Ruben Dewitte

From: Ruben Dewitte
Sent: donderdag 3 februari 2022 13:37
To: 'thomas.chaney@gmail.com'
Subject: Questions regarding JPE response to note on original JPE article ``The Gravity Equation in International Trade: An Explanation"

Dear prof. Chaney,

I am writing you regarding your response to my note on the original JPE article titled ``The Gravity Equation in International Trade: An Explanation". As my note aims to incite dialogue on a possible generalization of the original paper that can broaden its empirical support, I am happy that you accept to be part of this dialogue.

To my understanding, your response leans on two arguments to claim the results reported in the original paper hold for some subsamples of the data. First, the Pareto distribution deviates from the data for both small *and large* firms. Second, the original paper purposefully does not report statistical tests for conditions (i) and (ii) of proposition 1. I appreciate your acknowledgment that condition (iii) of proposition 1 of the original paper only holds for a small subsample of the data, underwriting the primary motivation for my note's existence. However, I have some doubts regarding the two arguments you lean on in your response, which I was hoping you could alleviate?

First, while I wholeheartedly agree that a Pareto distribution deviates from the data for small firms, I wondered whether you would be able to motivate why this would also be the case for large firms? The claim that Pareto is not a good fit for large firms is not in line with the empirical evidence, broadens the concept of `large firms' beyond what was intended by Axtell (Nature, 2001), and is not in line with the common conception in the trade literature, including your work.

- In Online Appendix B of my note, I report the Kolmogorov-Smirnov (KS) test for the Pareto distribution on several subsamples of the data. Whereas the KS test rejects the Pareto distribution as a good fit to the data for low size thresholds, it fails to reject the hypothesis that the Pareto distribution is a good fit to the data for firms with high thresholds and small samples. Even though this KS-test, at your request, has been relegated to the online Appendix, the idea that the Pareto distribution is not a bad fit for smaller samples with larger firms is also reported on p.3 of my note:
``The Pareto assumption for firm size, for instance, is more likely to hold for samples that consider only the largest 5% (Freund and Pierola, 2015) and/or 1% (Head et al., 2014; Bas et al., 2017) of exporting firms, which falls outside the sample range where parameter restrictions are satisfied."
- The quote *"There are too few very small and very large firms with respect to the Zipf fit (…)"* (Axtell, Nature, 2001, p.1819) refers to the deviation for a bin with the largest six US firms in terms of employment firms in 1997, as can be deduced from an earlier working paper of Axtell (http://www2.econ.iastate.edu/tesfatsi/USFirmSizesAreZipfDistributed.RAxtell2001.pdf). These 6 US firms reside in a bin with employment figures ranging from 265,721 to 797,161 employees. In comparison, the dataset you provided assigns the six largest firms to bins 44-50 of the dataset, while condition (iii) does not hold from bin 10 onwards, that is, for the largest 8,868 firms.
- In line with the empirical evidence (see above), the common conception in the trade literature is that the Pareto distribution holds only for large firms. This is also what I understood from your earlier work, for example: ``There is wide empirical evidence that the Pareto distribution is a good approximation *of the upper tail of the distribution of firm sizes*. Since exporters are overwhelmingly large firms, and therefore in the upper tail of the size distribution, this distribution is a good candidate for a theoretical model of firm selection into export markets." (Chaney, AER 2008, p. 1709).

Second, as already argued during the revision rounds, I contest that no tests were reported for conditions (i) and (ii) of proposition 1 in Chaney (JPE, 2018) and that such tests have no purpose for a stylized model. Therefore, I wondered what your counterarguments are to motivate the argumentation in your response?

- There are ample references in the paper that refer to the empirical evaluation of conditions (i), (ii), and (iii) of proposition 1:
    - ``Table 1 presents formal statistical tests for conditions (i)–(iii) and proposition 1.
      The Pareto distribution in condition (i) offers a precise approximation of the distribution of firm sizes. The R2 from estimating equation (4) is 98.1 percent. The relationship between firm size and the average squared distance of exports is close to the log-linear relation of condition (ii). The R2 from estimating equation (5) is 81.7 percent. '' (Chaney, JPE, 2018, pp. 162)
    - `` Using data on French exporters, I show that Zipf's law is a good approximation of the distribution of firm sizes among large firms; larger firm export over longer distances than small ones in a such way that the average squared distance of exports is approximately a power function of firm size, …." (Chaney, JPE, 2018, p.152)
    - ``Section III presents empirical evidence using French firm-level trade data showing that conditions (i), (ii), and (iii) hold approximately …" (Chaney, JPE, 2018, p.156)
    - ``First, I present evidence that conditions (i)–(iii) and proposition 1 hold in the data on all firms" (Chaney, JPE 2018, p.158)
    - ``Figure 1 shows that conditions (i)–(iii) in proposition 1 are approximately satisfied. The top panel shows that the distribution of firm sizes is well approximated by Zipf's law…" (Chaney, JPE, 2018, pp. 161-162)
    - ``If firm sizes are well approximated by Zipf's law and if the average squared distance of firms' exports is a power function of firm size, as the data suggest, then the distance elasticity of trade ought to be close" (Chaney, 2018, JPE, p.173)
- As argued during the revision rounds, testing (even informally) whether the Pareto distribution provides a good fit to the data prevents cherry-picking lower size thresholds in function of the Pareto shape parameter one would like to obtain. As indicated in Figure (i) of Chaney (JPE, 2018), the data is log-concave in a rank-size plot. On the other hand, the Pareto distribution is log-linear in such a plot. Therefore, when fitting a log-linear Pareto distribution with an increasing lower bound to a log-concave function, we will obtain an increasing shape parameter (the slope of the log-linear distribution line) for the Pareto distribution. Thus, if one is allowed to choose the lower bound of the Pareto distribution freely, it is always feasible to find a cutoff such that the Pareto shape parameter is approximately one. However, it is not always feasible to simultaneously claim the resulting Pareto distribution is a sufficiently good approximation of the actual firm size distribution (as condition (i) requires). A log-linear distribution line will only concur with the log-concave empirical distribution for specific data ranges.

Thank you in advance for taking my questions into consideration. I hope you are willing to help improve my understanding of your response to my note.

Kind regards,

Ruben