

INNOVATION DIFFUSION ON SCALE-FREE NETWORKS

Maria Letizia Bertotti¹, Giovanni Modanese¹

(1) Free University of Bozen-Bolzano, Faculty of Science and Technology, 39100 Bolzano, Italy.

(e-mail: marialetizia.bertotti@unibz.it and giovanni.modanese@unibz.it)

The network of connections between individuals or firms is one of the crucial factors affecting the diffusion of technological innovations. The structure of inter-firm connections is especially sensitive to geographical and logistic influences. In Alpine regions like South Tyrol, this structure tends to be more scale-free and hierarchical than elsewhere. The Bass diffusion equation, which is an effective forecasting tool for innovation diffusion based on large collections of empirical data, assumes an homogeneous diffusion process. We introduce for the first time a network structure into this model and investigate it numerically in the case of scale-free networks with link density $P(k) = c/k^\gamma$, where $k = 1, \dots, N$. The resulting curve of the total adoptions in time is qualitatively similar to the homogeneous Bass curve corresponding to the same average number of connections. The peak of the adoptions, however, tends to occur earlier, particularly when γ and N are large (i.e., there are few hubs with a large maximum number of connections). Most interestingly, the adoption curve of the hubs anticipates the total adoption curve in a predictable way, with peak times which are, in a typical case with $N = 15$, approx. 60% of the total adoptions peak. This may allow to monitor the hubs for forecasting purposes.

[1] T. Di Matteo, T. Aste and M. Gallegati, *Innovation flow through social networks: productivity distribution in France and Italy*, Eur. Phys. J. **B 47**, 459-466 (2005)

[2] N. Meade, T. Islam, *Modelling and forecasting the diffusion of innovation - A 25-year review*, Int. J. of Forecasting **22**, 519-545 (2006)

[3] M.A. Serrano, M. Boguna, R. Pastor-Satorras, A. Vespignani, *Correlations in complex networks*, in: "Large scale structure and dynamics of complex networks: from information technology to finance and natural sciences", G. Caldarelli, A. Vespignani Eds., World Scientific, 35-65 (2007)

[4] M.L. Bertotti, G. Modanese, *Discretized kinetic theory on scale-free networks*, arXiv: 1503.03744