The effect of wind power investments on rural labor markets: A Bayesian multilevel approach

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Data

1.) US Energy Information Agency (IEA): Wind energy investments:

- Data on every power plant of over 1MW
- Date of first operation, size, county, ownership, grid-connection, etc

2.) Bureau of Labor Statistics (BLS): Quarterly Census of Employment and wages:

- County-level average weekly wages, employment
- 2009-2016

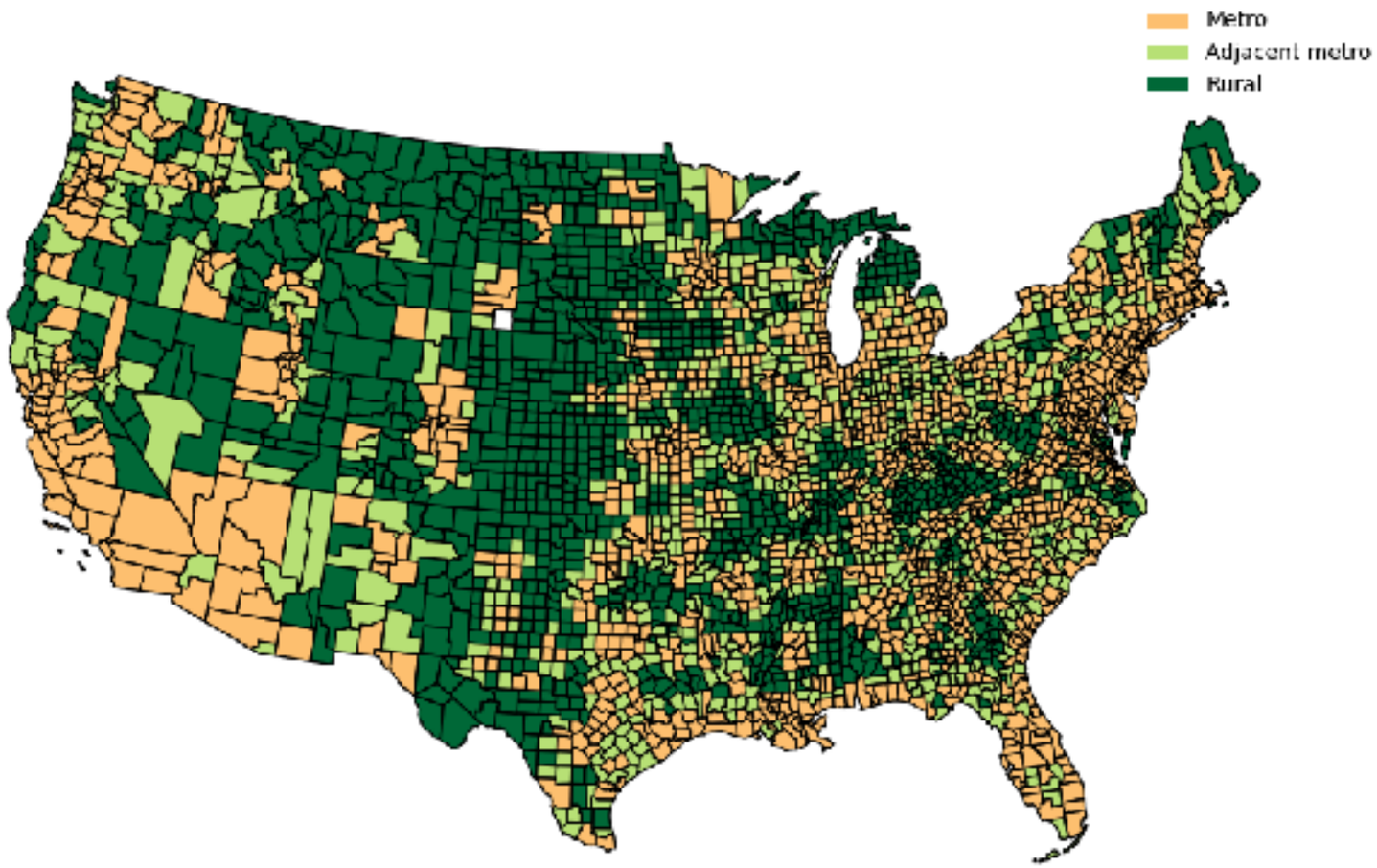
3.) US Department of Agriculture's Economic Research Service (ERS).

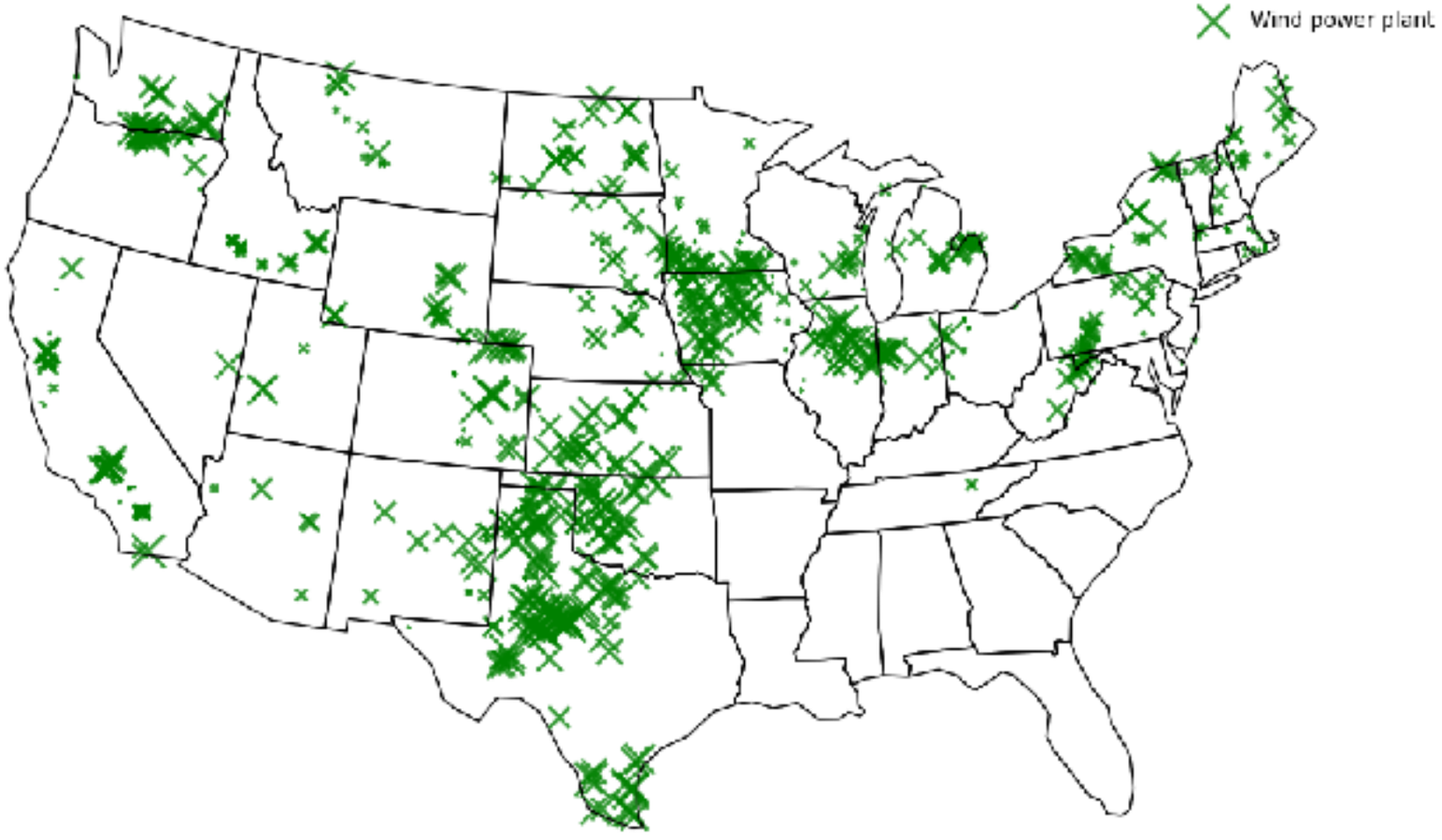
- Rural-Urban Continuum Codes (RUCC)
- Agg. Land values
- Population

RUCC

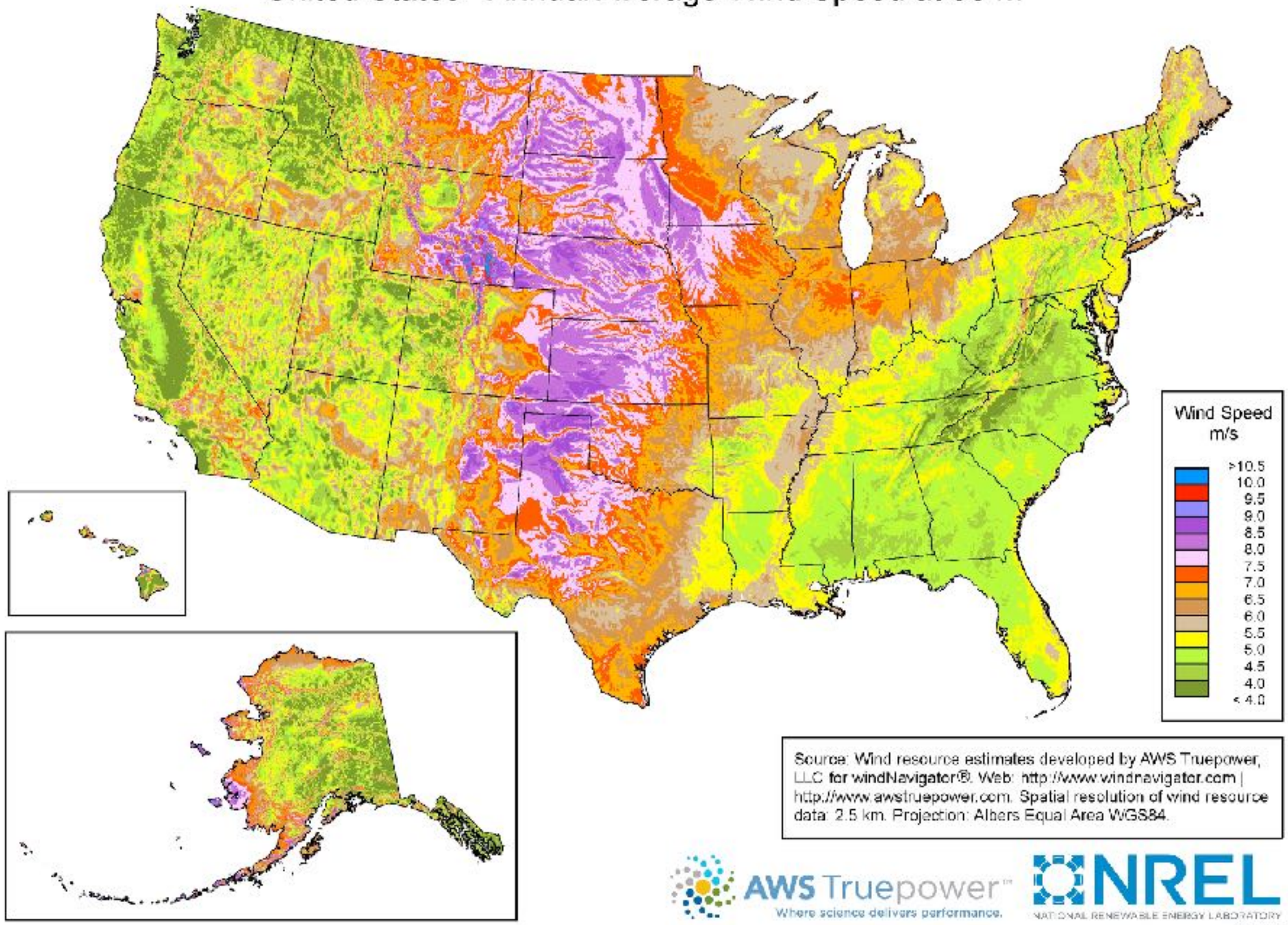
	County Rural-Urban Continuum Codes (RUCC)
1	Counties in metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population
3	Counties in metro areas of fewer than 250,000 population
4	Urban population of 20,000 or more, adjacent to a metro area
5	Urban population of 20,000 or more, not adjacent to a metro area
6	Urban population of 2,500 to 19,999, adjacent to a metro area
7	Urban population of 2,500 to 19,999, not adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area
	Aggregated categories
1	Metro counties (1,2,3)
2	Non-metro with urban population, adjacent to a metro area (4,6)
3	Completly rural, or small urban population not adjacent to metro area. (5, 7, 8, 9)

Table 1: Rural Urban Continuum Codes obtained from the Department of Agriculture Economic Research Service (ERS) are aggregated into three broader categories.


Metro
Adjacent metro
Rural


Wind power plant

United States - Annual Average Wind Speed at 80 m



Source: Wind resource estimates developed by AWS Truepower, LLC for windNavigator®. Web: http://www.windnavigator.com | http://www.awstruepower.com. Spatial resolution of wind resource data: 2.5 km. Projection: Albers Equal Area WGS84.

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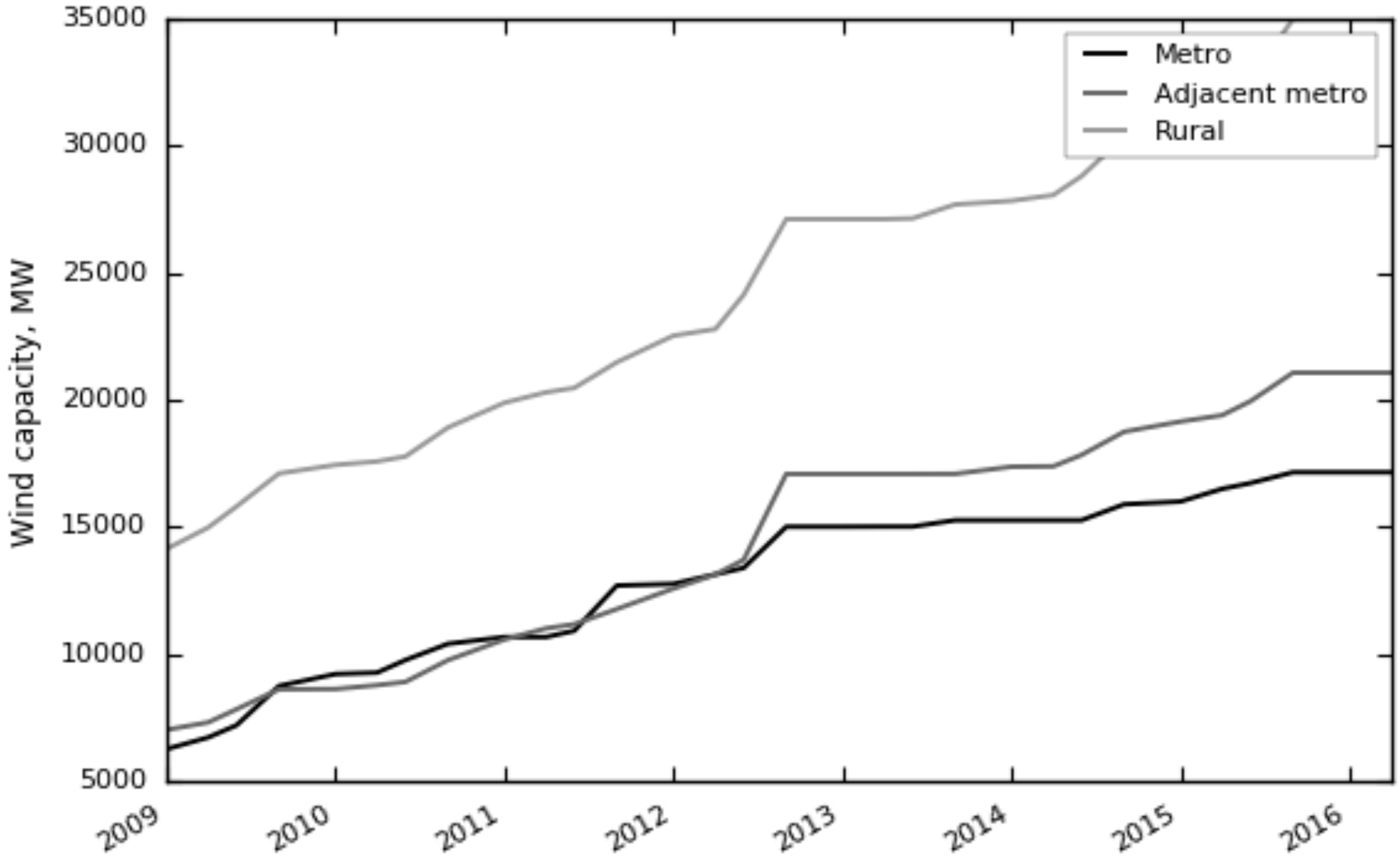
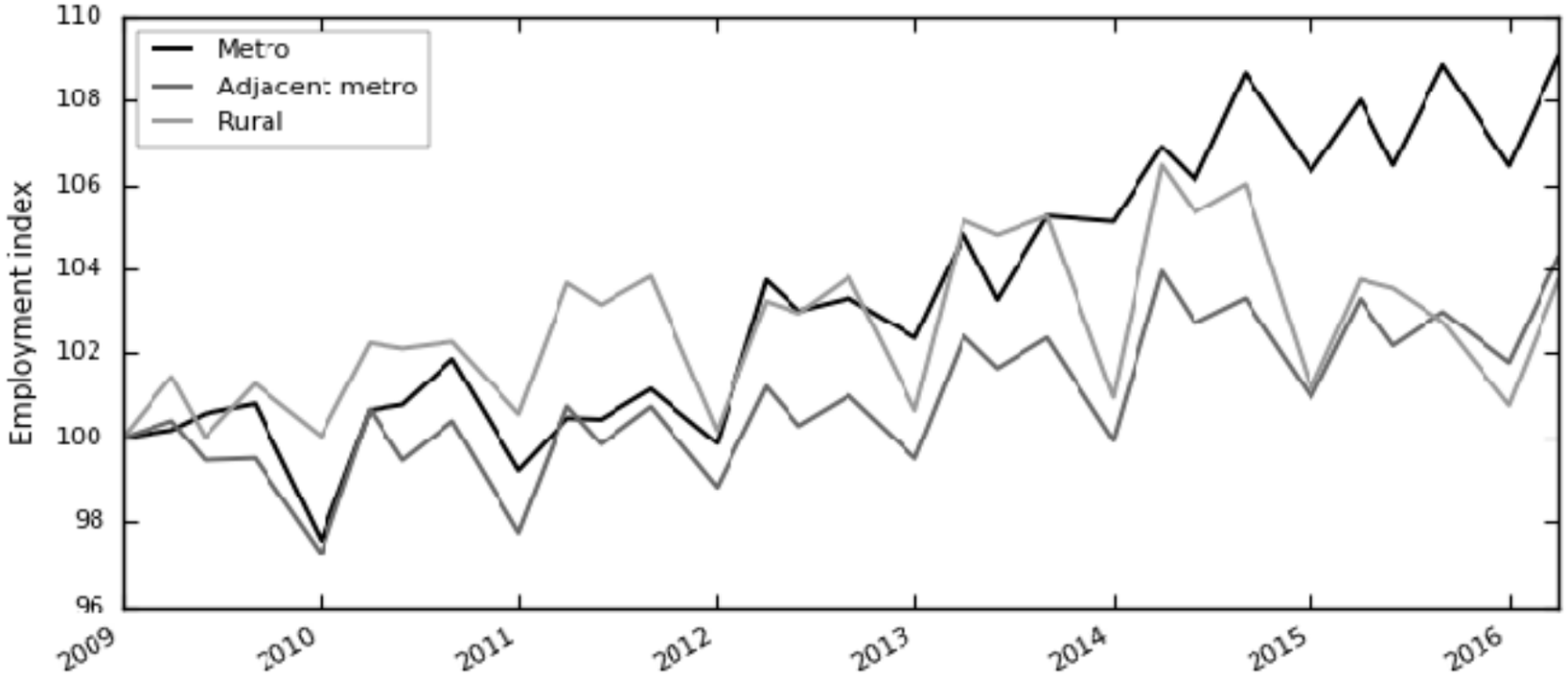
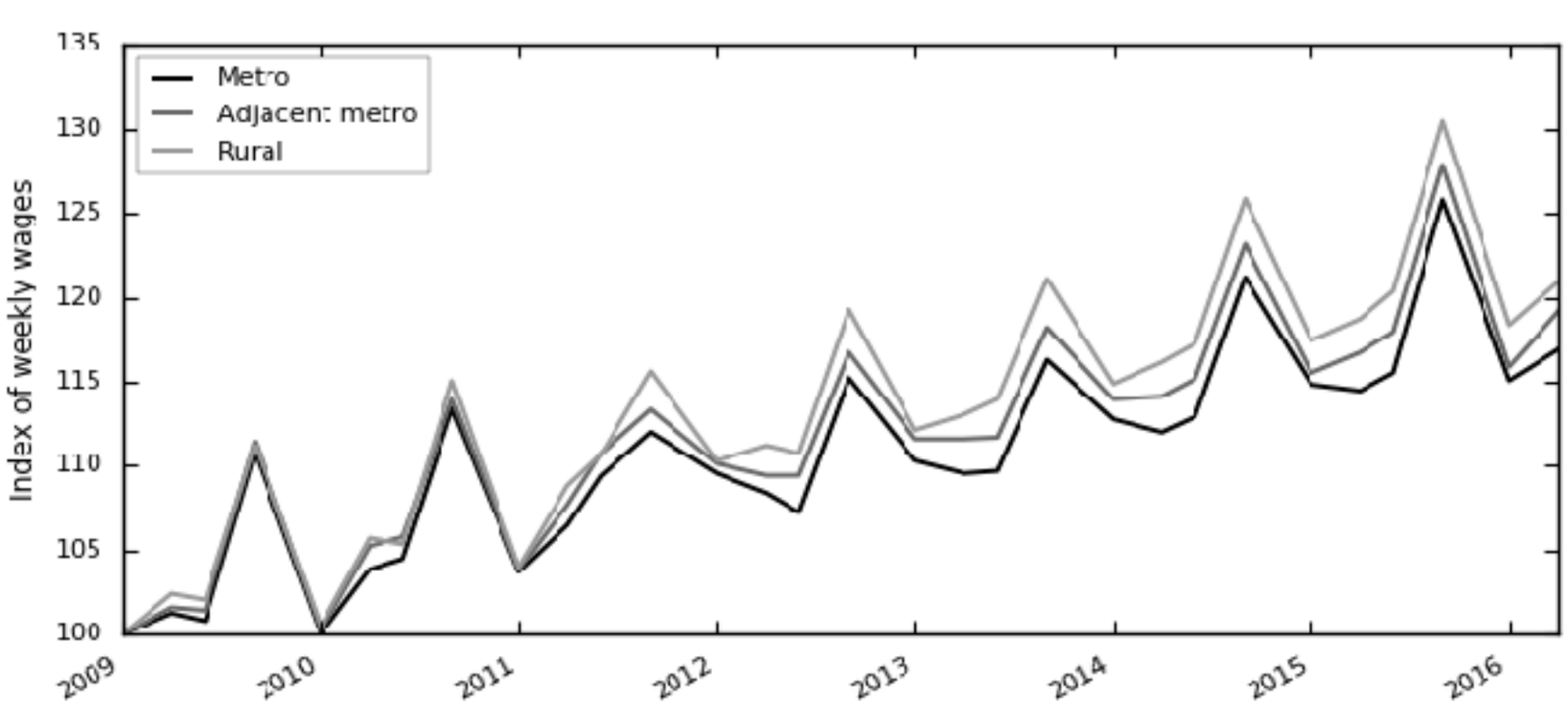

Wind capacity, MW
35000
30000
25000
20000
15000
10000
5000
2009
2010
2011
2012
2013
2014
2015
2016
Metro
Adjacent metro
Rural


Metro
Adjacent metro
Rural
Employment index
110
108
106
104
102
100
98
96
2009
2010
2011
2012
2013
2014
2015
2016


Metro
Adjacent metro
Rural
Index of weekly wages
135
130
125
120
115
110
105
100
2009
2010
2011
2012
2013
2014
2015
2016

Multilevel model of wind investment and labor market outcomes

Likelihood

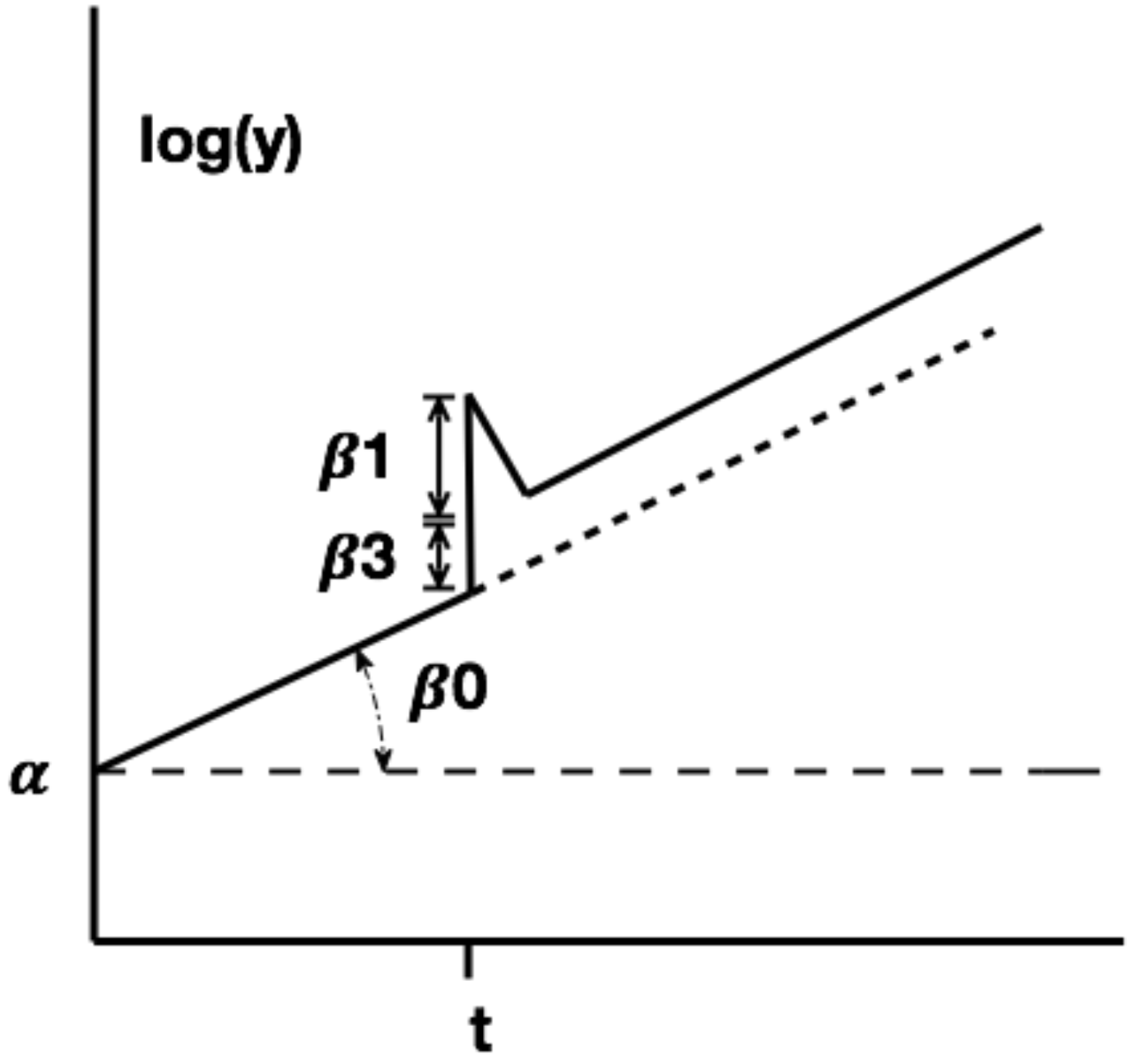
$$log(empl_{c,t}) \sim normal(\widehat{y^{empl}_{c,t}}, sigma^{y})$$

$$log(wages_{c,t}) \sim normal(\widehat{y^{wages}_{c,t}}, sigma^{y})$$

County-level regression

$$\widehat{y_{c,t}^{empl}} = \alpha_c + \theta y_{c,t-1} + \beta_c^0 period_{c,t} + \beta_c^1 capacity\_addition_{c,t}$$
$$+ \beta_c^2 capacity\_addition_{c,t+1} + \beta_c^3 capacity_{c,t} + \beta_{\mathbf{r}}^{\mathbf{c}} \mathbf{quarter_t}$$

$$\widehat{y_{c,t}^{wages}} = \alpha_c + \beta_c^0 period_{c,t} + \beta_c^1 capacity\_addition_{c,t}$$
$$+ \beta_c^2 capacity\_addition_{c,t+1} + \beta_c^3 capacity_{c,t} + \beta_{\mathbf{r}}^{\mathbf{c}} \mathbf{quarter_t}$$


log(y)
β1
β3
β0
α
t

Meta-parameters

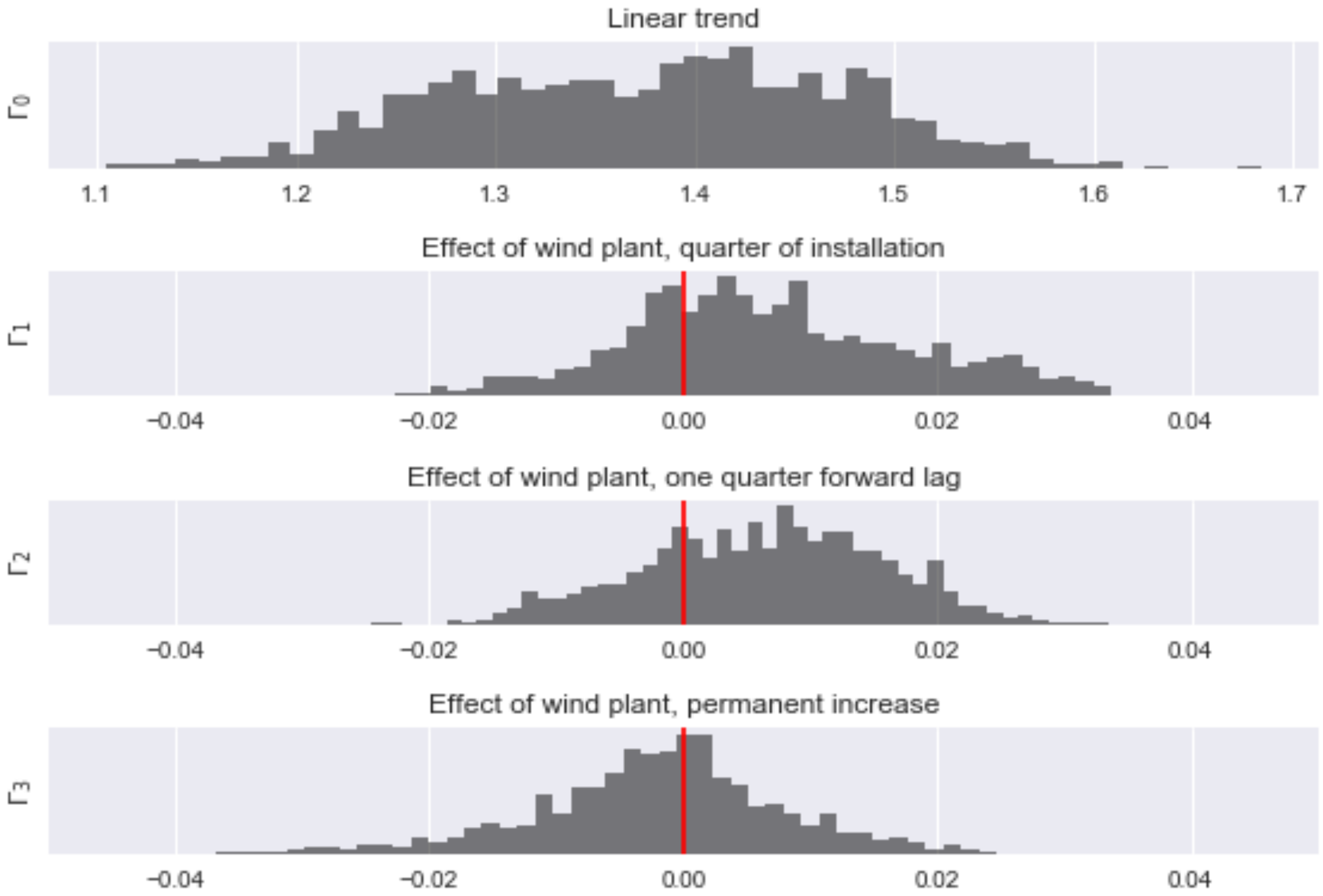
$$\alpha_c = \Gamma^a + \Phi^1 population_c + \Phi^2 log\_agg\_land\_value_c + \alpha_c^{re}$$

$$\beta_c^i = \Gamma^i + \beta_c^{i,re} \quad i \in \{0,1,2,3,4\}$$

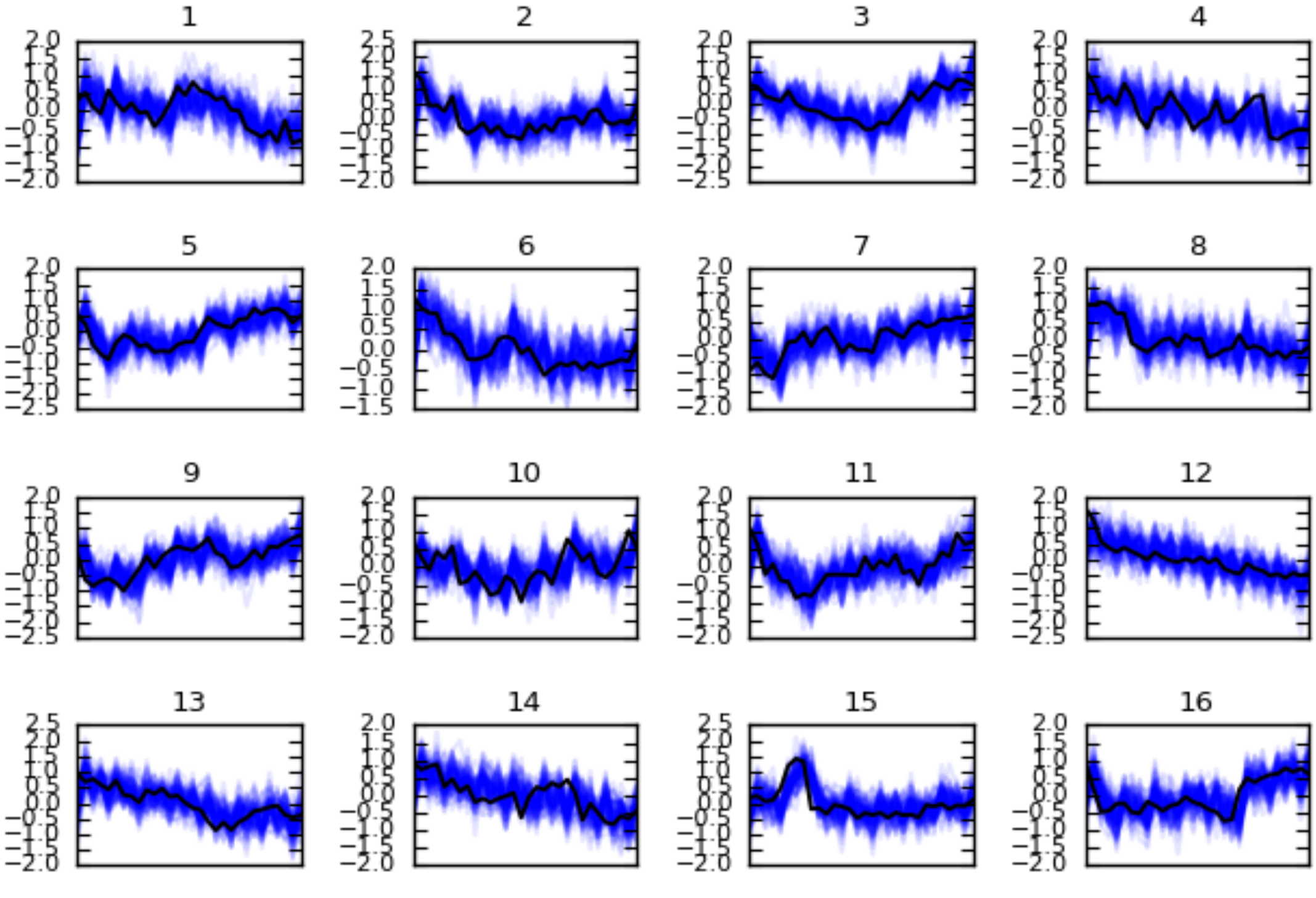
Priors

$$
\begin{aligned}
\Gamma^{i} &\sim cauchy(0,\sigma^{i}) && i \in \{0,1,2,3,4\} \\
\Gamma^{\alpha} &\sim cauchy(0,\sigma^{\alpha}) && i \in \{0,1,2,3,4\} \\
\phi^{j} &\sim cauchy(0,\sigma^{\phi}) && j \in \{0,1\} \\
\alpha_{c}^{re} &\sim cauchy(0,\sigma^{\alpha^{re}}) && \\
\beta_{c}^{k} &\sim cauchy(0,\sigma^{qtr}) && k \in \{5,6,7,8\} \\
\beta_{c}^{l,re} &\sim cauchy(0,\sigma^{re}) && \\
\sigma^{m} &\sim half-cauchy(0,5) && m \in \{0-4, y, \alpha, \alpha^{re}, re, \phi, qtr\}
\end{aligned}
$$

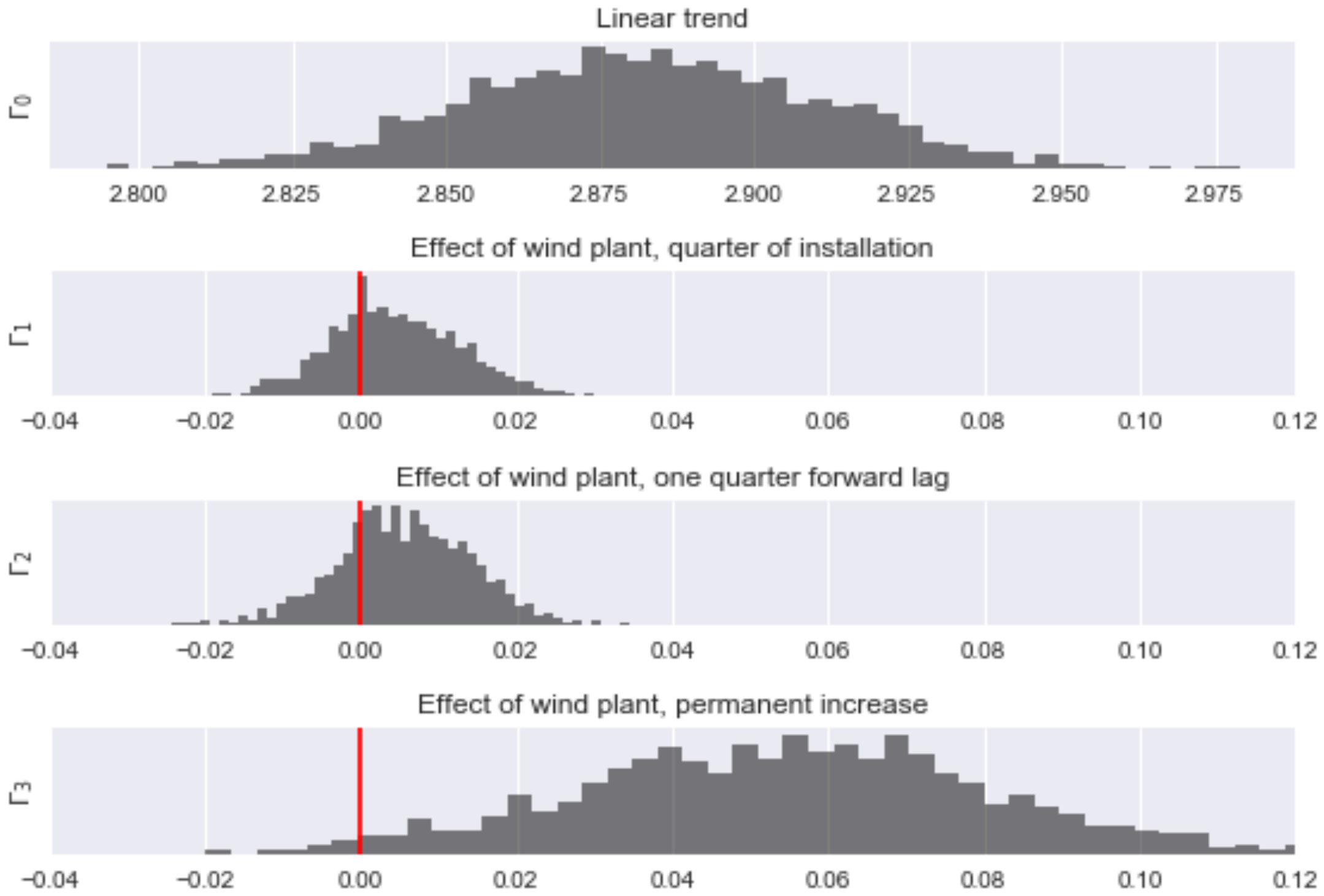
Estimation: Employment



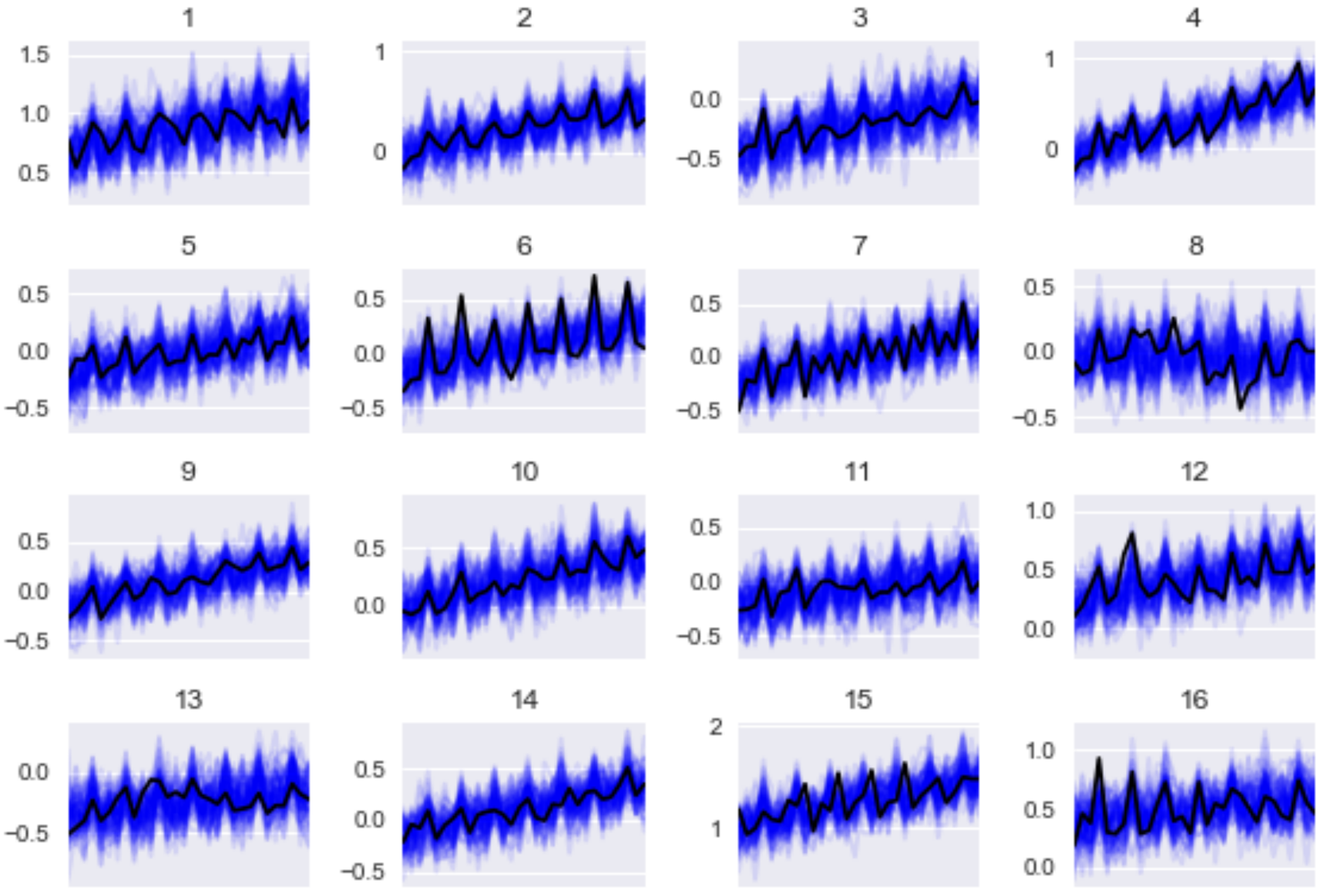
Employment: Posterior Predictive Check



Estimation: Wages



Wages: Posterior Predictive Check



County-level coefficients : Betas and Alphas