**Karp Emissions Estimation Project – Meeting notes for 9/13/22**

Aaron Watt

Observed emissions (1945-2005)

Chart, line chart

Description automatically generated

Chart, line chart

Description automatically generated

Chart, line chart

Description automatically generated

Predicted emissions for sigma^2s ~ 100

Chart, line chart

Description automatically generated

Predicted emissions for sigmas ~ 10^10

Chart, line chart

Description automatically generated

Predicted emissions for sigmas ~ 10^12

Chart, line chart

Description automatically generated

Log Likelihood function, sigma\_a^2 on x-axis, sigma\_u^2 on y-axis

Shape

Description automatically generated

Chart, bar chart

Description automatically generated

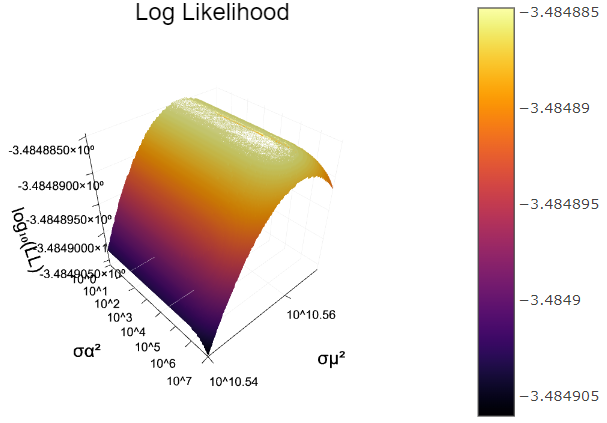
Log Likelihood (flat in sigma\_a direction)

Chart

Description automatically generated

Chart, surface chart

Description automatically generated



Chart

Description automatically generated

This looks pretty straight (constant maximum in the sigma\_u direction).

But the scale that sigma\_a is changing the LL function is very small compared to sigma\_u.

I could trace out the maximum ridge if wanted to determine if it’s slightly diagonal.

Fix sigma\_u^2 at 10^10.56 (sigma\_u ~ 190,000 – on the order of magnitude of year-over-year changes)

Plot LL as a function of sigma\_a

Chart, scatter chart

Description automatically generated

Chart, line chart, scatter chart

Description automatically generated

Chart

Description automatically generated

It appears thought that for any fixed sigma\_u, sigma\_a = 0 maximized the LL function.

The lowest LL I’ve been able to achieve in MLE interations in simulated data: -2754

MLE on both simulated data and real data drive sigma\_a to 0.

To trace out the ridge:

* fix sigma\_a at many values from 10^-2 to 10^4
* find max of LL in sigma\_u direction

My current prior is that the LL is maximized at roughly sigma\_u ~ 10^10.56 and sigma\_a = 0.

Could it be that the model is best fit when there is no shared year shock, just the region-year shocks?

Could mean that there is too much difference between countries trends to pick up shared year shocks when idiosyncratic shocks are also present.

\*Experiment:

* fix sigma^2\_u
* simulate data with very different values for sigma^2\_a (0.1, 10^12, 10^13)
* look at variance in time series data
* perhaps look over many MC simulations and calculate CI’s for different sigma\_a's

\* Need to fix the optimization routine:

- Try using adaptive step size algorithms (from Algorithms for Optimization 2019)

- 5.6 RMSProp

- 5.7 Adadelta

- 5.8 Adam adaptive moment estimation method

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- Decrease the tolerance to see if it will run all the way to the ridge from anywhere

- if that doesn’t work, may need to figure out how to weight the different components of the gradient differently.

What is the statistic that reflects the role of sigma\_a?

* Take many draws
* detrend data
* Is there a way to aggregate the data and estimate just sigma\_a without sigma\_u?

\*Andy:

* Aggregate the data, estimate the variance = sigma\_a^2 + sigma\_u^2/n (use simulated data too! First? To see if this still holds)
* Use cross-sectional data to estimate sigma\_u^2
* Estimate sigma\_a^2 = sigma\_a^2 + sigma\_u^2/n – sigma\_u^2/n
* Think through the aggregation steps, write up the steps and email Larry to confirm the steps are correct

Low priority test that Aaron thought of:

Test if the the sample size (n) is an issue: try simulating date with n=100 and see if sigma\_a still goes to zero?

Next meeting: Tuesday Oct 4, 2pm PT