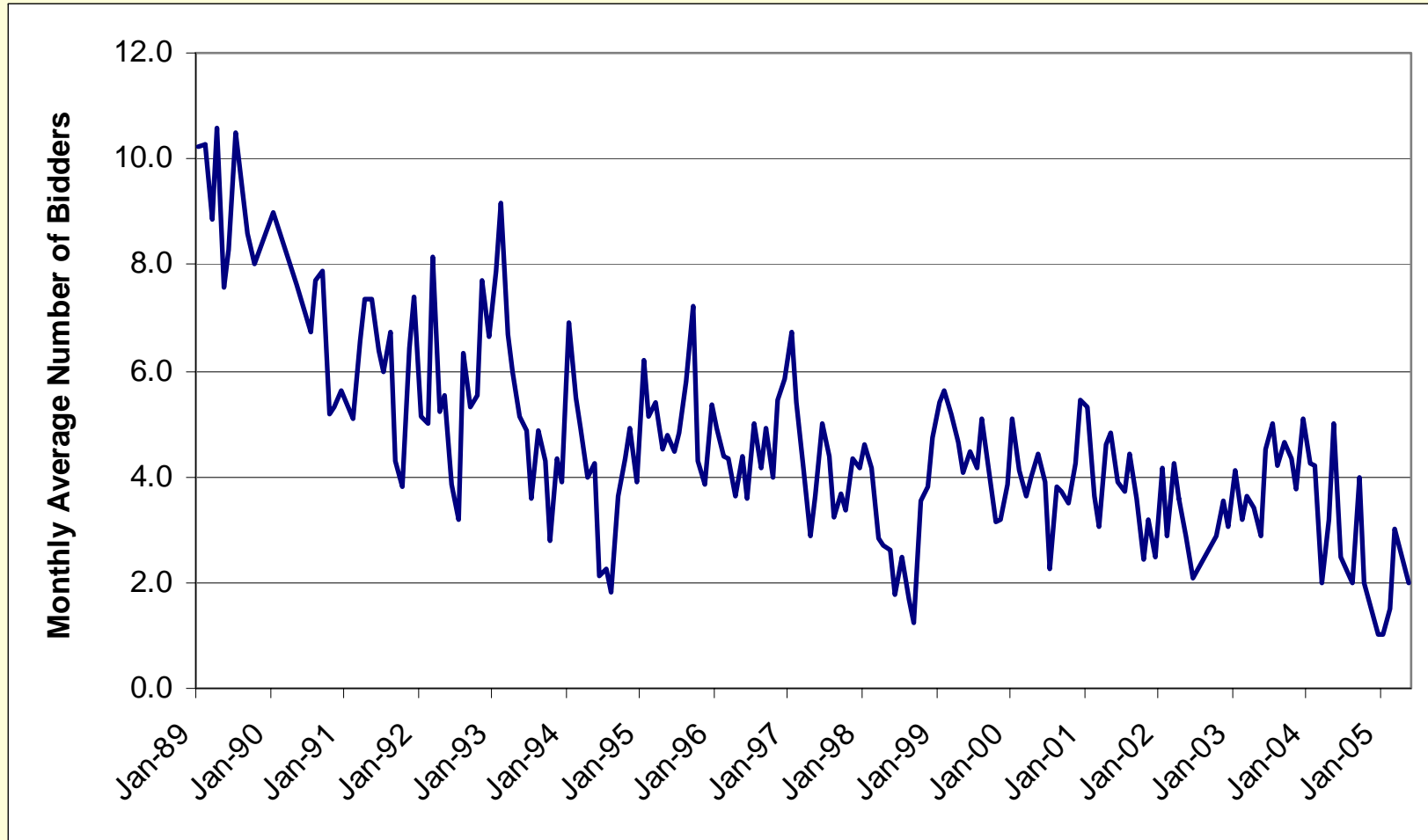
- It is no secret that different species and different log grades have different market prices.
- However, understanding how the distributions of volume among species and grade classifications effect the final sale price on lump sum sales has both management and marketing implications.

Work in Progress:

- Currently exploring a log-linear estimation of the model to deal with heteroscedasticity.
- Considering using the variable for US housing starts instead of the lumber import variable.
- Including various dummy variables.

Number of Bidders Averaged by Month

Source: WA DNR



Further Research Recommendations:

- The effects of the acreage variable in empirical estimation and decreases in the average number of bids observed in the raw data are interesting issues.
- Research into the the source of these issues would be extremely pertinent.
- IE: The demand for stumpage, recent sawmill consolidation in the PNW, log flows out of WA, possible competitive advantages to larger producers, etc.
- Research into whether the impacts of sawtimber diversity can be mitigated through other timber sale methods.

Acknowledgments

- Angus Brodie
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Sources:

- American Forest & Paper Association. *Wood Statistical Roundup*. Washington, DC. Various issues.
- Bare, BB and Smith RL. (1999) *Estimating Stumpage Values from Transaction Evidence Using Multiple Regression*. Journal of Forestry, Volume 97, No. 7: 32-39 (July 1999)
- Boltz et al. (2002) *Shadow pricing diversity in U.S. national forests*. Journal of Forest Economics 8: 185 - 197.
- Buongiorno et al. (1994) *Tree Size Diversity and Economic Returns in Uneven-Aged Forest Stands*. Forest Science, Volume 40, No. 1: 83-103 (February 1994).
- Buongiorno et al. (1995) *Growth and Management of Mixed-Species, Uneven-Aged Forests in French Jura: Implications for Economic Returns and Tree Diversity*. Forest Science, Volume 41, No. 3: 397-429 (August 1995).
- Carter, DR and Newman, DH. (1998) *The impact of reserve prices in sealed bid federal timber sale auctions*. Forest Science 44: 485 – 495.
- Daniels, Jean M. (2005) *The Rise and Fall of the Pacific Northwest Log Export Market*. USDA Forest Service Gen. Tech. Rep. PNW-GTR-624. February 2005.
- Greene, WH. (2003) *Econometric analysis*, 5th Ed. Prentice-Hall, Upper Saddle River, NJ.
- Haynes, RW. (1980) *Competition for National Forest Timber in the Northern, Pacific Southwest, and Pacific Northwest Regions*. USDA Forest Service Research Paper PNW-266. January 1980.
- Hotvedt, J. (1999) *Timber Sales Appraisal System*. Unknown publication explaining the WA DNR approach to transaction evidence appraisal.
- Huang, MF and Buongiorno, J. (1986) *Market value of timber when some offerings are not sold: implications for appraisal and demand analysis*. Forest Science. 32: 845 – 854.
- Huebschmann et al. (2004) *A Bid Price Equation for National Forest Timber Sales in Western Arkansas and Southeastern Oklahoma*. Southern Journal of Applied Forestry, Volume 28, No. 2: 100-108.
- Ingram, CD and Buongiorno, J. (1996) *Income and Diversity Tradeoffs from Management of Mixed Lowland Dipterocarps in Malaysia*. Journal of Tropical Forest Science, Volume 9, No. 2: 242-270 (March 1996).
- Ladd, GW and Martin, MB. (1976) *Prices and Demands for Input Characteristics*. American Journal of Agricultural Economics, Volume 58, No. 1: 21-30 (February 1976).
- Leffler, KB and Rucker, RR. (1991) *Transaction Costs and the Efficient Organization of Production: A Study of Timber-Harvesting Contracts*. The Journal of Political Economy, Vol. 99, No.5: 1060-1087. (Oct., 1991)
- Lippke, HL. (1994) *The Economic Effects of the Forest Resources Conservation and Shortage Relief Act on Timber Prices*. Reprint 25A, Center for International Trade in Forest Products, College of Forest Resources, University of Washington, Seattle, WA (May 1994).
- Mason, LC. (2005) *An Examination of the Washington Department of Natural Resources Timber Sale Program Against a Backdrop of Changing Regional Infrastructure and a Growing Forest Health Crisis*. Rural Technology Initiative, Working Paper 2, College of Forest Resources, University of Washington, Seattle. April 2005.
- Munn, IA and Palmquist, RB. (1997) *Estimating hedonic price equations for a timber stumpage market using stochastic frontier estimation procedures*. Canadian Journal of Forest Resources, 27: 1276-1280 (April 1997).
- Munn, IA and Rucker, RR. (1995) *An Economic Analysis of the Differences Between Bid Prices on Forest Service and Private Timber Sales*. Forest Science, Volume 41, No. 4: 823-840 (November 1995).
- Munn, IA and Rucker, RR. (1998) *Predicting Forestry Consultant Participation Based on Physical Characteristics of Timber Sales*. Journal of Forest Economics, Volume 4, No. 2: 105-124.
- Perez-Garcia et al. (2005) *Washington's Sawmilling Sector Analysis: Capacity Utilization Rates and Timber Outlook*. Working Paper 99, Center for International Trade in Forest Products, College of Forest Resources, University of Washington, Seattle, WA (September 2005).
- Perez-Garcia, J. and Barr, JK. (2005) *Forest Products Export Trends Update for the Pacific Northwest Region*. Northwest Environmental Forum, College of Forest Resources, University of Washington. November 2005.
- Puttock et al. (1990) *Stumpage Prices in Southwestern Ontario: A Hedonic Function Approach*. Forest Science, Volume 36, No. 4: 1119-1132 (December 1990).
- Rosen, S. (1974) *Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition*. The Journal of Political Economy, Volume 82, No. 1: 34-55 (January-February 1974).
- Sendak, PE. (1991) *Timber sale value as a function of sale characteristics and number of bidders*. Research Paper NE-657, USDA Forest Service, Northeastern Forest Experiment Station, Radnor, PA.
- Shramek, J and Nicholas, G. (1998) *Timber Marketing Strategy Plan for the Washington State Department of Natural Resources*. Washington State Department of Natural Resources, Forest Resources Division, Marketing and Program Development Section. Olympia, Washington (August 1998).
- Shramek, J. (1999) *Implementing the Strategic Timber Marketing Plan: PNW Timber-Processing Industry Segment Analysis and Recommended Target Segments*. Washington State Department of Natural Resources, Forest Resources Division, Marketing and Program Development Section. Olympia, Washington (March 1999).
- U.S. Census Bureau. *New Privately Owned Housing Units Started*, Annual Data. U.S. Census Bureau, July 14, 2005 < <http://www.census.gov/const/startsna.pdf>>
- Washington State Department of Natural Resources. *Washington Timber Harvest Report*. Olympia, Washington. Various years.
- Washington State Department of Natural Resources. *Washington Mill Survey*. Olympia, Washington. Various years.
- Washington State Department of Natural Resources. (1997) *Final Habitat Conservation Plan*. Olympia, Washington. September 1997.
- Western Wood Products Association. *PNW Coast Lumber Price Index*. Portland, Oregon. Various issues.

Questions?

