University-Industry Technology Transfer and Innovation Activity in Mexico

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1. Objective

This paper analyzes the process of university-industry technology transfer (UITT) and innovation activity among universities in Mexico. The objective of this paper is twofold. First, it presents the main results from the *University-Industry Technology Transfer Activity survey in Mexico* (UITTAM) (UITTAM, 2018). Second, it investigates the process of UITT activity in Mexico, applying the Qualitative Comparative Analysis (QCA) methods developed by C.C. Ragin (1987, 2000, 2006, 2008). In so doing, the QCA model computed in this research makes use of data released from the UITTAM.

1.1. The UITTAM survey

In North America, UITT has been a pivotal engine to promote regional development (Rodríguez, 2010; Trosow et al., 2012). For example, in this region, data on technology transfer

activity has been released from several sources, such as the AUTM Licensing Survey and the AUTM Salary Survey. In this regard, the UITTAM survey conducted among thirty Technology Transfer Offices (TTOs) in Mexico aims to get insight into the process of UITT in this country. The UITTAM survey inquired into eight main topics: R&D Investment and Financing, Human Resources for R&D Activities, Policy for Technology and Knowledge Transfer, Management of Resources for Technology Transfer Activities, R&D Results, Technology Transfer Activities, Creation of Spin-offs, and Technology Transfer Offices. Besides, this survey was conducted in twelve Mexican states, namely Baja California, Chihuahua, Guanajuato, Jalisco, Mexico City, Morelos, Nuevo León, Puebla, Querétaro, Sonora, Veracruz, and Yucatán.

1.2. Results from the UITTAM survey

The main results from the UITTAM survey are summarized as follows:

1. Since the process of UITT and innovation activity at Mexican universities is still in its rising phase, this phenomenon imposes a significant challenge on the agenda of universities, as well as on the agendas of federal and provincial governments in this country;
2. In the case of Mexico, the UITTAM Survey demonstrated that the process of UITT is quite different since many universities in this country do not have implemented adequate policies to support the process of technology and knowledge transfer from universities to firms;
3. TTOs in Mexico are characterized not to be homogenous in terms of structure, organization, and size, resulting in quite different outcomes when transferring technology and new knowledge from universities to industry;
4. In many cases, a TTO serves only one university. Actually, it is common to find that universities rule their TTO;

5. There is a great interest among universities and higher education institutions for the creation of spin-offs;
6. Patents are the most common form of intellectual property used to protect technology developments (inventions) among Mexican universities;
7. Patents are often registered only at the Mexican office for intellectual property (*Instituto Mexicano de la Propiedad Industrial, IMPI*).

2. A fsQCA model on UITT in Mexico

2.1. The QCA methodology

A fuzzy-set Qualitative Comparative Analysis (fsQCA) model was computed to get insight into the process of UITT and innovation activity in Mexico (Berger, 2016; Ragin, 2008). In this regard, the model uses data released from the UITTAM survey and conducted across Mexican universities during 2017-2018.

From a general perspective, the QCA approach aims to reveal the complex causality between variables (Ragin, 2008). Following Manzo and Rodríguez (2020), it is possible to summarize QCA methods as follows:

1. QCA is a method founded on the binary logic of Boolean algebra, where each case is represented as a combination of causal and outcome conditions (Poveda and Pardo, 2013).
2. QCA methods assume that cases can be denoted by formal logical statements in which the conditions for each case are seen as logical, implying the score on the outcome for that case (Ragin, 1987, 2000).

3. The combinations of variables can be compared to each other and then logically simplified through a process of paired comparison (Ragin, 1987).
4. QCA provides powerful tools for analyzing causal complexity and testing whether all conditions are necessary and sufficient for an outcome to occur (Ragin, 2008; Rihoux and Ragin, 2009).
5. Accordingly, QCA makes it possible to evaluate causation complexity, involving different combinations of causal conditions capable of generating the same outcome (Ragin, 2008).
6. QCA methods allow developing fuzzy set relations (Seny et al., 2015).
7. The fsQCA approach is one of the main three variants of the QCA methods that develops causal claims through supersets and subsets (Ragin, 2008).

Therefore, fsQCA is a data analysis technique where each case is represented as a combination of causal and outcome conditions (Ragin, 2000, 2006, 2008). From a general perspective, the are some steps that must be followed when computing fsQCA models. First, fsQCA models must specify the significant causal conditions for the outcome variable. Second, calibration of the causal conditions is a necessary procedure that consists of noting cases with set membership values, 1.0 (full membership), 0.5 (cross over point), and 0 (full non-membership) (Schneider and Wagemann, 2012). Third, the next step is to build a truth table with data for selected cases regarding the causal conditions and the outcome variable. The truth table solution is called the causal sufficiency analysis, and it shows a list of different combinations of causal conditions that have met the specified criteria of sufficiency for the outcome to occur (Cotte and Pardo, 2013). Fourth, the final step is to obtain the complex solution, the parsimonious solution, and the intermediate solution to evaluate the results. However, the intermediate solution is the most interpretable (Ragin, 2006, 2008).

2.2. Results from the fsQCA model

Given the research question addressed in this study, fsQCA is especially helpful to recognize the necessary and sufficient conditions that lead TTOs to better-performing technology transfer activities at universities in Mexico. In this regard, results from this model reveal the necessary and sufficiency conditions (set-theoretic relations) that might be observed among variables to acquire a high-performance level concerning technology transfer and innovation activity at Mexican universities. These results also suggest the need to have adequate technology and innovation policies to support UITT and innovation developments at Mexican universities.

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