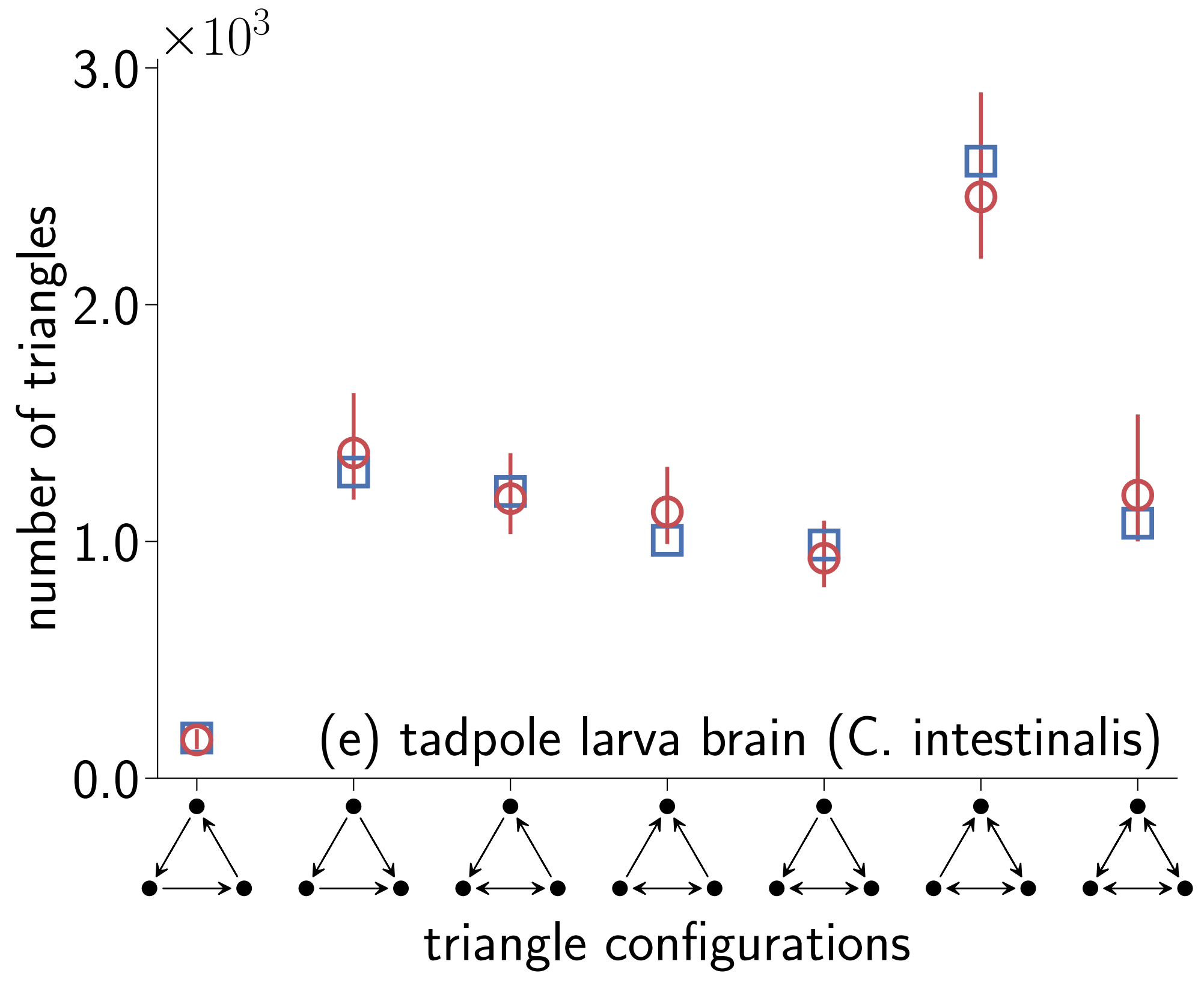
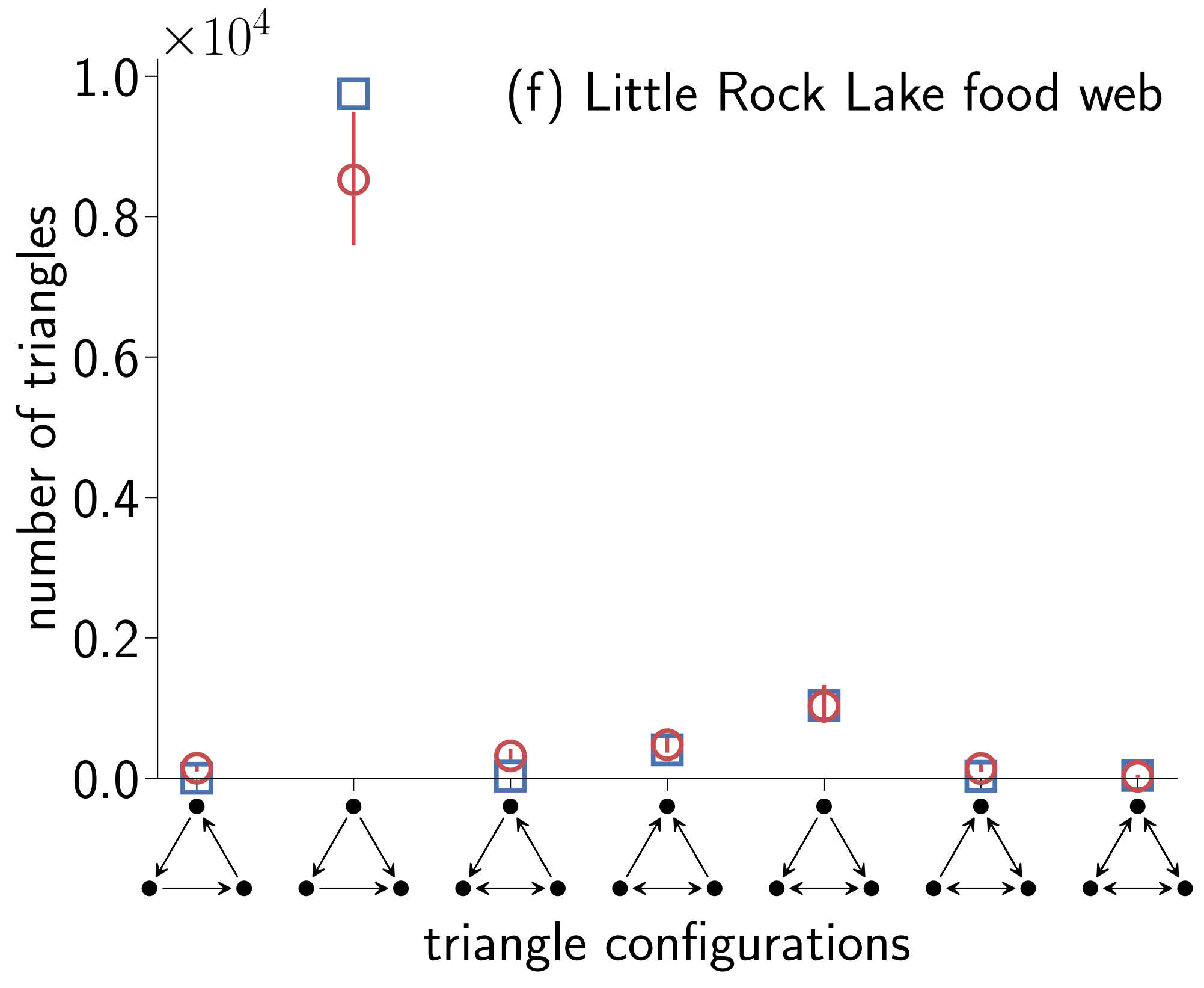
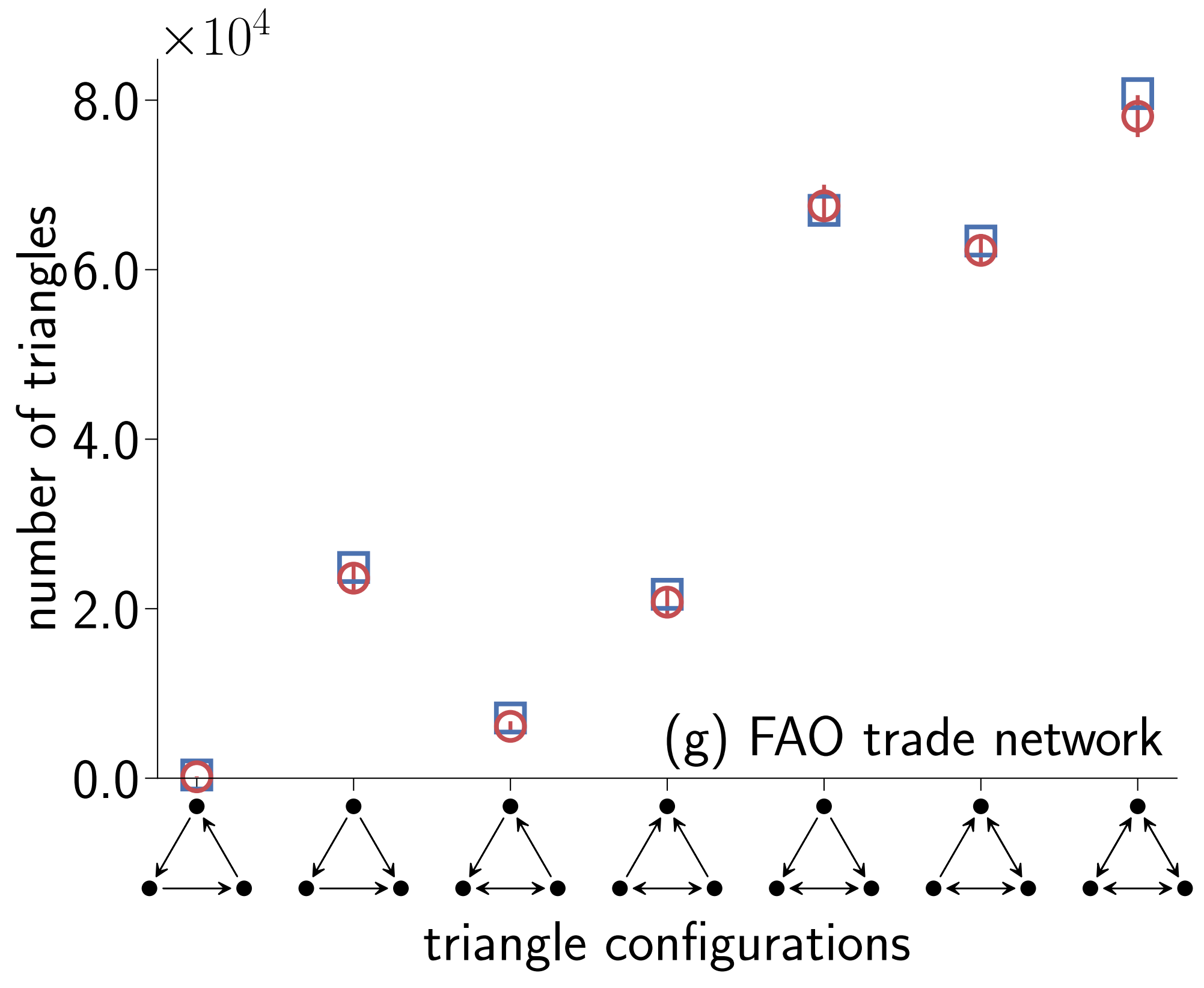
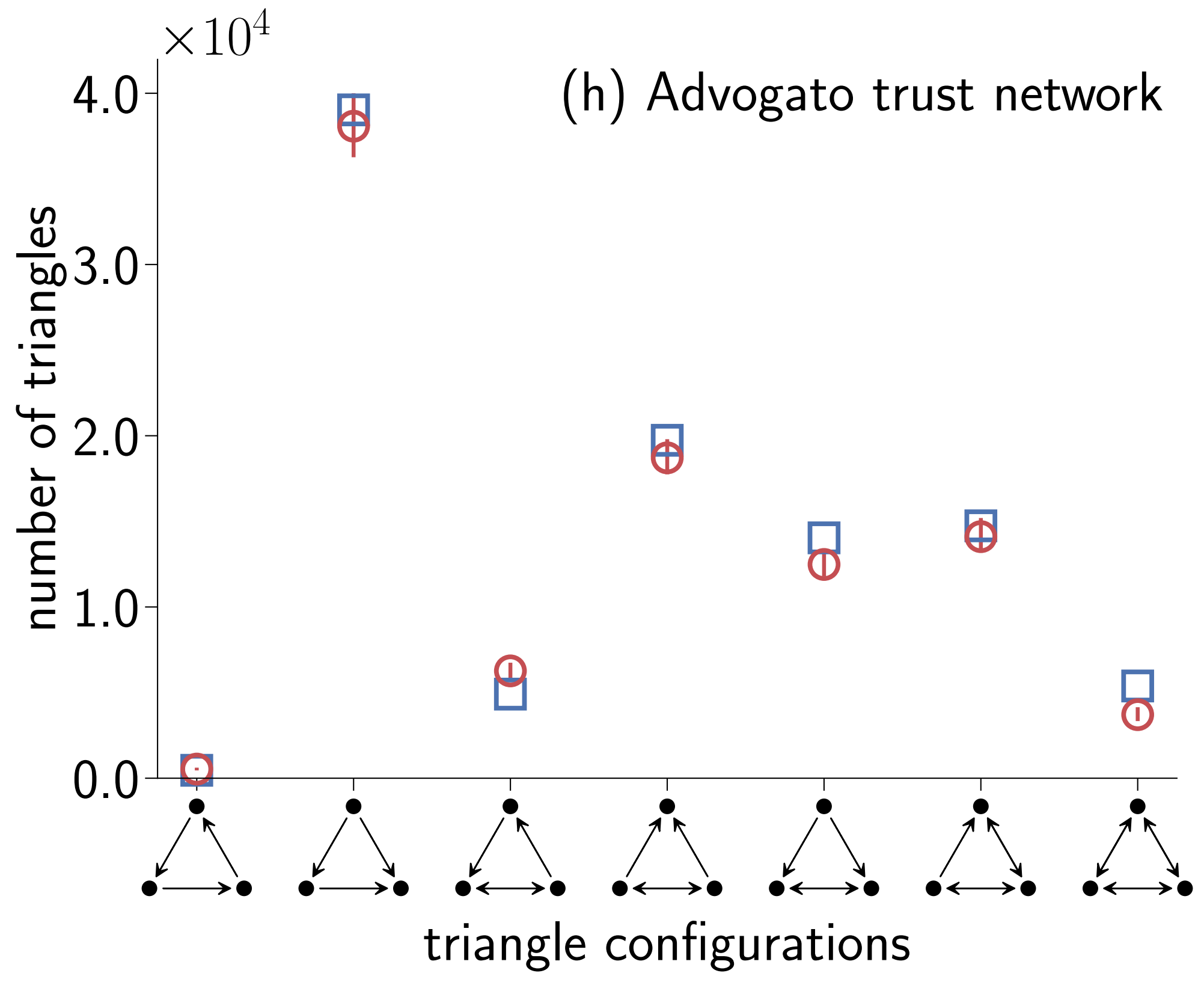
17

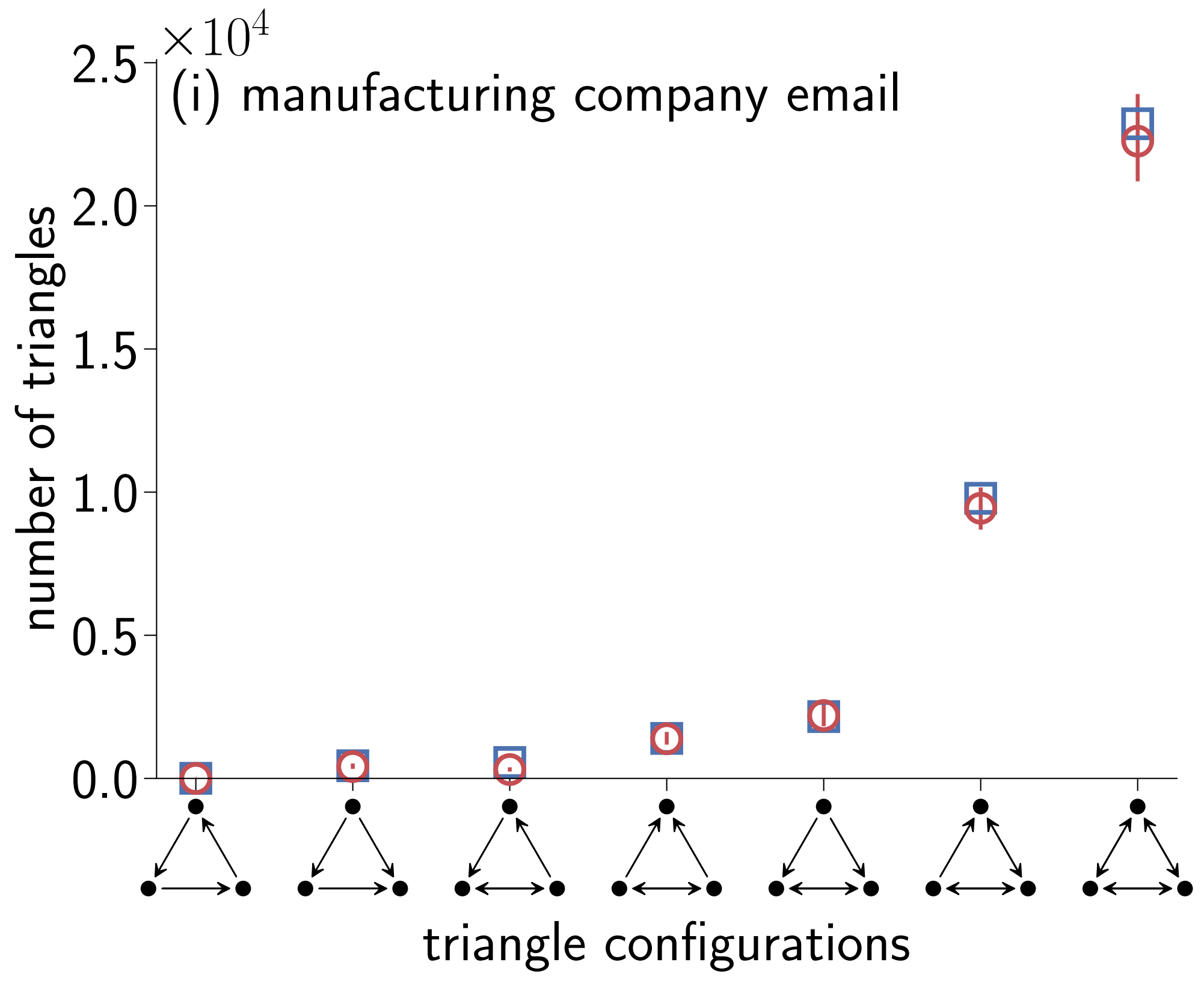
Realistic clustering patterns in directed geometric networks

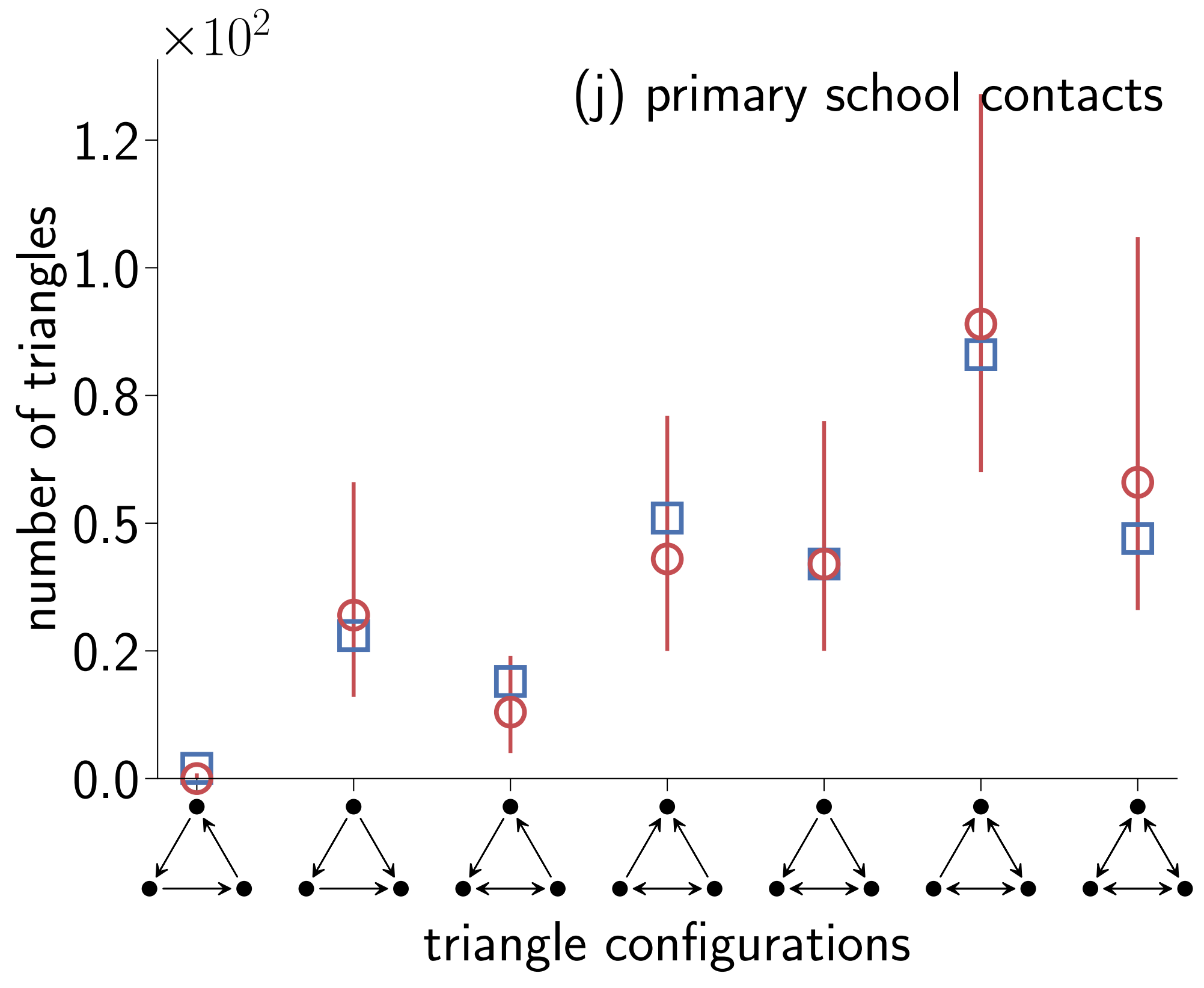

$\times 10^3$
3.0
2.0
1.0
0.0
number of triangles
(e) tadpole larva brain (C. intestinalis)
triangle configurations

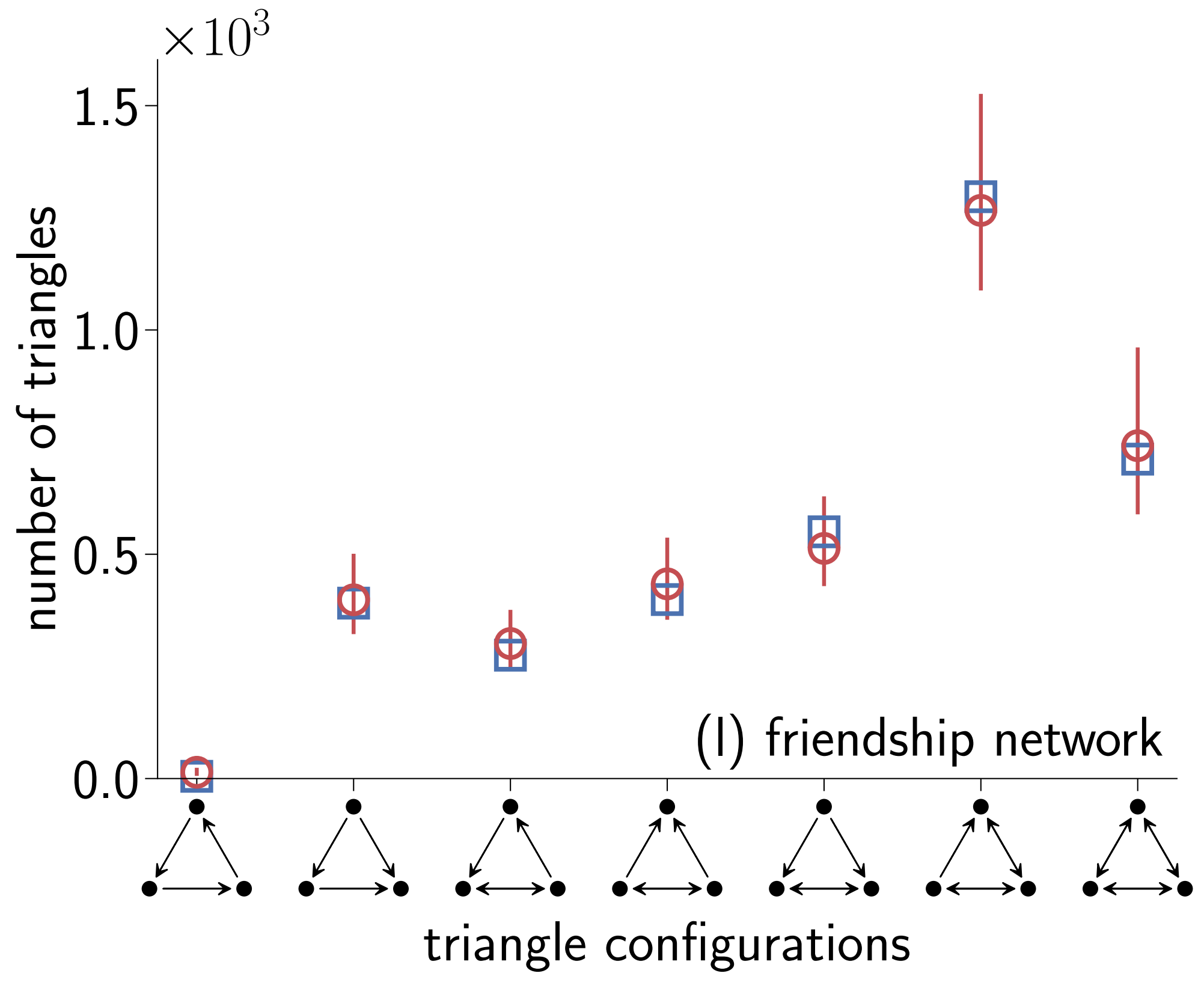

(f) Little Rock Lake food web
$\times 10^4$
1.0
0.8
0.6
0.4
0.2
0.0
number of triangles
triangle configurations

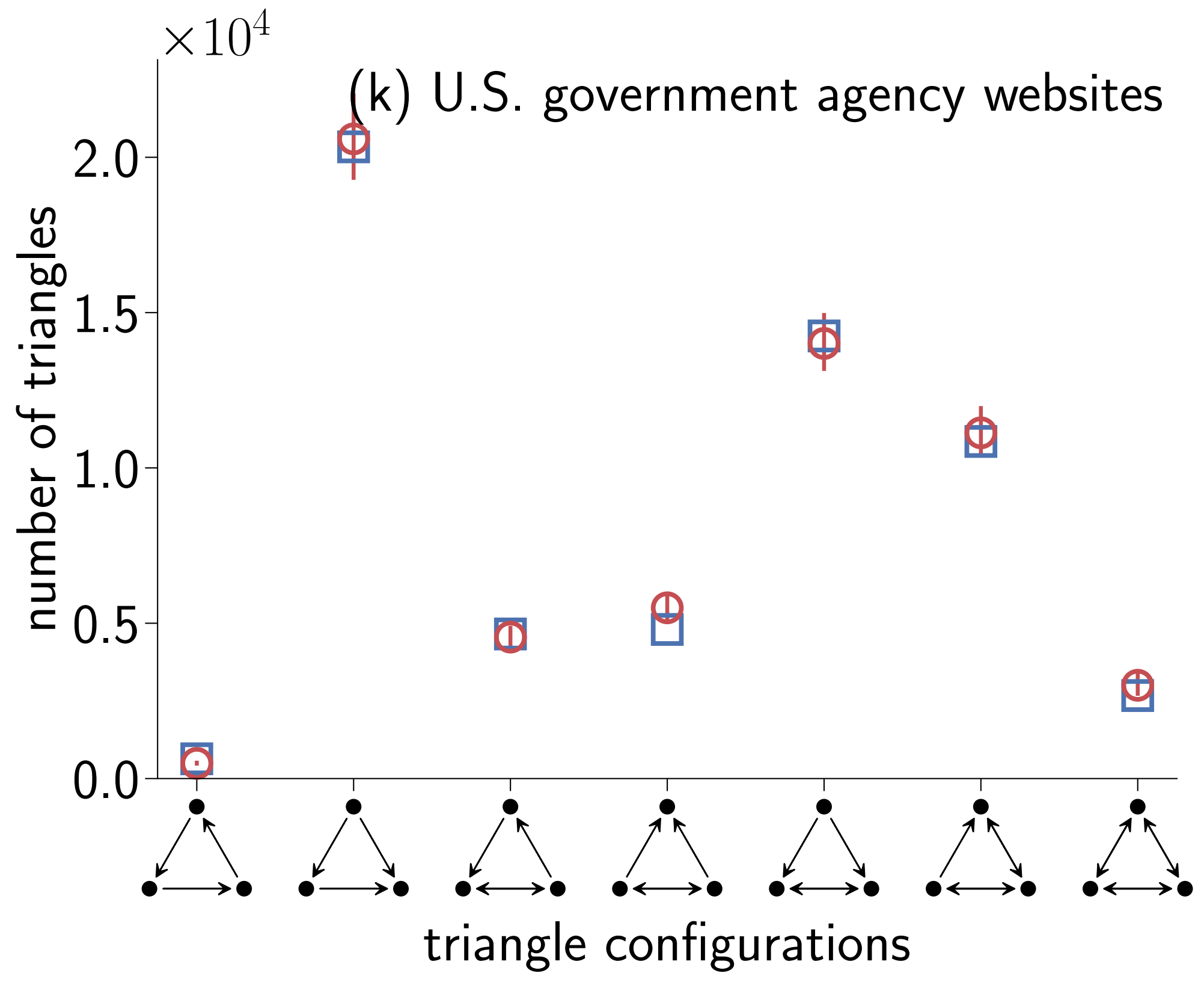

×10^4
8.0
6.0
4.0
2.0
0.0
number of triangles
(g) FAO trade network
triangle configurations


(h) Advogato trust network
$\times 10^4$
4.0
3.0
2.0
1.0
0.0
number of triangles
triangle configurations

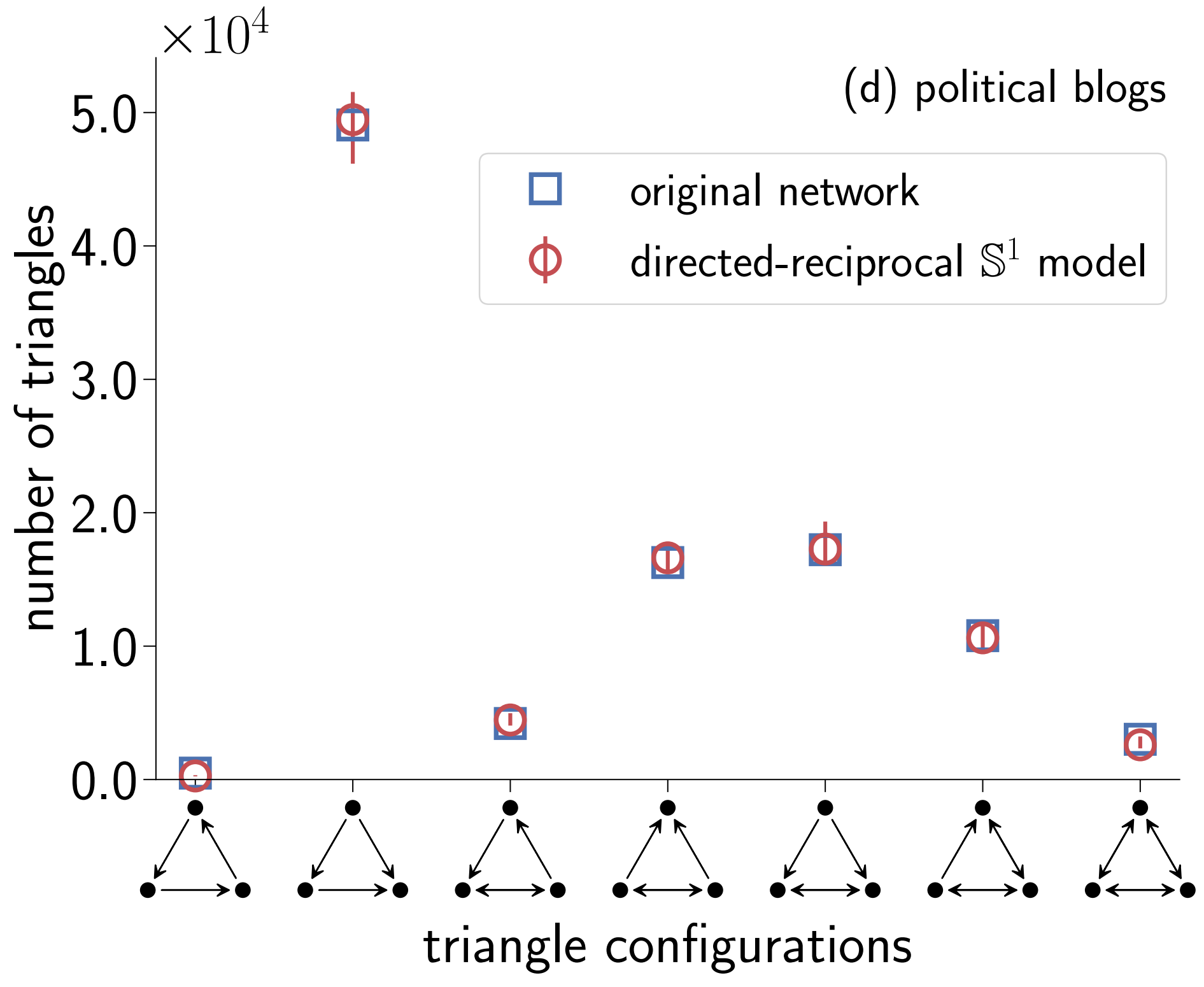

(i) manufacturing company email
$\times 10^4$
2.5
2.0
1.5
1.0
0.5
0.0
number of triangles
triangle configurations


(j) primary school contacts
$\times 10^2$
1.2
1.0
0.8
0.5
0.2
0.0
number of triangles
triangle configurations


$\times 10^3$
1.5
1.0
0.5
0.0
number of triangles
(I) friendship network
triangle configurations


(k) U.S. government agency websites
$\times 10^4$
2.0
1.5
1.0
0.5
0.0
number of triangles
triangle configurations

. . . and many more.


(d) political blogs
original network
directed-reciprocal $\mathbb{S}^1$ model
number of triangles
$\times 10^4$
5.0
4.0
3.0
2.0
1.0
0.0
triangle configurations

Coupled with an underlying geometry, the joint degree distribution, the reciprocity, and the density of triangles fix the clustering patterns in the network.

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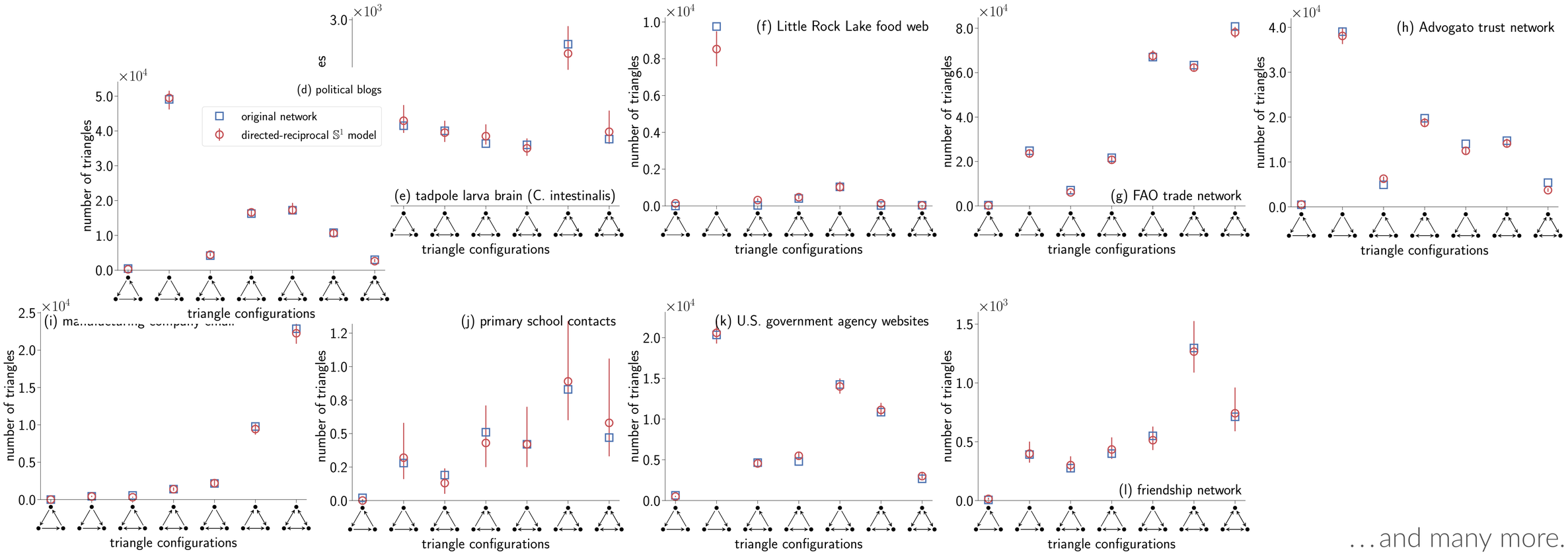

. . . and many more.

Coupled with an underlying geometry, the joint degree distribution, the reciprocity, and the density of triangles fix the clustering patterns in the network.

Summary

1. Presented a generalization of the $\mathbb{S}^1$ model to directed networks.
2. Proposed a general approach to control reciprocity in any random network model.
3. Showed that the interplay between in/out-degree, reciprocity and clustering in directed networks can be accurately captured by a geometric approach.

Further details

- ▷ Allard, Serrano & Boguñá, *Geometric description of clustering in directed networks*, Nat. Phys. (in press), arXiv:2302.09055
- https://github.com/networkgeometry/directed-geometric-networks

Ongoing work / open questions

- ▷ How to infer the angular positions as well. Does this information improve the accuracy of the model?
- ▷ Can we disentangle the effect of ν, β and the correlation between in- and out-degrees on the accuracy of the model?
- ▷ Why are some real networks not fitted well by the model?
- ▷ What about vertex-wise reciprocity? Is it uniform/heterogeneous? Is the model accurate?