

Mapping Triple Helix innovation in developing and transitional economies: webometrics, scientometrics, and informetrics

Chung Joo Chung · Han Woo Park

Received: 17 July 2013 / Published online: 2 August 2013
© Akadémiai Kiadó, Budapest, Hungary 2013

Since Etzkowitz and Leydesdorff (1995) introduced the Triple Helix (TH) model of university-industry-government (UIG) relationships to explain structural developments in knowledge-based economies, many scholars, entrepreneurs, and administrators have attempted to extend the TH model. According to a recent special issue of *Scientometrics* (edited by Khan and Park 2012), the cumulative employment of the TH model in the analysis of knowledge-based economies and the application of new webometric, scientometric, and informetric research methods have provided many opportunities for stimulating intellectual discussions on the direction of the TH model and its methods. The growing importance of the TH model has led to the emergence of a rich body of theoretical and empirical research discussing new methods for knowledge creation. In particular, the emergence of research on the TH model in Asian contexts has been noteworthy (Meyer 2012). The beauty of TH research lies in its diversity and innovativeness, reflecting the dynamic characteristics of the approach.

The TH model and its indicators have been evolving and thus have invited scholars to suggest new ways to operationalize UIG relations in various contexts. The Center for Science and Technology Studies (CWTS) of Leiden University in the Netherlands has recently started producing an indicator for measuring university-industry research collaboration (UIRC) since 2009 (<http://www.socialsciences.leiden.edu/cwts/research/uirc-scoreboard-2011.html#introducing-uirc-2011>). UIRC is an internationally comparative index based on coauthored papers using Thomson Reuters' Web of Science (WoS) database. UIRC (in this case, university-industry co-publication) is calculated based on the number of research papers published jointly by universities and private organizations such as manufacturing/service firms and for-profit research organizations. The 2011 edition was the first to present separate results for universities worldwide and for those in Europe.

C. J. Chung
Department of Journalism & Mass Communication, Kyungpook National University, Daegu, Korea

H. W. Park (✉)
Department of Media and Communication, YeungNam University, Gyeongsan, South Korea
e-mail: hanpark@ynu.ac.kr

Entropy-based methods have been effective in measuring relationships within/between academic (U), market (I), and political/regulatory (G) systems. The analysis of UIG relations have become a key subject of the contemporary TH analysis. TH data have been obtained mainly from the use of bibliometric services (e.g., Web of Science, Scopus, and Google Scholar) to examine the co-authorship, inter-citation, and co-citation behavior of researchers, journals, disciplines, institutions, cities, and nation-states. Both mapping and measurement exercises can be further facilitated through social network analysis (SNA) techniques. Within the SNA framework, however, one may raise the question of what roles the three institutional actors (UIG) play in TH innovation systems and how they are related to one another. In addition, the emergence of data-driven research methods has enabled researchers to examine the roles of actors beyond UIG relationships through the TH model. For example, Park and his colleagues have recently considered a wide range of complex social contexts, including the entertainment industry (Khan et al. 2012), political communication (Kim and Park 2012), electronic government (Khan and Park 2013), and open innovation (Choi et al. 2012).

Gilbert (2010) highlighted several major factors influencing the development of data-driven research in social sciences. Ackland (2013) focused on a particular subset of computational social sciences by using web data. Gilbert (2010) argued that data-driven social research has become the “third way”, standing alongside quantitative and qualitative interpretative approaches. That is, TH analyses can be more specific than generalized UIG analyses or three-dimensional environments, and therefore one can discover the emergence of Quadruple Helix or N-Tuple Helix relations, which can be extended from “mode 2” to “mode 3” knowledge production systems through the use of public, social, or local–global components for the fourth (or higher) dimension. However, none of these important questions have been systematically addressed in contexts outside North America and Western Europe (Lengyel and Leydesdorff 2011; Leydesdorff and Strand 2012).

This may lead to a global gap in the literature, that is, a scientific divide. This special issue attempts to fill this gap and contributes to the growing body of TH knowledge by considering developing and transitional economies. Starting off this article, Yangson Kim and his colleagues consider 46 Korean universities to determine whether UIG research collaboration is an indicator of research performance. Here they focus on distinct characteristics of each university to show how they influence its overall performance. To evaluate research performance, they consider coauthored papers based on UIG relations in Korea.

Hee Dae Kim and his colleagues argue that the network structure of a cluster provides a firm with practical tools, including TH and virtual clusters, to examine its own growth. Accordingly, they analyze the correlation between structural changes in a network and firm performance and then employ a cluster of software firms as an example. Noteworthy is that the paper shows how firms build their strategies for future growth.

Yi Zhang and his colleagues present the TH model by paying special attention to its innovation patterns. For this, they consider the case of China’s dye-sensitized solar cells and classify innovation patterns into three major categories: universities, industries, and governments. Then they argue that visualized patterns can be displayed with respect to TH inferences established by bibliometrics and text mining.

While these three papers take UIG collaboration and its innovation into account, the following two focus more on its knowledge-production aspect. Bobby Swar and Gohar Feroz Khan explore information and communication technology (ICT) in South Asia, which has not been able to disclose some of the features of the ICT research domain in the region. Here they approach the topic by employing both SNA and TH methods. Daniel

Fink and his colleagues compare Brazil with Korea for the 2000–2009 period with respect to science and technology (S&T) knowledge production and demonstrate that both these countries have witnessed an increase in the production of scientific papers in the last decade and that their knowledge production systems are likely to be stable in the future.

Loet Leydesdorff and his colleagues introduce the open-source program th4.exe, which enables the TH computation through the Internet. Its web-based operation allows th4.exe greater applicability to data. Th4.exe computes entropy and mutual information in various dimensions, including institutional UIG addresses in document sets. In addition, the study investigates the relationships between the TH model and its indicators.

Based on the assumption that there is a limited overview of TH research indicators, Martin and his colleagues apply bibliographic coupling and co-citations in conjunction with the content analysis technique to provide a better understanding of the literature. They identify and discuss four research streams, including indicators of science-technology interactions, information and meaning flows, and their measures, capturing university-based entrepreneurialism and applying TH indicators at the global level. From a similar research perspective, Chung Joo Chung analyzes the characteristics of scholars, referred journals, international linkage patterns, and semantic discourse networks based on SSCI journals to provide a better understanding of TH research in Asia. He identifies the most prominent TH scholars, journals, issues, and research trends in Asia and argues that the academic visibility of scholars is closely related to other capacities such as their publication performance and academic affiliations. In general, his research provides an overview on the TH in Asia for its more in-depth assessment.

Extending the TH model to various cases, Han Woo Park investigates Korea's 2012 presidential election by adopting negative-entropy indicators and explores the presidential campaign by employing a data set collected from Google, Twitter, and Facebook. Providing support for Leydesdorff's findings, he emphasizes entropy-based indicators, suggesting that they can reveal the value of entropy formulated by UIG relations. He introduces an interesting application of the N-Tuple Helix model, which refers to bilateral, trilateral, and quadruple relationships.

Extending TH relations, Marko M. Skoric applies the TH model to implications of big data for developing and transitional economies. That is, he extends the TH model to evaluate big data and its evolution in social sciences. He highlights the issue of the widening gap in research competency between advanced and transitional economies because big-data research has the ability to enhance the world economy by increasing the productivity of firms and enhancing the efficiency of governments. He then suggests an extended TH model as a tentative solution to this growing problem.

Given the importance of the TH model and its potential applications, Han Woo Park conducts interviews with Loet Leydesdorff, a leading TH scholar, and with Elias G. Carayannis and David Campbell, co-developers of the quadruple and quintuple concepts. In the first interview, Loet Leydesdorff provides important insights into how the TH of UIG relationships can contribute to research on knowledge-based innovation and considers the applicability of the TH to various circumstances. In the second interview, Elias G. Carayannis and David Campbell suggest the N-Tuple Helix model, which extends the TH. In particular, they guide the emergence of the Quadruple and Quintuple Helix models of innovation. Here the former combines UIG relations with civil society, and the latter, the Quadruple Helix model with the environment. They explain the implications of these models for developing and transitional economies.

The editors first thank the authors who contributed to this special issue for their commitment to studying the TH/N-Tuple Helix models and UIG relations in Asia. The editors

are also grateful to the anonymous reviewers for their valuable comments and suggestions, which have been vital in improving the quality of papers in this special issue. Finally, Tibor Braun, the Editor in Chief, deserves special recognition for his support and guidance in compiling this special issue.

Acknowledgments The corresponding author acknowledges a partial support from the SSK (Social Science Korea) Program funded by the National Research Foundation of South Korea; 204 NRF-2010-330-B00232.

References

- Ackland, R. (2013). *Web social science: Concepts, data and tools for social scientists in the digital age*. Thousand Oaks, CA: Sage.
- Choi, S. J., Park, J. Y., & Park, H. W. (2012). Using social media data to explore communication processes within South Korean online innovation communities. *Scientometrics*, *90*(1), 43–56.
- Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix—University-Industry-Government relations: A laboratory for knowledge based economic development. *EASST Review*, *14*, 14–19.
- Gilbert, N. (2010). *Computational social science. SAGE benchmarks in social research methods series*. Thousand Oaks, CA: Sage.
- Khan, G. F., Cho, S. E., & Park, H. W. (2012). A comparison of the Daegu and Edinburgh musical industries: A Triple Helix approach. *Scientometrics*, *90*(1), 85–99.
- Khan, G. F., & Park, H. W. (2012). Editorial: Triple Helix and innovation in Asia using Scientometrics, Webometrics, and Informetrics. *Scientometrics*, *90*, 1–7.
- Khan, G. F., & Park, H. W. (2013). International collaboration within electronic government research domain: A Triple Helix network analysis of collaboration at the regional, country, and institutional levels. *Government Information Quarterly*, *30*(2), 182–193.
- Kim, M. J., & Park, H. W. (2012). Measuring Twitter-based political participation and deliberation in the South Korean context by using social network and Triple Helix indicators. *Scientometrics*, *90*(1), 121–140.
- Lengyel, B., & Leydesdorff, L. (2011). Regional innovation systems in Hungary: The failing synergy at the national level. *Regional Studies*, *45*(5), 677–693.
- Leydesdorff, L., & Strand, Ø. (2012). The Swedish system of innovation: Regional synergies in a knowledge-based economy, *Journal of the American Society for Information Science and Technology*, in press.
- Meyer, M. (2012). Triple helix indicator: A bibliometric perspective. *The Triple Helix Association Newsletter*, *1*(2), 4–6.