STUMPAGE MARKET INTEGRATION FOR NATIONAL FOREST TIMBER IN THE WESTERN U.S.

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USDA Forest Service PNW Research Station
Western Forest Economist meeting
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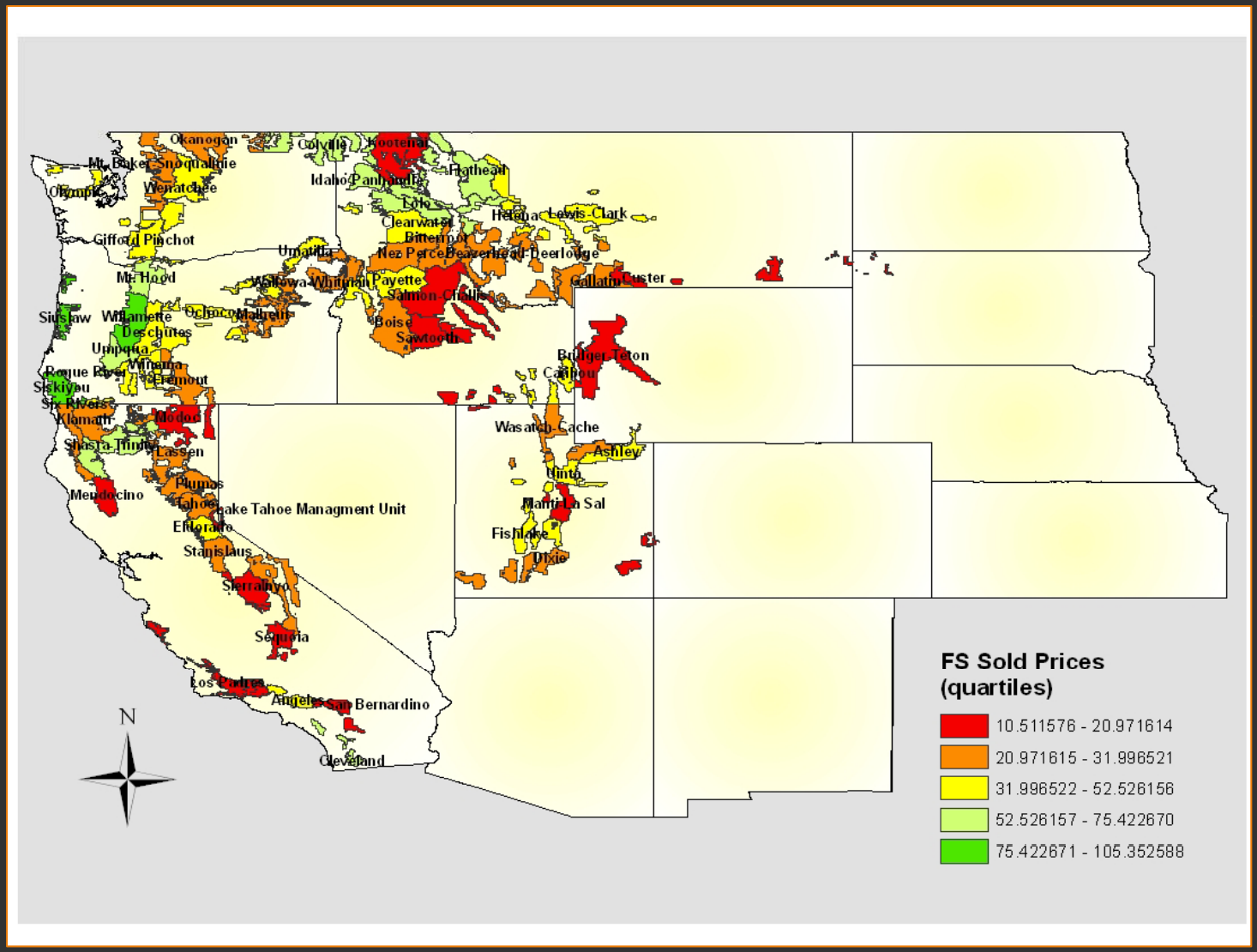
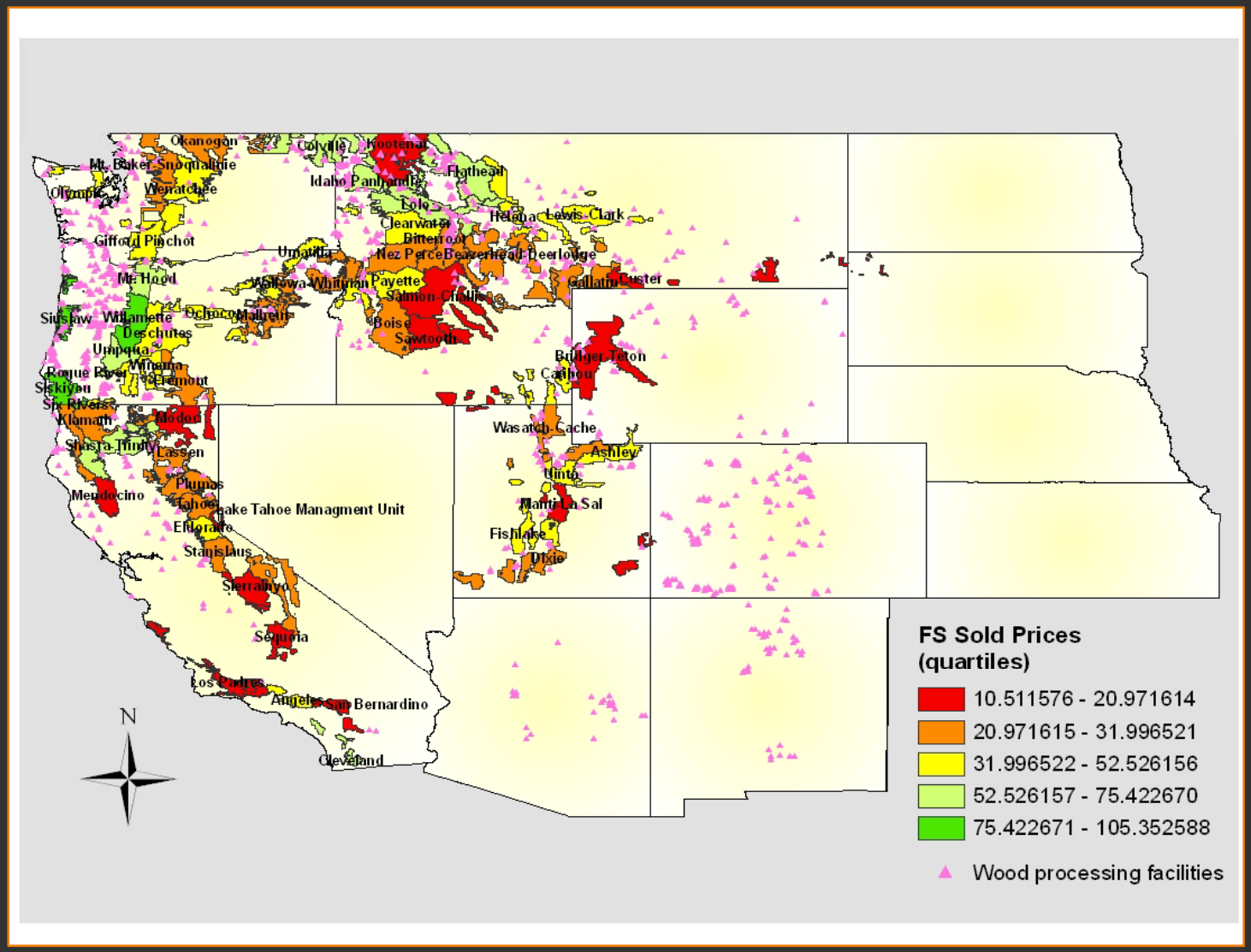
The Context

- Develop a spatial pricing model for national forest timber
- Persistent differences in stumpage prices
  - Can studying the locations of mills relative to national forests explain some of these differences?
  - Are stumpage prices of forests closest to mills/mill clusters higher than those distant from mills?
- What is the extent of markets for national forest stumpage across the West?

FS stumpage prices



Stumpage prices and mills



Are markets for national forest stumpage integrated?

- Are national forest stumpage markets linked?
- What is the geographic extent of linkages?
- **Degree of market integration** can be detected empirically using tests for arbitrage and the law of one price (LOP) from trade theory.
  - Implications for model development: links among stumpage markets must be accounted for in models
  - Implications for policy: can shocks in one forest influence prices across several forests?

Arbitrage

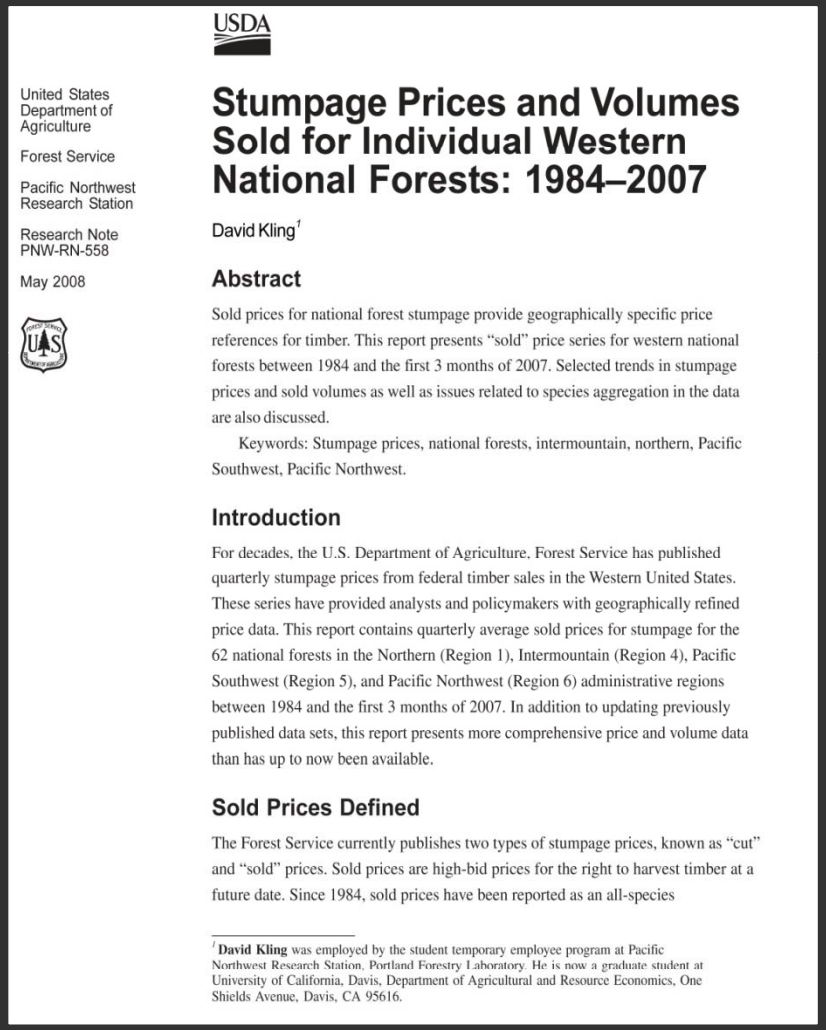
- Arbitrage is the pursuit of opportunities to profitably move commodities across markets until price differences just offset transaction costs.
- Prices in different markets converge by encouraging people to buy low and sell high.
- In integrated markets, arbitrage opportunities are eventually exhausted and prices differ only by transaction costs.
- Markets that appear separate can be viewed as one effective market if prices move together over time.
- The force behind these parallel price movements is arbitrage.
- Arbitrage can be detected using cointegration analysis.

Previous studies, U.S. and Canada

- Product markets
  - Lumber
    - Uri and Boyd (1990)
    - Jung and Doroodian (1994)
    - Murray and Wear (1998)
    - Nanang (2000)
    - Stevens and Brooks (2003)
    - Yin and Xu (2003)
    - Baek (2006)
    - Shahi et al. (2006)
  - Newsprint
    - Tang and Laaksonen-Craig (2007)
  - Pulp and paper
    - Buongiorno and Uusivuori (1992)
    - Alavalapati et al. (1997)
- Stumpage markets
  - U.S. South
    - Yin and Newman (1996)
    - Prestemon and Holmes (2000)
    - Nagubadi et al. (2001)
    - Prestemon (2003)
  - U.S. West
    - Prestemon et al. (2003)
      - EIS of the Biscuit Fire salvage
    - **No studies testing for stumpage market integration in the western United States.**
    - **No studies of the extent, integration, or long-run relationships of national forest stumpage markets.**
    - **No studies testing stationarity of national forest timber prices.**

Data

- Kling (2008)
- 62 western national forests
- Average sold prices
- Q1:1984 and Q1:2007
- FS Regions 1, 4, 5, 6
  - Northern
  - Intermountain
  - Pacific Southwest
  - Pacific Northwest



USDA

United States Department of Agriculture

Forest Service

Pacific Northwest Research Station

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Stumpage Prices and Volumes Sold for Individual Western National Forests: 1984–2007

David Kling[1]

Abstract

Sold prices for national forest stumpage provide geographically specific price references for timber. This report presents "sold" price series for western national forests between 1984 and the first 3 months of 2007. Selected trends in stumpage prices and sold volumes as well as issues related to species aggregation in the data are also discussed.

Keywords: Stumpage prices, national forests, intermountain, northern, Pacific Southwest, Pacific Northwest.

Introduction

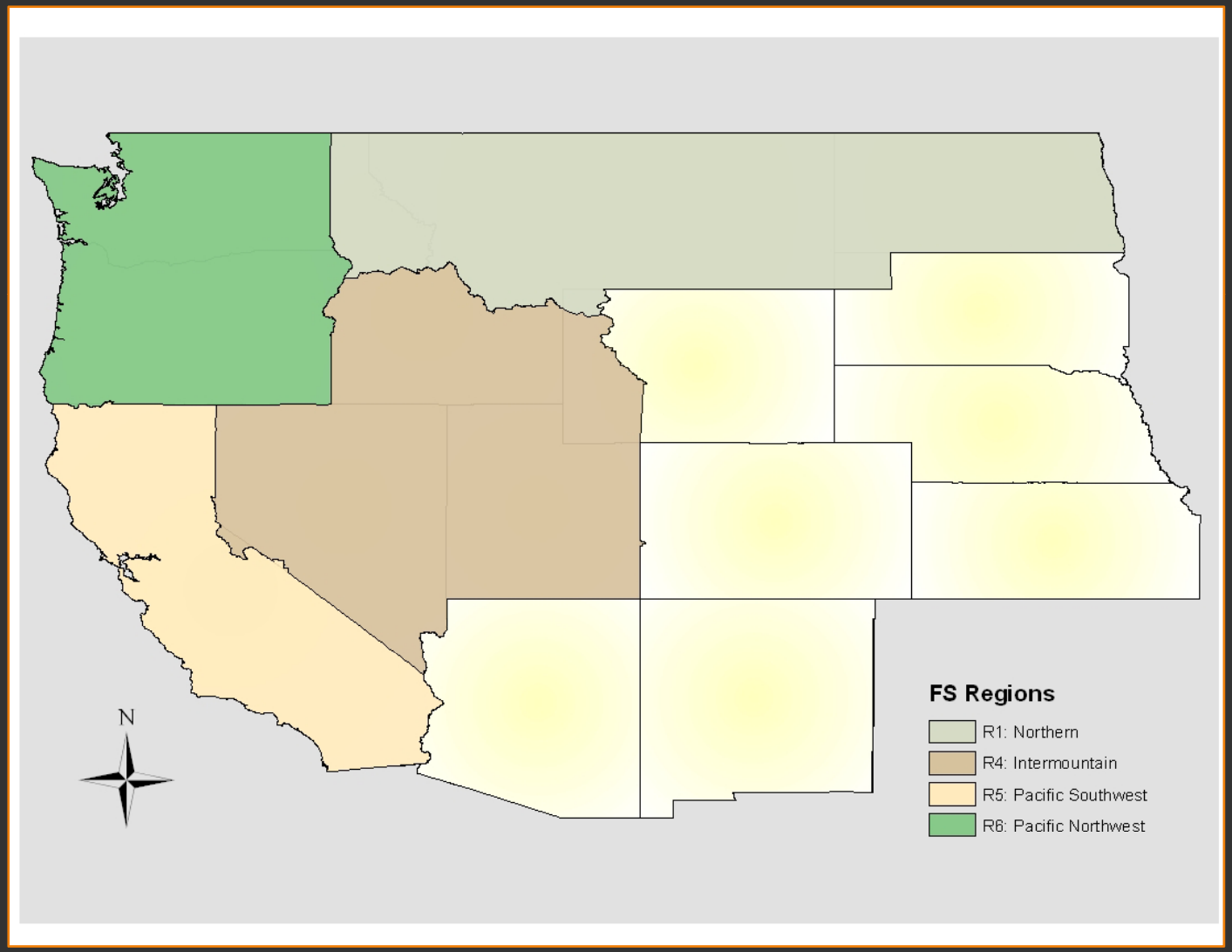
For decades, the U.S. Department of Agriculture, Forest Service has published quarterly stumpage prices from federal timber sales in the Western United States. These series have provided analysts and policymakers with geographically refined price data. This report contains quarterly average sold prices for stumpage for the 62 national forests in the Northern (Region 1), Intermountain (Region 4), Pacific Southwest (Region 5), and Pacific Northwest (Region 6) administrative regions between 1984 and the first 3 months of 2007. In addition to updating previously published data sets, this report presents more comprehensive price and volume data than has up to now been available.

Sold Prices Defined

The Forest Service currently publishes two types of stumpage prices, known as "cut" and "sold" prices. Sold prices are high-bid prices for the right to harvest timber at a future date. Since 1984, sold prices have been reported as an all-species

[1] **David Kling** was employed by the student temporary employee program at Pacific Northwest Research Station, Portland Forestry Laboratory. He is now a graduate student at University of California, Davis, Department of Agricultural and Resource Economics, One Shields Avenue, Davis, CA 95616.

FS Regions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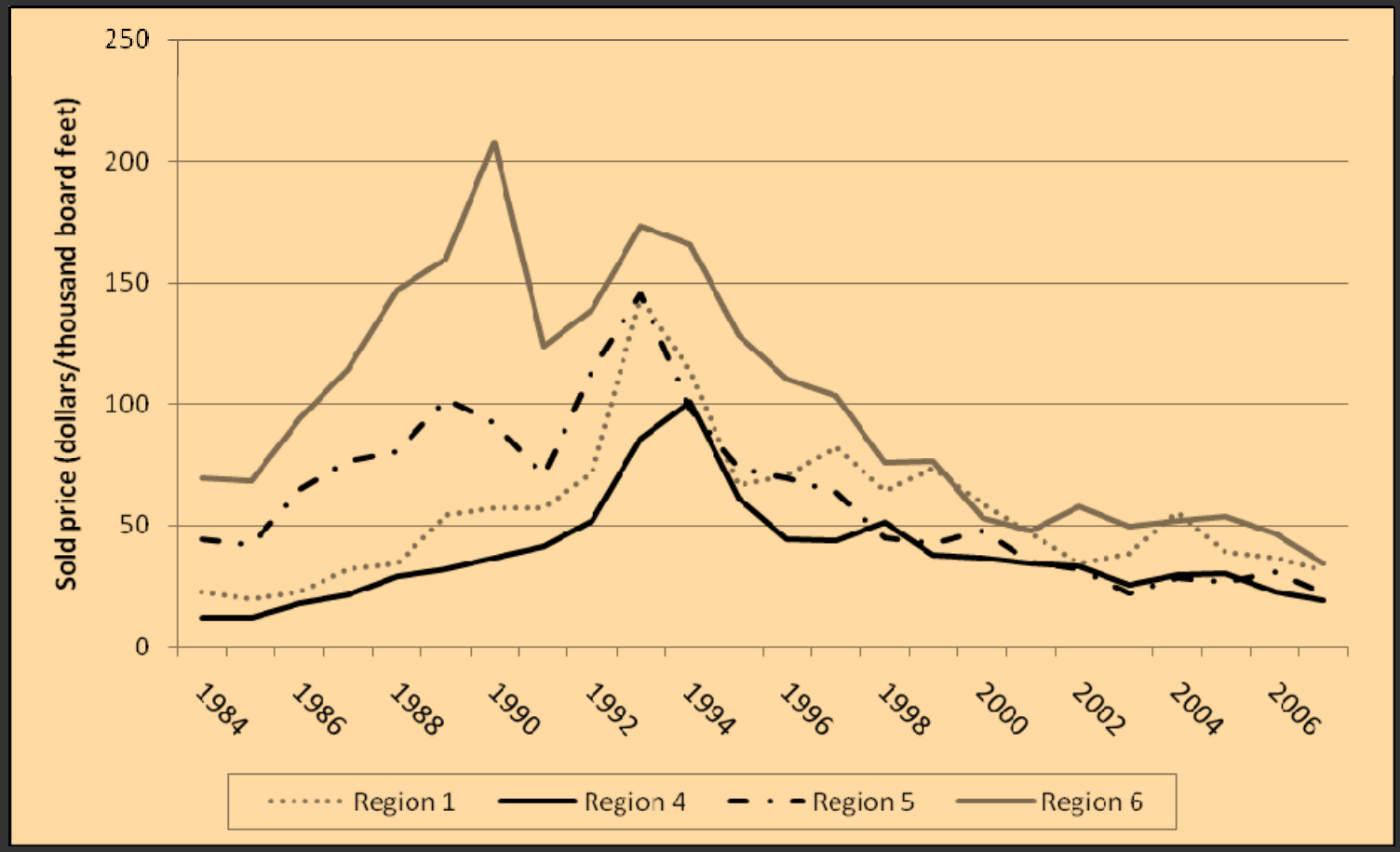
FS Regions
R1: Northern
R4: Intermountain
R5: Pacific Southwest
R6: Pacific Northwest

Stumpage prices by region



Methods

- Price series for 62 national forests
- Testing procedure
  - Test for stationarity
    - Augmented Dickey-Fuller unit root test on levels
    - Lag length, exogenous trend variables
  - Test for cointegration
    - Prices with a unit root in levels were tested again in first differences
    - Prices that were stationary after first differencing were eligible for cointegration analysis
    - Johansen's maximum likelihood procedure (1995)
- Forests with cointegrated prices have integrated stumpage markets

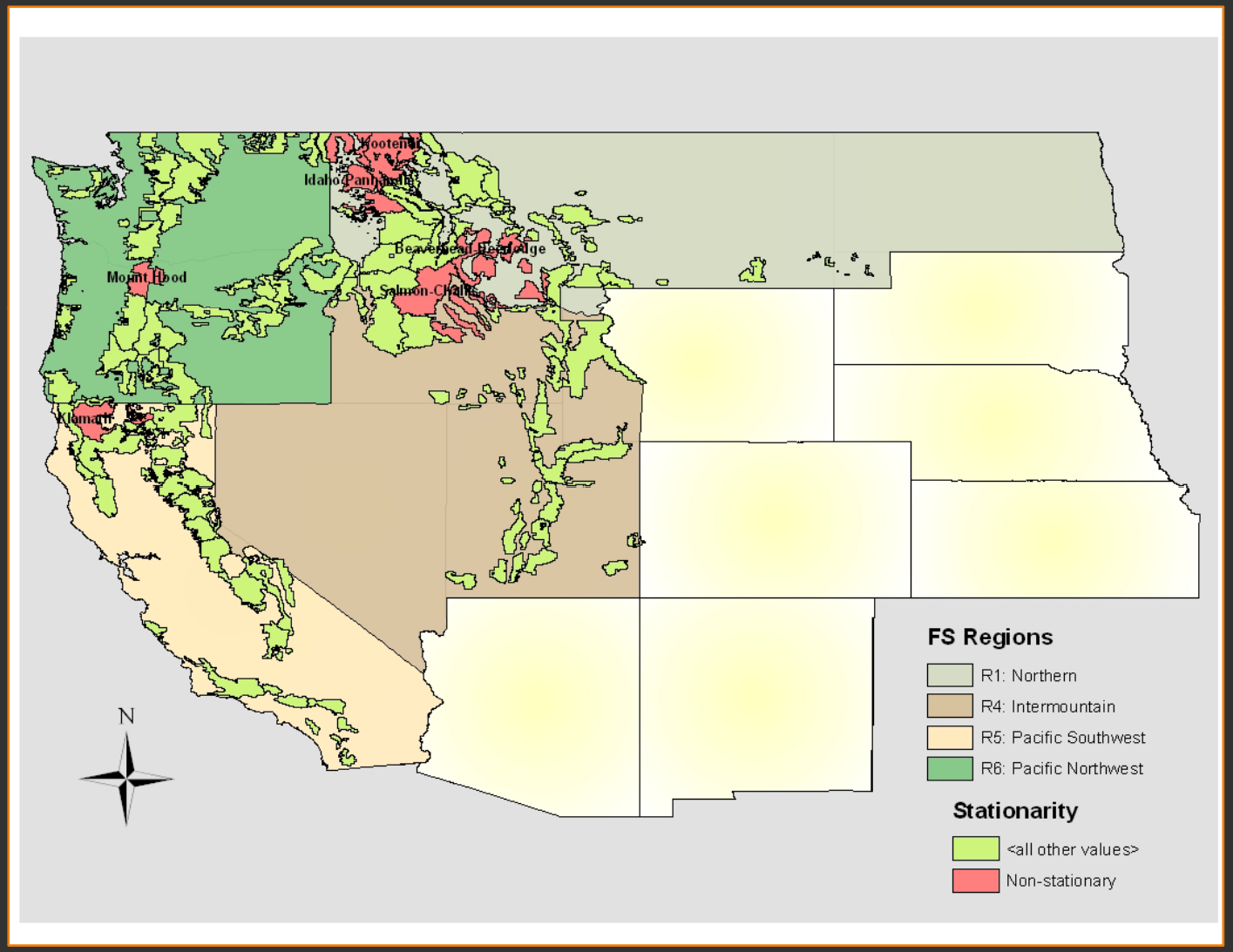
Cointegration analysis

- Although stumpage prices themselves may be nonstationary, a linear combination of them may exist that is stationary.
- If a stationary linear combination exists, the nonstationary series are cointegrated.
- The stationary linear combination is represented by a cointegrating equation that can be interpreted as a long run equilibrium relationship.
- Cointegration rank, *r*, that defines the number of cointegration equations among the price series.
- Two likelihood ratio tests for cointegration rank, trace and maximum eigenvalue tests.

Results

- Unit root tests
  - Stationary: 56 forests
  - Non-stationary: 6 forests
    - Beaverhead-Deerlodge, Idaho Panhandle, Kootenai; Salmon-Challis; Klamath; Mt. Hood
- All were stationary after first-differencing
- Beaverhead-Deerlodge, Idaho Panhandle, Kootenai, Salmon-Challis national forests were tested for cointegration

Results: stationarity



Cointegration

Beaverhead-Deerlodge, Kootenai, Idaho Panhandle, Salmon-Challis

Null hypothesis	Lags	Trace statistic p-value	Max-eigen statistic p-value
r = 0	2	0.0004*	0.0046*
r ≤ 1		0.0336*	0.0646
r ≤ 2		0.2452	0.2531
r ≤ 3		0.5107	0.5107

Trace indicates 2, max eigen indicates 1 cointegrating equations

Kootenai, Idaho Panhandle

Null hypothesis	Lags	Trace statistic p-value	Max-eigen statistic p-value
r = 0	2	0.0004*	0.0015*
r ≤ 1		0.6756	0.6756

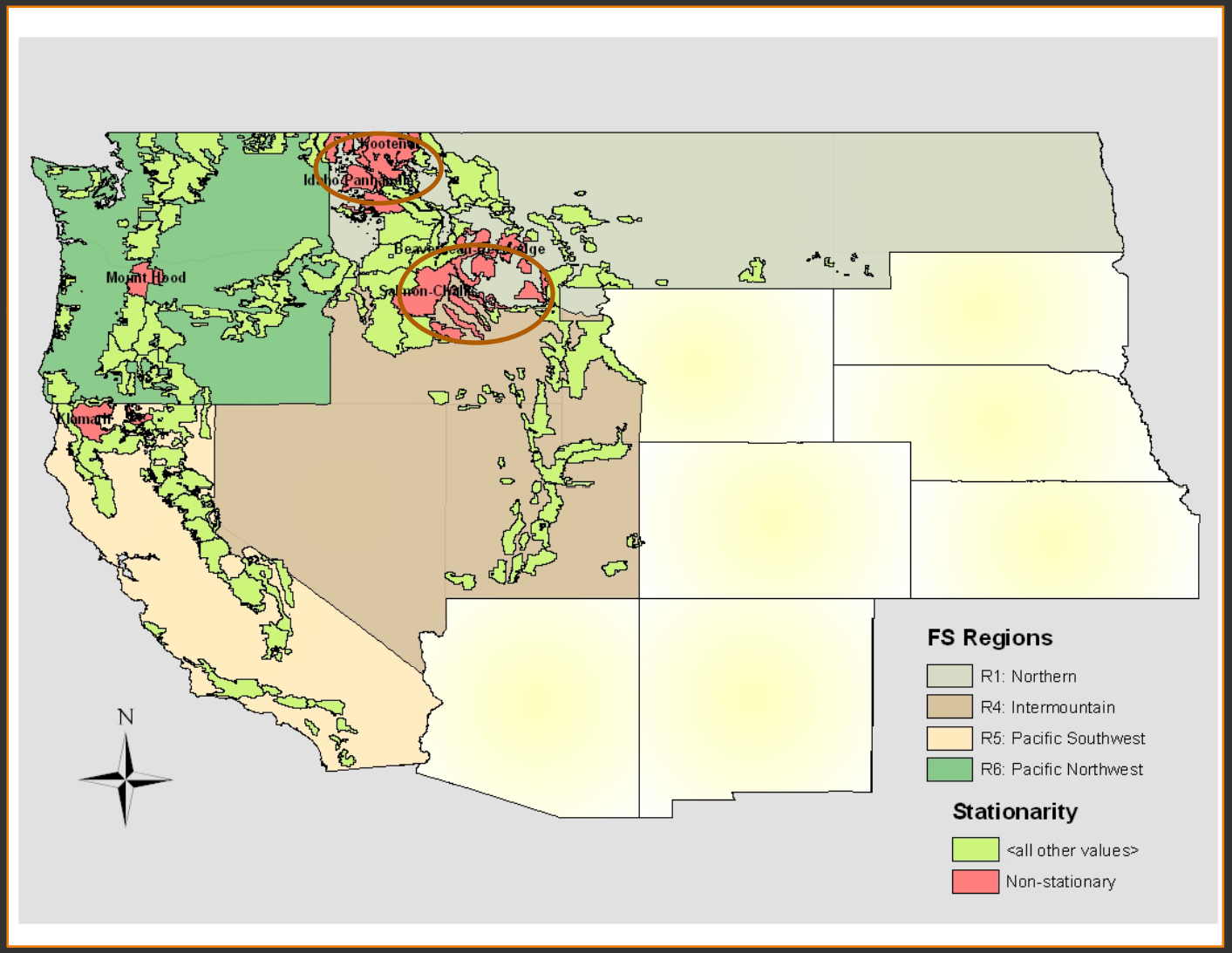
Trace, max eigen indicate 1 cointegrating equation

Beaverhead-Deerlodge, Salmon-Challis

Null hypothesis	Lags	Trace statistic p-value	Max-eigen statistic p-value
r = 0	2	0.0138*	0.0072*
r ≤ 1		0.5527	0.5527

Trace, max eigen indicate 1 cointegrating equation

Results: cointegration



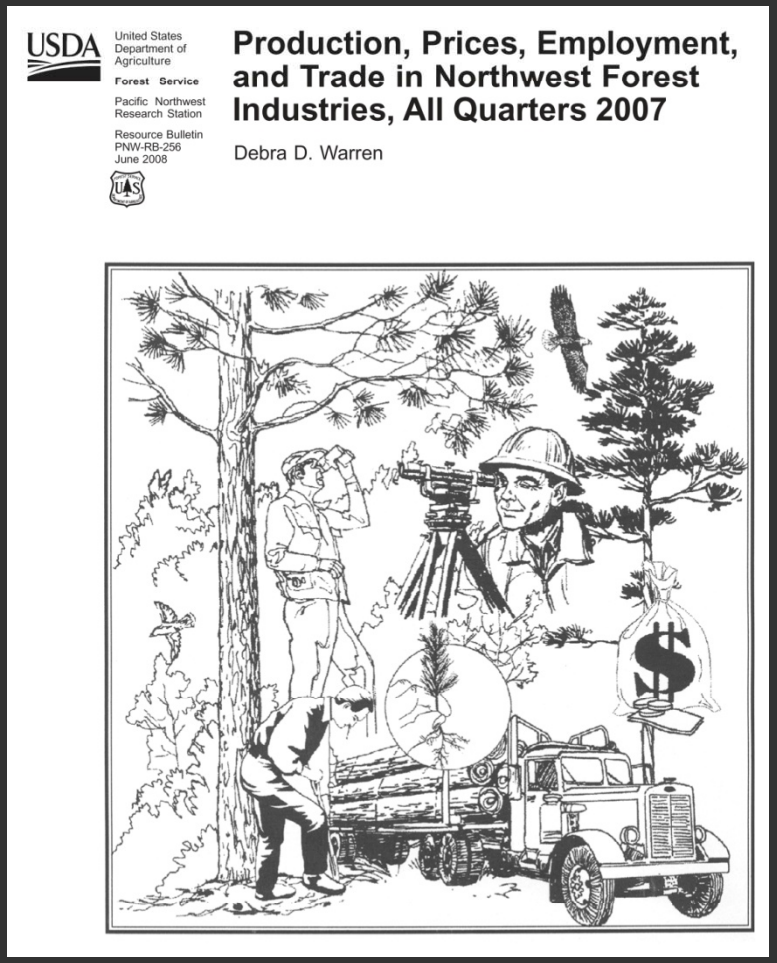
Conclusions

- Of 62 national forests, only 4 have integrated stumpage markets:
  - Kootenai, Idaho Panhandle
  - Beaverhead-Deerlodge, Salmon-Challis
- All other forests: no evidence of stumpage market integration
  - No evidence of arbitrage behavior among purchasers of timber from those forests.
  - No single market for national forest timber in the Western U.S. but rather a series of geographically distinct markets.

Implications

- Prices should be differenced as a precautionary measure to avoid spurious regression results
- Stationarity
  - Access to market information
  - Non-competitive markets (monopoly/monopsony)
- Modeling-many models assume stumpage market integration
- Shocks should not impact surrounding forests
- Granger Causality Tests-who's with me?

And for something completely different:



- Excel Web version is done!
- Go to:

http://www.fs.fed.us/pnw/ppet/

THANKS!

Questions or comments?

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