US Farm-Household Consumption Expenditures and the Value of Crop Insurance

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SCC-76 2017 Annual Meeting

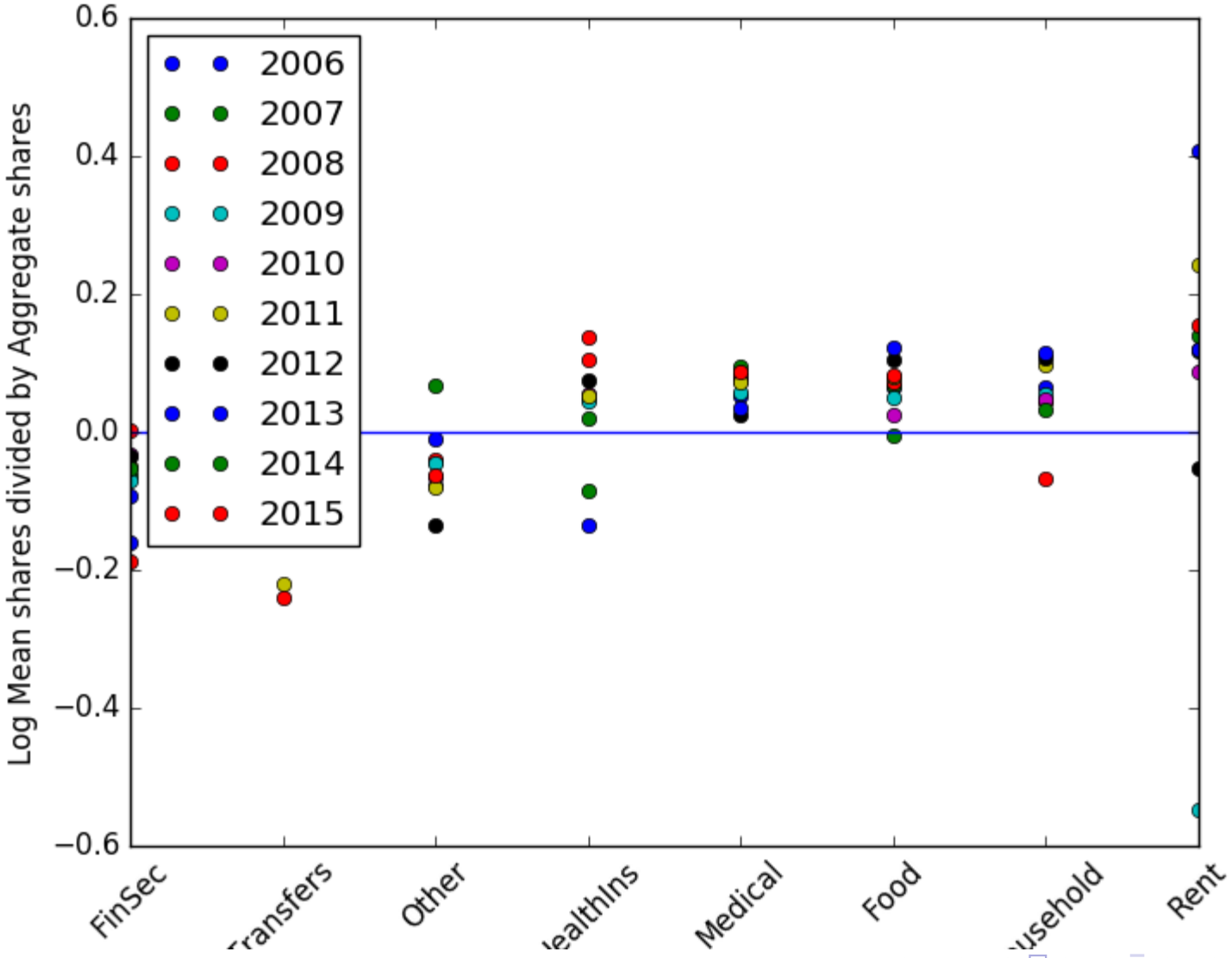
Motivation and Introduction.

- The 2014 Farm Bill made crop insurance central to "farm safety net."
- No one has measured the effect of crop insurance on the **well-being** of farmers in the US. Brief literature review.
- Our contributions:
  - Apply Ligon's "neediness" measure (IoMUE) to farm-households in the US using ARMS expenditure data.
  - Using IoMUE as a "neediness" measure, determine the effect of farm business income on household welfare.
  - Using IoMUE as a "neediness" measure, determine the effect of insurance payments on household welfare.

Making an ARMS pseudo-panel.

- The Agricultural Resource Management Survey (ARMS) has been collecting data on farm-household expenditures since 2006. We use data from 2006-2015.
- The survey asks a different subset of farmers each year.
- To use this repeated cross-section as a panel, we create a set of representative farmers each year.
- We combine counties such that each county-group has minimum three farmer responses each year.

Data


Log Mean shares divided by Aggregate shares
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
FinSec
Transfers
Other
HealthIns
Medical
Food
Household
Rent

What is λ?

In the next few slides will describe how we estimate our index of marginal utilities of expenditures (IoMUE) parameter, $\log \lambda$.[1] What is it?

- **Precise definition**: The rate at which a particular cardinalization of household utility would increase if the household's expenditures received a small increase in a given period.
- **The Lagrange Multiplier on the Budget Constraint.** This is intuitive to economists, but no one else. It can also be thought of as the "neediness" of the household.

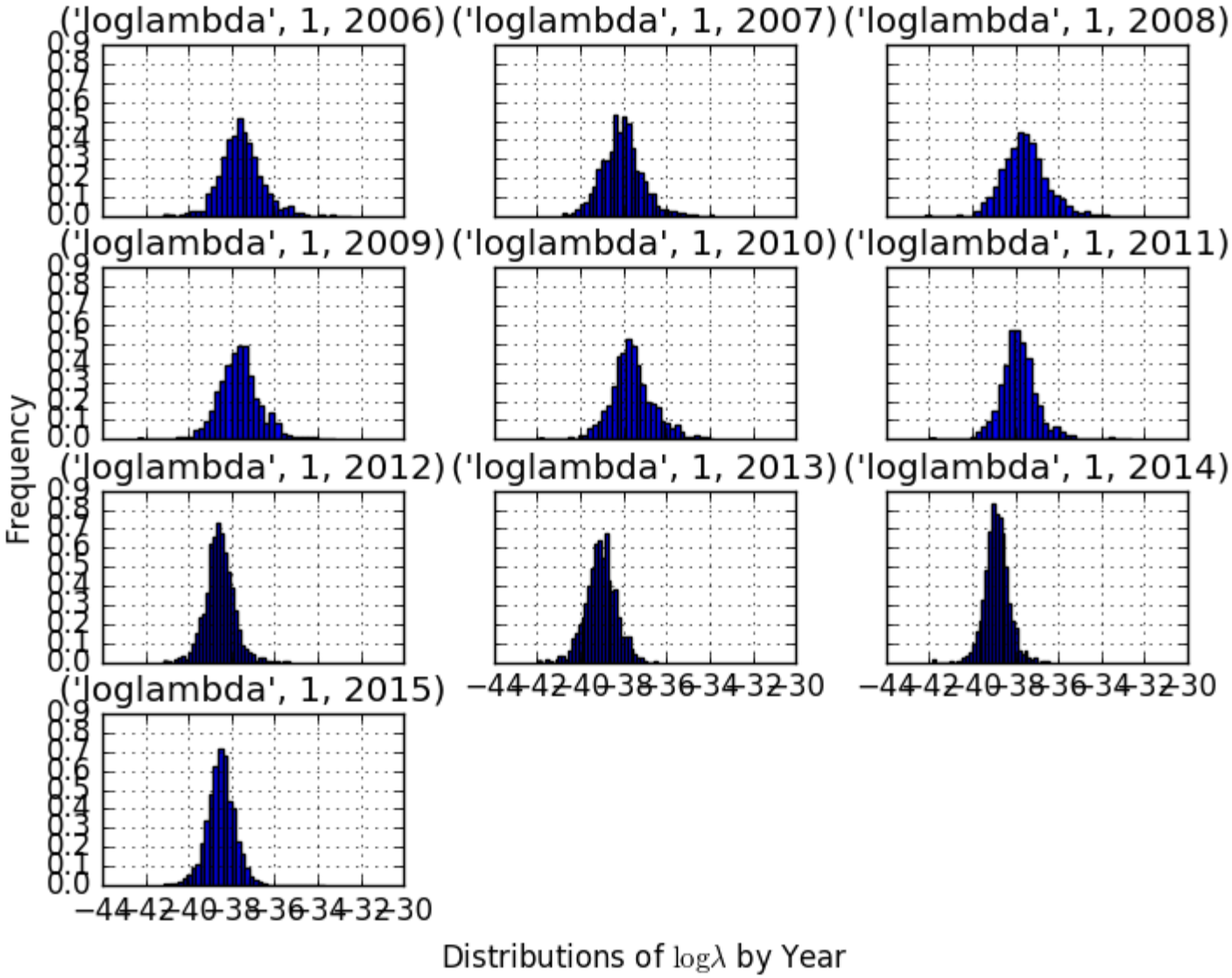
[1] These slides follow the argument from a working paper by Ligon (2016): "Estimating household neediness from disaggregate expenditures".

Estimating $\log \lambda$.

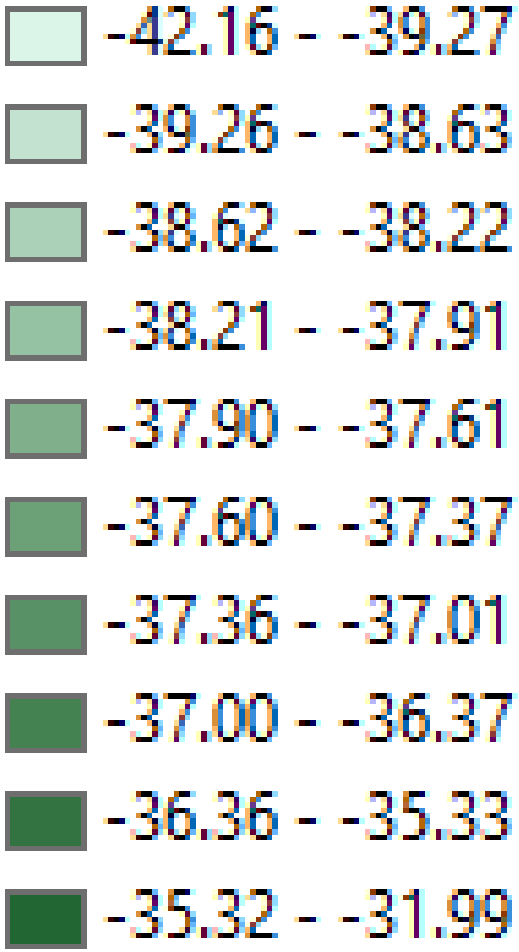
Estimation of $\log \lambda$ will take several steps.

1. Beginning with our standard household optimization problem, we analytically derive an estimable equation in which $\log \lambda$ enters linearly. In this expression we control for relative prices with year-good fixed effects.
2. Regress log household expenditures on household characteristics with good-year fixed effects.
3. Use singular value decomposition of the residual to recover the log lambdas.

Data

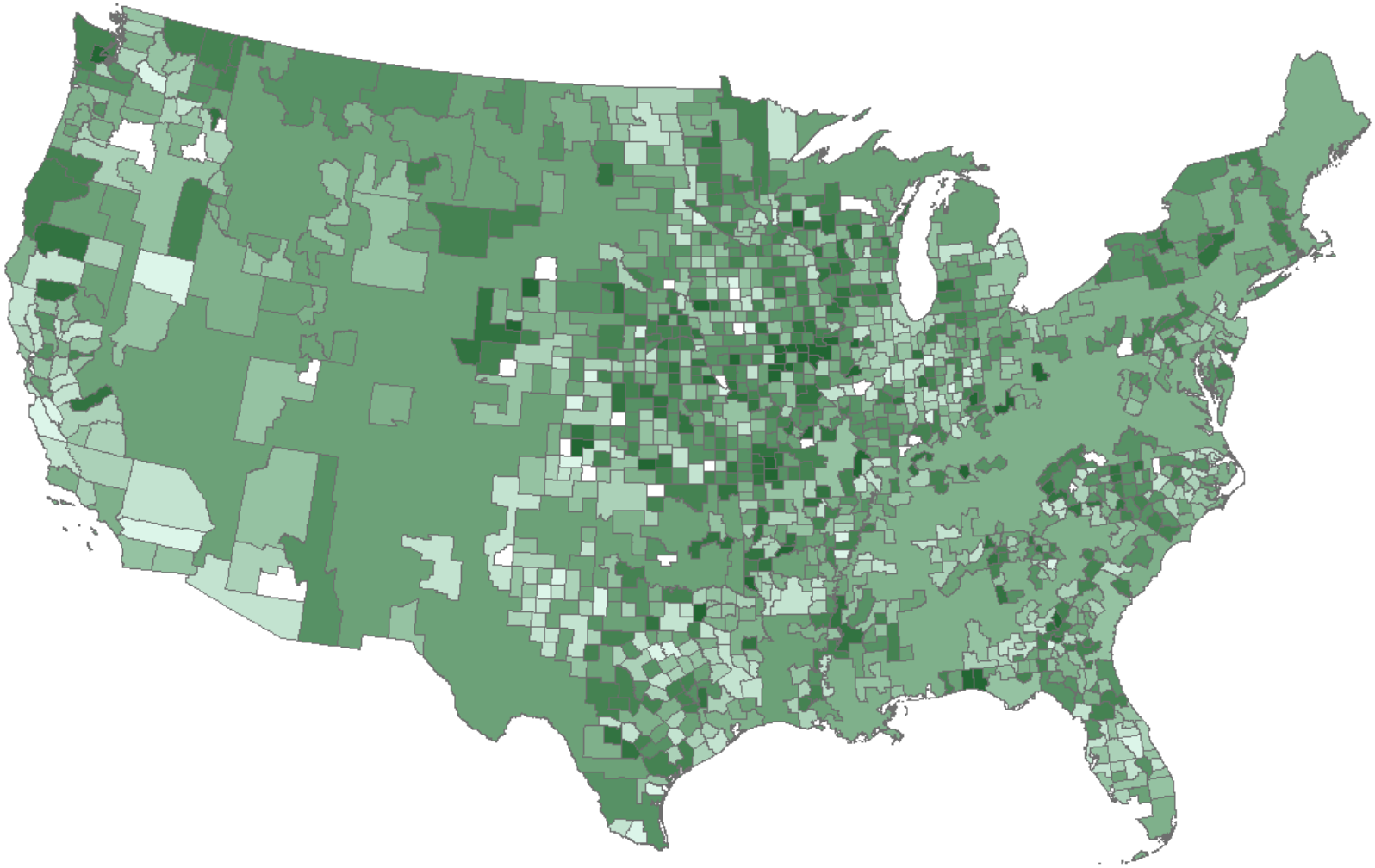

('loglambda', 1, 2006)
('loglambda', 1, 2007)
('loglambda', 1, 2008)
('loglambda', 1, 2009)
('loglambda', 1, 2010)
('loglambda', 1, 2011)
('loglambda', 1, 2012)
('loglambda', 1, 2013)
('loglambda', 1, 2014)
('loglambda', 1, 2015)
Frequency
−44 −42 −40 −38 −36 −34 −32 −30
Distributions of $\log\lambda$ by Year

Log λ Map scale

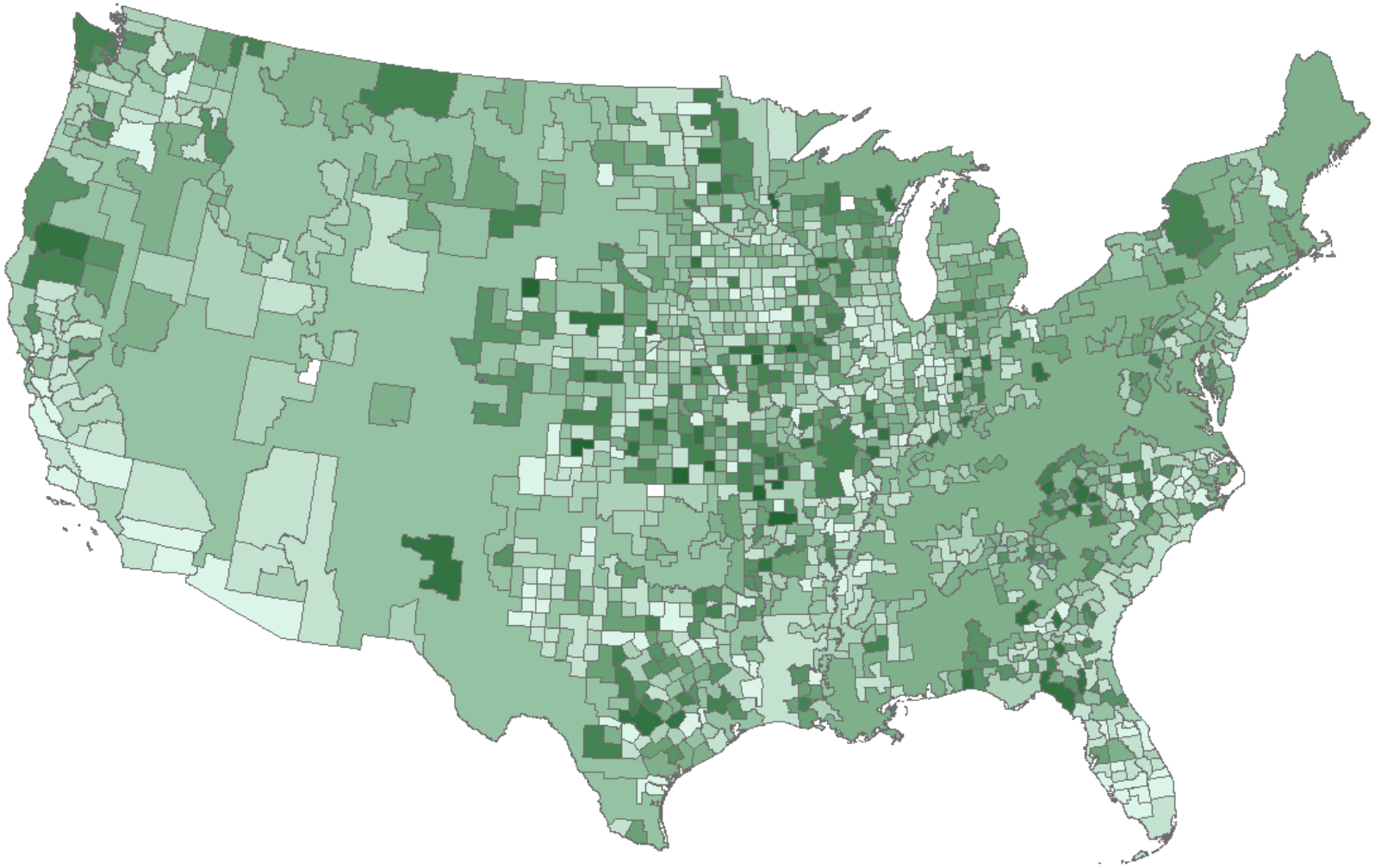


More negative $\implies$ less needy.

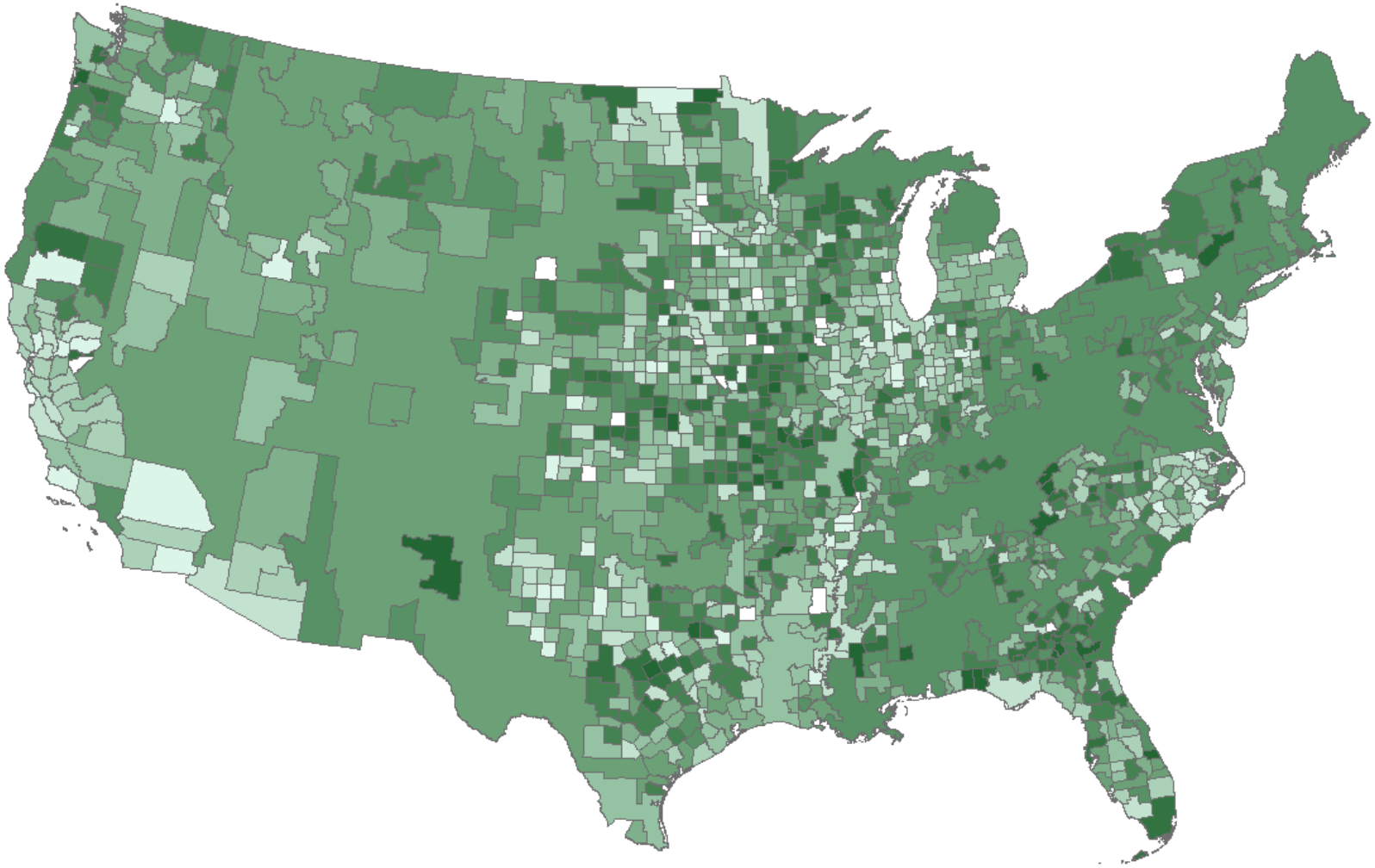
Log λ Map 2006



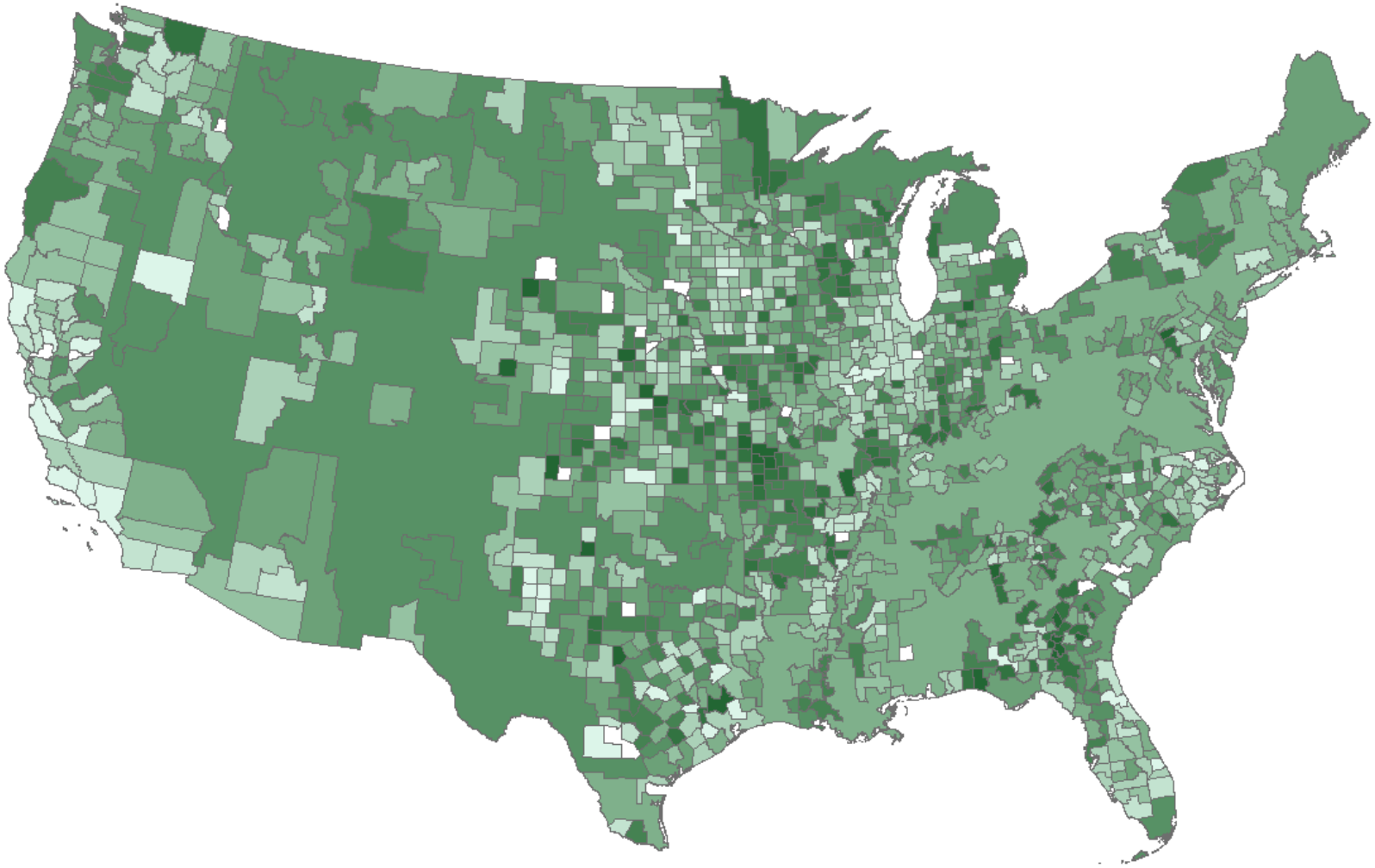
Log λ Map 2007



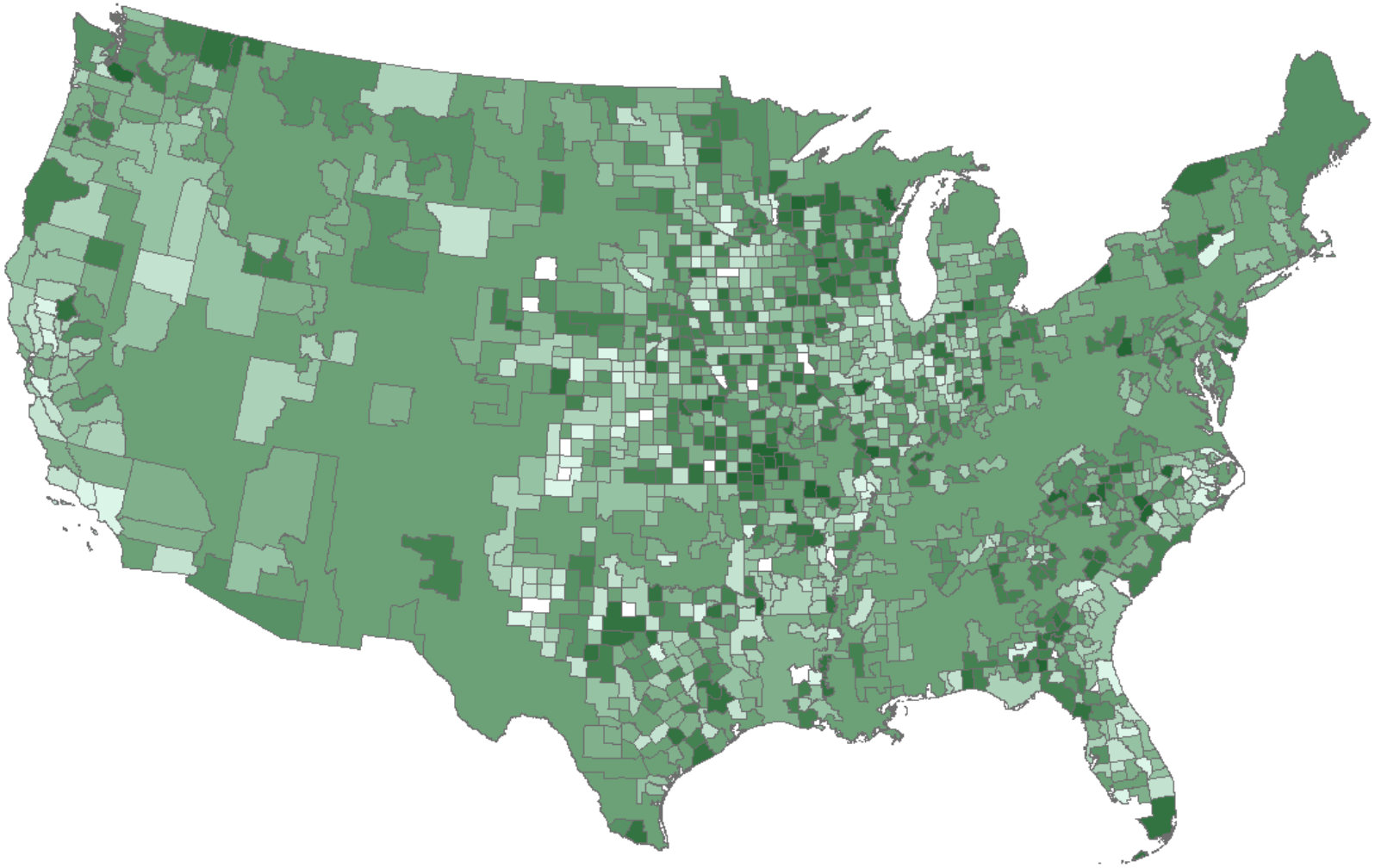
Log λ Map 2008



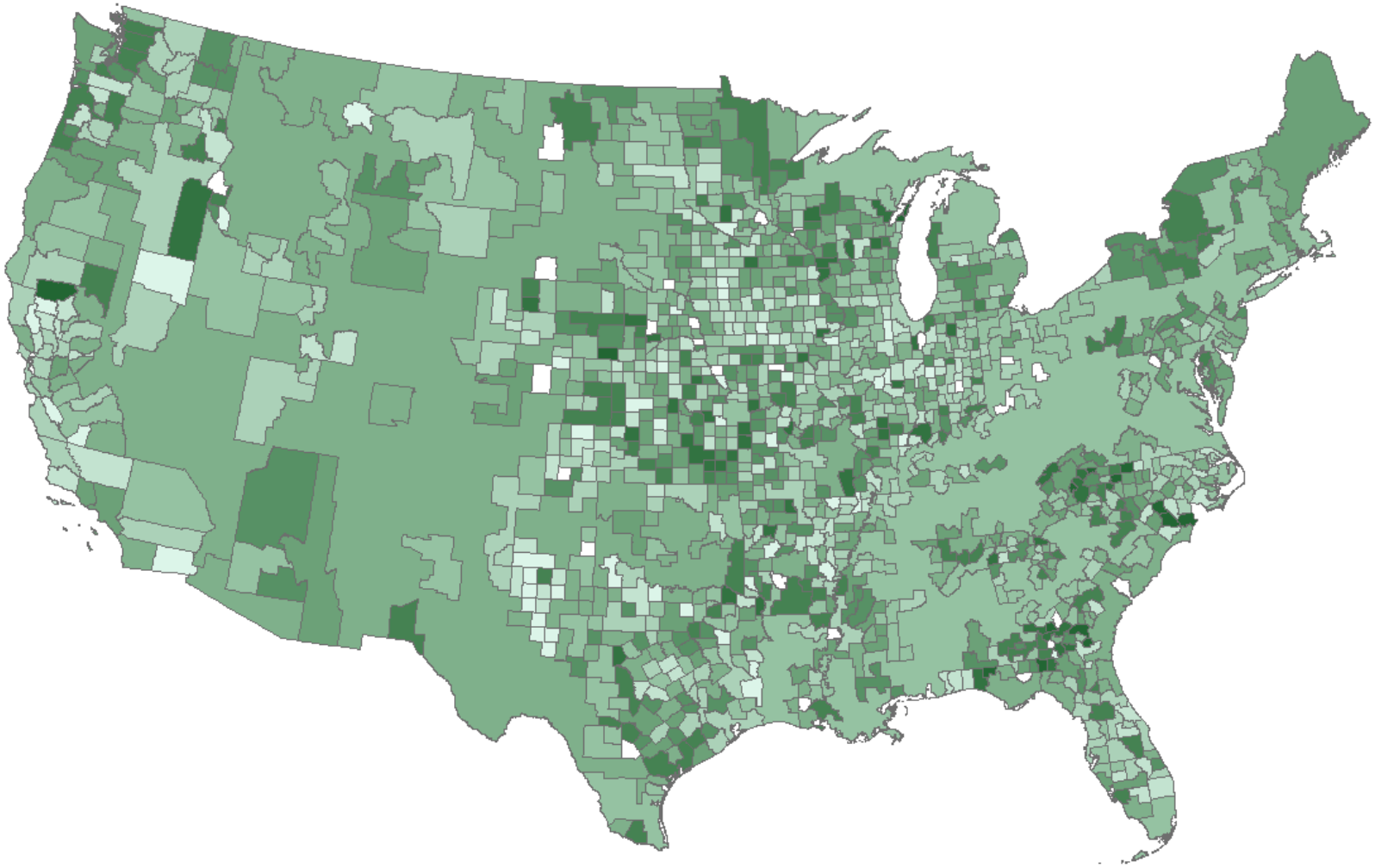
Log λ Map 2009



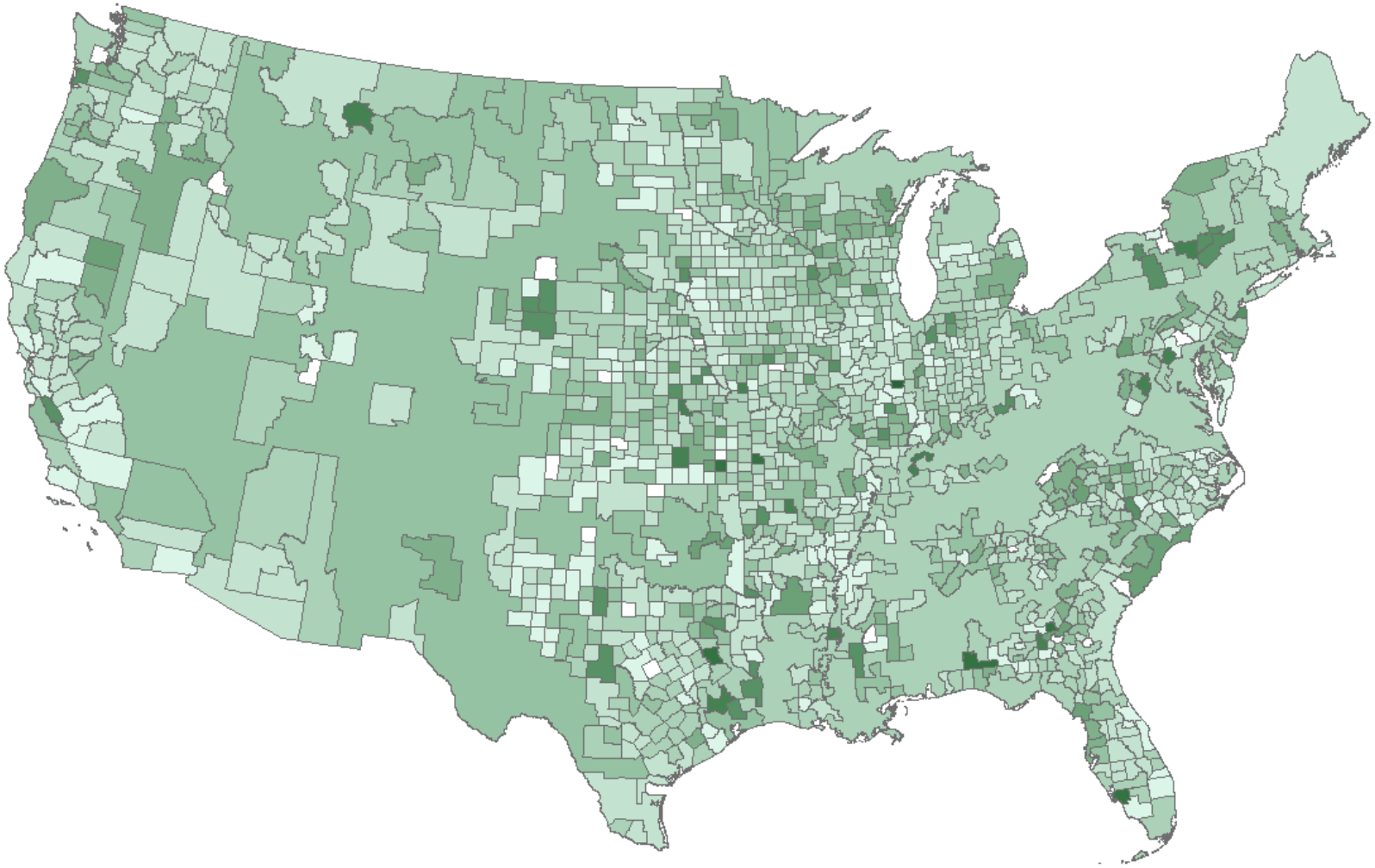
Log λ Map 2010



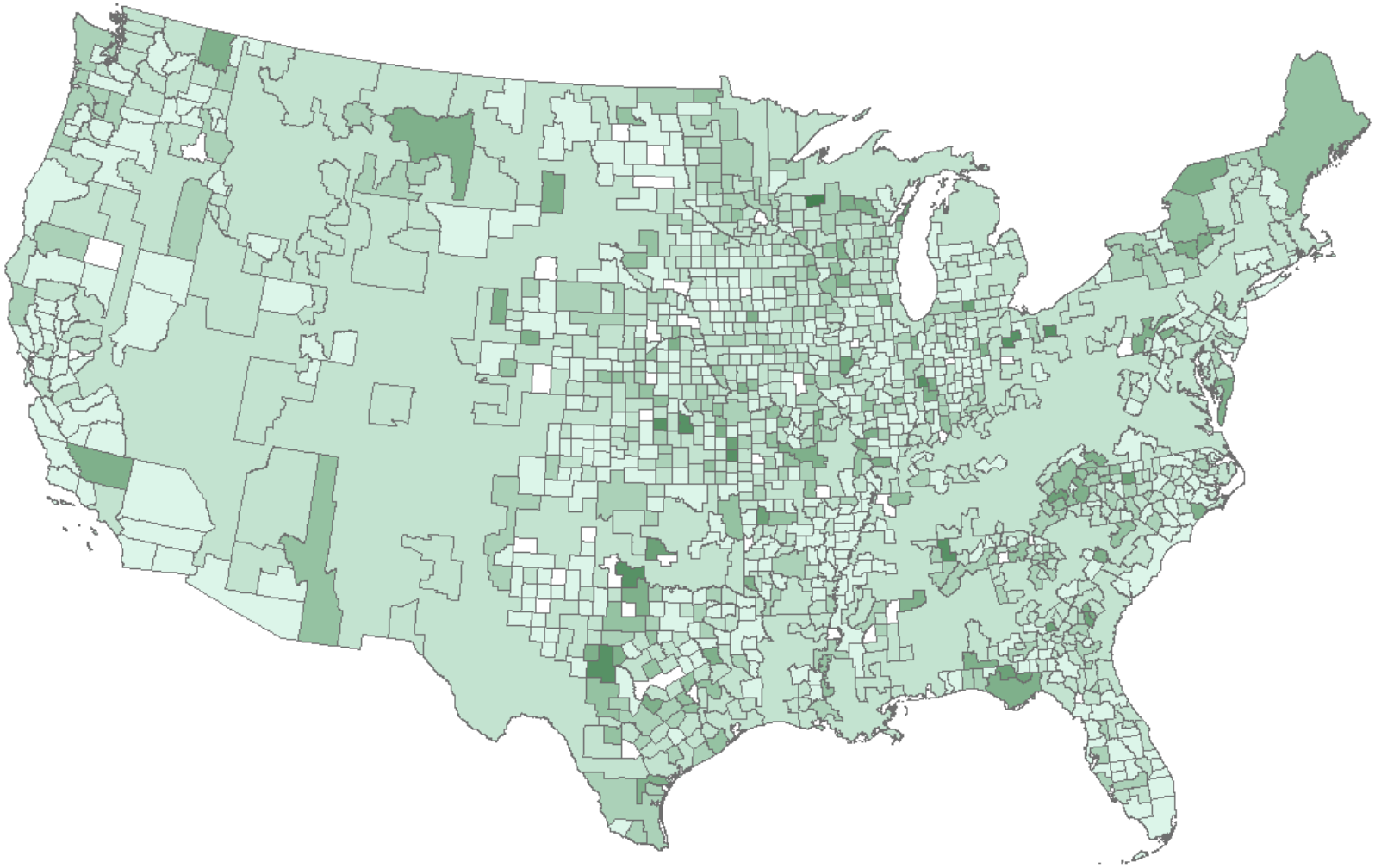
Log λ Map 2011



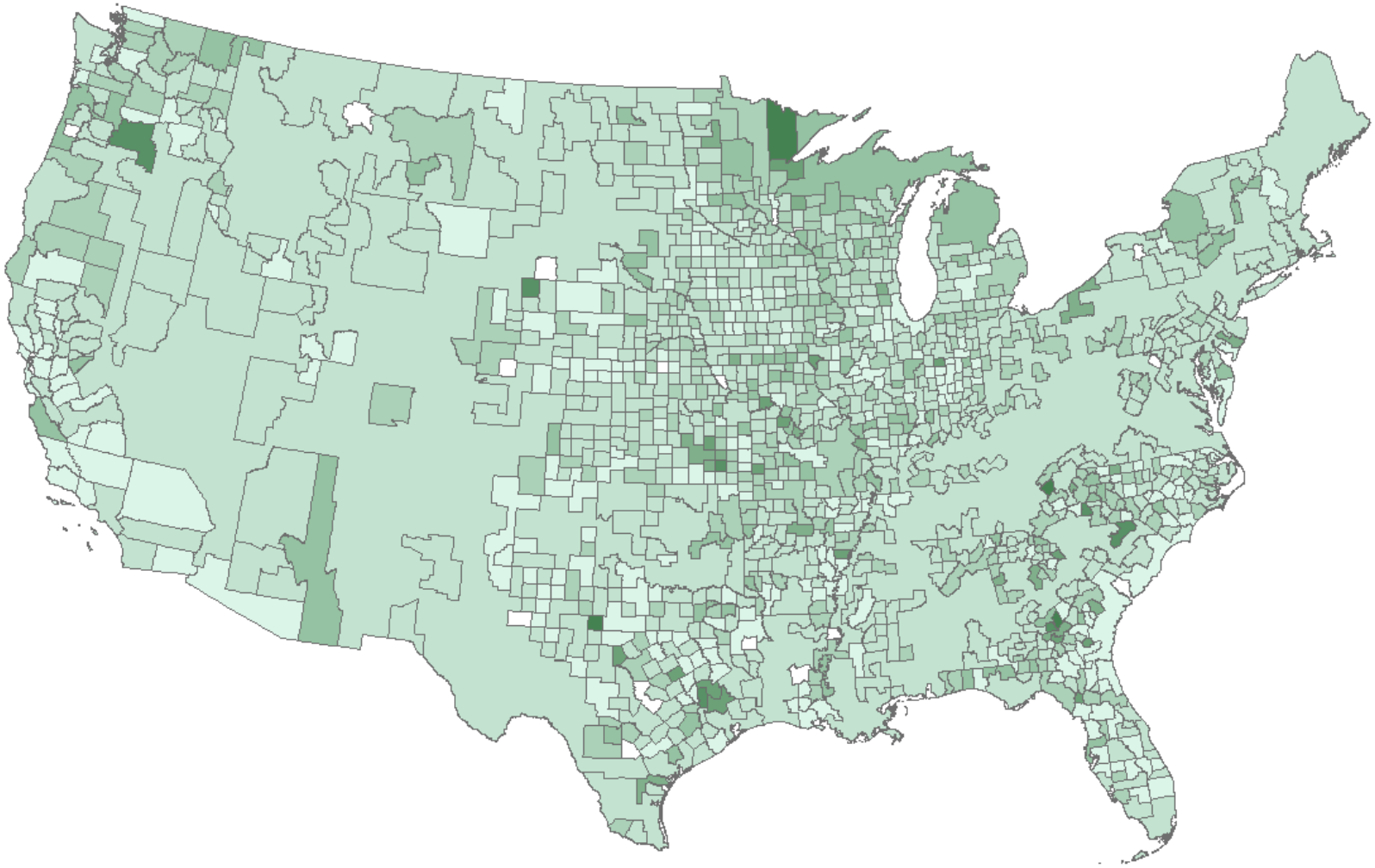
Log λ Map 2012



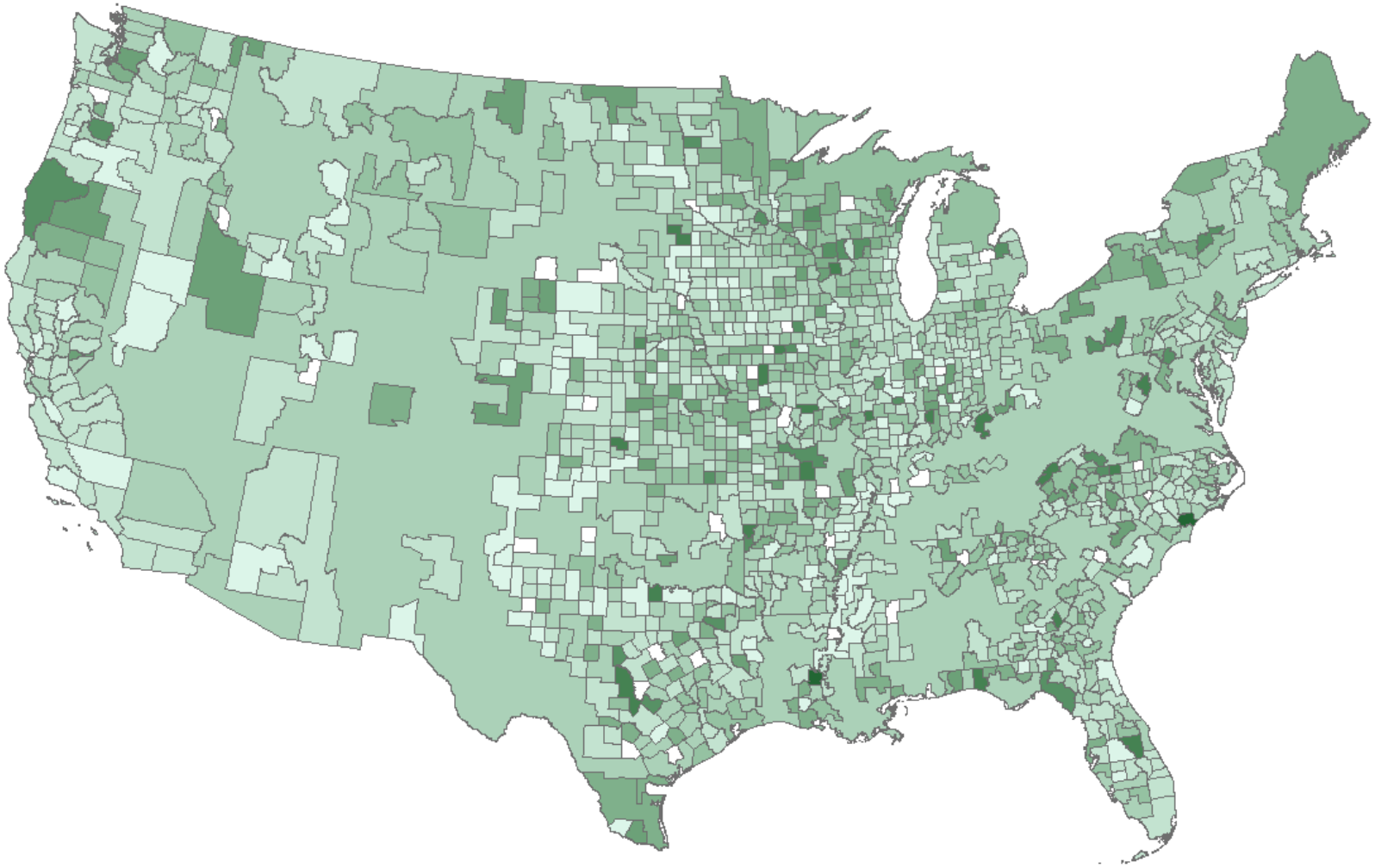
Log λ Map 2013



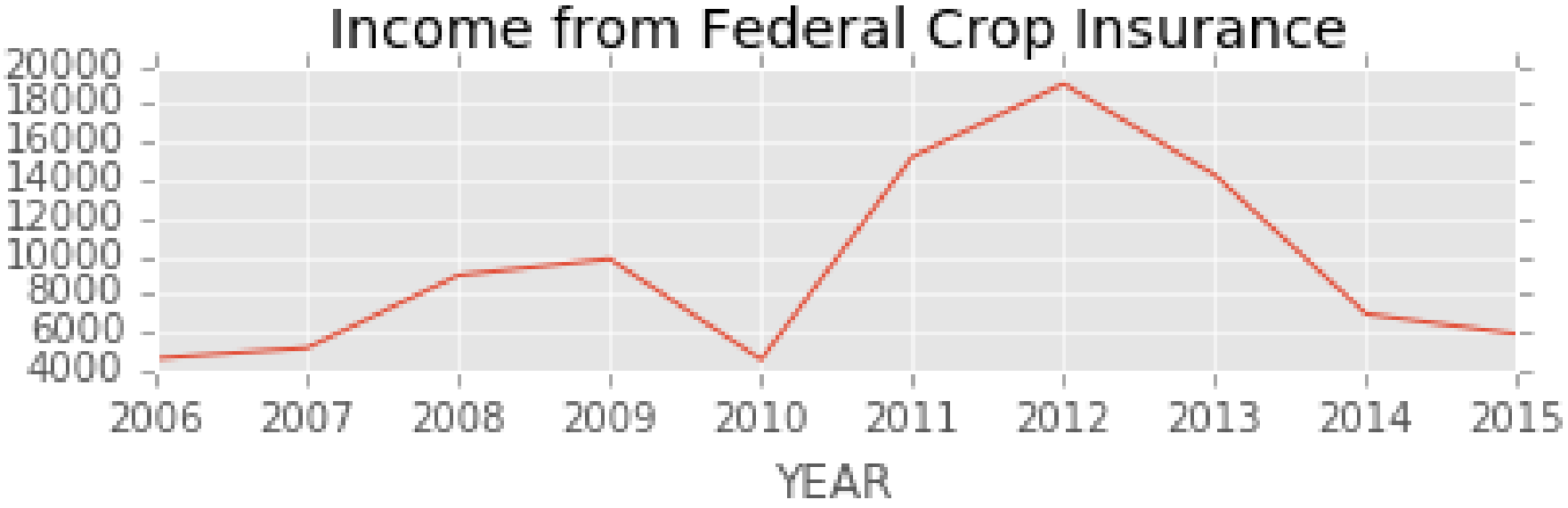
Log λ Map 2014

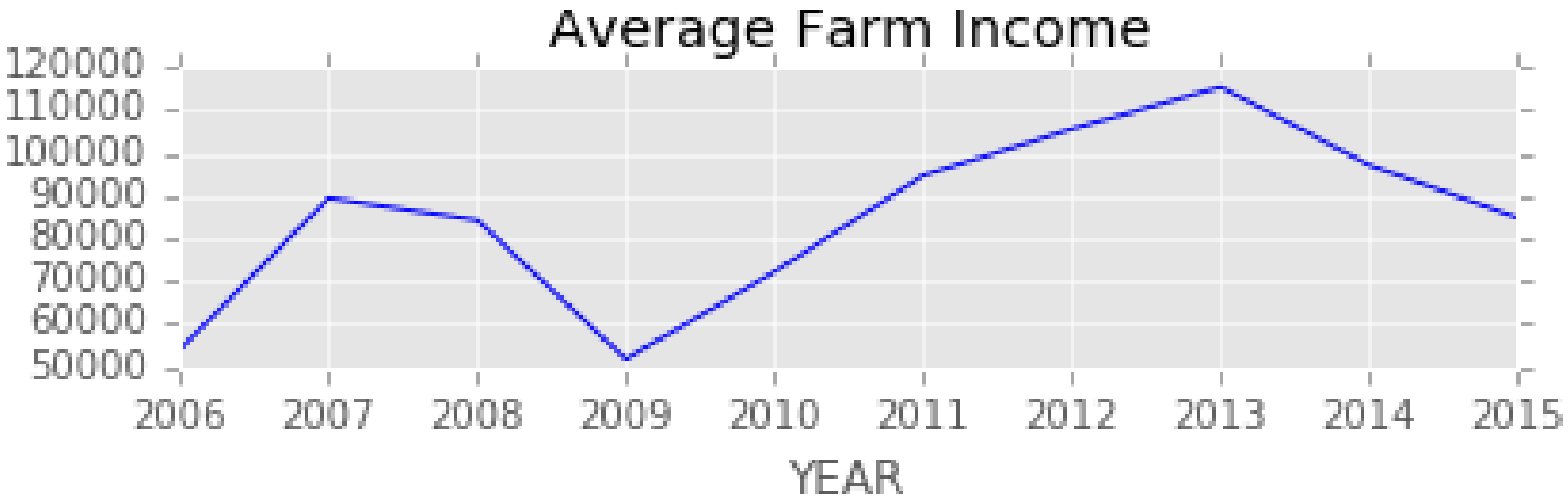


Log λ Map 2015



Data


Income from Federal Crop Insurance
20000
18000
16000
14000
12000
10000
8000
6000
4000
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
YEAR


Average Farm Income
120000
110000
100000
90000
80000
70000
60000
50000
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
YEAR

Results

Table: Regressions on Farm Business Income

	Dependent variable:		
	loglambda		
	(1)	(2)	(3)
log Income	-0.294^{***}	-0.226^{***}	-0.241^{***}
	(0.010)	(0.013)	(0.009)
Constant	-35.025^{***}		
	(0.111)		
Group FE	No	Yes	No
Year FE	No	No	Yes
Observations	10,171	10,171	10,171
R^2	0.074	0.243	0.354
Adjusted R^2	0.074	0.137	0.354
Note:		$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$	

Results

Table: Regressions on Federal Crop Insurance Income

	Dependent variable:		
	loglambda		
	(1)	(2)	(3)
log Insurance Income	-0.131^{***}	-0.122^{***}	-0.064^{***}
	(0.007)	(0.008)	(0.006)
Constant	-36.919^{***}		
	(0.068)		
Group FE	No	Yes	No
Year FE	No	No	Yes
Observations	8,506	8,506	8,506
R^2	0.038	0.266	0.302
Adjusted R^2	0.038	0.142	0.301
Note:		$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$	

Results

Table: Regressions on Farm Income

	Dependent variable:		
	log Farm Income		
	(1)	(2)	(3)
log Insurance Income	0.131***	0.085***	0.113***
	(0.007)	(0.007)	(0.007)
Constant	9.516***		
	(0.065)		
Group FE	No	Yes	No
Year FE	No	No	Yes
Observations	7,570	7,570	7,570
R^2	0.046	0.468	0.078
Adjusted R^2	0.046	0.368	0.077
Note:	*p<0.1; **p<0.05; ***p<0.01		

Further Work

- Our preliminary results imply that our welfare measure is reasonable.
- Future work for this paper:
  - Add a measure of federal crop insurance availability to regressions. If insurance is working as it should, we should see that farmers with insured crops have a lower correlation between expenditures and income than do uninsured farmers.
  - Improve estimates of $\log \lambda$ by adding household characteristics.
  - Run model on disaggregated data.

Thank You!

Estimating $\log \lambda$.

Assume prices are unknown, but all households face the same price. Then for household j, good i, and time t:

$$y_{it}^j = a_{it} + b_i^T(z_t^j - \bar{z}_t) + c_i w_t^j + e_{it}^j, \tag{1}$$

where

$$\begin{aligned}
y_{it}^j &= \log x_{it}^j \\
a_{it} &= \log \alpha_i + \left[\log p_{it} - \sum_{k=1}^{n} \theta_{ij} \log p_{kt}\right] - \beta_i \overline{\log \lambda_t} + \beta_i \bar{\epsilon}_{it} + \bar{\xi}_{it} \\
b_i &= \beta_i \delta_i \\
e_{it}^j &= \beta_i(\epsilon_{it}^j - \bar{\epsilon}) + (\xi_{it}^j - \bar{\xi}_{it}) \\
c_i w_t^j &= -\beta_i(\log \lambda_t^j - \overline{\log \lambda_t}).
\end{aligned}$$

Brief Literature Review

Existing research on crop insurance in the US generally focuses on one of three things:

1. the distribution of costs and payments under the program (Babcock 2012, Goodwin et al 2012);
2. farmer demand for crop insurance Goodwin 1993, Sherrick et al 2004, Du et al 2013) (but this work generally focuses on the characteristics of farms that purchase insurance);
3. or the effects of crop insurance on production decisions (Horowitz Lichtenberg 1993, Lafrance et al 2012, Goodwin et al 2004, Goodwin et al 2012, Ligon 2012, Walters et al 2012).

Ligon 2016 estimates a similar $\log \lambda$ for households in Uganda.

Back.