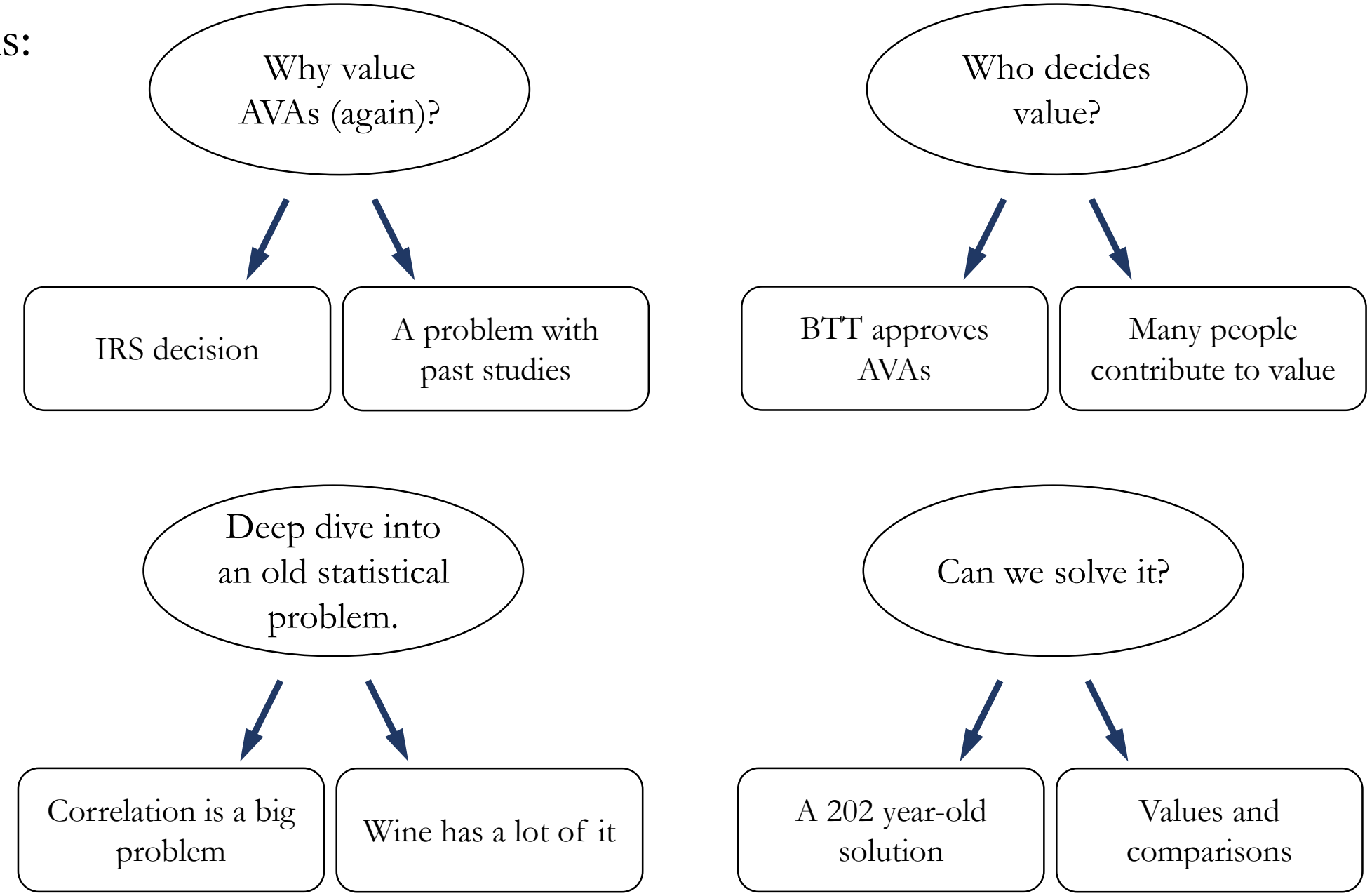
Valuing Oregon's Winegrowing Regions

Robin Cross
Applied Economics, OSU
Grape Day, April 3, 2018

Contributors

Funding	Oregon Wine Research Institute
Research motivation	OWA, winegrowers, Susan Capalbo, Mark Chien
Data	Northwest Farm Credit Services & other partners
Data mastery	Jason Beasley (during comps)
Theory & design	Juan-Carlos López, Steven Buccola, Jason Beasley, Jennifer Alix-Garcia, Steven Dundas

Four goals:

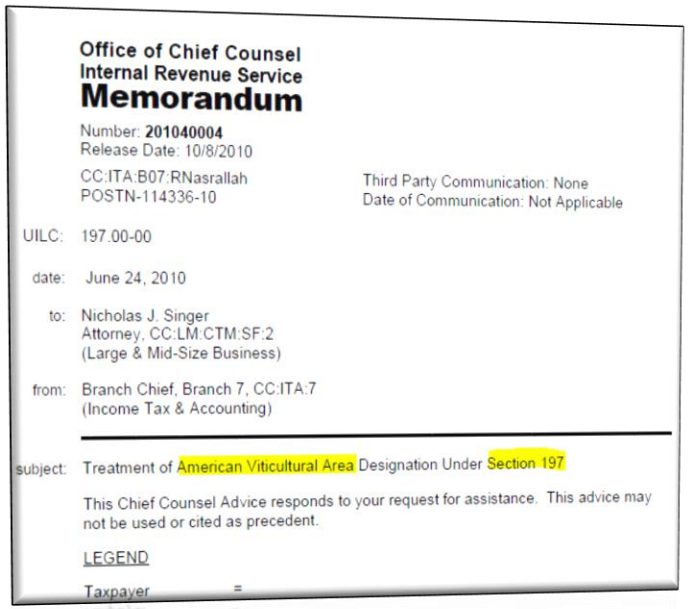

Why value AVAs (again)?
IRS decision
A problem with past studies
Who decides value?
BTT approves AVAs
Many people contribute to value
Deep dive into an old statistical problem.
Correlation is a big problem
Wine has a lot of it
Can we solve it?
A 202 year-old solution
Values and comparisons

Why value AVAs

(again)?

Why value AVAs (again)?

June 24th 2010 Memorandum



Office of Chief Counsel
Internal Revenue Service
Memorandum

Number: **201040004**
Release Date: 10/8/2010

CC:ITA:B07:RNasrallah
POSTN-114336-10

Third Party Communication: None
Date of Communication: Not Applicable

UILC: 197.00-00

date: June 24, 2010

to: Nicholas J. Singer
Attorney, CC:LM:CTM:SF:2
(Large & Mid-Size Business)

from: Branch Chief, Branch 7, CC:ITA:7
(Income Tax & Accounting)

subject: Treatment of American Viticultural Area Designation Under Section 197

This Chief Counsel Advice responds to your request for assistance. This advice may not be used or cited as precedent.

LEGEND

Taxpayer =

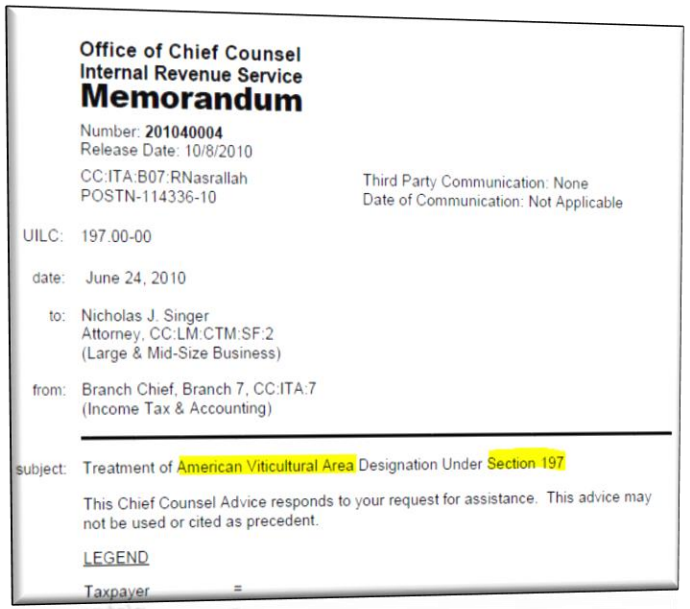
Vineyard buyers may allocate a portion of the purchase price to the AVA designation and deduct this portion from their taxes.

"…right to use an AVA designation… is not… land."

"…distinguishable by geographical features…"

Why value AVAs (again)?

June 24th 2010 Memorandum



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LEGEND

Taxpayer =

Big challenge for appraisers and vineyard buyers:

"…unclear whether the value…attaches to…[a] vineyard…"

"…making an appraiser's determination…factually difficult."

"Only…a factual showing of some clear premium…would be recognized."

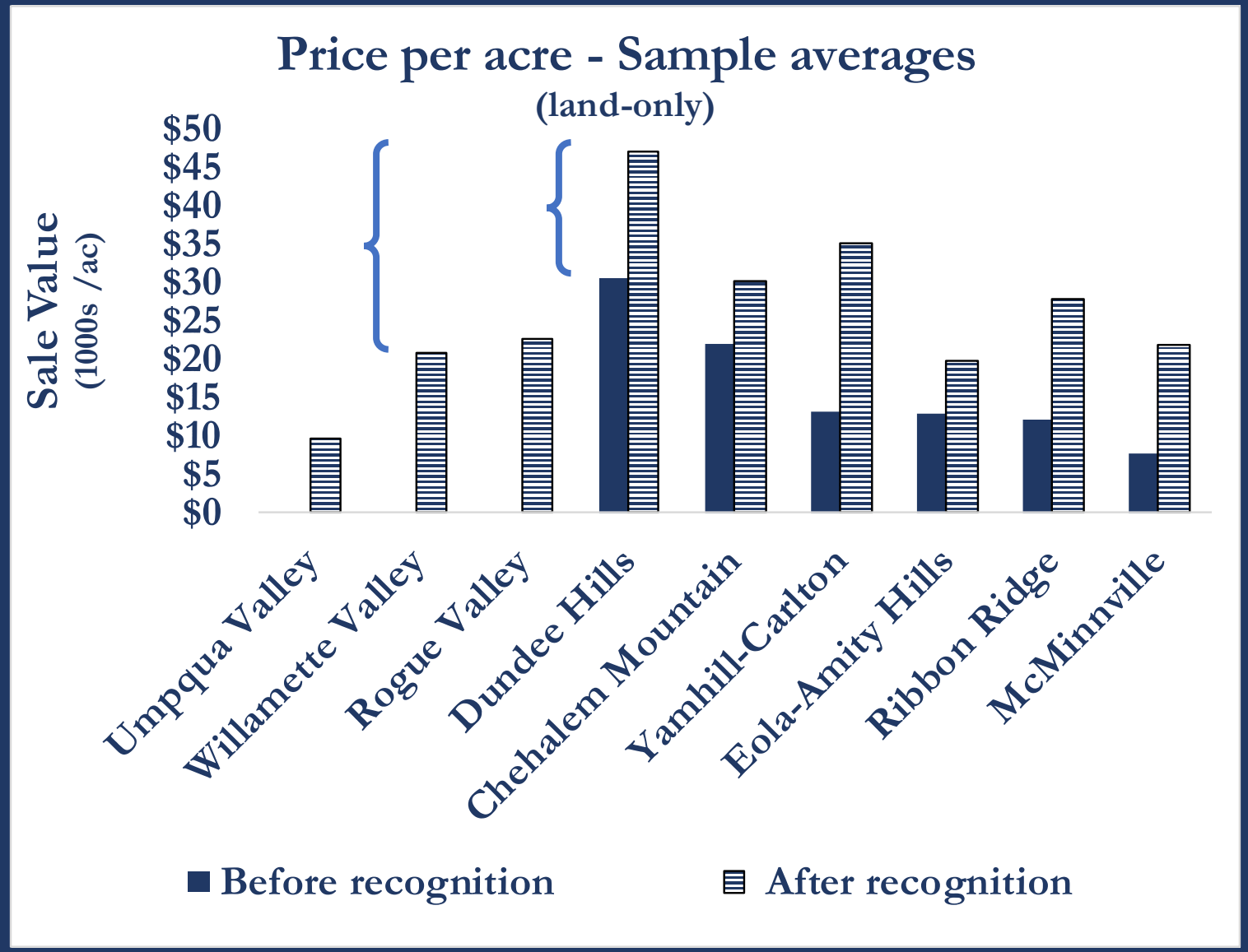
Why value AVAs (again)?

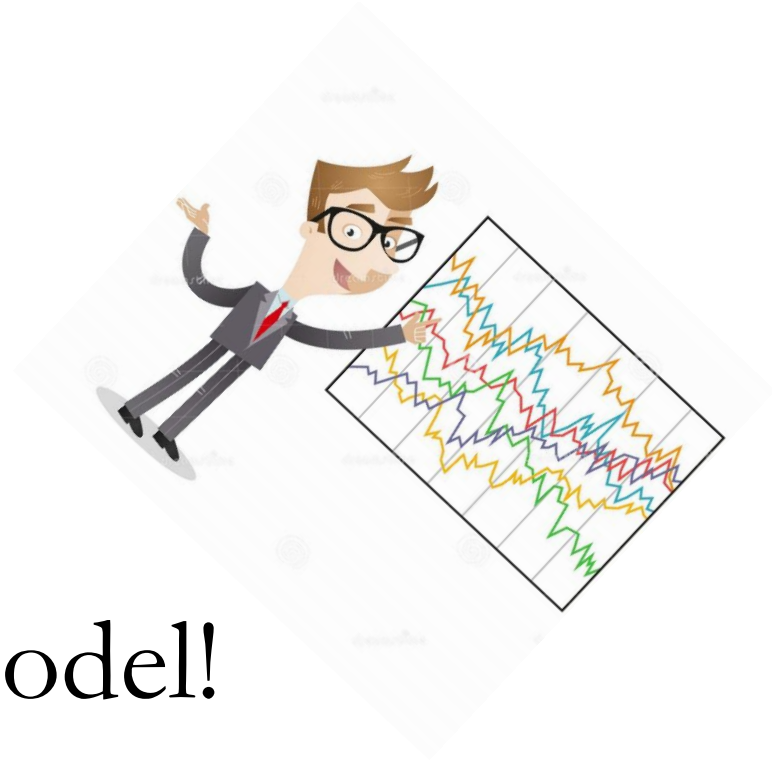
Just use sales averages?

Dundee is 127% higher than the Willamette Valley.

Sales values increased 37% -180% after federal recognition.

Other things happen.





Time for a statistical model!

Why value AVAs (again)?

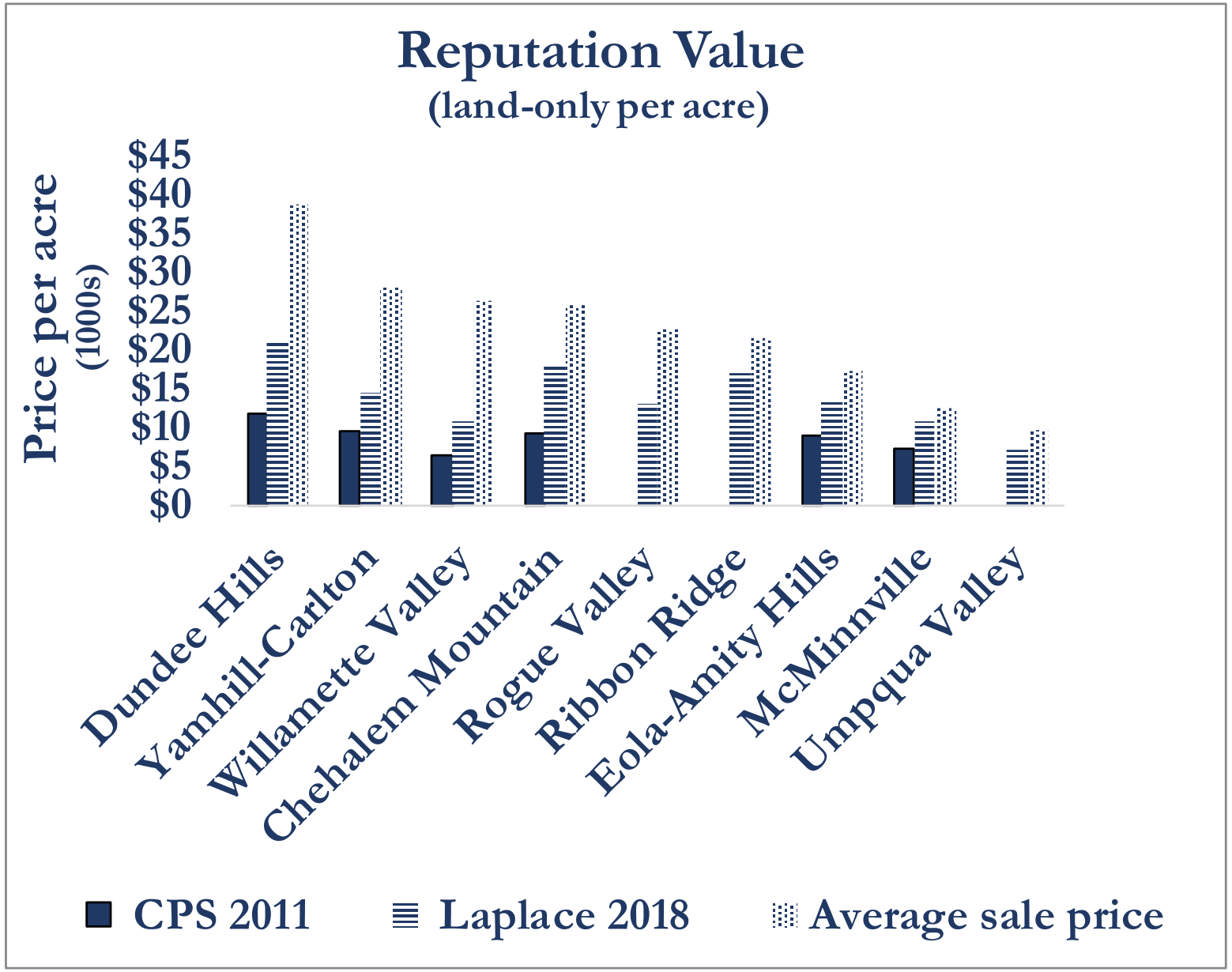
What is the value of Terroir?
Cross, Plantinga, and Stavins, 2011 (CPS 2011)

Reputational contribution to vineyard sale value

104 vineyard sales (1997-2007)

108 control variables available

15 used - expert opinion



Who decides reputation's value?

Who decides value?

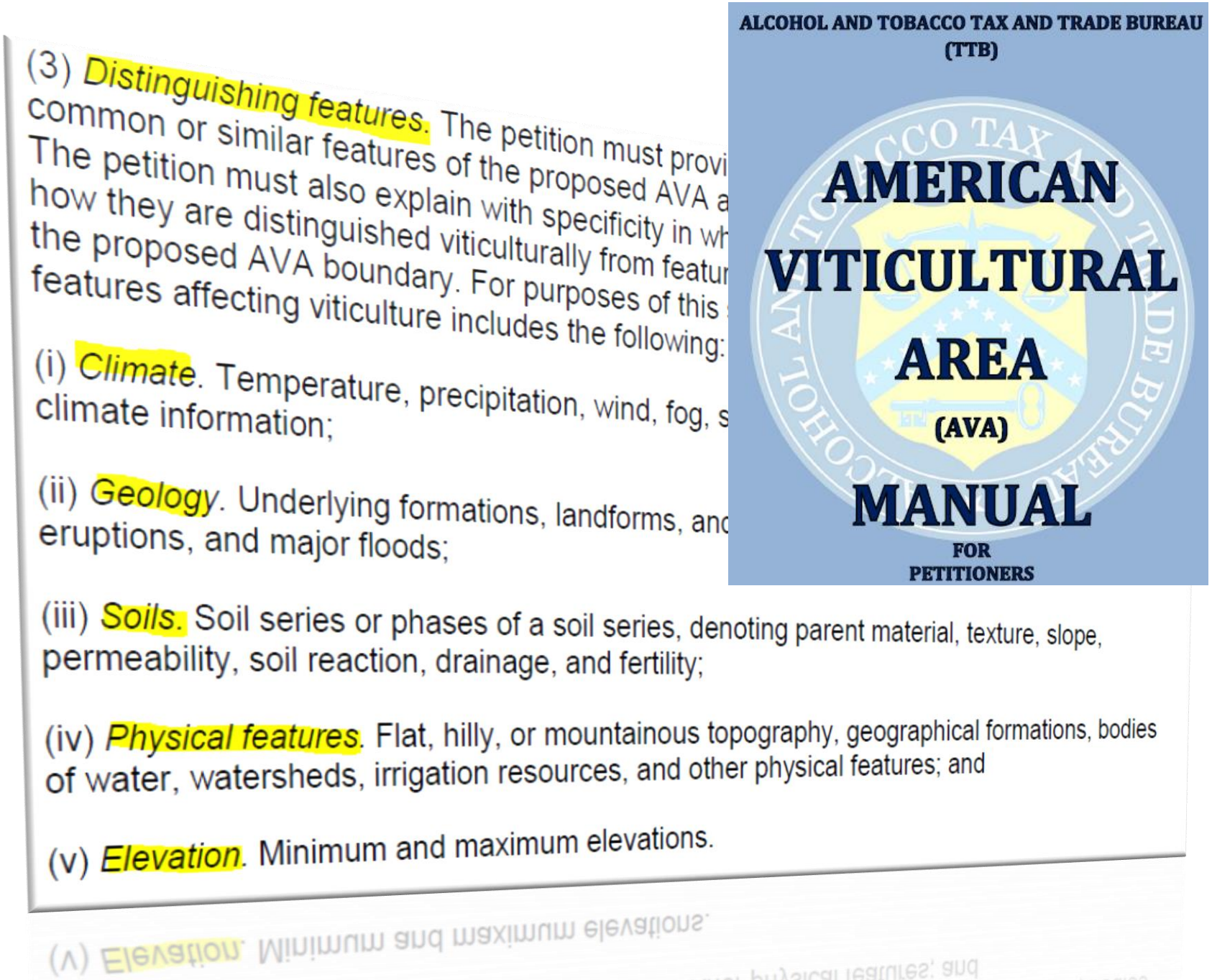
Who defines terroir?

TTB?

AVA manual, p. 32/35

No “terroir” reference.

Includes human activity.



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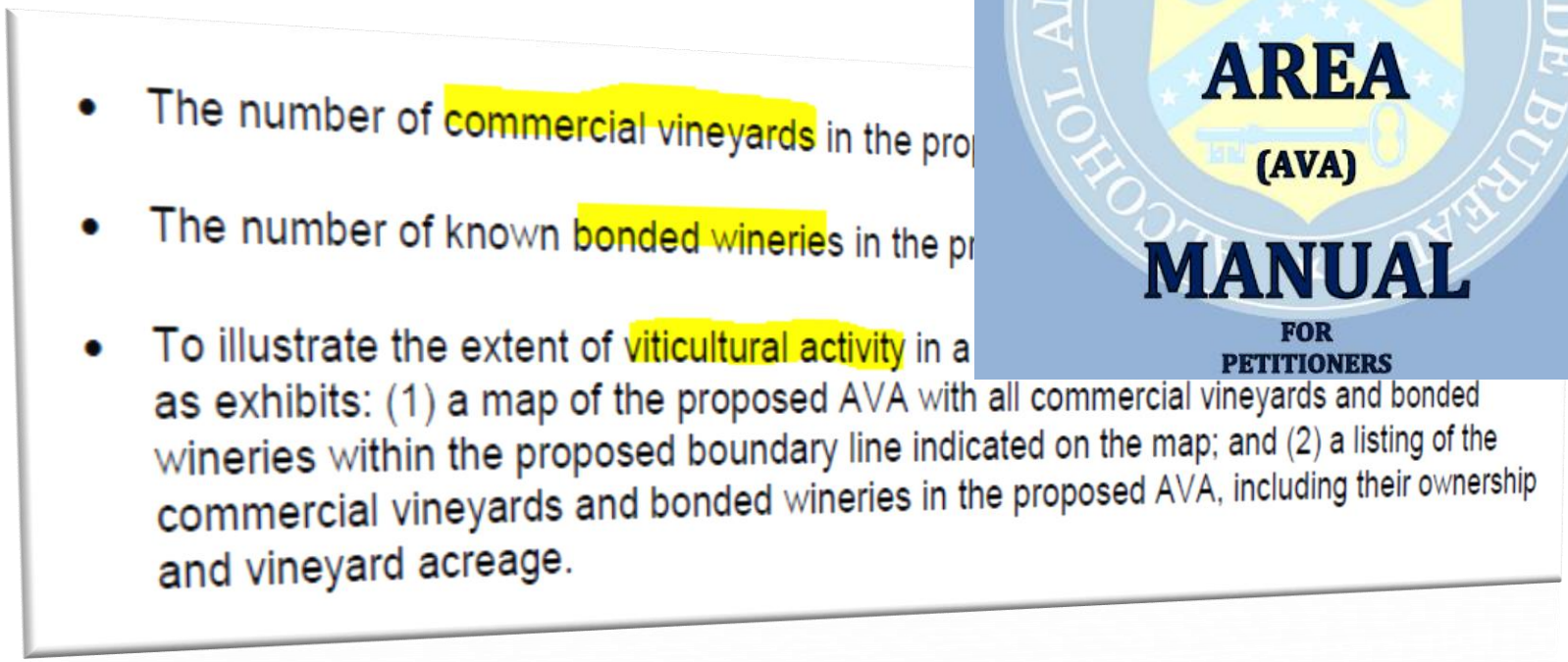
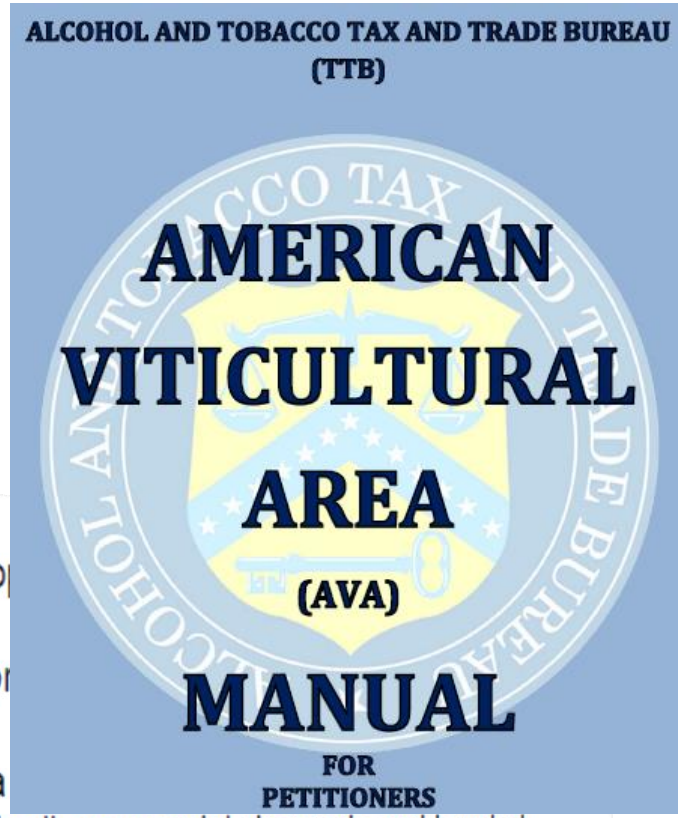
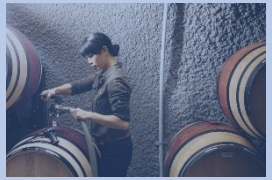
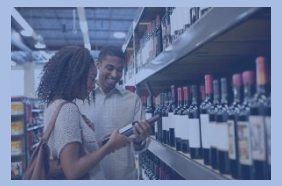


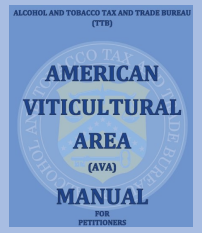


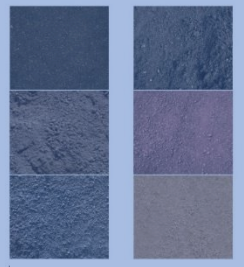
Who decides value?

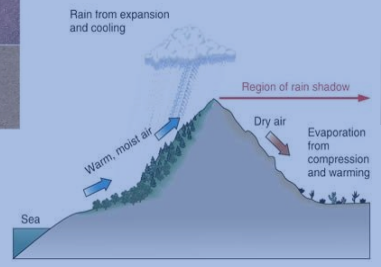


Vineyard buyers may allocate a portion of the purchase…

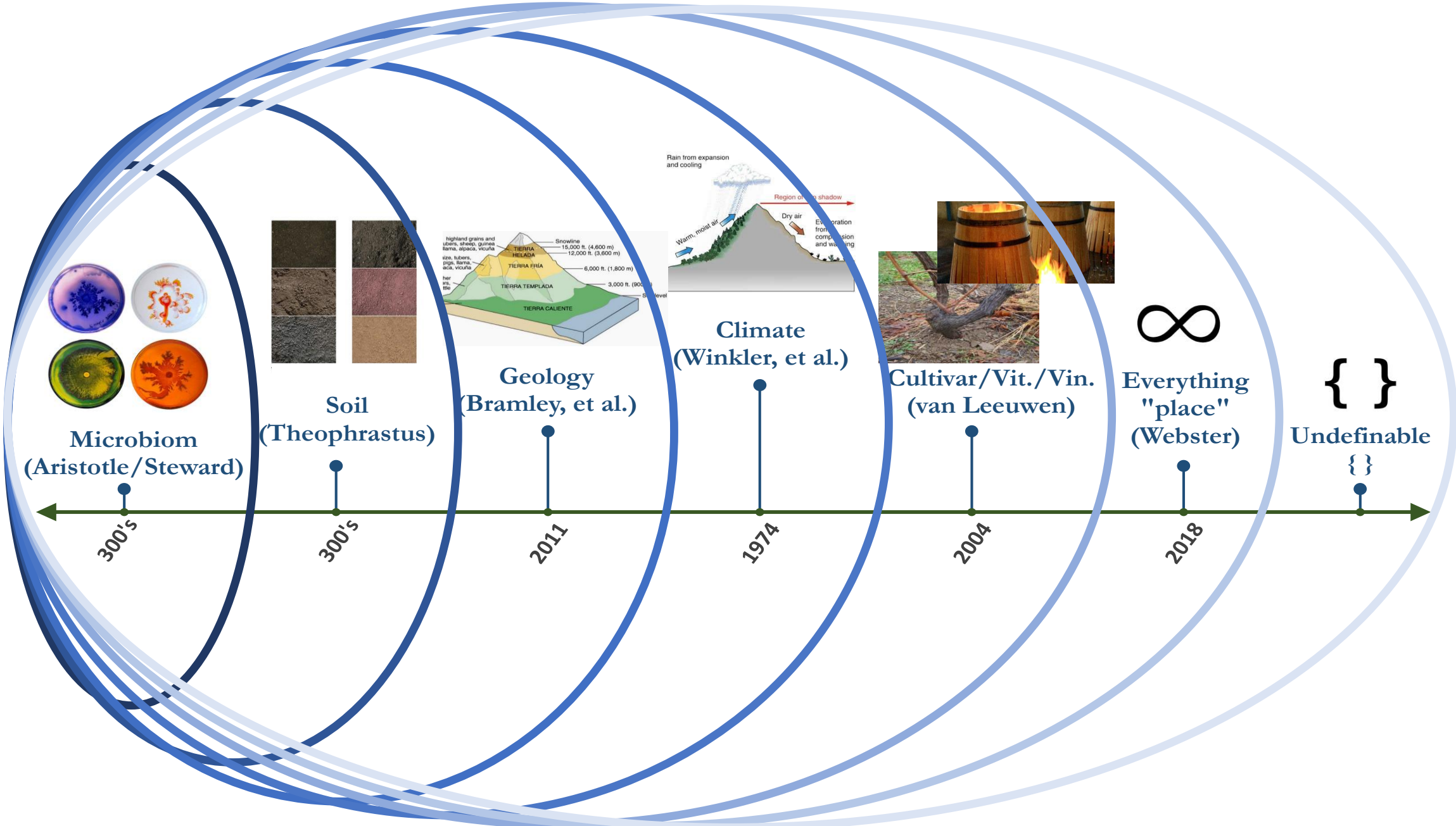




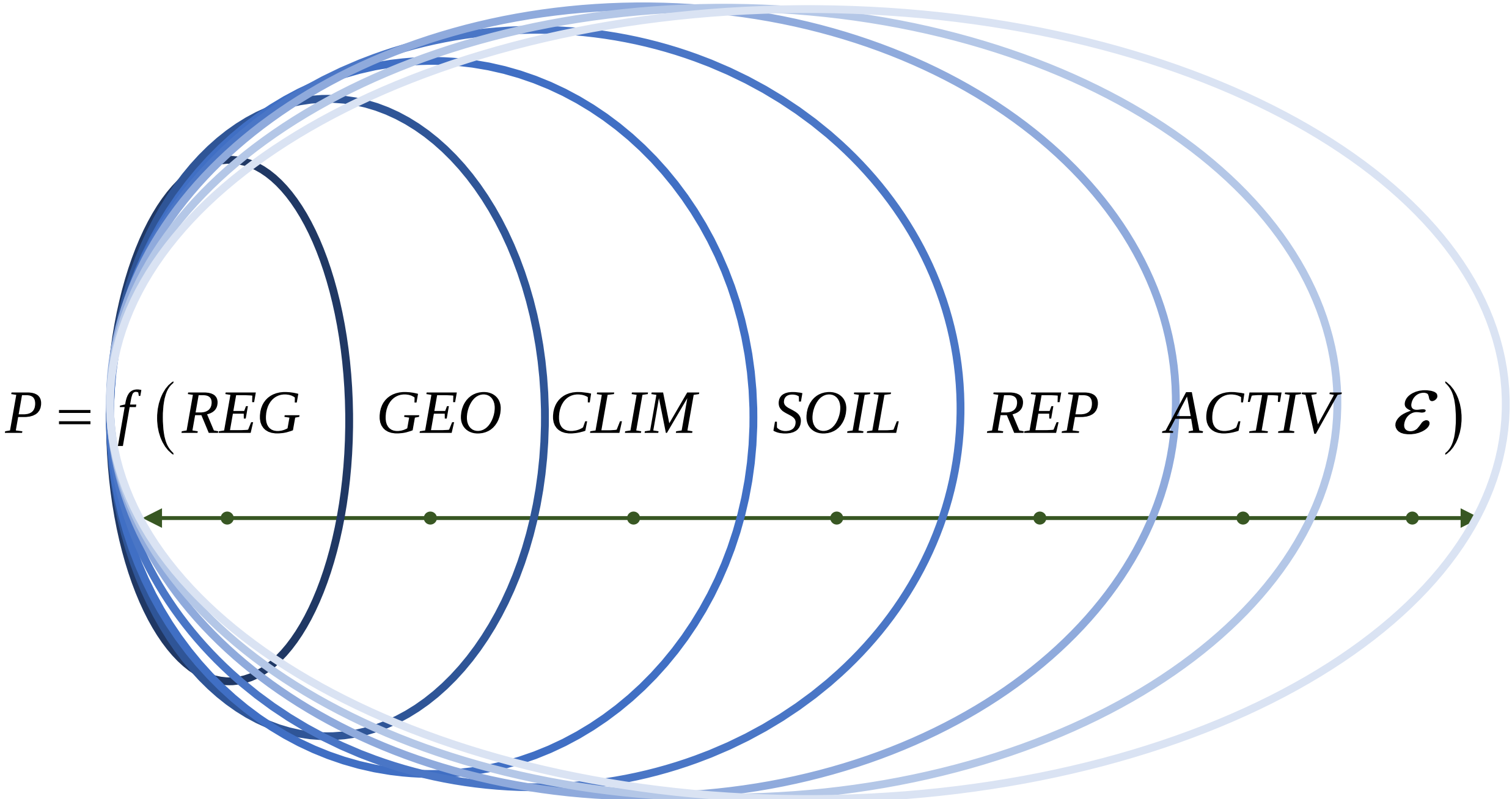




Terroir definition continuum…



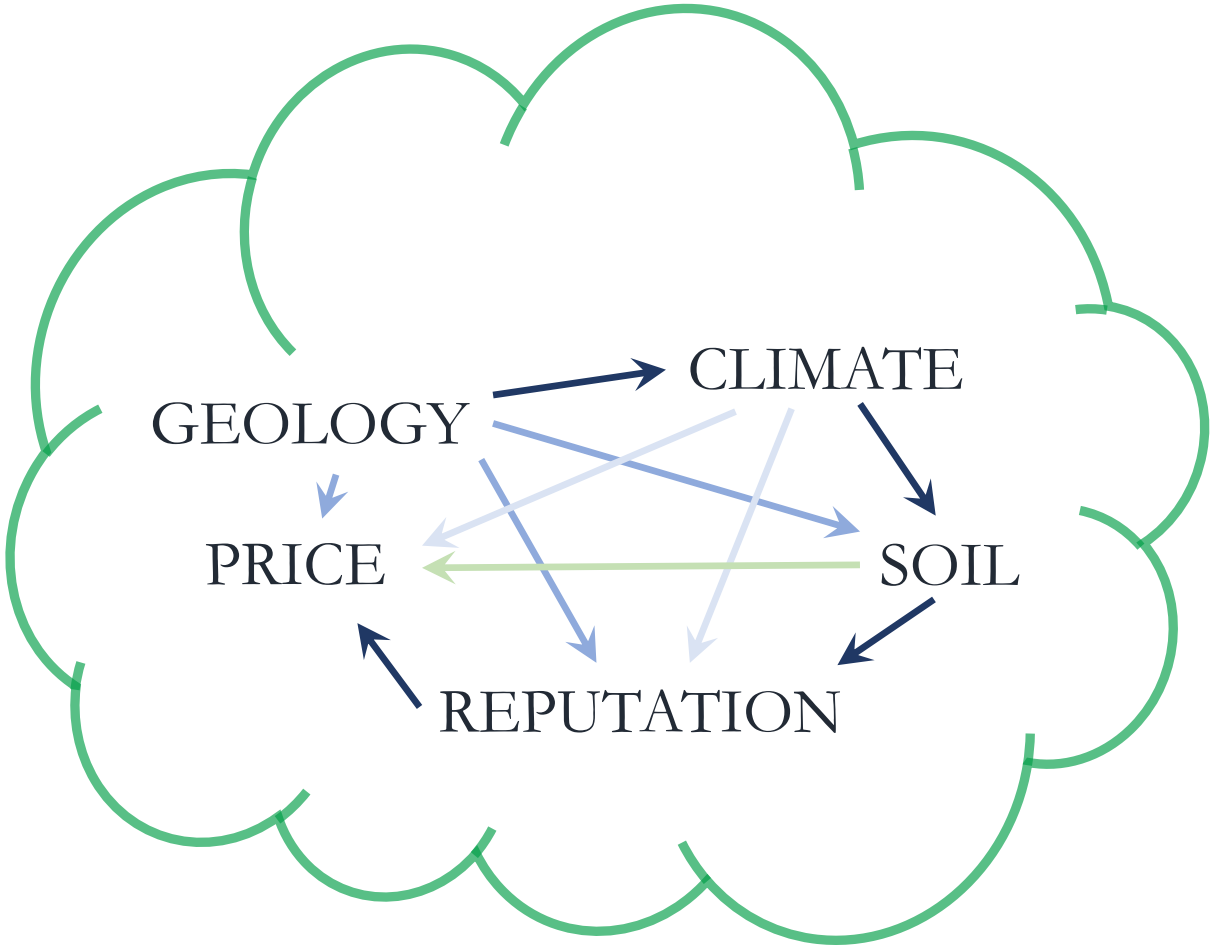
Terroir definition continuum…



The big problem for statistics: Correlation

It confuses humans and statistical models alike.

Correlation: Confuses humans and statistical models alike.



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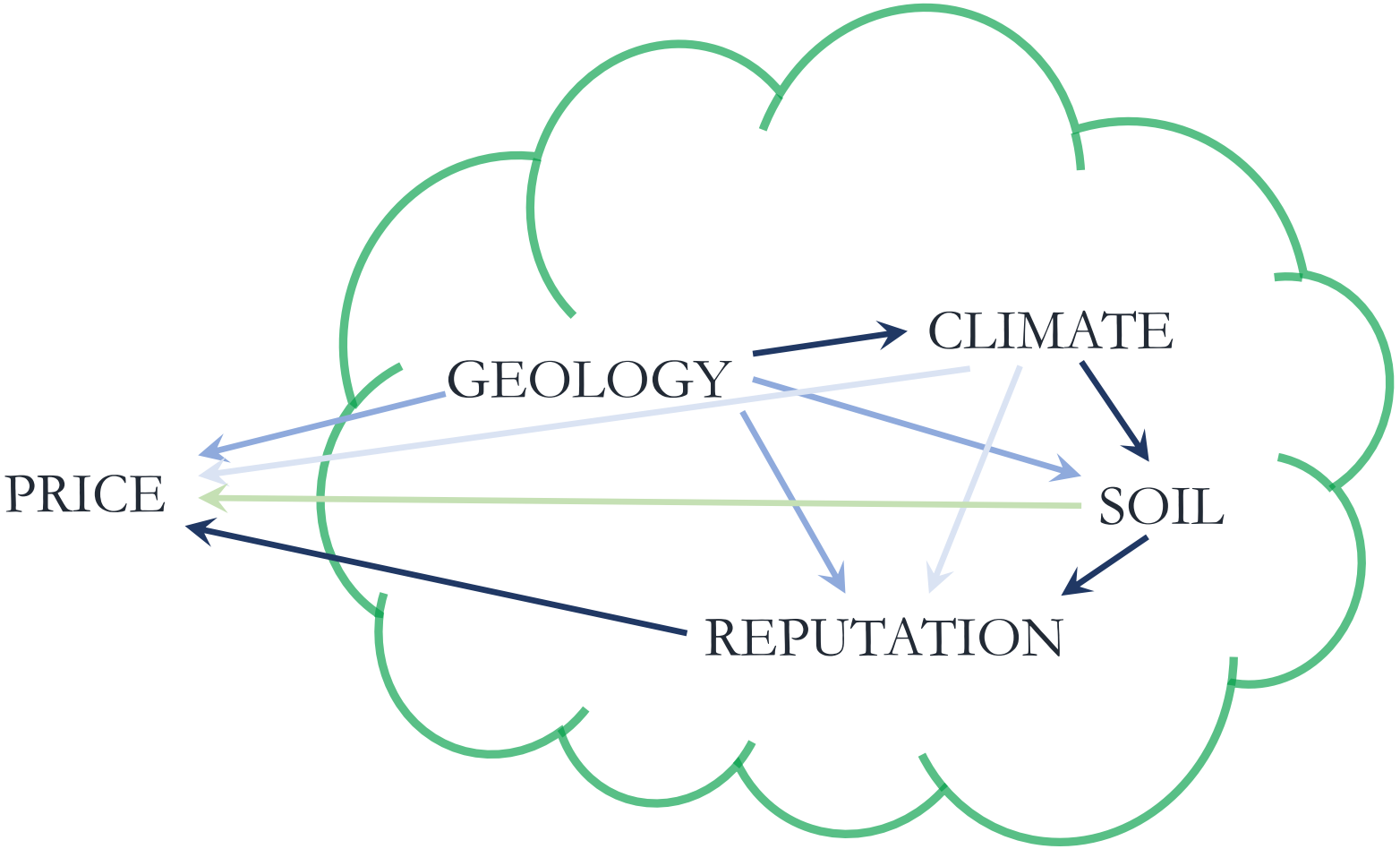

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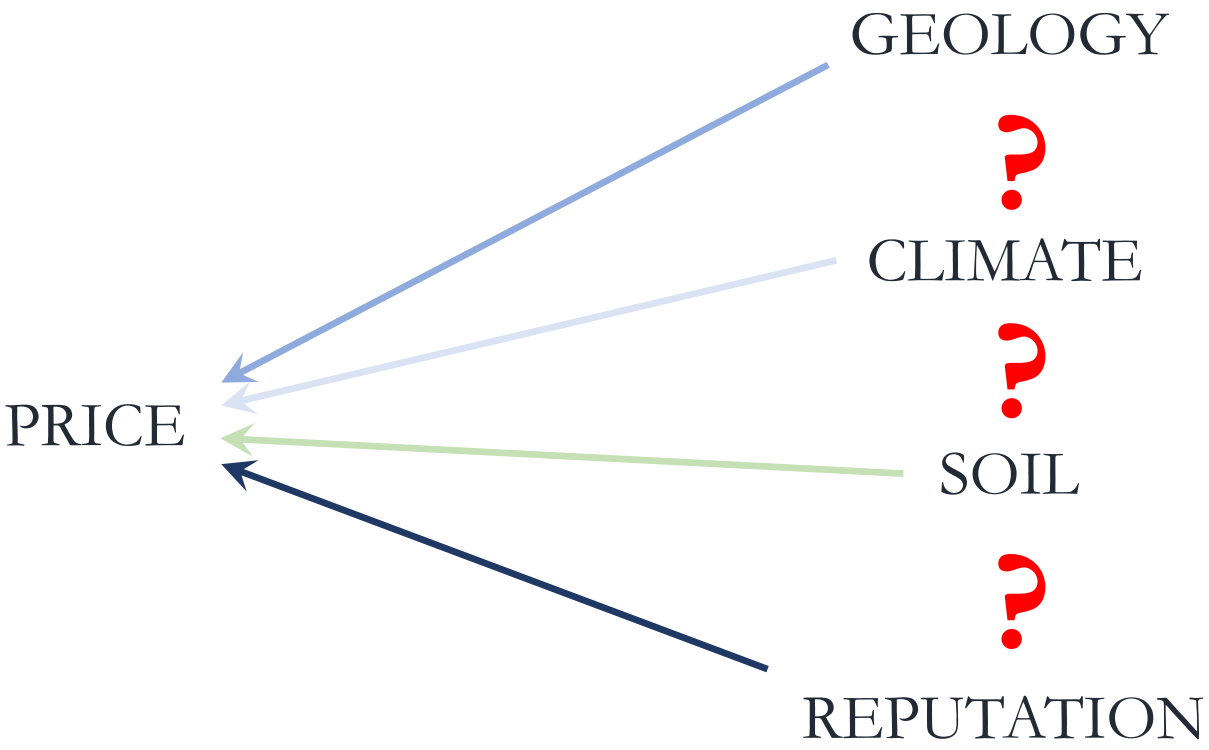


Do we have correlation?

Yes – It's in the soil.

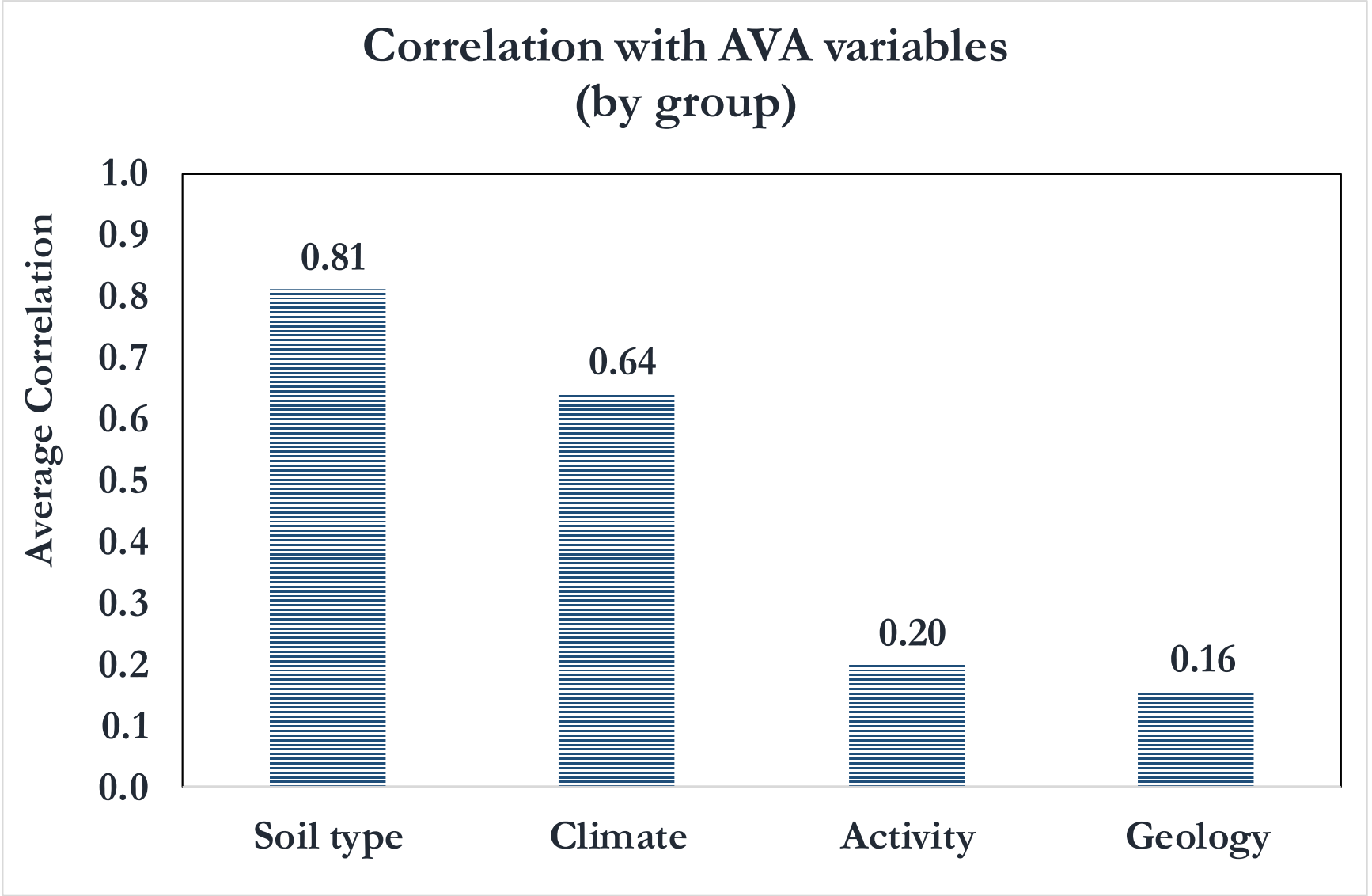
Do we have a correlation problem?

Soil is highly correlated with AVA.

What does correlation mean?

Soil example: A mostly Jory vineyard is less likely to be in the Rogue Valley. A mostly Oakland soil vineyard is not in the Eola Hills.

Climate example: A vineyard with a hot-dry May is more likely to be in the Umpqua Valley.



What does correlation do?

What does correlation do?

- Results fail to appear "statistically significant."
- Findings are highly unstable – important results change direction (positive to negative).
- Reported values are too small.

Do we have a correlation problem?

$$PRICE = f(REG, GEO, SOIL)$$

What is the value of Terroir?
Cross, Plantinga, and Stavins, 2011 (CPS)

Reputational contribution to vineyard sale value

104 vineyard sales (1997-2007)

108 control variables available

15 used - expert advice

Table 3
Estimation Results: Basic Model

Variable	*Estimate*	*Standard error*	*p-value*
→ constant	8.582	0.3328	0.000
→ vineacres	−0.005	0.0021	0.013
→ sqvineacres	0.000014	0.000006	0.016
bestelev	0.157	0.1539	0.311
posselev	0.130	0.1641	0.430
south	0.202	0.2684	0.453
southew	−0.088	0.2673	0.743
eastwest	0.270	0.4710	0.567
bestsoil	−0.030	0.1565	0.850
goodsoil	0.048	0.1369	0.725
bestslope	0.075	0.2856	0.792
→ eola	0.438	0.1382	0.002
mcminnville	0.154	0.2303	0.504
→ yamhill	0.529	0.1350	0.000
→ dundee	0.852	0.1425	0.000
→ chehalem	0.482	0.1246	0.000
Dependent variable = log of vinevalue			
Number of observations = 104			
Adj. R-squared = 0.422			

Do we have a correlation problem?

$$PRICE = f(REG, GEO, SOIL)$$

What is the value of Terroir?
Cross, Plantinga, and Stavins, 2011 (CPS)

Reputational contribution to vineyard sale value

104 vineyard sales (1997-2007)

108 control variables available

15 used - expert opinion

Table 4

Estimation Results: No Sub-AVA Variables

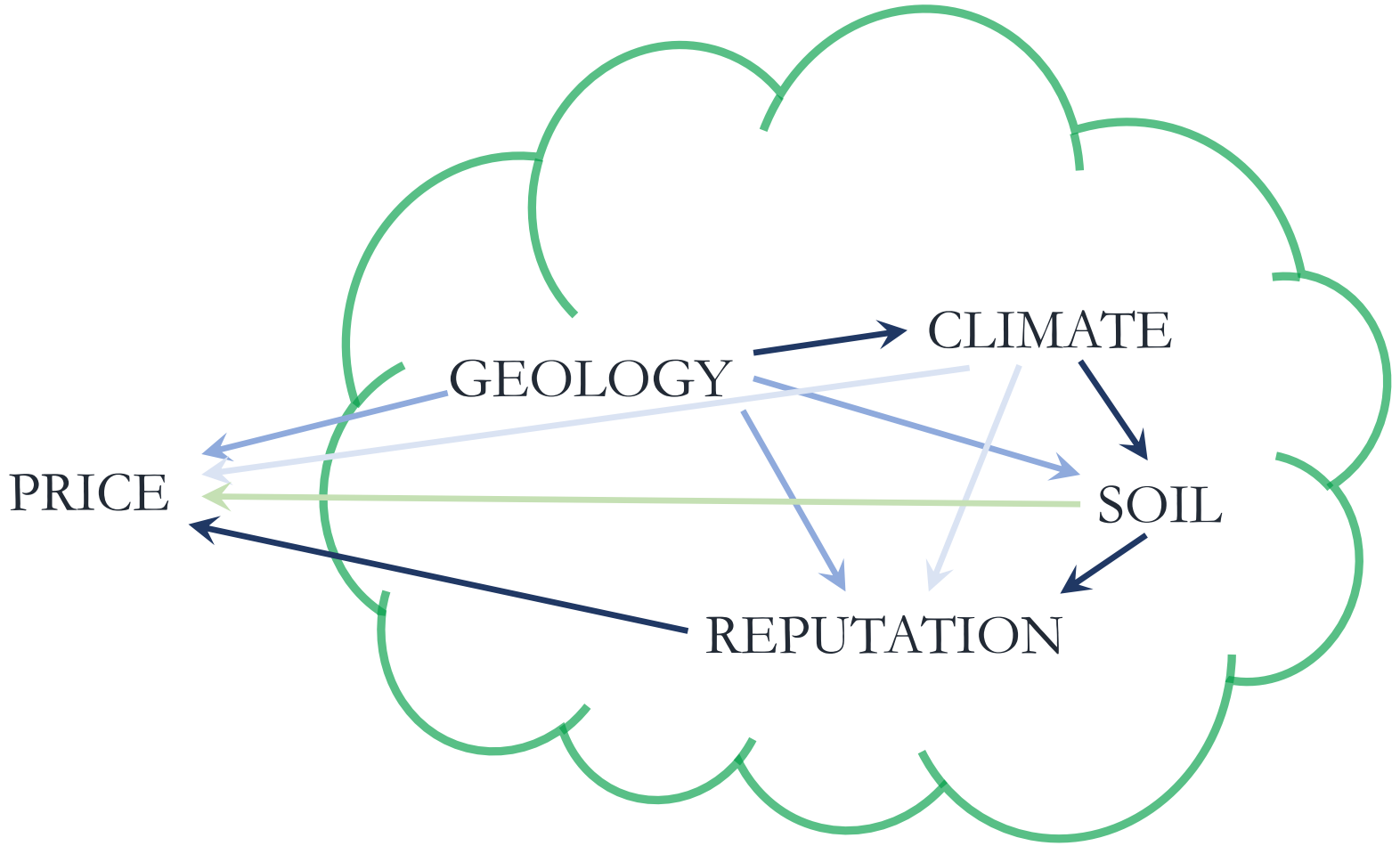
Variable	*Estimate*	*Standard error*	*p-value*
constant	8.822	0.3842	0.000
vineacres	−0.008	0.0024	0.001
sqvineacres	0.000018	0.000007	0.009
bestelev	0.255	0.1766	0.152
posselev	−0.009	0.1933	0.961
south	0.102	0.3101	0.743
southew	−0.189	0.3104	0.544
eastwest	0.337	0.5298	0.526
bestsoil	0.494	0.1443	0.001
goodsoil	0.242	0.1422	0.093
bestslope	0.192	0.3370	0.571
Dependent variable = log of vinevalue			
Number of observations = 104			
Adj. R-squared = 0.165			

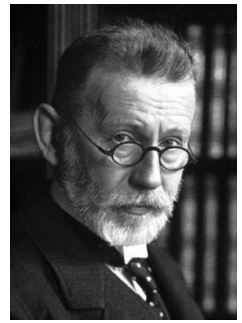
bestsoil	−0.030	0.1565	0.850

The Solution:

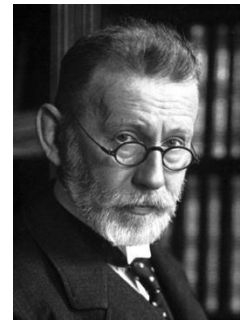
(Re)invented every ~50 years for the last 202 years.

Solution: Laplace





Solution: Laplace



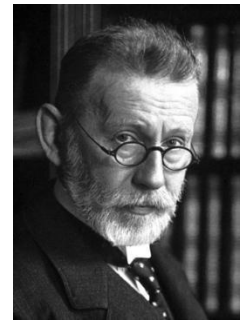
PRICE

GEOLOGY → CLIMATE

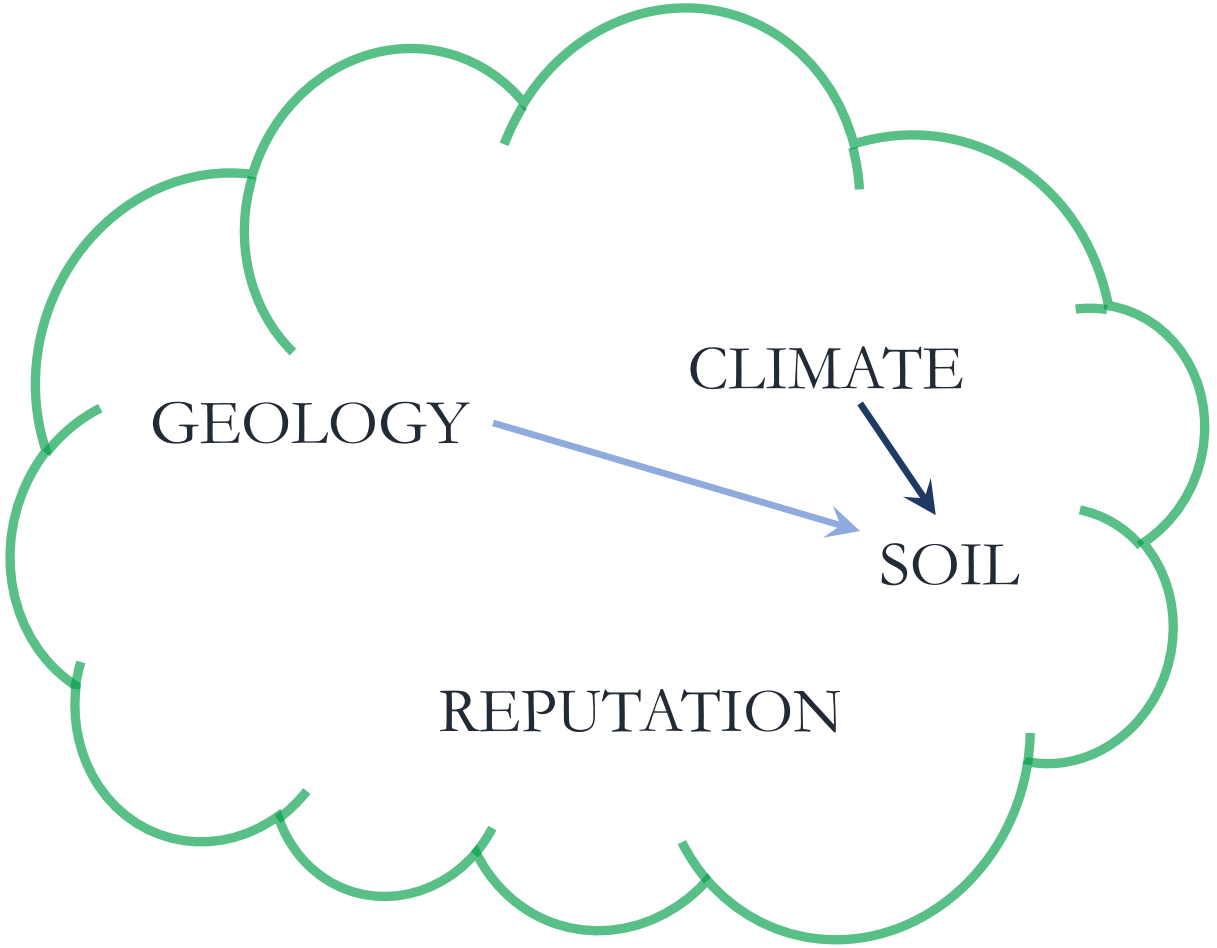
SOIL

REPUTATION

Solution: Laplace

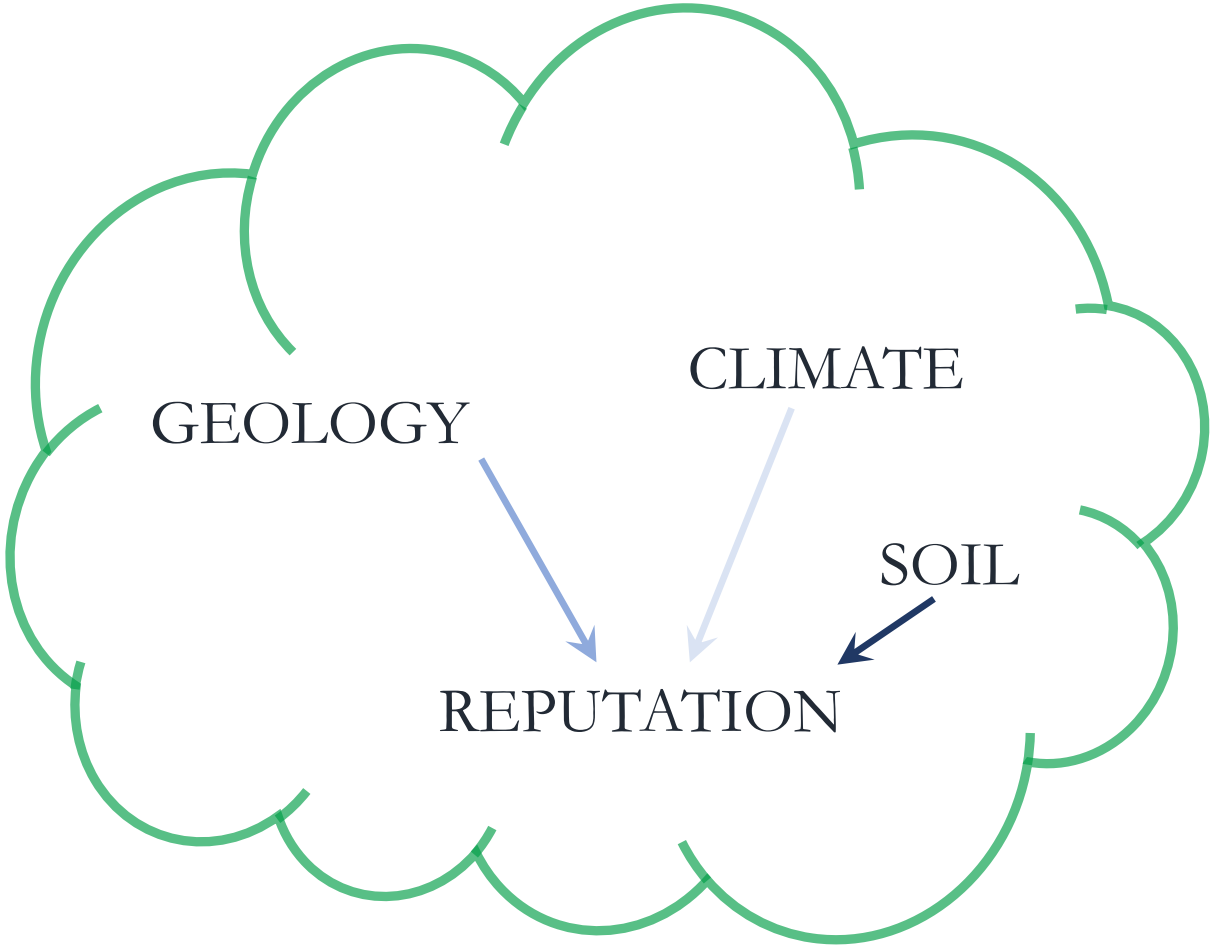


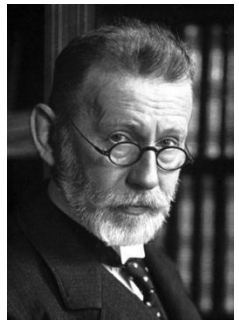
PRICE



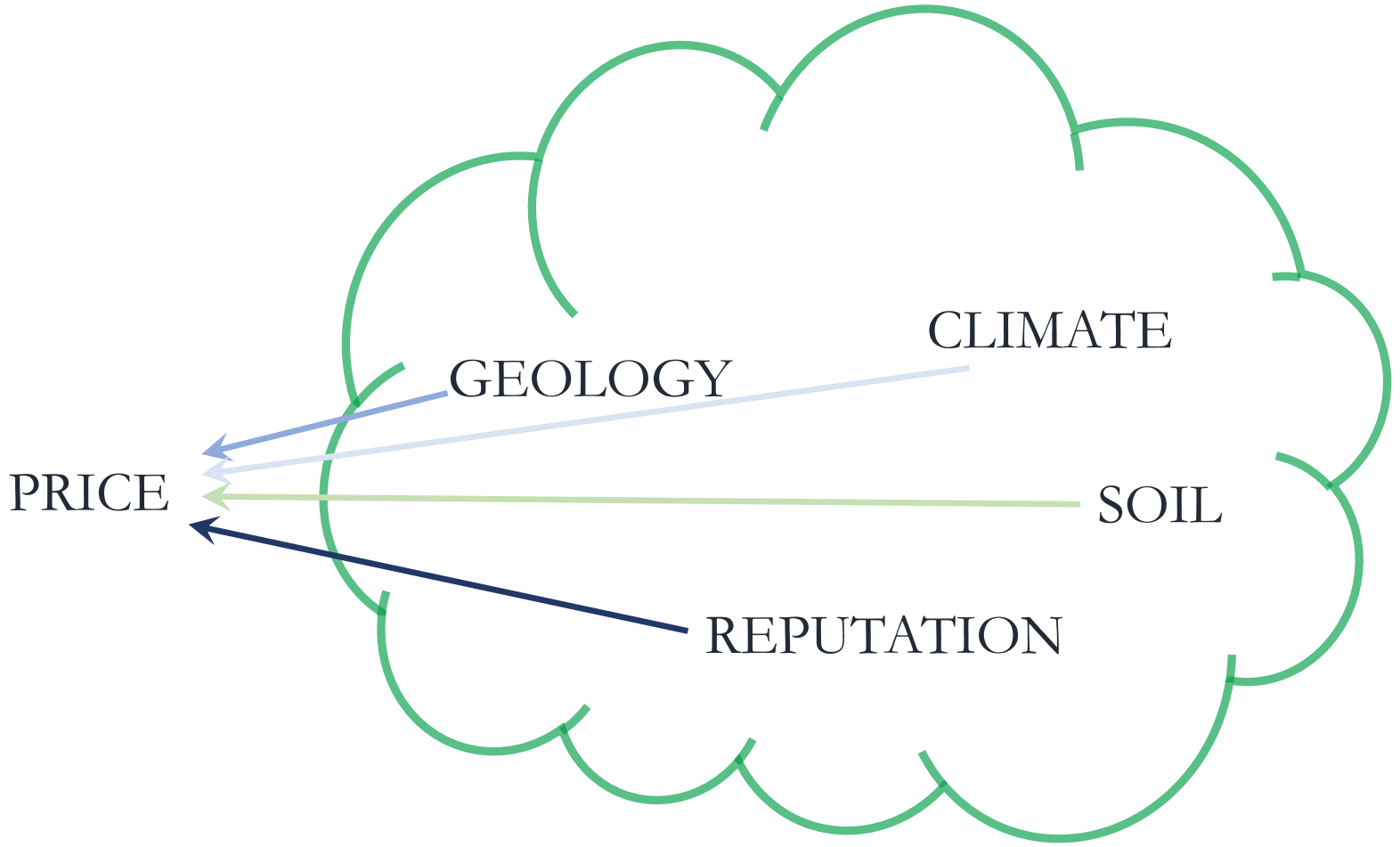
Solution: Laplace

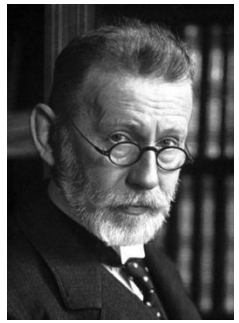
PRICE





Solution: Laplace





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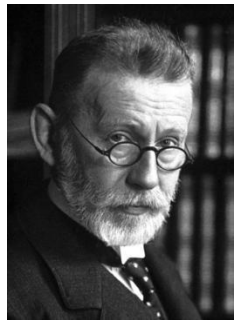


$$
\begin{aligned}
GEO &= f_1(REG) \\
CLIM &= f_2(REG, GEO) \\
SOIL &= f_3(REG, GEO, CLIM) \\
&\vdots \\
PRICE &= f_6(REG, GEO, CLIM, SOIL, REP, ACTIV)
\end{aligned}
$$

The Proofs:

(or: eight months of your life you will never get back.)

The Laplace model (GSM) - properties

Greater certainty

Theorem 1 – Efficiency.

GSM parameters γ_k are more efficient than LRM parameters b_k, $\mathrm{V}[\gamma_k] \leq \mathrm{V}[b_k]$.

The LRM variance is greater by the ratio $\mathrm{V}[b_k] / \mathrm{V}[\gamma_k] = 1/(1-R^2_{kJ})$, where R^2_{kJ} is the coefficient of variation corresponding to the regression of down-stream covariate set J on covariate k.

Greater stability

Theorem 2 – Stability.

GSM parameters γ_k have zero covariance, $\mathrm{Cov}(\gamma_i, \gamma_j) = 0$.

Theorem 3 – Information preservation.

The R-squared statistic is identical between the GSM and LRM, $R^2_{yU} = R^2_{yX}$.

The Laplace model (GSM) - properties

Theorem 4 – Partial derivative bias.

GSM parameters γ_k are unbiased estimates of partial derivatives of y, $\mathrm{E}[\gamma_k] = \partial y / \partial X_k$.

The LRM bias is given by the difference $\mathrm{E}[b_k] - \mathrm{E}[\gamma_k] = -\sum_{n=k+1}^{K} \beta_n \alpha_{nk}$.

Larger

Theorem 5 – Partial derivative efficiency.

GSM partial derivative estimates have lower variance than those recovered from the LRM, $V[\gamma_k] < V[b_k + \sum_{j=k+1}^{K} a_{jk} b_j]$.

The LRM variance is greater by the difference term $\sum_{j=k+1}^{K} \sigma_{U_j}^2 \beta_j^2$.

The Laplace model (GSM) - properties

Theorem 6 – Omitted variable bias.

GSM parameters γ_k remain unbiased when down-stream covariates are eliminated from the model.

The LRM is biased to omitted variables, with the penalty given by the difference $\mathrm{E}[b_k] - \mathrm{E}[\gamma_k] = \sum_{n=k+1}^{K} \beta_n \alpha_{nk}$.

Theorem 7 – Included irrelevant variables.

GSM parameters γ_k remain unbiased when down-stream irrelevant variables are included with lower variance than the LRM, $\mathrm{V}[\gamma_k] \leq \mathrm{V}[b_k]$.

The LRM variance is greater by the ratio $\mathrm{V}[b_k] / \mathrm{V}[\gamma_k] = 1/(1 - R_{kJ}^2)$, where R_{kJ}^2 is the coefficient of variation corresponding to the regression of down-stream covariate set J on covariate k.

New effort – 2018

$$PRICE = f\left(REG, GEO, SOIL\right)$$

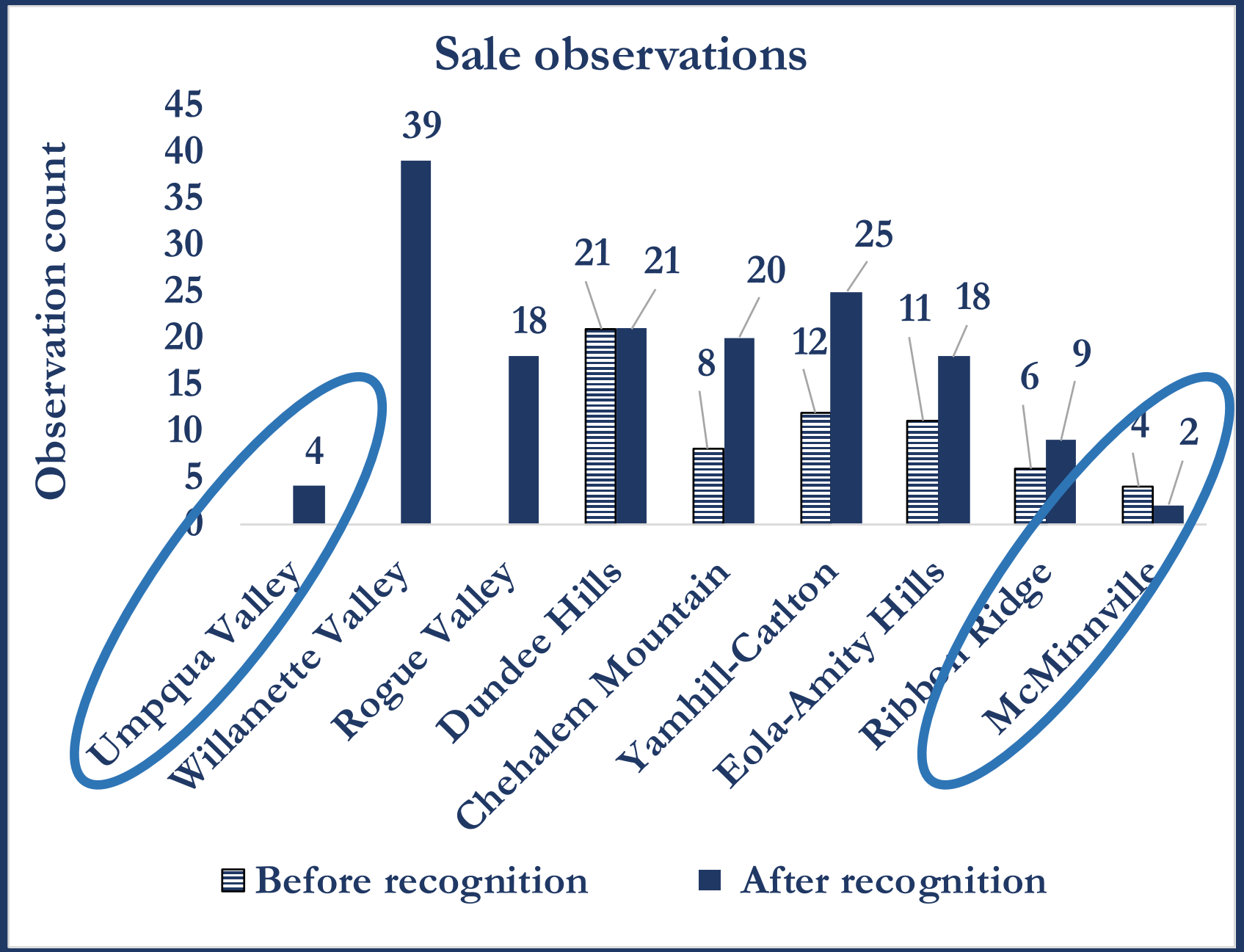
We added data:

- 217 observations (1997 – 2015)
- Added local climate data & reputation indicators
- 268 control variables available
- 80 control variables (survived)

$$PRICE = f\left(REG, GEO, CLIM, SOIL, REP, ACTIV\right)$$

Data summary

Especially thin samples in Umpqua Valley and McMinnville.



Results

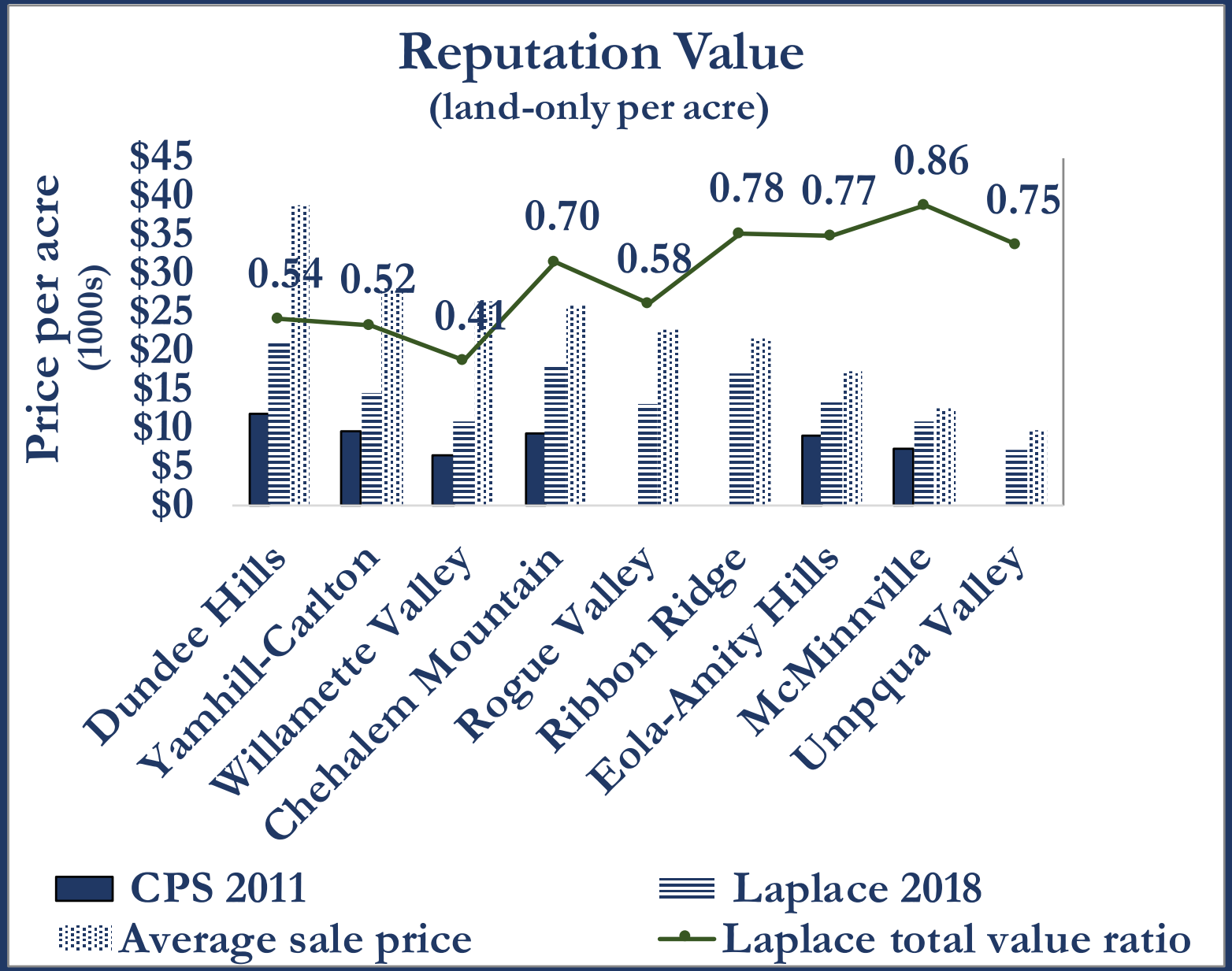
Compare to CPS 2011

What is the value of Terroir?

Cross, Plantinga, and Stavins, 2011 (CPS)

CPS regional effects are lower.

Higher value regions benefit (proportionately) less from regional effects.



Results

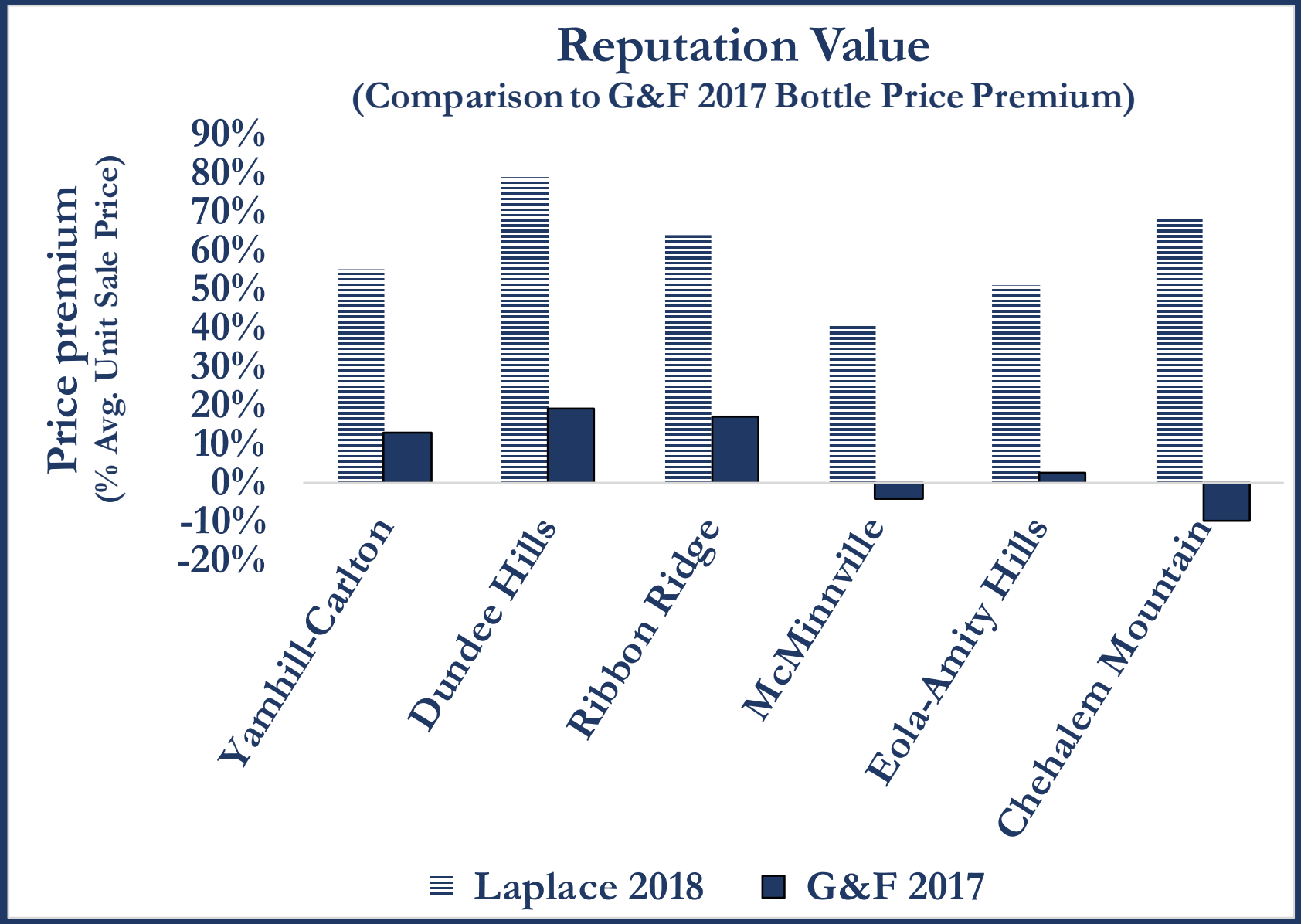
Compare to G&F 2017

Price Effects of Establishing a New Sub-AVA?

Gockekus and Finnegan, 2017 (G&F 2017)

Region values:

Laplace region effects much larger than G&F 2017 effects.



Conclusion

IRS requires rigorous evidence to support AVA values.

Previous studies suffer from small and unstable value estimates, due to correlation.

The Laplace model solves the correlation problem and produces complete value estimates.

An AVA's reputation may represent 41-86% of the vineyard sale price (on average).

Reputation plays a proportionately larger role in lower priced AVAs.

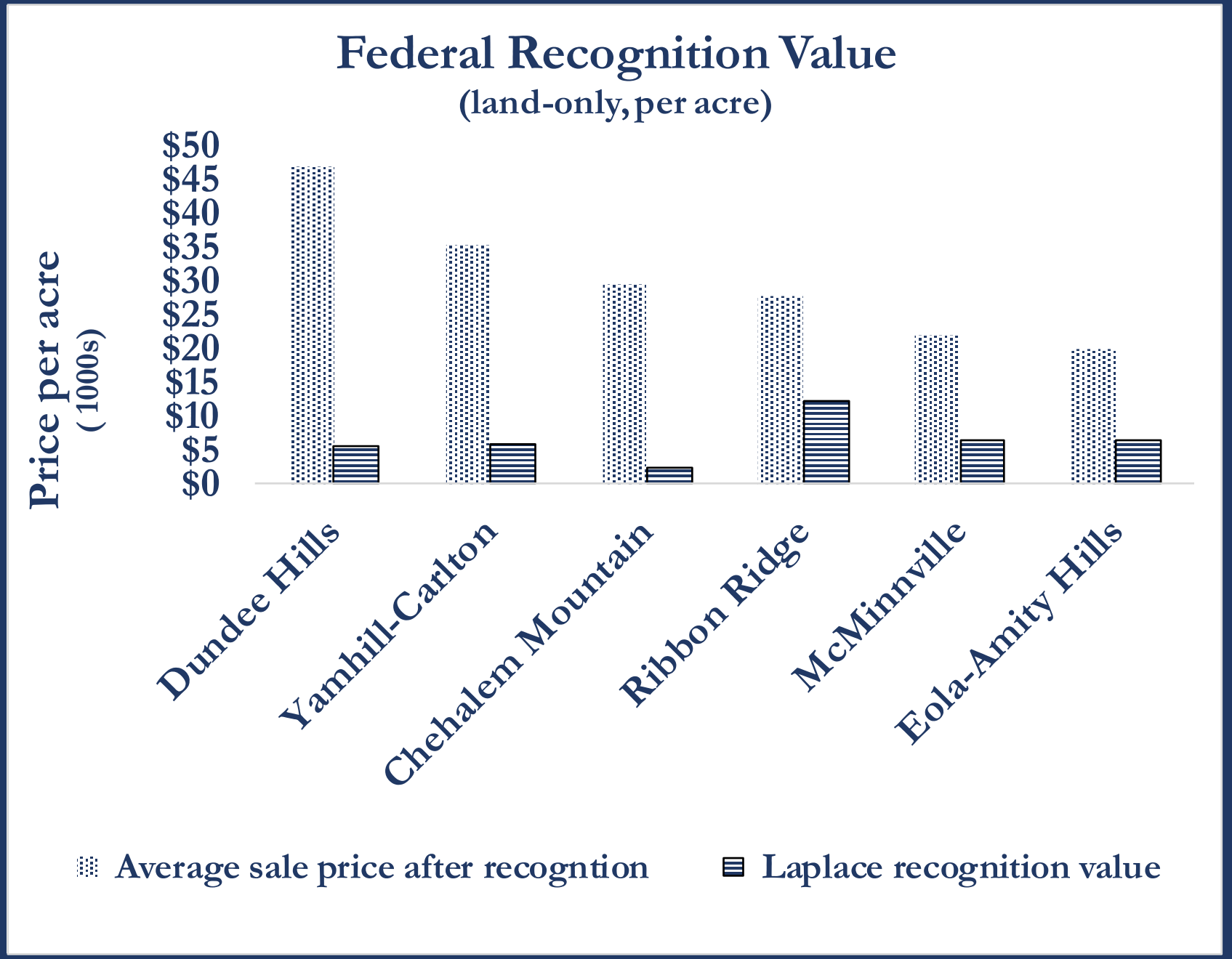
We provide evidence of a "clear premium."

Federal Recognition Value

Results

Federal recognition value

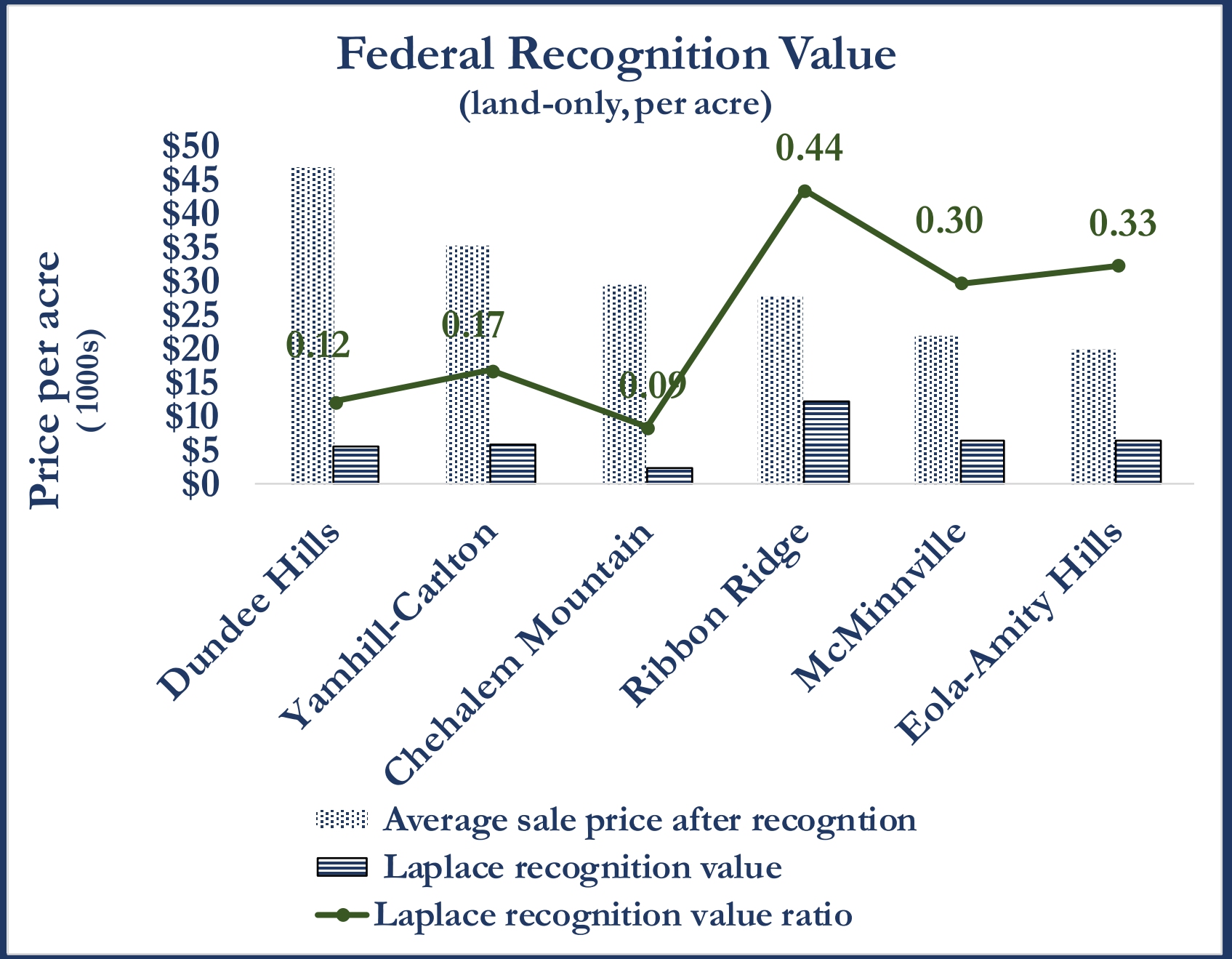
Higher value regions benefit less from federal recognition.



Results

Federal recognition value

Higher value regions benefit less from federal recognition.

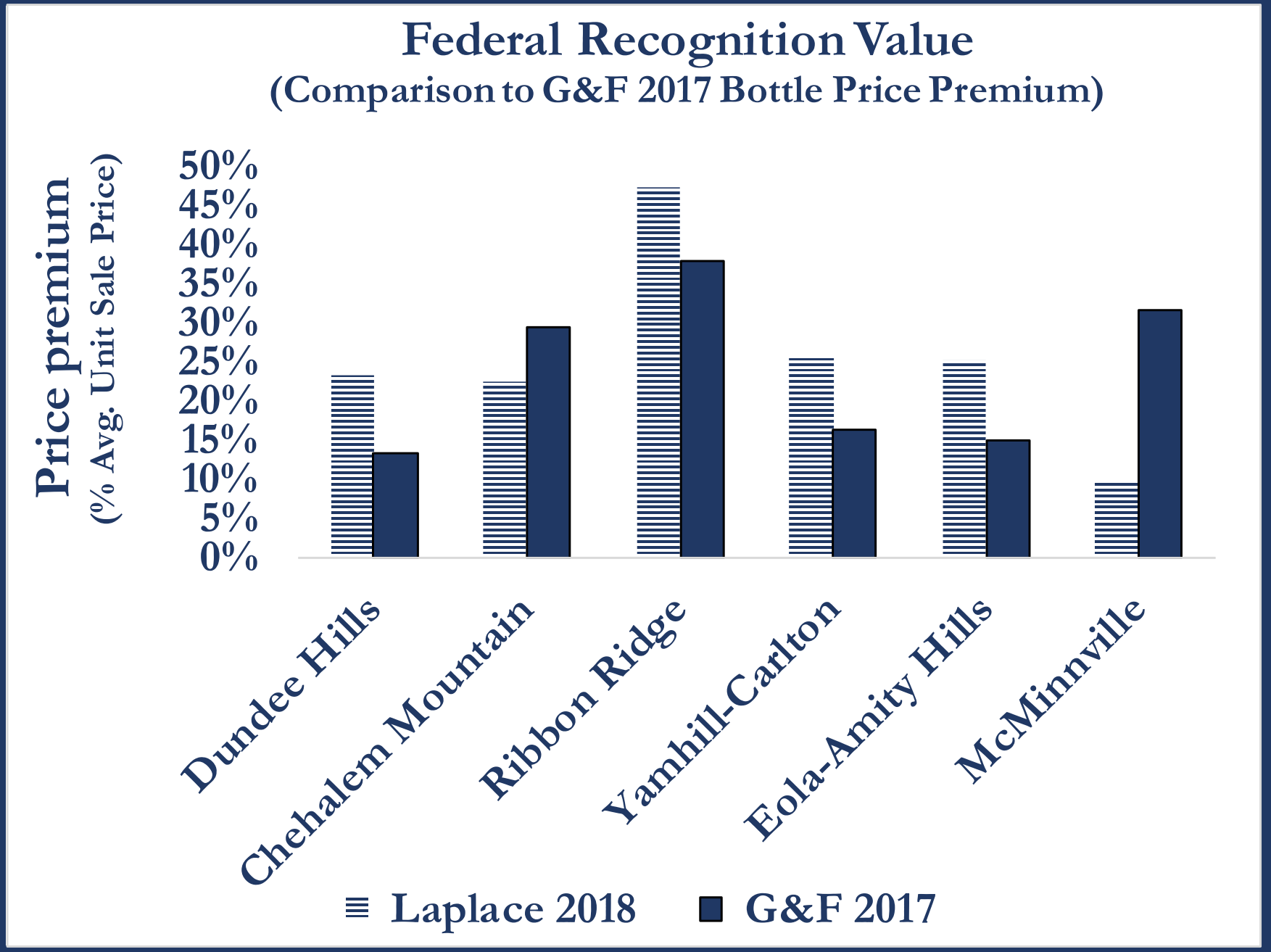


Results

Federal recognition comparison to G&F.

Very similar (proportions).

Last in time.

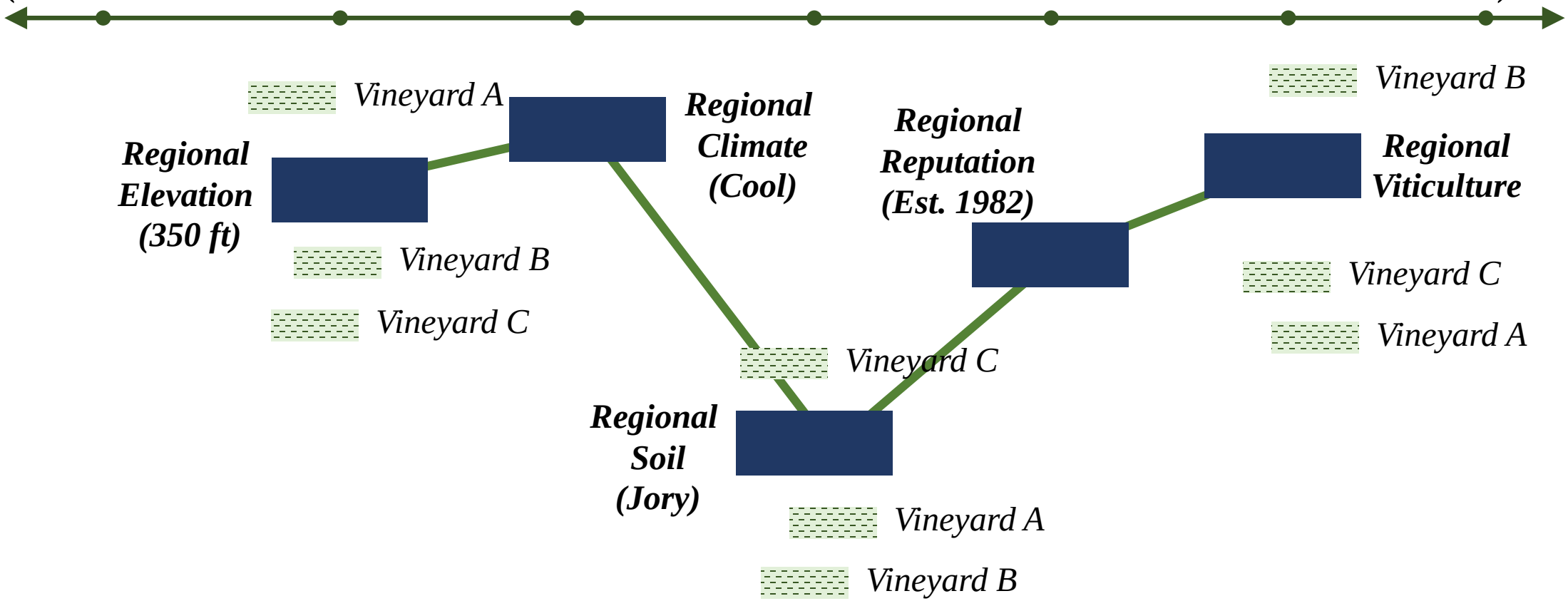


Barrier #2: Separation

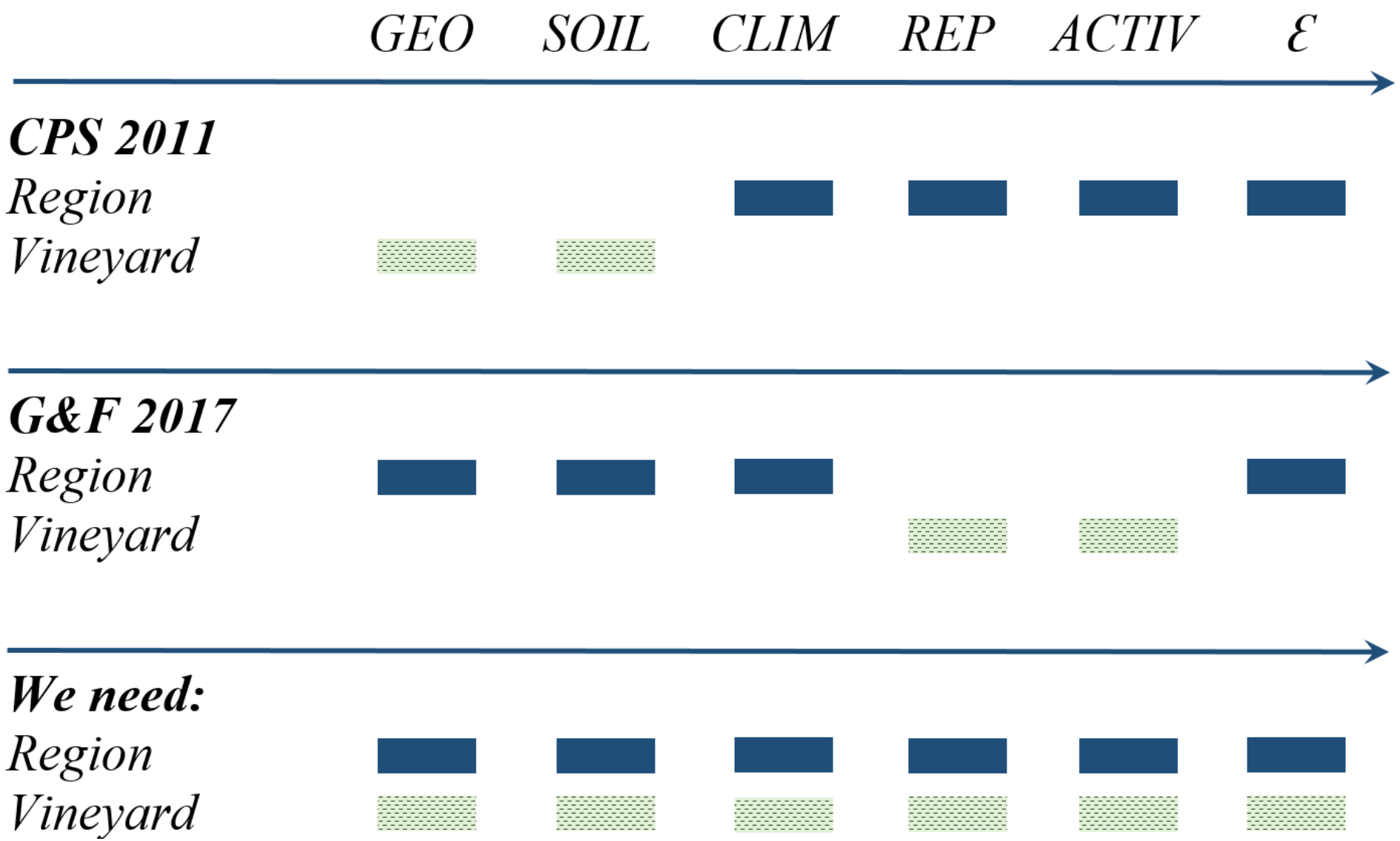
Because breaking up is never easy.

Separation: How do we separate regional from vineyard contribution to value?

$$P = f\left(REG \quad GEO \quad CLIM \quad SOIL \quad REP \quad ACTIV \quad \varepsilon\right)$$



Separation: How do we separate regional from vineyard contribution to value?



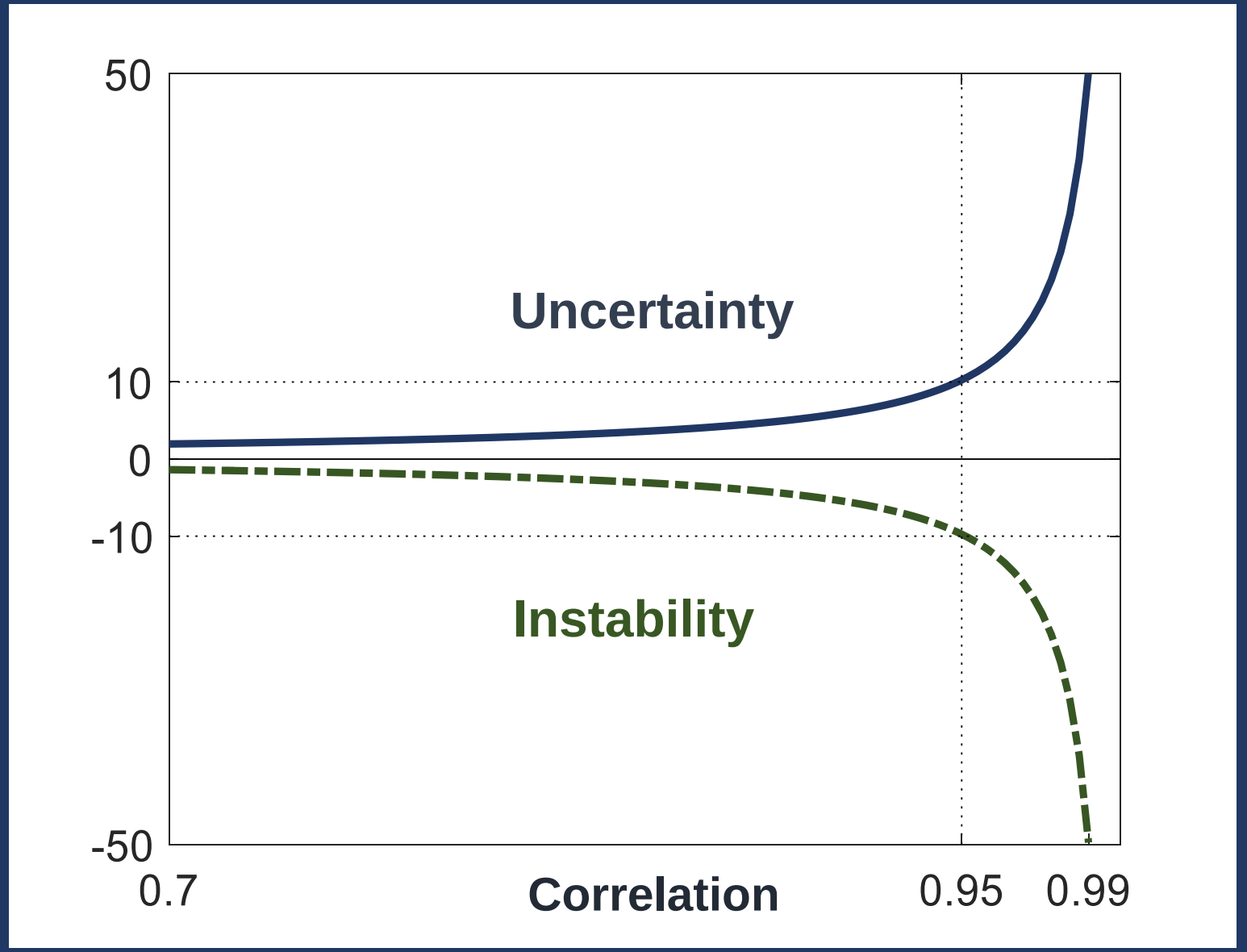
Additional information on correlation impact.

Uncertainty

2x at 70% correlation

10x at 95% (“near-perfect”)

50x at 99%



Results – More confidence

Laplace statistical confidence intervals are 1-30 times narrower than standard regression.