

Referee report: *Network Structure of Japanese Firms. Analysis from 800,000 Firms* by Tomohiko Konno.

I have read the manuscript *Network Structure of Japanese Firms. Analysis from 800,000 Firms* by Tomohiko Konno. The manuscript contains two interesting results that could be published as a letter or short communication. The current form of the manuscript, however, is not suitable for publication in *Economics*. With revision the manuscript could be made acceptable and to this end the following comments and recommendations are offered.

Comments:

The manuscript builds on the work of Saito *et al.*¹ who found a power law for interfirm relationships using an expanded data-set of 800,000 Japanese firms from Tokyo Shoko Research Ltd. (TSR). The paper by Saito *et al.*¹, in turn, extended previous research on firms in Japan and other countries that found scale-free network characteristics and power-law distributions.

The manuscript contains two major results. The first is the discovery that the network of firms in the TSR data-set has hierarchical structure. This is accomplished by (i) noting that scale-free and hierarchical networks can be distinguished by the scaling of the clustering coefficient $C(k)$ (the clustering coefficient for scale free networks is independent of link number k while for hierarchical networks $C(k) \sim k^{-1}$) and then (ii) establishing that the empirical degree exponent of the clustering coefficient is close to 1. The second result is that the empirical degree-degree correlation is represented well by the relationship $k_{nn} \sim k^{-0.5}$. Unlike the clustering-coefficient scaling result, the importance of this result is not made clear: the discussion of this result should be enhanced in the revised manuscript.

The layout of the manuscript needs to be brought into alignment with that commonly found in *Economics*: specific recommendations are provided below. Also, the author needs to get permission from the Nature Publishing Group to use Figure 8 and must modify the Figure caption as directed in the permission².

Recommendations:

There is a lot here, but much of it is restructuring the existing work to conform with the structure of other papers in *Economics* and to bring out the

¹Y. U. Saito, T. Watanabe and M. Iwamura, “Do Larger Firms Have More Interfirm Relationships?”, *Physica A* **383** 158-163 (2007).

²To get permission to use this Figure go to http://www.nature.com/search/adv_search and search for the Barabási and Oltvai paper. When the search has found the paper you will see a line of links below the summary of the paper: click the **Rights and Permissions** link and follow the directions on the Rightslink page to get Figure use permission. The author should include a copy of this permission with the resubmitted manuscript.

results in the manuscript.

1. The author should consider a new title that is more descriptive of the results in the paper. Network structure has been found in Japanese firms by Saito *et al.*¹ and others (cf. references therein) so that isn't new. Saito *et al.*¹ used the same 800,000 firm data-set so that's not new. What is new is the discovery of hierarchical structure in Japanese firm networks and the title should reflect this.
2. The abstract should be a straightforward declaration of what has been done in the paper. The first sentence of the abstract needs to capture the interest of the reader and should be a statement of the central discovery or result. The phrase 'hierarchical structure' should appear without quotation marks and without capitalization here and throughout the paper.
3. The title page needs to be cleaned up and brought into the format of *Economics*. Please download a few papers to get the general sense of how the title page should look. In particular:
 - (a) The author's name should appear without a comma.
 - (b) Does the email address of the author begin with a period?
 - (c) JEL codes need to be added.
 - (d) Keywords need to be added.
 - (e) Correspondence information such as email addresses appears below the Keywords section.
 - (f) Acknowledgments in *Economics* papers do not appear as footnotes: please restructure accordingly. The acronym RIETI needs to be defined before it is used (cf. acknowledgment section in Saito *et al.*¹).
4. The Introduction needs to be rewritten to be more direct and concise. This can be done in a few simple paragraphs. The following is a suggestion:
 - (a) First, a paragraph placing the work in the general context of existing work by commenting on the importance of network structure: beginning generally as it applies to micro and macro properties in other areas of science as mentioned in the Conclusion (a couple of quick examples mentioned in passing would be good here), and then specifically to the importance of the work that has preceded this work: the scale-free network analysis of Saito *et al.*¹, those referenced therein and anyone else who has built on their work. This

establishes the basis for the current work both in terms of historical and current research. The review papers and books on complex network theory should be limited to the most important and mentioned in passing. End this paragraph with the statement of how this work extends this line of research with the discovery of hierarchical structure. Something along the lines of “The purpose of the present paper”

- (b) Second, a paragraph explaining why hierarchical structure is important. A few sentences summarizing other work where the importance of hierarchical structure has been observed³. In principle the entire “Implications” section could go here: I suggest, however, that the current “Implications” section be distilled to only those items that speak directly to the issue of hierarchical structure: a sentence for each PD paper is not needed.
 - (c) Finally a paragraph outlining the remainder of the paper so that the reader has a sense of what is to come.
 - (d) There are a number of items that appear in the current Introduction that would better appear in an analysis section (cf. discussion immediately below).
5. Analysis. There is much that appears in the current Introduction that would fit better in a subsequent Analysis Section. Basically this amounts to restructuring Sections 1.11 through 3 into a new Section 2 with three subsections.
- (a) The first section needs to present the approach to identifying hierarchical structure. Keep Figure 8 and get rid of Figures 1-4, and 7 since they all appear in Figure 8. Get rid of Equation 2 and its discussion as it does not help to illuminate the results. Walk the reader through Figure 8 (now your Figure 1) with particular focus on panels Bb, Cb, Bc and Cc. This and the equation representation of these panels (i.e. $P(k) \sim k^{-\gamma}$, $C(k) = a$ where a is a constant and $C(k) \sim k^{-1}$) are central to your analysis and should appear here. Present the notion of degree-degree correlation and how it relates to degree distributions and clustering coefficients.
 - (b) Second, a paragraph discussing the data and how to calculate the degree distribution and clustering coefficient. The data discussion in Saito *et al.*¹ is passable but try to give more detail: what does the data look like and what did the author with it? This is a particularly

³The recent book by Aoki and Yoshikawa - *Reconstructing Macroeconomics: A Perspective from Statistical Physics and Combinatorial Stochastic Processes* (Cambridge University Press, 2007) - and references therein, for example, discuss the importance of hierarchical structure in finance and economics.

important section: someone with a copy of the TSR data should be able to reproduce Figures 5, 9 and 10 without communicating with the author.

- (c) Third, a paragraph presenting the results and discussing them. Figure 5 reproduces the relationship found by Saito *et al.*¹ and it should be presented as such. This provides the reader with an important touchstone to previous research demonstrating the scale-free nature of the network and shows that this result is reproducible. Then walk the reader through the results shown in Figures 9 and 10. You might want to expand your discussion of Figure 9. There seems to be a lot of structure the dots for $\text{Log}(\text{Degree})$ of less than 4 aligning on lines with negative slope. Why is this? Figure 10 might be even more compelling if plotted on log-log axes to highlight the inverse-root relationship.
- 6. Conclusion Section. Be careful in what is claimed to have been discovered. Scale-free characteristics of firm networks in general, Japanese firm networks in particular and of you data-set specifically have been reported before and, therefore, can't really be claimed as a 'discovery' of the current manuscript. Hierarchical structure and degree-degree correlation do appear to be new: focus on them and (i) what was done, (ii) what was discovered and (iii) why it is important.
- 7. Complete first names and initials are mixed in the bibliography. *Economics* citation style uses initials only for first names.