Assessing Risk and Asset Prominence within a Portfolio of Timberland Investments

Tony Cascio, Ph.D. candidate,
Mike Clutter, Ph.D.,
Warnell School of Forestry & Natural Resources,
University of Georgia

Western Forest Economists Mtg. – Welches, OR
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We Employ Portfolio Optimization & Simulation Techniques To:

- Explore the prominence, or persistence of U.S. South timberland regions within a portfolio, as a function of:
  - portfolio risk,
  - security allocation constraints
- Estimate the value at risk (VAR) of a timberland portfolio utilizing Monte Carlo simulation.
  - Value at risk (VAR) is a measure of the financial risk of an investment over some specified period of time.

Analysis Framework:
The Portfolio Security-Selection Decision

- Several analyses have identified the role that timberland can play in a diversified portfolio of investments.
  - The Asset-Allocation Decision
  - Utilize modern portfolio theory (MPT), developed by Markowitz.
- Once a decision is made to invest in timberland, what is the next step?
  - The Security-Selection Decision
  - Identify timberland with specific attributes consistent with those of the asset class in general, and that best fit the investor's objectives.
  - Can we use MPT to help us here?

Analyze Timberland Regions Using Portfolio Theory

- Focus on the US South
- We would like to have historical return data for the universe of timberland investments in the South – impossible!
- NCREIF return data for the South is all we've got (aside from individual fund data).
- We need time series of return data at a finer level of resolution.
  - Can we synthesize this?
  - At what level?

Requirements For A Synthetic Timberland Return

- A timberland return model
- Data for the model components at an appropriate geographic level of interest, and with a significant history. Such as:
  - timber prices
  - consumption levels
  - etc.

John Hancock Timberland Index (JHTI) (HTRG 2003)

- Calculates a quarterly, composite pine stumpage price, based upon published prices:
  - P_t = 0.5 * ppwd $ + 0.5 * pst $
- Develops a quarterly return series, reflecting income and capital appreciation components:
  - $Return_t = [(Net\ Income_t + Capital\ Value_t)/Capital\ Value_{t-1}]-1$
- Net Income = P_t * Income Rate
- Capital Value =

$$(8P_t + 7P_{t-1} + 6P_{t-2} + 5P_{t-3} + 4P_{t-4} + 3P_{t-5} + 2P_{t-6} + P_{t-7})/36$$

A Good Start, But We Would Like To Have:

- Finer geographic resolution:
  - TMS divides the US South into 22 areas.
    - TMS Map
- Finer product resolution:
  - Pine chip-n-saw should be included. TMS has this.
- Region-specific product harvest weights for developing a region-specific composite stumpage price:
  - $P_t = W_1 * \text{ppwd \$} + W_2 * \text{cns \$} + W_3 * \text{pst \$}$
  - Not so easy.

Region-Specific Product Harvest Data

- USFS Timber Product Output (TPO) data
  - Surveys mills to determine usage by product.
  - Matches this consumption to USFS Forest Inventory and Analysis (FIA) origination data.
- The result is volume harvested by:
  - Species Group,
  - Product,
  - County,
  - Ownership class – we are most interested in the Forest Industry class.
- With a catch...

A Helpful Workaround

- Legalities prevent the USFS from publishing forest ownership data at the county level.
- A special request to the USFS resulted in us getting Forest Industry data at the TMS area level, without the FS having to reveal county-level ownership data.
- A big THANKS to Tony Johnson at the Southern Research Station!

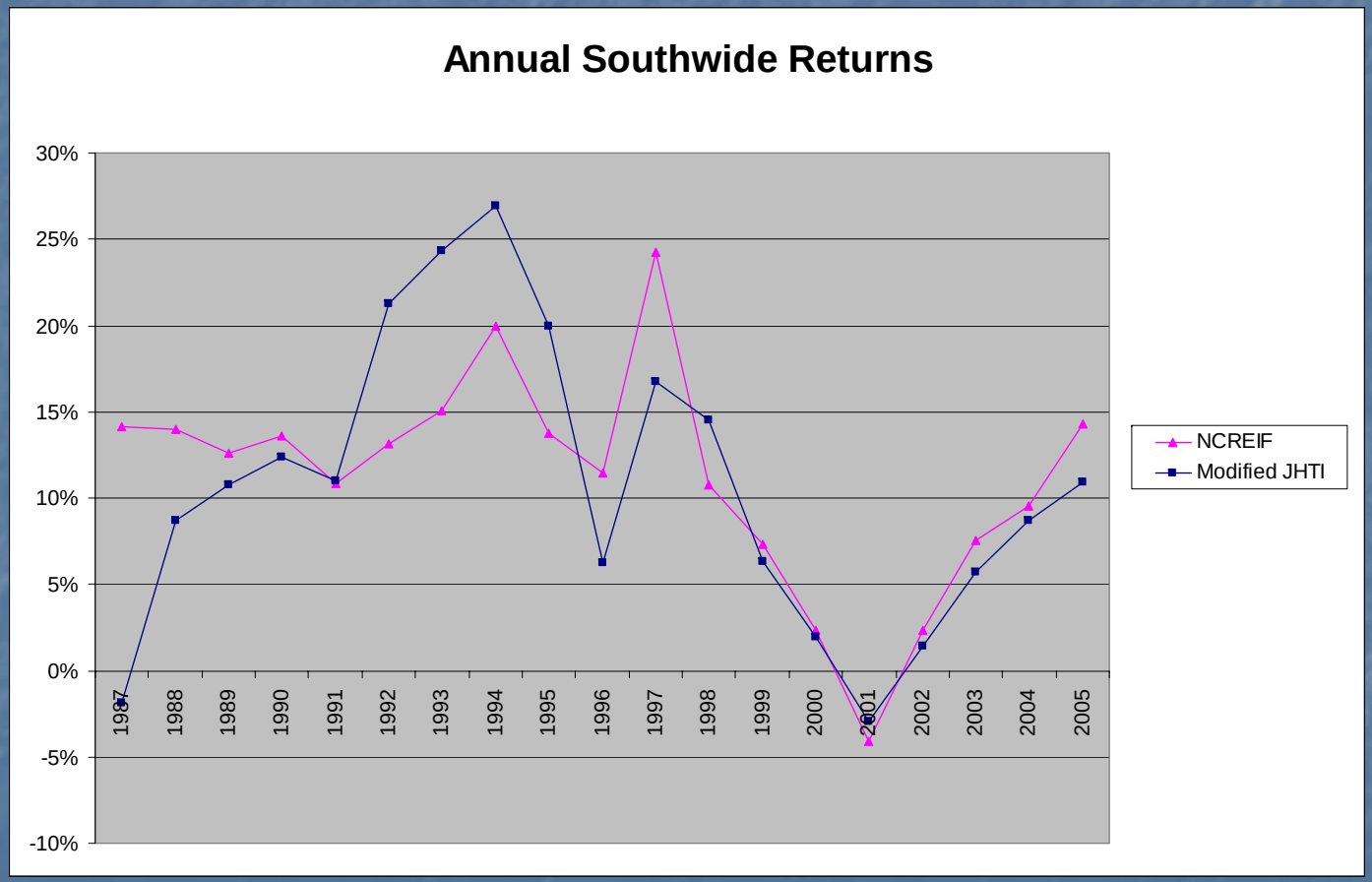
Almost There

- USFS TPO data includes pine pulpwood and sawtimber harvest data – not pine chip-n-saw.
- We needed a way to apportion the sawtimber removals to cns and pst for the 22 TMS areas.
- Utilized the Southern Forest Products Association Mill Survey...
- ...with a special request
- ...And another big thanks!

Almost There

- Net Income = P_t * Income Rate,
  - where *Income Rate* represents ratio of Income to Capital Value
  - Adjust *Income Rate* to minimize sum of squared differences between annual returns of synthetic & NCREIF South series.
- Capital Value:
  - Use 12 previous qtrs. composite stumpage prices, rather than 8.

Comparing Our South-wide, Synthetic Return Series to NCREIF



Correlation

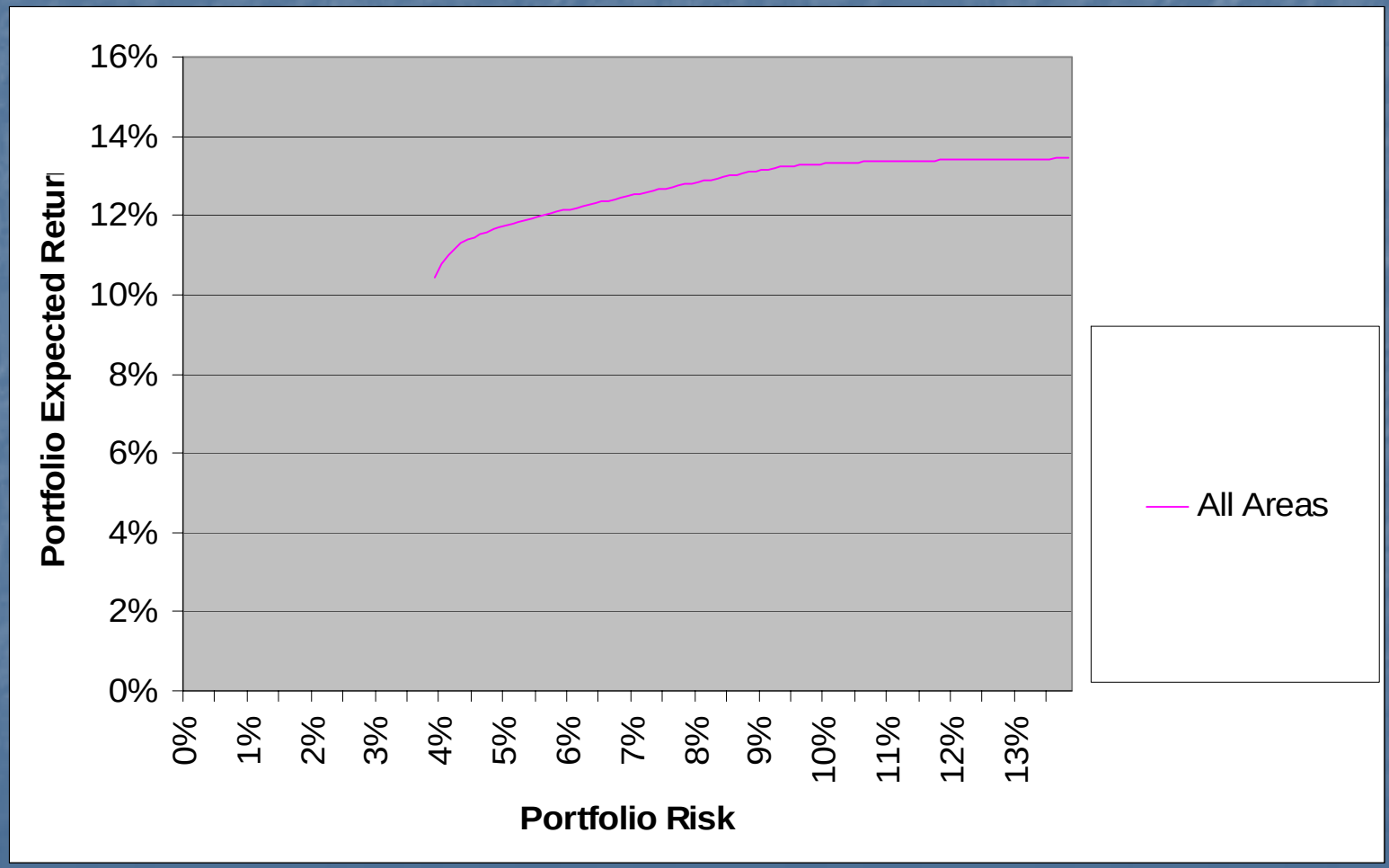
0.710 - 19 years

0.936 - 9 years

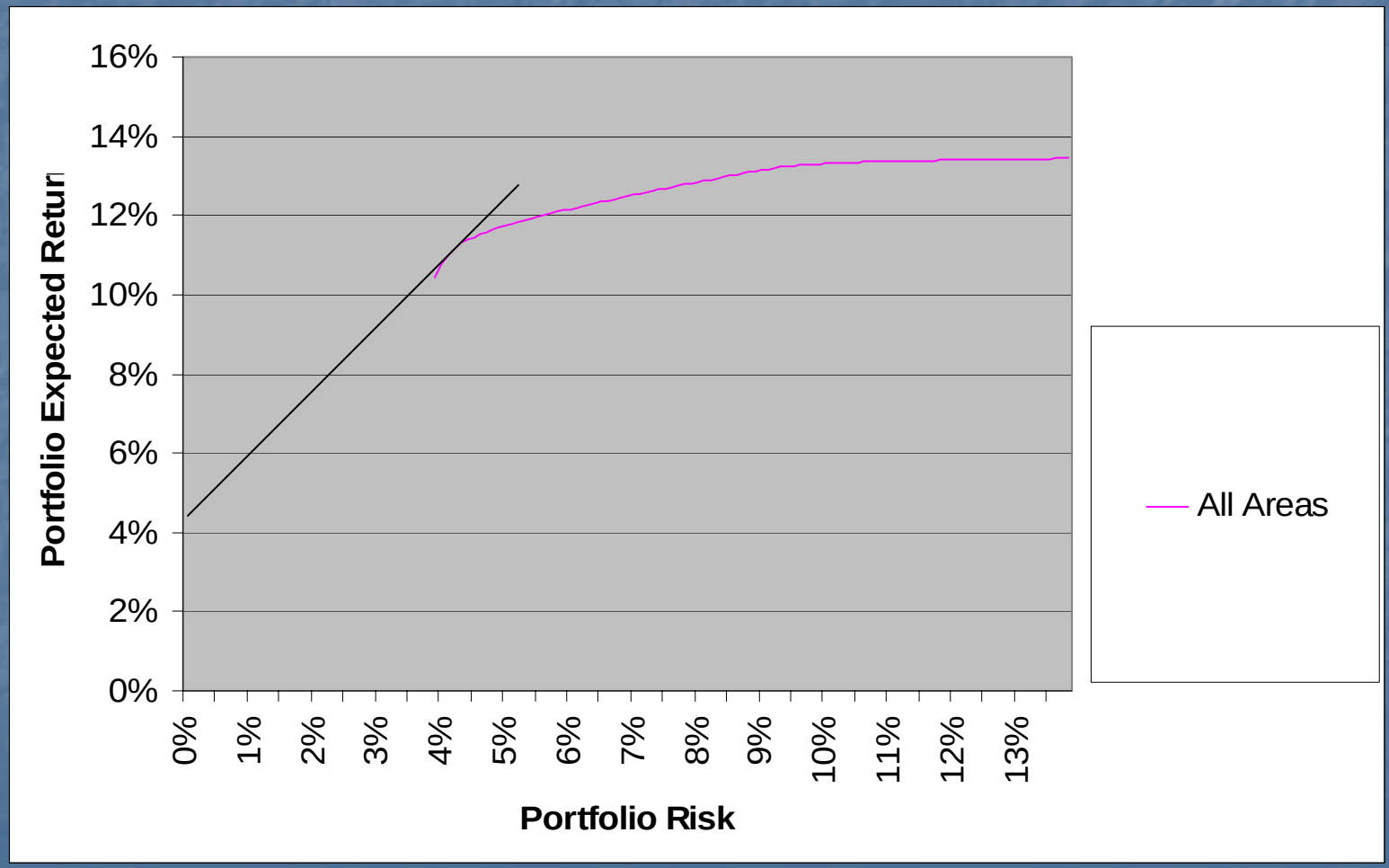
Historic Annual Returns of our Synthetic Regional Series (1987-2005)

TMS Area		AL	ARK	FLA	GA	LA	MS	NC	SC	TN	TX	VA
1	Avg. Ret.	10.8	11.2	9.4	8.9	11.5	13.0	10.4	8.5	13.3	12.9	10.1
	Std. Dev.	8.0	10.4	8.6	10.7	8.0	11.2	9.6	7.5	13.8	10.2	6.0
2	Avg. Ret.	10.4	7.0	8.3	8.0	11.5	11.8	10.5	8.9	12.4	10.2	10.6
	Std. Dev.	9.4	18.0	9.1	7.7	9.7	9.7	4.8	6.6	13.9	11.7	6.9

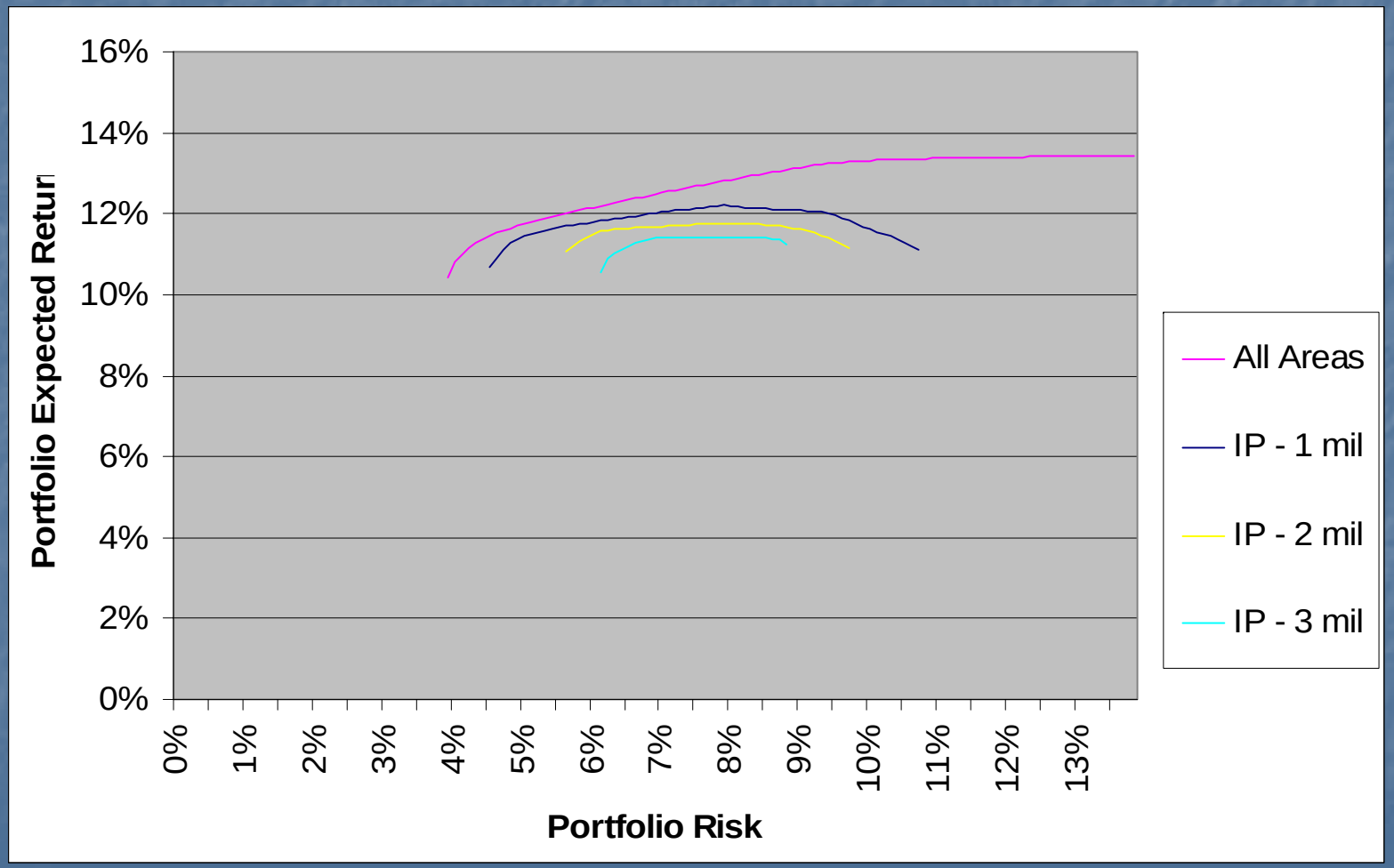
Efficient Frontier – No Constraints



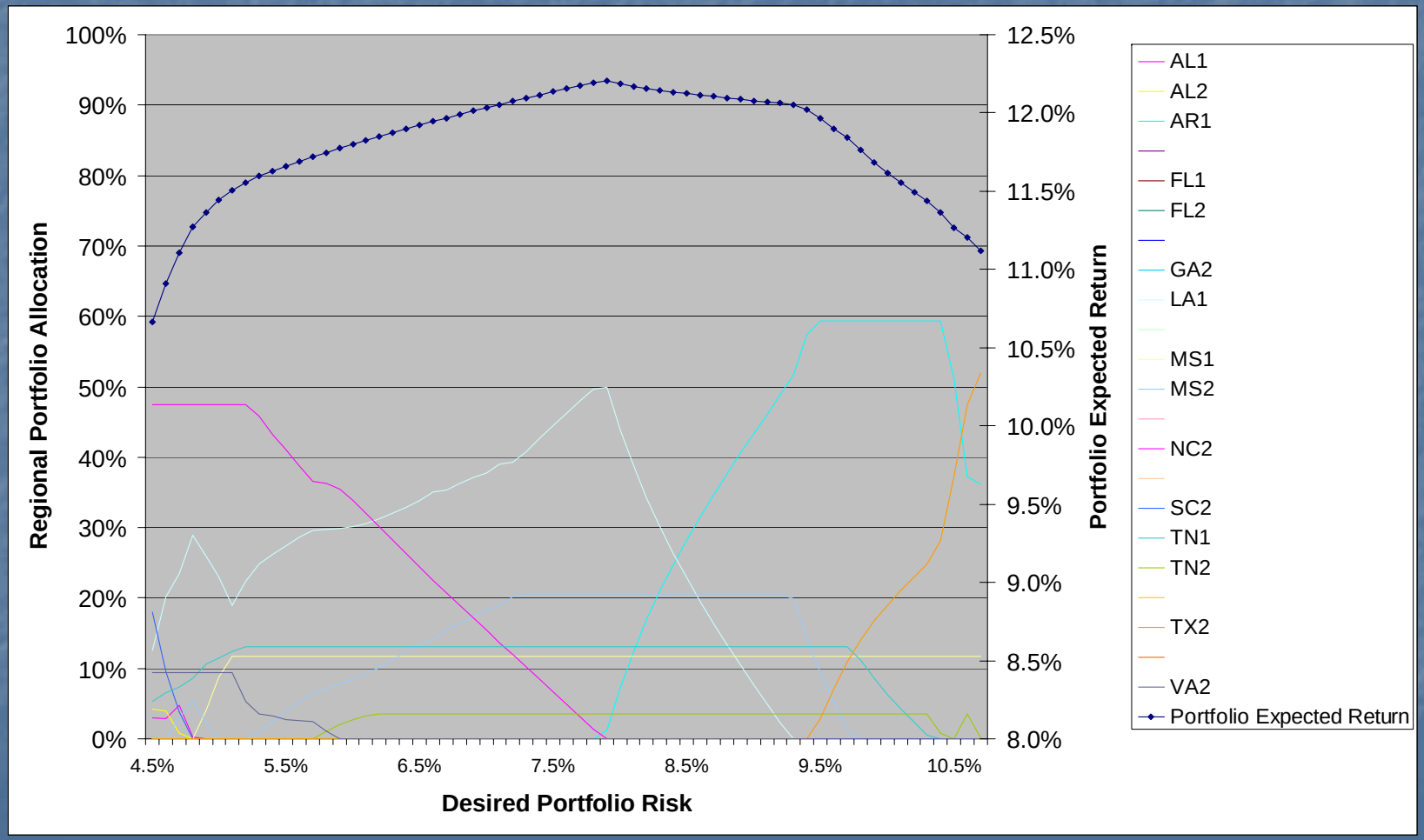
Efficient Frontier – No Constraints



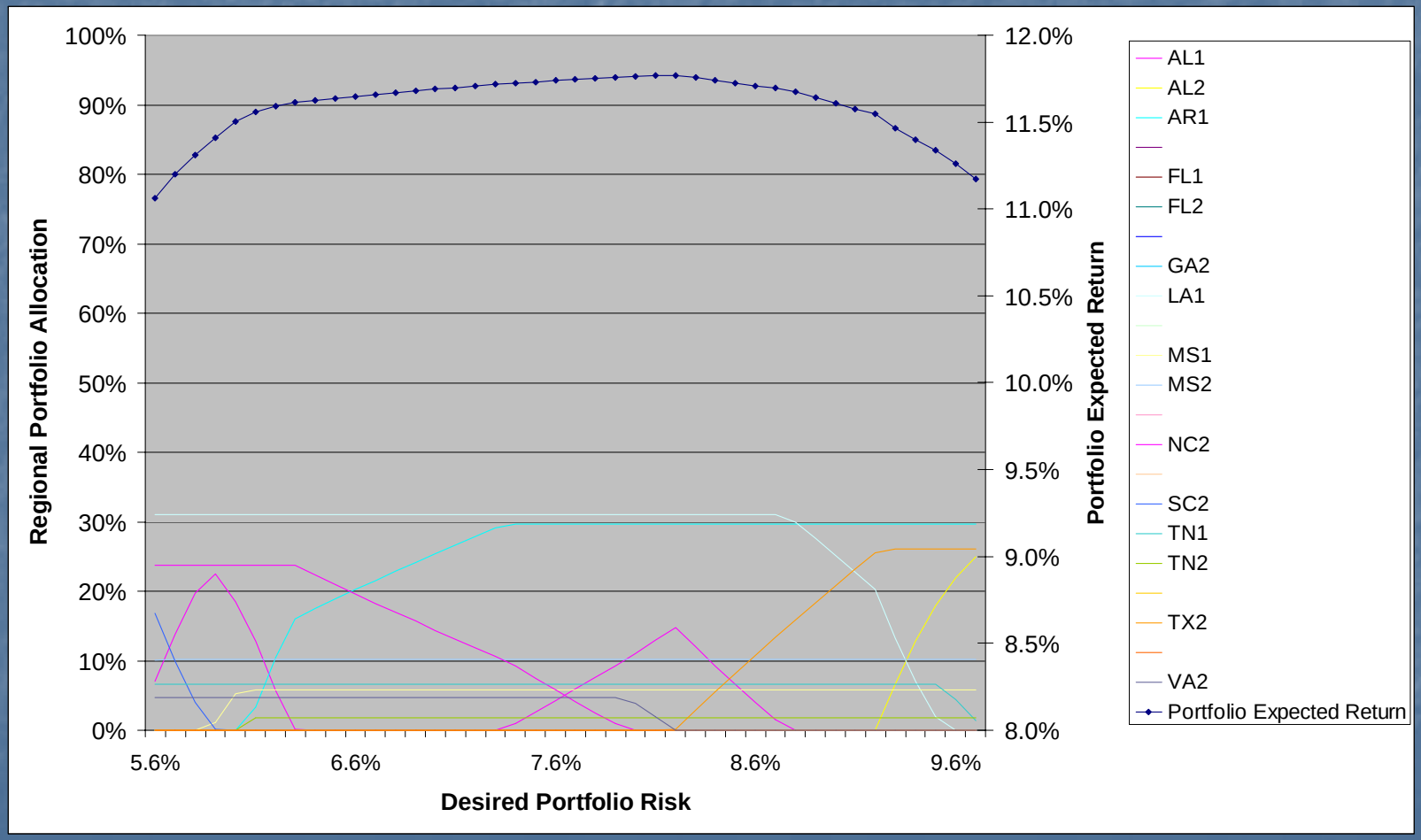
Efficient Frontiers: With Constraints



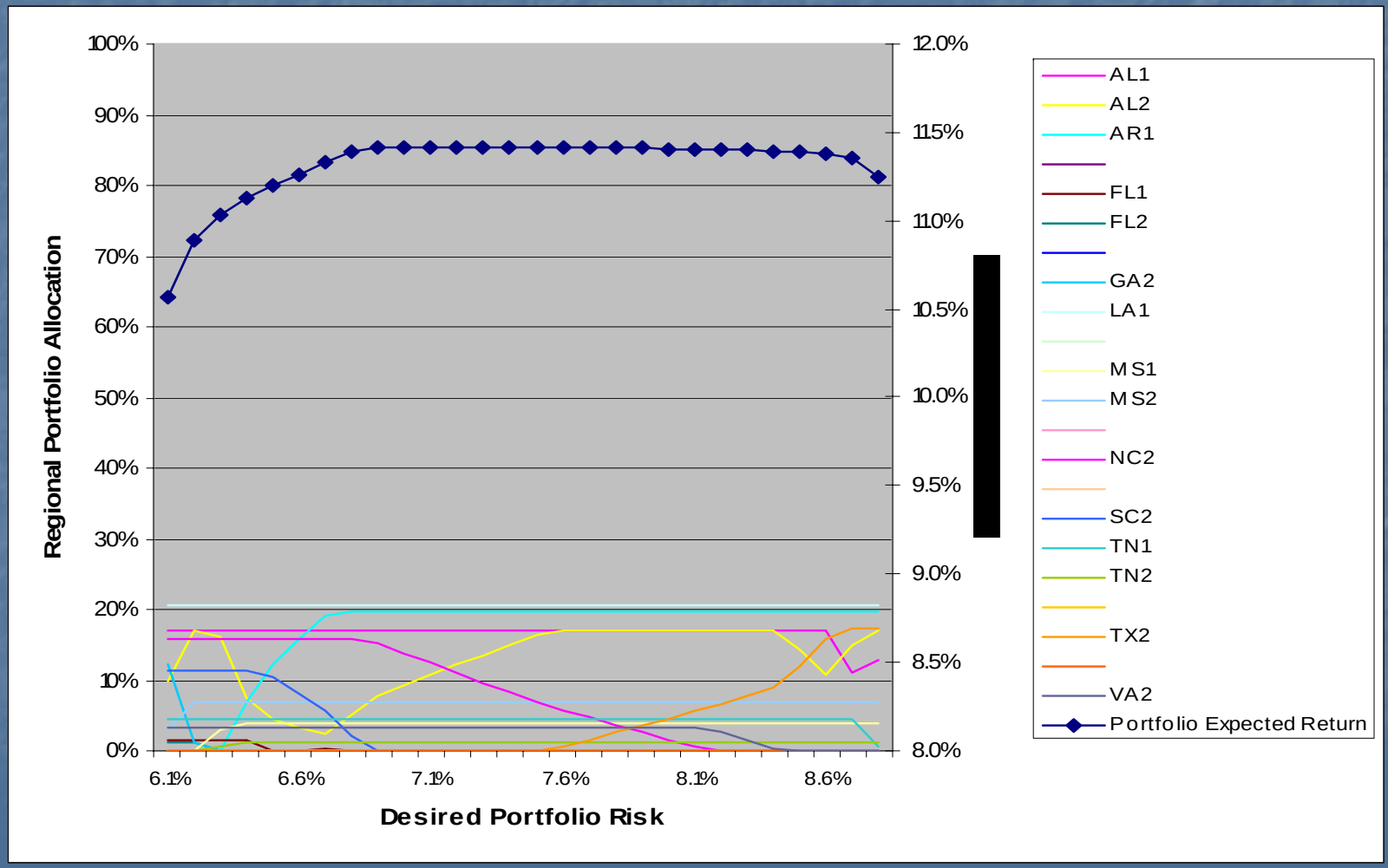
1 mil acre excursion



2 mil acre excursion



3 mil acre excursion



Asset Selections: 1 mil acre Excursion

Asset	Maximum Allowable Allocation	Optimal Allocation	Asset Prominence	Constrained Allocations
AL 1	51%	1.1%	0.2%	0.0%
AL 2	51%	0.0%	0.1%	0.0%
AR 1	59%	0.0%	19.4%	34.5%
FL 1	5%	0.0%	0.0%	0.0%
FL 2	3%	0.0%	0.0%	0.0%
GA 2	44%	0.0%	0.0%	0.0%
LA 1	62%	28.4%	22.5%	0.0%
MS 1	12%	0.0%	10.8%	96.6%
MS 2	20%	5.2%	10.9%	41.7%
NC 2	47%	47.0%	15.7%	20.6%
SC 2	34%	0.0%	0.5%	0.0%
TN 1	13%	8.4%	11.1%	78.0%
TN 2	4%	0.0%	2.6%	87.8%
TX 2	52%	0.0%	4.8%	7.7%
VA 2	9%	9.5%	1.4%	50.0%

Monte Carlo Simulation & Value At Risk

- Value at risk (VAR) is a method of measuring the financial risk of a portfolio over some specified period of time.
- VAR estimates the maximum reasonable loss that could be expected.
  - 'reasonable' is usually defined as the portfolio value at the 5% probability level of a distribution of possible returns.
- If a normal distribution of returns is assumed, the 5% VAR will equal the expected portfolio value - 1.645 * std. dev. of expected return.
- We can use Monte Carlo simulation to estimate the distribution of returns for a timberland portfolio after each year of a 10 year horizon.
  - With this distribution, we will know the 5% VAR, or worst-case scenario.

Value At Risk (VAR)

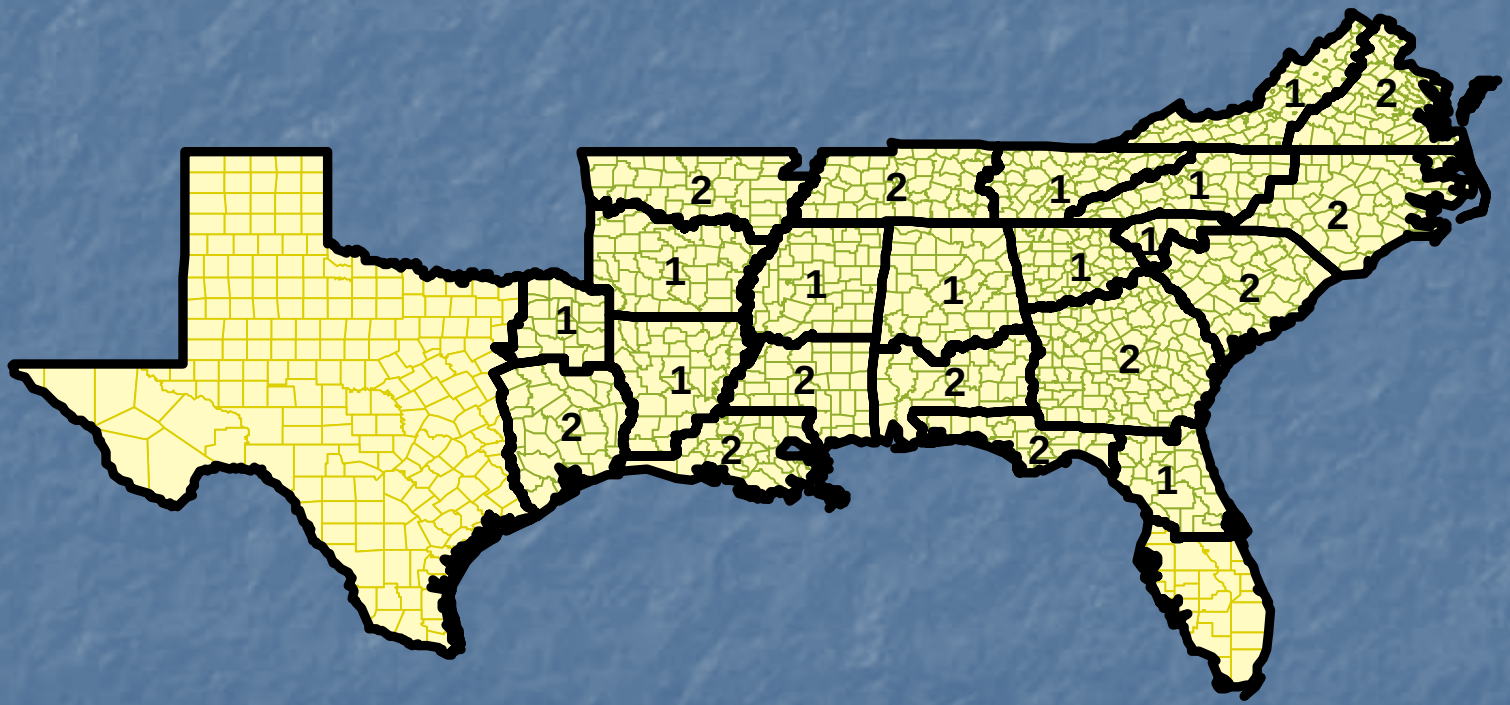
Expected Portfolio Value Over Time

Investment Year	Mean	Std Dev	5% VAR
1	$ 891,255,260	$ 46,195,151	$ 827,947,840
2	$ 992,828,990	$ 71,463,959	$ 887,470,784
3	$ 1,106,013,102	$ 99,973,715	$ 963,367,616
4	$ 1,232,321,540	$ 31,713,289	$ 1,042,946,304
5	$ 1,372,921,782	$ 163,123,876	$ 1,131,435,136
6	$ 1,529,656,267	$ 200,875,865	$ 1,244,753,536
7	$ 1,703,956,519	$ 239,462,905	$ 1,380,284,800
8	$ 1,899,486,588	$ 296,818,518	$ 1,490,860,288
9	$ 2,116,522,319	$ 350,543,612	$ 1,633,660,672
10	$ 2,357,176,537	$ 405,656,102	$ 1,792,319,360

Conclusion

- Analyzing sub-regional asset return series within a portfolio optimization context, and utilizing Monte Carlo simulation for a longer term perspective, can assist in the construction of optimal timberland investment portfolios, and help to characterize risk levels through time.
- Neither of these techniques should be used to dictate investment strategies.
- There are many facets of a potential timberland investment that cannot be sufficiently quantified or qualified to allow comprehensive, automated analysis and subsequent recommendations.

Timber Mart-South Areas



Return

http://www.tmart-south.com/tmart/