Proceedings of 14th International Conference on Webometrics, Informetrics and Scientometrics & 19th COLLNET Meeting 2018
>> Collaboration - Impact on Productivity and Innovation <<
Article DOI: 10.22032/dbt.39353 Proceedings DOI: 10.22032/dbt.39296

Who fosters innovation from U.S. academic patents: A new innovation path from university to government to industry?

*Chunjuan LUAN[1, 2], Bowen SONG[1]

[1]*julielcj@163.com; CLuan@dlut.edu.cn*

Institute of Humanities & Social Sciences, Dalian University of Technology, Dalian, 116085, Ch*ina*

[2]*bowensong333@163.com*

School of Intellectual Property, Dalian University of Technology, Panjin, 124221, China

Introduction

Academic patenting represents the developing directions of future industries (Lee and Gaertner 1994, Dorner, Fryges et al. 2017), and scientific breakthroughs coming from universities can contribute to the emergence of new industries, such as in the case of biotechnology (Guerzoni, Aldridge et al. 2014). Many significant innovations impacting on our lives on a daily basis are the products of professors and students working at universities, from the internet to the nicotine patch, often in ways we don't even realize (Staff Writers 2017). However, who fosters innovation from academic patents? Fostering innovation has been recognized as a better R&D tool than mandates and funding (Snow 2017), facilitating innovation as soon as possible would be a more effective step than simply imposing mandates or increasing funding in breaking an apparent U.S. energy and climate research and development logjam. This paper aims at having an insight into leading cultivators in fostering innovations from academic patents in the leading U.S. states in terms of innovation facilitating, by analysing top Assignees in top Assignee states in respect of U.S. academic patent licenses, a proxy of technology transfer.

Data source and data process

Data in this study is from the official website of *United States Patent and Trademark Office, USPTO*, during the execution years of 1980-2016. Data of technology transfer from academic institutions are needed in this study. First, we search out academic patent assignment data during the execution years during 1980-2016, with search strategy of "Assignor name: university* OR institute* OR college* OR academy*", from the official website of *United States Patent and Trademark Office, USPTO*.

There exists a wide range of writing ways for a specific Assignee in the original patent assignment data recorded in the official website of *USPTO*. Such as there are 14 writing ways for *U.S. Navy*. It is a time-consuming work for us trying to find out a variety of writing types for a specific Assignee among bulk of patent assignments, and then merge them into one.

Analysis and results

The leading U.S. states fostering innovation

Which states have U.S. academic technology transferred to? The leading U.S. states receiving more patent licenses from academia are considered as U.S. innovation fostering centres. It is recognized that innovation fuels economic growth, and technology transfer is a key driver of successful innovation, which helps the private sector adapt Federal research for use in the marketplace. It is well known that Silicon Valley is an established technology innovation centre in U.S. (Fleming and Frenken 2007, Henton and Held 2013), however, little investigations have been found on technology innovation fostering centres. Outcomes of our empirical analysis by employing previously unexploited data disclose the status of highly concentrated of U.S. technology innovation fostering centres.

Empirical analysis of top Assignee states uncovers that the majority of academic patents have been licensed to just a few U.S. states. There are only 7 Assignee states each getting more than 100 academic patent licenses (**Figure 1**).

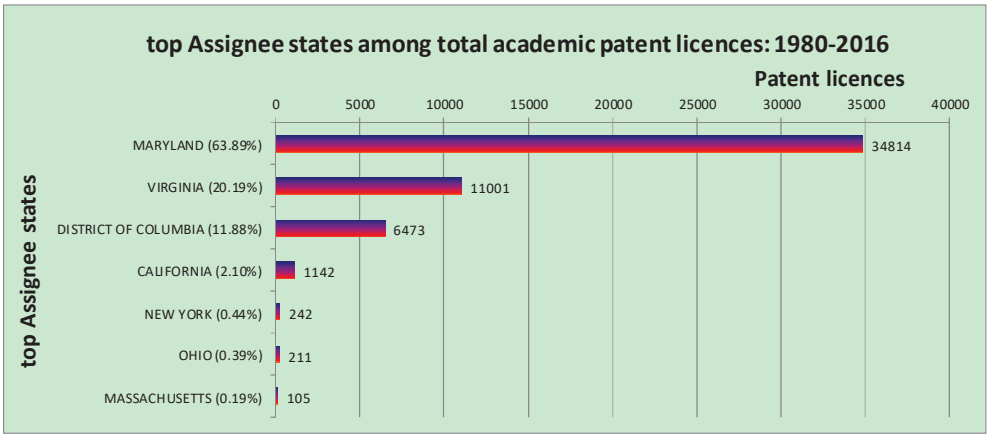

Figure 1. Top Assignee states among total academic patent licences: 1980-2016

Note: *District of Columbia, i.e., Washington District of Columbia, Washington, D.C., or WDC, the Capital of U.S., data of patent licenses is statistically paralleled with U.S. states.*

Figure 1 shows that the state of *Maryland* get the biggest number of academic patent licenses up to 34, 814, accounting for 63.89%; *Virginia* ranks 2nd with 20.19% proportion; *District of Columbia* ranks 3rd with rate of 11.88%. Other top Assignee states with more than 100 patent licenses are *California* with 2.10%, *New York* with 0.44%, *Ohio* with 0.39% and *Massachusetts* with 0.19%, respectively.

The leading fosterers/top Assignees in the leading U.S. states

The leading fosterers in Maryland

The state of *Maryland* is well known as the hometown of high-tech. Maryland gets the biggest number of academic patent licenses during the execution years of 1980-2016, up to 34, 814, accounting for 63.89% of total, being far ahead of other states. Top Assignees in Maryland, that is, academia technology innovation fosterers

in Maryland, have been shown in **Figure 2**.

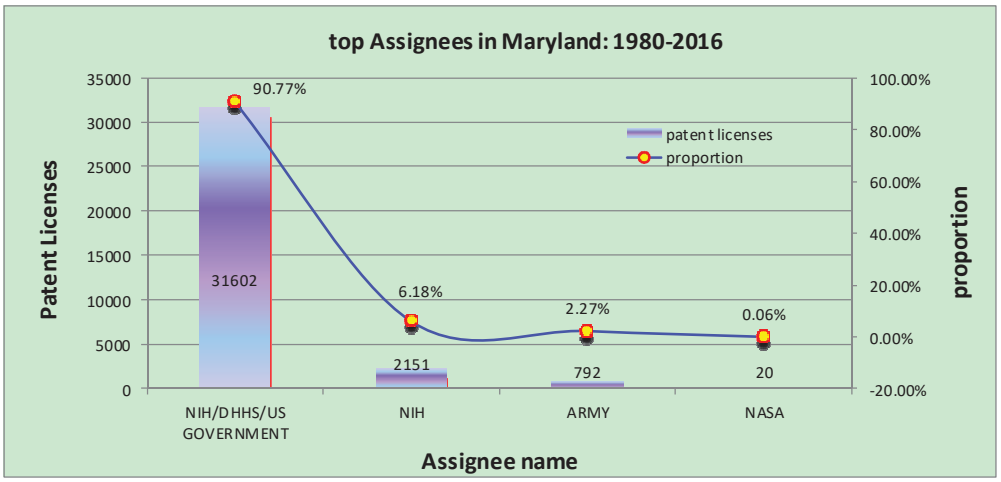

Figure 2. Top Assignees/the leading fosterers in Maryland: 1980-2016

As a whole Assignee of *NIH/DHHS/US GOV.*, abbr. of *National Institutes of Health (NIH)/ U.S. Dept. of Health and Human Services (DHHS)/ U.S. Government*, gets the majority of academic patent licenses up to 31, 602, accounting for 90.77% of total licenses transferred to Maryland, being far ahead of other top Assignees. The total proportion of other Assignees in Maryland is less than 10% and the comparative top ones are as follows: *NIH* (6.18%), *U.S. Army* (2.27%), *NASA* (0.06%), respectively.

The leading fosterers in Virginia

Virginia receives the second biggest number of academic patent licenses, 11001 items, during 1980-2016, accounting for 20.19% of all. Top Assignees in Virginia, that is, leading fosterers in Virginia, have been drawn in **Figure 3**.

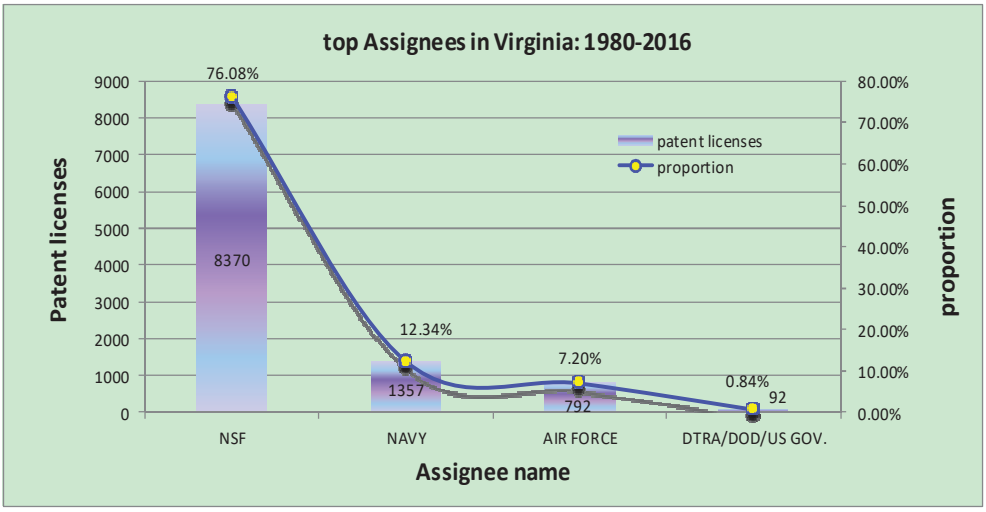

Figure 3. Top Assignees/the leading fosterers, in Virginia: 1980-2016

Figure 3 discloses that *NSF* takes the first place with 8370 academic patent licenses, accounting for 76.08% of total academic patent licenses transferred to Virginia, the most leading fosterers in this state. *U.S. Navy* takes the second place with more than 1000 academic patent licenses, accounting for more than 10% of total academic patent licenses transferred to Virginia. The innovation of *U.S. Navy* is closely related to the location of the world's largest Naval Station Norfolk in Virginia. The proportion of *U.S. Air Force* is listed at the third place.

The leading fosterers in District of Columbia

District of Columbia, i.e., Washington District of Columbia, Washington, D.C., or WDC, the Capital of U.S., data of patent licenses is statistically paralleled with U.S. states. *WDC*, together with America's fifty states composes the United States of America. WDC, as the U.S. political centre, the majority of Federal Government Agencies and foreign embassies are gathering here. WDC gets the third biggest number of academic patent licenses, 6473 items, during 1980-2016, accounting for 11.88% of total. Top Assignees in WDC, that is, leading fosterers in WDC, have been drawn in **Figure 4**.

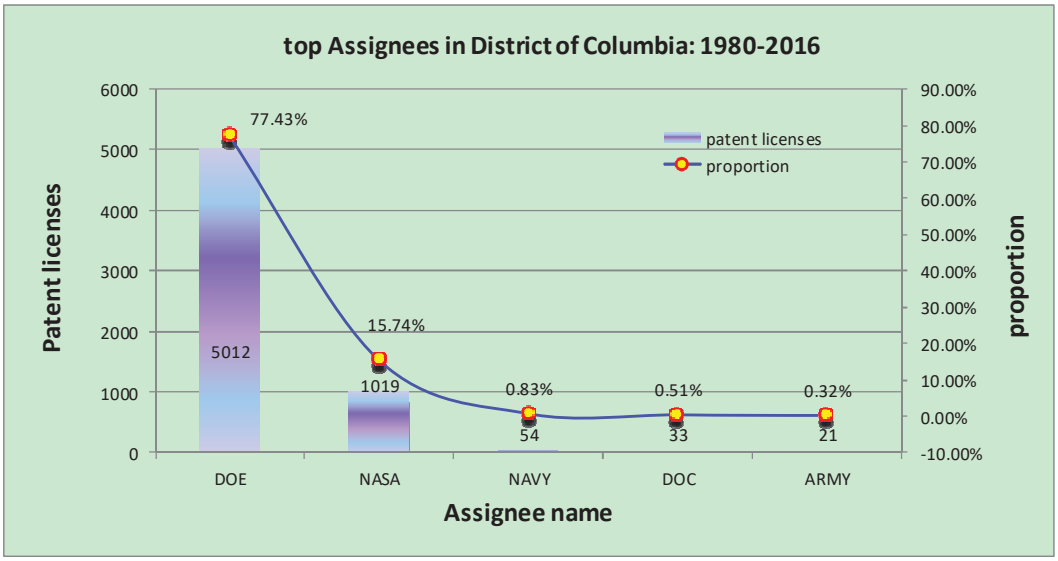

Figure 4. Top Assignees/the leading fosterers, in District of Columbia: 1980-2016

DOE, U.S. Department of Energy, with the mission to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions, takes the first place with 5012 academic patent licenses, accounting for 77.43% of total academic patent licenses transferred to *WDC*, the most leading innovation fosterer in this area, being far ahead of other fosterers. *NASA* takes the second place with more than 1000 academic patent licenses, accounting for 15.74% of total academic patent licenses transferred to *WDC*.

The leading fosterers in California

California is one of the largest users of energy for it is the most populous U.S. state, and there are a few national laboratories of *DOE* locate in California, such as *Lawrence Berkeley National Laboratory at Berkeley*, California (founded in 1931); *Sandia National Laboratories at Livermore*, California (founded in 1948); *Lawrence Livermore National Laboratory at Livermore*, California (founded in 1952); *SLAC National Accelerator Laboratory at Menlo Park*, California (founded in 1962); et al. which play a significant role in fostering innovation from academic inventions,

especially in the area of energy.

California ranks the fourth of academic patent licenses, total 1142 items, during 1980-2016, accounting for 2.10% of all. Top Assignees/the leading fosterers in California have been shown in **Figure 5**.

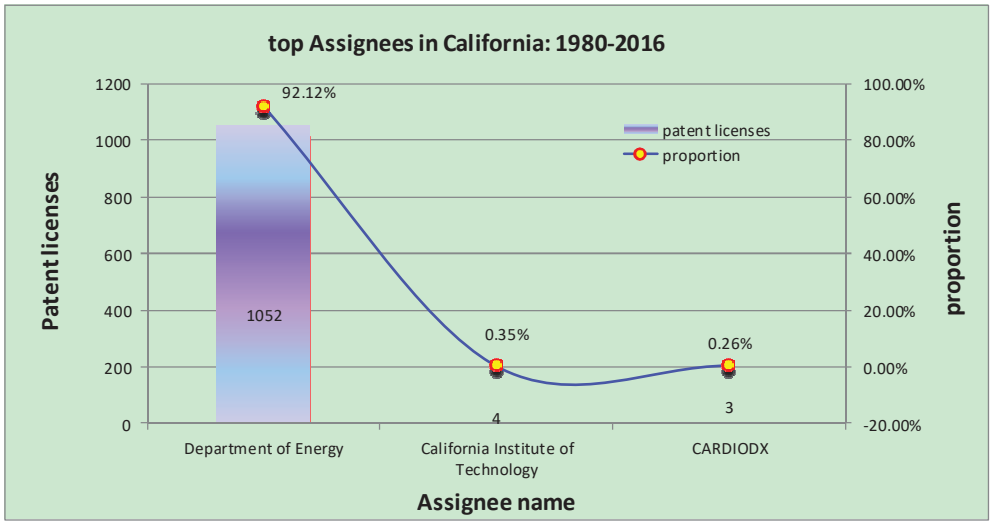

Figure 5. Top Assignees/the leading fosterers in California: 1980-2016

DOE takes the first place receiving 1052 academic patent licenses, accounting for 92.12% of total academic patent licenses transferred to *California*, the most leading fosterer in this state, being far ahead of other fosterers.

Discussions

Traditionally, industries are widely recognized that they take responsibilities for industrialization from academic inventions and further to commercialization (Lee and Gaertner 1994). However, our empirical analysis of top Assignees in top Assignee states in terms of U.S. academic patent licenses, by employing previously unexploited data disclose that it is U.S. government agencies who are the leading fosterers in fostering innovation from academic inventions. The findings of this study disclose that U.S. government has played a significant role in fostering technology innovation

from academic patents instead of industries. Such results let us reflect on the government role in Triple Helix innovation system. The concept of the Triple Helix of university-industry-government relationships initiated by Etzkowitz (Etzkowitz 1996) and Etzkowitz and Leydesdorff (Etzkowitz and Leydesdorff 2000), interprets the shift from a dominating industry-government dyad in the Industrial Society to a growing triadic relationship between university-industry-government, UIG model, in the Knowledge Society (Stanford 2017).

Why the U.S. government is the academic technology fosterer rather than the industry? On one hand, it is generally acknowledged that universities are creators of new knowledge in history which have brought the revolutionary breakthroughs for human society and technology development(Guerzoni, Aldridge et al. 2014, McGrath 2015). On the other hand, general knowledge resulted by basic scientific research provides the means of answering a large number of important practical problems, though it may not give a complete specific answer to any one of them (Bush 1945). Based on such situations, the industry tends to be lack of motivations in fostering the emerging and strategic technologies coming from universities for the uncertainties and risks(Tsai, Lin et al. 2009, Tang, Murphree et al. 2016), whereas U.S. government has recognized the significance for supporting academic research from 1945 when the Second World War ended, or even earlier (Bush 1945, Hong, Lippman et al. 1995, Aizenman and Noy 2007), and further has promoted academic technology fostering via the implementations of a series of related policies (Negoita 2014, Liu and Guan 2016, Zehavi and Breznitz 2017), such as *Bayh-Dole Act of 1980, Stevenson-Wydler Technology Innovation Act of 1980, Small Business Technology Transfer Act, STTR* of 1992, *The America COMPETES Act of 2007*, et al.

What measures U.S. government have taken for boosting innovation? U.S. government takes a positive attitude and a series of steps in fostering academic inventions. Government selects and hatches cutting-edge technologies from universities; simultaneously, government adopts steps deregulating industries,

encouraging emerging industries development, affording education and training for the structural unemployment, offering subsidies for sunset or uncompetitive industries, et al., for the groups losing interest due to technological change to insure the transform implemented (Miyazaki and Islam 2007, Reich 2009); government also implements public procurement and related financial policies in boosting technology innovation from academic patents. United States is acknowledged as the first and the most successful country adopting public procurement promoting innovation and emerging industries development (Aschhoff and Sofka 2009, Uyarra, Edler et al. 2014, Hellsmark and Soderholm 2017). The implementation of U.S. relevant financial policies have played a crucial role in facilitating and supporting emerging industries development in the fields of high technologies around 1970s.

U.S. government role in fostering technology innovation from academic inventions has significant policy implications and referential values to Chinese government in the process of construction of innovative country (Liu and Chen 2012, McMahon and Thorsteinsdottir 2013). A key problem for Chinese government to solve is the considerable low rate of university technology transfer (Zhang and Gallagher 2016, Zhang, Duan et al. 2016). A few related laws and regulations for promoting academic inventions transfer have been introduced in China recent year, even including a *Bayh-Dole-like law* named *the Revised Science and Technology Progress Law* implemented in 2008. However, Chinese legal system construction pertinent to university technology transfer seems playing a weak role in boosting academic technology innovation.

It is essential for Chinese government to foster academic inventions running ahead of industries. Industries tend to take a wait-and-see attitude to emerging technologies, especially academic inventions, due to the risks and uncertainties in the process of technology innovation. Government's involvement into fostering innovation includes the following steps: select emerging, cutting-edge technologies, especially from academic patents, which will play crucial roles in the future industry and society;

foster such potential technologies and promote them into industrialization and commercialization; further globalization. A number of high-tech industrializations promoted by U.S. government in advance since 1990s, have developed into mainstay industries of national economy afterwards (Doutriaux 1992, Etzkowitz 1997, Merchant 1997, Pisano and Shih 2009), further bloomed into high-end industries in 2000s.

Another effective measure Chinese government should take is public procurement in boosting innovation. Government procurement can reduce market uncertainty and risk (Keller 2011, Arve and Martimort 2016, De Clerck and Demeulemeester 2016), strengthen industries' confidence adapting new technologies and products. United States is acknowledged as the most successful country applying government procurement promoting innovation in the world (Aschhoff and Sofka 2009, Uyarra, Edler et al. 2014, Hellsmark and Soderholm 2017).

Acknowledgments

This work was supported by the National Natural Science Foundation of China (NSFC) under Grant 71774020 & 71473028; Fundamental research funds for the central universities under Grant No. DUT17RW224.

References

Aizenman, J. and I. Noy (2007). Prizes for basic research: Human capital, economic might and the shadow of history. Journal of Economic Growth 12(3): 261-282.

Arve, M. and D. Martimort (2016). Dynamic Procurement under Uncertainty: Optimal Design and Implications for Incomplete Contracts. American Economic Review 106(11): 3238-3274.

Aschhoff, B. and W. Sofka (2009). Innovation on demand-Can public procurement drive market success of innovations? Research Policy 38(8): 1235-1247.

Bush, V. (1945). Science. The endless frontier. A report to the president. Washington, DC: United States Government Printing Office.

De Clerck, D. and E. Demeulemeester (2016). Creating a More Competitive PPP Procurement Market: Game Theoretical Analysis. Journal of Management in Engineering 32(6).

Dorner, M., H. Fryges and K. Schopen (2017). Wages in high-tech start-ups - Do academic spin-offs pay a wage premium? Research Policy 46(1): 1-18.

Doutriaux, J. (1992). EMERGING HIGH-TECH FIRMS - HOW DURABLE ARE THEIR COMPARATIVE START-UP ADVANTAGES. Journal of Business Venturing 7(4): 303-322.

Etzkowitz, H. (1996). The triple helix: Academic-industry-government relations - Implications for the New York regional innovation environment. Technology Link to Economic Development: Past Lessons and Future Imperatives. S. U. Raymond. New York, New York Acad Sciences. 787: 67-86.

Etzkowitz, H. (1997). From zero-sum to value-added strategies: The emergence of knowledge-based industrial policy in the states of the United States. Policy Studies Journal 25(3): 412-424.

Etzkowitz, H. and L. Leydesdorff (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations. Research Policy 29(2): 109-123.

Fleming, L. and K. Frenken (2007). The evolution of inventor networks in the silicon valley and Boston regions. Advances in Complex Systems 10(1): 53-71.

Guerzoni, M., T. T. Aldridge, D. B. Audretsch and S. Desai (2014). A new industry creation and originality: Insight from the funding sources of university patents. Research Policy 43(10): 1697-1706.

Hellsmark, H. and P. Soderholm (2017). Innovation policies for advanced biorefinery development: key considerations and lessons from Sweden. Biofuels Bioproducts & Biorefining-Biofpr 11(1): 28-40.

Henton, D. and K. Held (2013). The dynamics of Silicon Valley: Creative destruction and the evolution of the innovation habitat. Social Science Information Sur Les Sciences Sociales 52(4): 539-557.

Hong, W. K., S. M. Lippman, W. N. Hittelman and R. Lotan (1995). Retinoid chemoprevention of aerodigestive cancer: From basic research to the clinic. Clinical Cancer Research 1(7): 677-686.

Keller, L. R. (2011). Multiattribute and Intertemporal Preferences, Probability, and Stochastic Processes: Models and Assessment. Decision Analysis 8(3): 165-169.

Lee, Y. and R. Gaertner (1994). TECHNOLOGY-TRANSFER FROM UNIVERSITY TO INDUSTRY - A LARGE-SCALE EXPERIMENT WITH TECHNOLOGY DEVELOPMENT AND COMMERCIALIZATION. Policy Studies Journal 22(2): 384-399.

Liu, M. C. and S. H. Chen (2012). MNCs' offshore R&D networks in host country's regional innovation system: The case of Taiwan-based firms in China. Research Policy 41(6): 1107-1120.

Liu, N. and J. C. Guan (2016). Policy and innovation: Nanoenergy technology in the USA and China. Energy Policy 91: 220-232.

McGrath, R. G. (2015). The Academic Entrepreneur: A Biographical Sketch of Ian C. MacMillan's Contributions to Establishing the Field of Entrepreneurship. Strategic Entrepreneurship Journal 9(2): 188-204.

McMahon, D. and H. Thorsteinsdottir (2013). Pursuing endogenous high-tech innovation in developing countries: A look at regenerative medicine innovation in Brazil, China and

India. Research Policy 42(4): 965-974.

Merchant, J. E. (1997). The role of governments in a market economy: Future strategies for the high-tech industry in America. International Journal of Production Economics 52(1-2): 117-131.

Miyazaki, K. and N. Islam (2007). Nanotechnology systems of innovation - An analysis of industry and academia research activities. Technovation 27(11): 661-675.

Negoita, M. (2014). Globalization, state, and innovation: An appraisal of networked industrial policy. Regulation & Governance 8(3): 371-393.

Pisano, G. P. and W. C. Shih (2009). Restoring American Competitiveness. Harvard Business Review 87(7-8): 114-+.

Reich, R. B. (2009). Government in Your Business. Harvard Business Review 87(7-8): 94-+.

Snow, N. (2017). Fostering innovation seen as better R&D tool than mandates, funding. Oil & Gas Journal 115(4A): 23-24.

Staff Writers (2017). 100 Important Innovations That Came From University Research. http://www.onlineuniversities.com/blog/2012/08/100-important-innovations-that-came-from-university-research/.

Stanford. (2017). The Triple Helix concept. from http://triplehelix.stanford.edu/3helix_concept.

Tang, L., M. Murphree and D. Breznitz (2016). Structured uncertainty: a pilot study on innovation in China's mobile phone handset industry. Journal of Technology Transfer 41(5): 1168-1194.

Tsai, Y. Y., J. Y. Lin and L. Kurekova (2009). Innovative R&D and optimal investment under uncertainty in high-tech industries: An implication for emerging economies. Research Policy 38(8): 1388-1395.

Uyarra, E., J. Edler, J. Garcia-Estevez, L. Georghiou and J. Yeow (2014). Barriers to innovation through public procurement: A supplier perspective. Technovation 34(10): 631-645.

Zehavi, A. and D. Breznitz (2017). Distribution sensitive innovation policies: Conceptualization and empirical examples. Research Policy 46(1): 327-336.

Zhang, F. and K. S. Gallagher (2016). Innovation and technology transfer through global value chains: Evidence from China's PV industry. Energy Policy 94: 191-203.

Zhang, G. P., H. B. Duan and J. H. Zhou (2016). Investigating determinants of inter-regional technology transfer in China: a network analysis with provincial patent data. Review of Managerial Science 10(2): 345-364.