UNIVERSIDAD DE CANTABRIA

FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES

DEPARTAMENTO DE ADMINISTRACIÓN DE EMPRESAS

PROGRAMA DE DOCTORADO: NEGOCIOS Y GESTION DE LA ACTIVIDAD EMPRESARIAL CON APLICACIÓN A PYMES, EMPRENDIMIENTO Y EMPRESA FAMILIAR

TESIS DOCTORAL

"EL PAPEL DE LAS INSTITUCIONES DE EDUCACIÓN SUPERIOR MEXICANAS COMO IMPULSORAS DE LA ACTIVIDAD INNOVADORA Y EMPRENDEDORA"

Presentada por:

Fernando Herrera Pons

Dirigida por:

Prof. Dra. Maribel Guerrero

Santander, Abril 2017

UNIVERSIDAD DE CANTABRIA

FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES

DEPARTAMENTO DE ADMINISTRACIÓN DE EMPRESAS

PROGRAMA DE DOCTORADO: NEGOCIOS Y GESTION DE LA ACTIVIDAD EMPRESARIAL CON APLICACIÓN A PYMES, EMPRENDIMIENTO Y EMPRESA FAMILIAR

DOCTORAL DISSERTATION

"THE ROLE OF MEXICAN HIGHER EDUCATION INSTITUTIONS AS DRIVERS OF INNOVATION AND ENTREPRENEURSHIP ACTIVITY"

PHD Candidate:

Fernando Herrera Pons

Thesis Director:

Prof. Dra. Maribel Guerrero

Santander, April 2017

AGRADECIMIENTOS

En esta sección, quisiera reconocer y agradecer a todas las organizaciones, empresas y personas que colaboraron en la realización de esta investigación.

En primer lugar, mi profunda admiración y agradecimiento para todos los profesores de la Universidad de Cantabria que han participado en el programa de doctorado. Por su apoyo, dedicación y conocimiento, muchas gracia. Agradezco de manera particular al Dr. Ladislao Luna Sotorrio, Dr. Francisco Somohano Rodríguez, Dra. María del Mar García de los Salmones, Dra. Andrea Pérez Ruíz, Dr. Ángel Herrero Crespo, Dr. Héctor San Martín Gutiérrez, Dra. Ana María Serrano Bedia y Dra. María Concepción López Fernández. También deseo brindar un reconocimiento muy especial al Dr. Francisco Javier Martínez García, Hugo Alfredo Vázquez López, y cada uno de los colaboradores de la Universidad de Cantabria por el invaluable apoyo brindado durante el período como doctorando. Además, agradezco a los profesores de otras universidades españolas que participaron en este programa, de manera particular al Dr. Ricardo Hernández Mogollón, Dra. Ana María Bojica, Dra. María del Mar Fuentes Fuentes, Dra. Virgina Fernández Pérez, Dra. Paloma Gallurt Plá, y Dr. Lázaro Rodríguez Ariza.

En segundo lugar, gracias al Tecnológico de Monterrey (ITESM) por su apoyo a través de la beca para el doctorado, tiempo y recursos, que me brindó la oportunidad de llevar a cabo este proyecto de desarrollo. Especialmente, agradezco el brindado por el Dr. Isaac Lucatero Castañeda, Dr. Juan Manuel López Ramírez, y Mtra. Lucila del Pilar Muñoz Tejeda, y el recibido por cualquier otro compañero del Campus León, que hicieron posible mi participación en este Programa de Doctorado. Un agradecimiento especial a la Dra. Elvira

Naranjo Priego y a todo el equipo del GEM México por su valiosa colaboración y contribución a esta disertación.

Reconozco el apoyo financiero complementario del programa Santander Universidades que posibilitó la realización de este trabajo de investigación dentro de las instalaciones de INEGI en la Ciudad de México.

También reconozco el apoyo recibido por el Instituto Nacional de Estadística y Geografía (INEGI) para acceder a las bases de datos en sus instalaciones del Laboratorio de Microdatos en la Ciudad de México y en sus oficinas de Aguascalientes. En particular, quisiera agradecer al personal del Laboratorio de Microdatos, Liliana Martínez Matías, María del Carmen Márquez Morán y Dra. Natalia Volkow Fernández. Adicionalmente, en las oficinas de Aguascalientes a Gerardo López Sánchez, Gerardo Alfonso Durand Alcántara y Adolfo Pons Garza.

Un importante aportante para mi trabajo fue el Consejo Nacional de Ciencia y Tecnología (CONACYT), a través de la Unidad de Desarrollo Tecnológico e Innovación, la de Desarrollo Científico y la de Asuntos Jurídicos. Agradezco especialmente el apoyo de Luis Gabriel Torreblanca Rivera, Alejandro Carlos Farias Zuñiga, Eugenio Augusto Cetina Vadillo, Miguel Gómez Bravo y David Mejía Gómez. En Guanajuato, es mi deseo brindar un reconocimiento al Consejo Estatal de Ciencia y Tecnología del Estado de Guanajuato (CONCYTEG), en especial al Dr. Antonio Vega Corona. Además, reconozco un importante aporte de información a la Secretaría de Desarrollo Económico Sustentable y a su red Novaera (Guillermo Romero Pacheco y Omar Silva Palancares).

Un reconocimiento muy especial va para cada una de las empresas que participaron en este estudio, cuya información ha sido muy útil para entender las colaboraciones entre empresas y universidades, y los procesos de innovación y emprendimiento.

También agradezco a Deusto Business School y a Orkestra-Instituto Vasco de Competitividad por el apoyo brindado durante mis períodos de estancia. Un reconocimiento especial al Dr. David Urbano por sus observaciones y enriquecimiento de mi tesis.

Mi mayor admiración, respeto y agradecimiento a la Dra. Maribel Guerrero, mi directora de tesis, por su tiempo, conocimiento y sobre todo por mantener el interés en el trabajo y lograr un resultado de gran interés para la comunidad universitaria y los generadores de políticas.

Finalmente, mi mayor reconocimiento es para mi familia, Adriana y Adrianita. Por darme apoyo en tiempos difíciles, por acompañarme y motivarme. Adriana, gracias por tu inestimable ayuda, confianza y amor. Adrianita, gracias por tu amor y comprensión.

ACKNOWLEDGEMENTS

In this section, I would like to recognize and acknowledge all of the organizations, companies and people that collaborated to carry out this research.

First, my deep admiration and appreciation goes out to all of the professors who have participated in the PhD program. For your support, dedication and knowledge thank you very much PhD Ladislao Luna Sotorrio, PhD Francisco Somohano Rodríguez, PhD María del Mar García de los Salmones, PhD Andrea Pérez Ruíz, PhD Ángel Herrero Crespo, PhD Héctor San Martín Gutiérrez, PhD Ana María Serrano Bedia and PhD María Concepción López Fernández. I also give an special acknowledge to PhD Francisco Javier Martínez García, Hugo Alfredo Vázquez López, any Cantabria University collaborators for the invaluable support provided during the PHD period. In addition, my acknowledgements for professors of other universities participating in this program: PhD Ricardo Hernández Mogollón, PhD Ana María Bojica, PhD María del Mar Fuentes Fuentes, PhD Virgina Fernández Pérez, PhD Paloma Gallurt Plá, PhD Lázaro Rodríguez Ariza.

Secondly, thanks to Tecnológico de Monterrey (ITESM) for its support with the PhD scholarship, time and resources, which gave me the opportunity to accomplish this development project. In particular, I appreciate PhD Isaac Lucatero Castañeda, PhD Juan Manuel López Ramírez, MBA Lucila del Pilar Muñoz Tejeda and other Leon Campus partners who made possible my participation in this PhD program. A special acknowledgement goes to PhD Elvira Naranjo and the entire team of GEM Mexico for their valuable collaboration and contributions to this dissertation.

I acknowledge the complimentary financial support from Santander Universidades (Iberoamerica Scholarship for Young Researchers), which made it possible to carry out this research work inside the INEGI facilities in Mexico City.

I also acknowledge the support received from the Mexican National Institute of Statistics and Geography (INEGI) to access the databases in its Microdata Lab facilities in Mexico City and from the Aguascalientes office. In particular, I would like to thank Microdata Lab personnel Liliana Martínez Matias, María del Carmen Márquez Morán and Natalia Volkow Fernández, as well as Aguascalientes office members Gerardo López Sánchez, Gerardo Alfonso Durand Alcantara and Adolfo Pons Garza.

An important contributor to my work was the National Council for Science and Technology (CONACYT), through the Technological Development and Innovations, Scientific Development, and Legal Affairs Unit. I would especially like to acknowledge the support of Luis Gabriel Torreblanca Rivera, Alejandro Carlos Farias Zuñiga, Eugenio Augusto Cetina Vadillo, Miguel Gómez Bravo and David Mejía Gómez. In Guanajuato, I would like to thank Antonio Vega Corona, Guanajuato State Council for Science and Technology (CONCYTEG). In addition, I recognize the important support of the Ministry of Sustainable Economic Development and its Novaera network (in particular, Guillermo Romero Pacheco and Omar Silva Palancares).

A very special acknowledgement goes to each of the enterprises that participated in this study. This information has been very useful to understand enterprise-university partnerships and innovation/entrepreneurial processes.

I also acknowledge the Deusto Business School, the Orkestra Basque Institute of Competitiveness and Cantabria University for their support during my visiting periods. A special acknowledgement goes out to Professor David Urbano for his observations and enrichment of my thesis.

My greatest admiration, respect and thanks to Professor Maribel Guerrero, my thesis director, for her time, knowledge and especially for maintaining interest in the work and achieving a result of high interest to the university community and policy makers.

Finally, the greatest recognition goes to my family, Adriana and Adrianita, for supporting me in difficult times and for accompanying me and motivating me. Adriana, thank you for your invaluable help, trust and love. Adrianita, thanks for your love and understanding.

RESUMEN

Estudios previos en el área han aportado diversas visiones sobre los factores determinantes internos y externos, así como, sobre los impactos asociados a la evolución de las universidades emprendedoras en economías desarrolladas (Estados Unidos, Alemania, Italia, Reino Unido entre otros). Según esta perspectiva, la universidad desempeña un papel relevante en la generación de capital humano (graduados, egresados), capital de conocimiento (explotación, exploración, transferencia y comercialización), y capital emprendedor (egresados emprendedores, intra-emprendedores y emprendedores académicos). Sin embargo, la investigación sobre el papel de las universidades en economías emergentes y en economías en desarrollo es limitada. Esta es una relevante oportunidad de investigación en contextos en los que las universidades han sido el medio de ejecución de programas gubernamentales orientados al fomento de la innovación y/o del emprendimiento como parte de una estrategia nacional de desarrollo. Otra área de oportunidad observada en la revisión de la literatura ha sido la idea de que los ecosistemas de emprendimiento y los sistemas de innovación actúan completamente separados. Curiosamente, si se adopta una perspectiva Triple o Cuádruple Hélice, ambos ecosistemas tienen relevantes similitudes y comparten los mismos agentes como son el gobierno, la universidad y la industria. En este supuesto, las universidades podrían considerarse el puente entre ambos ecosistemas que facilitaría el desarrollo de actividades emprendedoras e innovadoras.

A partir de dichos argumentos, el principal objetivo de esta investigación es proporcionar una mejor comprensión sobre el papel de las universidades como impulsoras del desarrollo de actividades de innovación y emprendimiento en las economías emergentes.

A partir de la revisión de literatura, esta tesis adoptó diversas bases teóricas (Sistemas Nacionales de Innovación, ecosistemas de emprendimiento, triple hélice, innovación abierta, asociaciones entre empresas y universidades, subsidios de I+D, emprendedores tecnológicos, emprendimiento naciente, universidades emprendedoras), así como, diversas aproximaciones metodológicas (Métodos mixtos: cualitativos y cuantitativos). Dada la naturaleza de este fenómeno, esta tesis se concentra en el análisis del contexto mexicano al tratarse de una economía emergente que, durante las últimas tres administraciones gubernamentales, ha tratado de pasar de una economía de eficiencia a una economía basada en la innovación; en una consecuencia, dichas administraciones han implementado diferentes estrategias encaminadas a reforzar la innovación y el emprendimiento.

Alineados con cada objetivo específico, los resultados muestran cuatro patrones interesantes. En *primer lugar*, las organizaciones mexicanas de educación superior en los ecosistemas de innovación y emprendimiento reflejan una baja participación y poco uso de sus recursos/capacidades para transformarse en organizaciones más innovadoras y emprendedoras. En *segundo lugar*, el papel de las universidades mexicanas en las actividades de innovación fue evidenciado en el análisis de las relaciones universidad-empresa a través del desarrollo de innovaciones radicales/incrementales, así como, en el acceso a programas de subsidios de I+D. En *tercer lugar*, el análisis del papel de las universidades en las actividades de emprendimiento evidenció una interesante tendencia en los emprendedores nacientes basados en la tecnología (con y sin educación superior) y en las condiciones del entorno asociadas a la innovación y a los ecosistemas de emprendimiento. Además, del efecto moderador que tiene la educación superior en el fuerte refuerzo de la relación entre el ecosistema y los aspectos organizacionales al

tratarse de emprendedores nacientes basados en tecnología. En *cuarto lugar*, el estudio de casos múltiples proporcionó información sobre la influencia de las universidades en los resultados de la innovación de las empresas; específicamente, el comportamiento oportunista/colaboración que hay detrás de las vinculaciones obligatorias mexicanas de empresas-universidades para poder acceder a los subsidios para I+D.

Este trabajo tiene varias limitaciones y varias preguntas que aún no tienen respuesta o no pudieron ser exploradas y que son directrices interesantes para futuras investigaciones orientadas a ampliar los enfoques teóricos/metodológicos. De esta investigación también emergen varias implicaciones para los responsables de la formulación de políticas públicas, para los directores de las universidades, y para los directores de empresas.

Palabras clave: Emprendimiento; Innovación; Organizaciones de Educación Superior; Universidades Emprendedoras; Economías Emergentes.

ABSTRACT

Previous studies in the field have provided insight into internal and external determinants as well as the impact associated with the entrepreneurial evolution of universities in developed economies (United States, Germany, Italy, and the United Kingdom, among others). Within this perspective, universities play a relevant role in the generation of human capital (graduates, alumni), knowledge capital (exploitation, exploration, transfer and commercialization) and entrepreneurship capital (graduates, entrepreneurs, intrapreneurs and academic entrepreneurs). However, research about the role of universities in developing and emerging economies is limited. It is a relevant research gap in the context in which universities are associated with government programs to foster innovation and/or entrepreneurship as part of a national development strategy. Another relevant gap observed in the literature review is the notion that entrepreneurship ecosystems and innovation systems are completely distinct and separate. Interestingly, if a triple- or quadruple-helix perspective is adopted, both systems have strong similitudes and share the same agents, such as government, university and industry. Under this assumption, universities could be considered a bridge between both systems, which could then contribute to the development of entrepreneurial and innovation activities.

Based on these arguments, the main purpose of this research is to provide a better understanding of the role of universities as drivers of innovation and entrepreneurship activities in emerging economies. Based on previous studies, this thesis adopted theoretical bases from several research lines (National Innovation Systems, entrepreneurial ecosystems, triple-helix, open innovation, enterprise-university partnerships, R&D subsidies, technology-based entrepreneurs, nascent entrepreneurship and entrepreneurial

universities) and methodological approaches (mixed methods: qualitative and quantitative). Given the nature of this phenomenon, this thesis focuses on the Mexican context because it is an emerging economy that during the past three Mexican administrations has tried to transition from an efficiency economy toward an innovation-based economy; as a consequence, those administrations have implemented several strategies to reinforce innovation and entrepreneurship.

The results of each specific objective show four interesting patterns. *First*, the involvement of Mexican higher education organizations in innovation and entrepreneurship systems reflects a lower participation and lower use of their resources/capabilities to transform themselves into more innovative and entrepreneurial organizations. *Second*, the role of Mexican universities' innovation activities was evidenced by the analysis of university–enterprise partnerships in the development of radical/incremental innovations as well as access to R&D subsidy programs. *Third*, the analysis of the role of universities in entrepreneurial activities showed interesting trends regarding technology-based nascent entrepreneurs (with and without higher education), and environmental conditions associated with innovation and entrepreneurial ecosystems were evidenced. Interestingly, the moderation effect of higher education reinforces the systems and the organizational nexus over technology-based nascent entrepreneurs. *Fourth*, a multiple case study provided insights into the influence of universities on enterprises' innovation outcomes; specifically, opportunistic/collaborative behaviors behind compulsory Mexican university–enterprise partnerships to access R&D subsidies. This thesis has several limitations and several unanswered or unexplored questions that are interesting directions for future research oriented to extending theoretical/methodological approaches. Several implications for policy makers, university managers and enterprise managers also emerge from this research.

Keywords: Entrepreneurship; Innovation; Higher Education Organizations; Entrepreneurial Universities; Emerging Economies

CONTENT

AGRADECIMIENTOS i
ACKNOWLEDGEMENTS v
RESUMEN ix
ABSTRACT xiii
TABLES xx
FIGURES xxi

INTRODUCCIÓN 1

i. Antecedentes 2
ii. Objetivos 7
iii. Aproximaciones teóricas 9
iv. Aproximaciones metodológicas 14
v. Contribuciones e implicaciones esperadas 16
vi. Estructura de la tesis 18

CHAPTER I: RESEARCH MOTIVATIONS 21

1.1. Problem statement 22
1.2. Research objectives 24
1.3. Theoretical approaches, methodological design and expected contributions 26
1.4. Structure of the thesis 29

CHAPTER II: EVOLVING ENTREPRENEURSHIP AND INNOVATION ECOSYSTEMS: THE MEXICAN EXPERIENCE 31

2.1. Introduction 32
2.2. Theoretical framework 34
2.3. Methodology 37
2.3.1. Case study approach 37
2.3.2. Understanding the Mexican entrepreneurship and innovation strategies 40

2.4. Results and discussions 43
2.4.1. Mexican innovation ecosystem 43
2.4.2. Mexican entrepreneurship ecosystem 47
2.4.3. The role of higher education organizations as drivers of entrepreneurship and innovation activities in Mexico 51
2.5. Conclusions 53

CHAPTER III: DO HIGHER EDUCATION ORGANIZATIONS MATTER IN ENTREPRENEURSHIP PRACTICES? LOOKING INSIDE MEXICAN UNIVERSITY-ENTERPRISE PARTNERSHIPS' STRATEGIC AND INNOVATION PURPOSES 57

3.1. Introduction 58
3.2. Theoretical framework 60
3.2.1. Motivated by strategic purposes 62
3.2.2. Motivated by government subsidies 64
3.3. Methodology 67
3.3.1. Data collection 67
3.3.2. Description of variables 68
3.3.3. Data analysis 71
3.4. Results and discussion 74
3.4.3. Robustness check 77
3.5. Conclusions 81

CHAPTER IV: DO HIGHER EDUCATION ORGANIZATIONS MATTER IN ENTREPRENEURSHIP PRACTICES? LOOKING INSIDE TECHNOLOGY BASED NASCENT ENTREPRENEURSHIP ACROSS COUNTRIES 85

4.1. Introduction 86
4.2. Theoretical framework 87
4.2.1. Environmental conditions 87
4.2.2. Strategic orientation 89
4.2.3. Higher education 90
4.3. Methodology 91
4.3.1. Data collection 91

4.3.2. Description of variables 92
4.3.3. Data analysis 93
4.4. Results and discussions 95
4.5. Conclusions 99

CHAPTER V: DO HIGHER EDUCATION ORGANIZATIONS MATTER IN INNOVATION IMPACTS? LOOKING INSIDE BEHAVIORS AND R&D OUTCOMES OF MEXICAN ENTERPRISE-UNIVERSITY PARTNERSHIPS 103

5.1. Introduction 104
5.2. Literature review 106
5.3. Methodology 113
5.4. Results and discussion 121
5.5. Conclusions 129

CHAPTER VI: CONCLUSIONS / CONCLUSIONES 133

6.1. Introduction / Introducción 134
6.2. Conclusions / Conclusiones 134
6.2.1. General conclusions / Conclusiones generales 134
6.2.2. Specific conclusions / Conclusiones específicas 137
6.3. Limitations and future research lines / Limitaciones y futuras líneas de investigación .. 142
6.4. Implications / Implicaciones 145

REFERENCES 149

TABLES

Tabla i.i: Aspectos generales de la economía mexicana 8

Table 1.1: Understanding the Mexican economy..... 26

Table 3.1: Descriptive statistics 72

Table 3.2: Multinomial regression analysis (all Mexican enterprises) 73

Table 3.3: Robustness test with multinomial regression analysis: Mexican enterprises without a growth patterns of >20% in either total sales or number of personnel in the 2011-2012 period..... 79

Table 3.4: Robustness test with multinomial regression analysis: Mexican enterprises with a growth patterns of >20% in terms of both total sales and personnel in the 2011-2012 period..... 80

Table 4.1: Descriptive statistics and correlation matrix 94

Table 4.2: Statistical model..... 95

Table 5.1: Enterprises' characteristics 120

Table 6.1: Main conclusions / Principales conclusiones..... 120

FIGURES

Figura i.i: Papel de las organizaciones de educación superior según el nivel de desarrollo de los países 6

Figura i.ii: Estructura de la tesis 18

Figure 1.1: Role of higher education organizations by level of economic development. 24

Figure 1.2: Structure of the thesis 29

Figure 2.1: Evolution of National Development Plans 41

Figure 2.2: Mexican Science, Technology and Innovation System 43

Figure 2.3: Mexican entrepreneurial ecosystem 48

Figure 2.4: Entrepreneurial ecosystems heat map by country. Pillars most important 52

Figure 5.1: Conceptual framework 113

Figure 5.2: Investment in the Incentive Program for Innovation 114

Figure 5.3: Adjusted conceptual framework 114

INTRODUCCIÓN

i. Antecedentes

Uno de los principales retos que presentan las sociedades es el cambio. De ahí qué, las diversas economías muestren diversos niveles de crecimiento y formas de gestión más o menos administrada *(World Economic Forum, 2014)*[1]. En general, esto se debe a que los principales factores o impulsores del desarrollo económico también han ido evolucionado a través del tiempo; particularmente, de simplemente considerar el capital humano como la principal palanca de transformación (Solow, 1956) hasta reconocer el relevante papel del capital conocimiento (Romer, 1990) o el capital emprendedor en el desarrollo económico (Audretsch, 2014). En cada escenario, las instituciones al ser "las reglas de la sociedad" han matizado la configuración de cada uno de los factores de producción (North, 1990). En la actualidad, la mayoría de las economías aspiran desarrollar escenarios donde la generación, difusión y explotación del conocimiento se vean favorecidas. Observándose una tendencia hacia sociedades más emprendedoras que fomente la actividad innovadora y emprendedora como los principales factores conducen al crecimiento económico (Audretsch, 2014; Stephan, 2012).

En este contexto, las organizaciones de educación superior han sido universalmente consideradas como fuentes generadoras de capital humano debido a que su principal actividad ha sido la docencia. Sin embargo, en décadas recientes, se ha reconocido su relevancia en la generación y transferencia de conocimiento (ej., patentes, licencias,

[1] Según el nivel de desarrollo de los factores de producción de cada país, el World Economic Forum los clasifica como: países *factor-driven* cuya economía se basa en los factores primarios de producción (tierra, trabajo, capital); países *efficiency-driven* cuyas economías están orientadas a la eficiencia mediante factores de producción especializados como capital humano; y países *innovation-driven* cuyas economías están dirigidas hacia la innovación mediante factores de producción como el capital conocimiento y/o emprendedor.

start-ups, etc.). Además de la denominada tercera misión de las universidades más orientada a fomentar el emprendimiento e incidir en el desarrollo socioeconómico de la zona en la que se localice (Guerrero and Urbano, 2012). Por lo cual, las universidades se han transformado en organizaciones más emprendedoras y han desarrollado sus propios ecosistemas de emprendimiento e innovación para apoyar a la comunidad universitaria (estudiantes, académicos, personal, y egresados) (Kirby et al., 2011). Bajo esta perspectiva, las organizaciones de educación superior tienen un papel relevante en la configuración de los factores de producción a través de sus principales actividades tales como la docencia e investigación (Guerrero et al., 2015). Sin embargo, para llevar a cabo dichas actividades, las organizaciones de educación superior han desarrollado e implementado diversos mecanismos que les permitan generar capital humano, generar conocimiento y transferirlo a través de iniciativas innovadoras/emprendedoras (Bramwell and Wolfe, 2008).

En este sentido, se destaca los esfuerzos realizados en el fortalecimiento de su vinculación con diversos agentes del ecosistema innovador (Mian, 1997) y ecosistema emprendedor (Etzkowitz, 2003; Perkmann and Walsh, 2007) tales como otras organizaciones de educación superior, empresas públicas/privadas, centros de investigación, entidades gubernamentales, entre otras organizaciones (Autio et al., 2014). Este tipo de vinculación se lleva a cabo a través de acuerdos de colaboración abierta que parte de una identificación de áreas de oportunidades que se explotan mediante integración de los recursos y capacidades de ambas partes con la finalidad de crear valor que puede materializarse desde un producto/servicio innovador hasta un nuevo modelo de negocio (Chesbrough et al., 2006). Asimismo, este tipo de vinculaciones favorece la

transferencia y difusión del conocimiento[2] entre los agentes involucrados en el sistema (Audretsch and Keilbach, 2007); produciéndose así, efectos directos e indirectos en el desarrollo regional cada vez que nuevas oportunidades son identificadas, analizadas y explotadas a través de iniciativas innovadoras/emprendedoras por los agentes que colaboran o por otros existentes en el sistema (Acs et al., 2009).

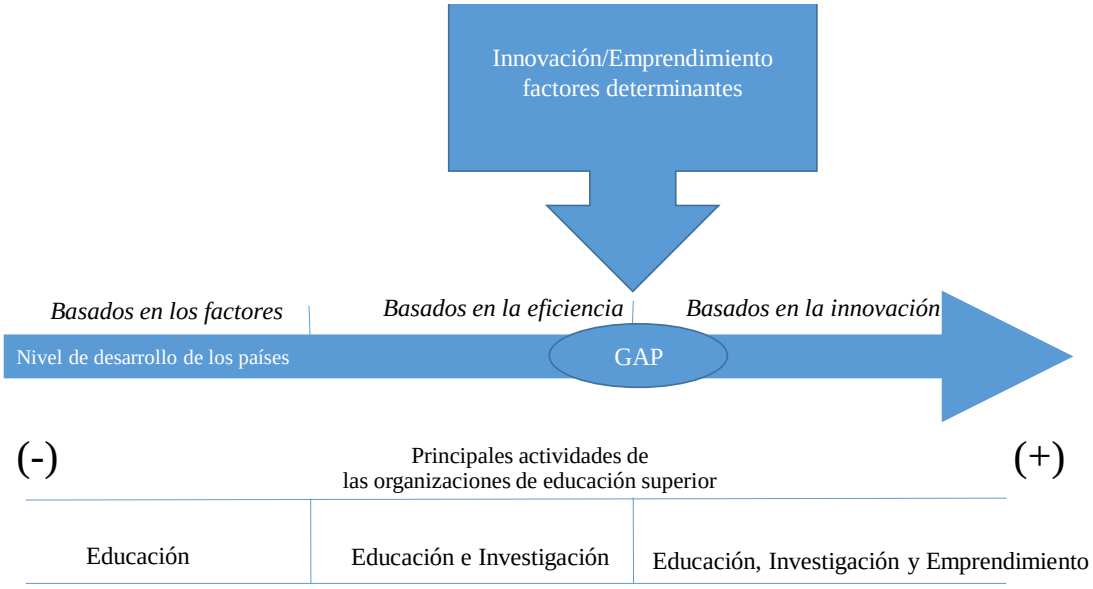
Los promotores de políticas, los directores de universidades y la comunidad académica han mostrado interés en explorar en mayor profundidad este fenómeno. A nivel académico, este interés se ha manifestado en el incremento de artículos académicos y de ediciones especiales publicadas en los últimos años en reconocidas revistas como *Journal of Technology Transfer* (2001, 2003, 2013, 2014), *Research Policy* (2003, 2004, 2005, 2011), *Small Business Economics* (2016), and *Technovation* (2016). Adicionalmente, las principales conferencias en el campo del Emprendimiento han incluido varias sesiones sobre el papel de las universidades como promotoras del emprendimiento (e.g., *Academy of Management Conference* en USA; *RENT Conference - Research in Entrepreneurship and Small Business* en Europa; Conferencia CLADEA en Latinoamérica; entre otras). A partir de estos esfuerzos, estudios previos han evidenciado sus determinantes internos y externos, así como, los impactos vinculados a la evolución emprendedora de las universidades en los Estados Unidos (Audretsch, 2014); Alemania (Audretsch y Lehmann, 2005), Italia (Colombo y Grilli, 2006; Colombo et al., 2010), Reino Unido (Guerrero et al., 2015); España (Guerrero y Urbano, 2012); es decir, la mayoría de los estudios se han realizado en economías consideradas innovadoras *(World Economic Forum*, 2014). Por lo anterior, la investigación sobre el papel de las universidades en economías en desarrollo y emergentes es limitada (Marozau et al., 2016).

[2] *Knowlegde spillover* en el lenguaje anglosajón

El desarrollo de este fenómeno no es uniforme en todos los países (*factor-driven, efficiency-driven o innovation-driven*) y los modelos de innovación/emprendimiento implementados cada uno de ellos pueden no ser los mismos que requieren economías que se encuentran en proceso de transición hacia el siguiente estadio de desarrollo. Debido a su propia naturaleza, un área de investigación es lograr un mejor entendimiento del rol de las organizaciones de educación superior en los diversos niveles de desarrollo de los países; en particular, analizarlas en aquellas economías que se encuentran en procesos de transición entre un estadio a otro donde es importante entender los factores determinantes que inciden en dichos procesos de transición y según las características de cada economía. Esto debido a la implementación de políticas gubernamentales orientadas al fomento a la innovación y/o emprendimiento como parte de una estrategia nacional de desarrollo.

Al respecto, la Figura i.i muestra como las actividades de las universidades (enseñanza, investigación y emprendimiento) están asociadas a cada factor de producción según el nivel de desarrollo económico de cada economía (Urbano y Guerrero, 2013; World Economic Forum, 2014). Desde esta perspectiva, la universidad juega un papel relevante en la generación de capital humano (graduados, egresados), capital de conocimiento (explotación, exploración, transferencia y comercialización) y capital emprendedor (graduados emprendedores, intraemprendedores y emprendedores académicos). Además se destaca, el área de interés de esta propuesta de investigación el cual consiste en analizar los factores determinantes de la innovación/emprendimiento en economías que se encuentran en proceso de transición de un nivel de desarrollo basado en la eficiencia a un nivel de desarrollo basado en la innovación.

Figura i.i: Papel de las organizaciones de educación superior según el nivel de desarrollo de los países



Papel de las Organizaciones de Educación Superior

Fuente: Adaptado de Marozau et al. (2016).

Otra área de oportunidad relevante observada en la revisión de la literatura ha sido la noción de que los ecosistemas de emprendimiento (Mason y Brown, 2014) y los sistemas de innovación (Carlsson et al., 2002) están separados completamente (Autio et al., 2014). Resulta de interés, si se adopta una perspectiva de Triple o Cuádruple Hélice (Miller et al., 2016), observar que ambos ecosistemas tienen muchas similitudes y además comparten los mismo agentes tales como el gobierno, la universidad y la industria. Bajo este supuesto, las universidades pudieran ser consideradas como el puente contribuye al desarrollo de actividades emprendedoras e innovadoras.

ii. Objetivos

Debido al importante papel de las universidades en el desarrollo social, económico y tecnológico, el objetivo principal de esta tesis es tratar de contribuir a una mejor comprensión sobre el papel de las universidades como impulsoras de actividades de innovación y emprendimiento en economías en transición basadas en la innovación hacia economías emprendedoras. En este sentido, los objetivos específicos de la investigación son los siguientes:

OE1: Comprender el papel de las organizaciones de educación superior en los sistemas de innovación y los ecosistemas empresariales

OE2: Explorar el papel de las organizaciones de educación superior como impulsoras de actividades de innovación

OE3: Explorar el papel de las organizaciones de educación superior como impulsoras de actividades empresariales

OE4: Explorar la influencia de las organizaciones de educación superior en los resultados de la innovación

Dada la naturaleza de este fenómeno y para dar cumplimiento a los objetivos de la investigación, esta investigación se concentra en el análisis de las organizaciones de educación en la economía mexicana. La Tabla 1.1 muestra los indicadores clave que permiten entender las condiciones socioeconómicas, el ecosistema de innovación y la actividad empresarial en México (Guerrero and Urbano, 2016).

Tabla i.i: Aspectos generales de la economía mexicana

Aspectos generales	Cifras	Referencias
Distribución geográfica (2014)	32 estados	INEGI, 2015
PIB per cápita (Dólares 2012)	$9749	The World Bank, 2014
Población nacional (2013)	119713203	CONAPO, 2014
Tasa de actividad emprendedora (2013)	14.8 %	Amorós & Bosma, 2014
Unidades económicas[1] (2008)	3724019	INEGI, 2015
Organizationes de educación superior[2] (2012)	2882	SEP, 2012
Públicas	68.3 %	SEP, 2012
Privadas	31.7 %	SEP, 2012
Vinculadas a ANUIES	180	ANUIES, 2015
Investigadores SNI[3] (2013)	2359	CONACYT, 2014
Organizaciones científico-tecnológicas[4] (2013)	6880	CONACYT, 2014 b
Aplicaciones de patentes (2012)	6030	IMPI, 2014
De centros de investigación	642	IMPI, 2014
De organizaciones de educación superior	957	IMPI, 2014

Notas:

1 Según el Instituto Nacional de Estadística y Geografía (INEGI), las unidades económicas son una medida aproximada del número de empresas existentes en el país que fueron identificadas en los censos económicos realizados cada cuatro años.

2 Según la Secretaría de Educación Pública (SEP), las organizaciones de educación superior están integradas por universidades, institutos tecnológicos, universidades tecnológicas, universidades politécnicas, universidades interculturales, centros de investigación, escuelas normales, escuelas de arte y escuelas militares.

3 Investigadores que forman parte del sistema nacional de investigadores (SNI) reconocidos y evaluados por el Consejo Nacional de Ciencia y Tecnología Mexicana (CONACYT)

4 Organizaciones que realizan actividades científico-tecnológicas en el país reconocidas por el Consejo Nacional de Ciencia y Tecnología Mexicana (CONACYT)

Fuente: Elaboración propia

La principal justificación es que México es una economía emergente (Amorós and Bosma, 2014) que durante las últimas tres administraciones mexicanas ha tratado de migrar de un estadio de eficiencia hacia uno basado en la innovación. Según el Plan Nacional de Desarrollo 2013-2018 (Gobierno de la República, 2015a), estas administraciones han implementado varias estrategias para reforzar la innovación y el emprendimiento. Según la OECD (2013), el gobierno mexicano ha subsidiado un alto porcentaje de los productos y procesos innovadores desarrollados por las empresas mexicanas. Según CONACYT[3], en el denominado "Incentivo para la Innovación", la inversión en I+D ha sido de más de 2,932

[3] Para mayor información, consultar [http://conacyt.gob.mx/index.php/fondos-y-apoyos/programa-de-estimulos-a-la-innovacion].

millones de dólares durante el periodo de 2009-2016 y se ha destinado al fomento de sectores o industrias prioritarias como la Alimentaria (30.5%), Energía (13.1%), Manufactura Avanzada (10.7%), Automotriz (8.7%), Salud (8.5%), Logística (7.9%), Metal Mecánica (3.2%), Ambiente y Sostenibilidad (2.8%), Minería (2.2%), Aeroespacial (2.0%), Cuero y Calzado (2.0%), Forestal (1.8%) y Química (1.2%). Este incentivo está orientado a apoyar a aquellas empresas mexicanas, enlistadas en el Padrón Nacional de Empresas Tecnológicas (RENIECYT), en el desarrollo de investigación y desarrollo de nuevas tecnologías e innovaciones. Para acceder a este incentivo, las empresas pueden realizar su solicitud de manera individual o en asociación con universidades públicas o privadas. Desde la perspectiva de política pública, a través de este incentivo a la innovación se busca fortalecer el crecimiento, competitividad y acuerdos de colaboración entre empresas y organizaciones científicas (universidades y centros de investigación) mediante la incorporación de capital humano, generación de innovaciones (nuevos productos/servicios o procesos) con un valor agregado a aquellos sectores estratégicos que contribuyen a la creación de propiedad intelectual. En este contexto, uno de los mecanismos para analizar la contribución de las universidades en la generación de actividades innovadoras y emprendedoras se realiza a través de la vinculación universidad-empresa (Perkmann and Walsh, 2007; Perkmann et al., 2013).

iii. Aproximaciones teóricas

Según la clasificación propuesta por el *Journal of Economic Literature Classification System*, el tema de investigación descrito en esta propuesta puede clasificarse en dos categorías: Administración de Negocios, y la de Educación. Sin embargo, la categorización más apropiada es la relativa al área de ciencias sociales vinculada al emprendimiento (M130) y la

de educación y políticas gubernamentales (I280). Esta clasificación puede ser corroborada en los diversos monográficos publicados sobre el tema en los diversas revistas académicas de reconocido prestigio a nivel internacional. A partir de ello, se enmarca el papel de las organizaciones de educación superior como promotoras de la actividad innovadora (ej., transferencia de conocimientos) y emprendedora (ej., creación de empresas de base tecnológica) en una región determinada.

Teniendo en considerar está área de conocimiento, para alcanzar los objetivos de investigación generales y específicos, a continuación se detallan los marcos conceptuales más apropiados y que se han utilizado para analizar este fenómeno.

- *Respecto al OE1*, para comprender el papel de las organizaciones de educación superior en los sistemas de innovación y ecosistemas empresariales, este estudio adopta las bases teóricas de los Sistemas Nacionales de Innovación (Carlsson et al., 2002) así como de los ecosistemas emprendedores (Mason y Brown, 2014; Autio et al., 2014). Respecto a los Sistemas Nacionales de Innovación, la literatura se concentra en el análisis de las complejas relaciones para lograr acuerdos de colaboración, definición de canales de comunicación y retroalimentación entre organizaciones en los procesos de innovación y desarrollo innovador en los diferentes países (Carlsson et al., 2002). Orientación que ha sido ampliamente criticada debido a la existencia de marcos conceptuales que sólo se limitan a analizar los factores que promueven su evolución a través del tiempo (Castellacci y Natera, 2013). En contraste, los ecosistemas emprendedores se han concentrado en analizar las condiciones que favorecen el desarrollo del proceso emprendedor tanto a nivel individual como organizacional (Parker, 2011). En ambas líneas de investigación,

la innovación y emprendimiento son considerados como dos fenómenos aislados a pesar de que en la práctica empresarial son elementos muy relacionados (Autio et al., 2014). Además, desde ambas perspectivas, las organizaciones de educación superior son agentes importantes que facilitan la generación/transferencia de conocimiento y que también contribuyen en la generación de capital humano y talento emprendedor (Guerrero et al., 2015). A partir de este argumento, en esta tesis las organizaciones de educación superior podrían ser el eslabón entre los Sistemas de Innovación y los Ecosistemas Emprendedores.

- *Respecto al OE2*, para explorar el papel de las organizaciones de educación superior como impulsores de las actividades de innovación, este estudio adoptó evidencias de diversas líneas de investigación tales como la colaboración para la innovación abierta (Van de Vrande et al., 2009), asociaciones empresa-universidad (Perkmann and Walsh, 2007), subsidios y estrategias de I+D gubernamentales (Dimos y Pugh, 2016). El *enfoque de innovación abierta* permite entender los mecanismos a través de los cuales diversos agentes buscan colaborar conjuntamente y de manera abierta en el desarrollo de actividades de valor agregado y alto componente innovador (West et al., 2014). Desde esta perspectiva, la innovación consiste en la colaboración y participación activa mediante la vinculación con agentes externos que poseen conocimiento/recursos complementarios (*outside-in process*), entre departamentos de la misma organización a través de los cuales se puedan multiplicar/perfeccionar las innovaciones existentes al compartir su *know-how* (*inside-out process*) o incluso la co-creación entre agentes externos/internos (*coupled process*) (Enkell et al., 2009). Alineado a este enfoque, la literatura relacionada a la vinculación universidad-empresa destaca una serie de factores motivadores de la colaboración entre las organizaciones

de educación superior y las empresas (Perkmann and Walsh, 2007). Por lo general, dichos factores motivadores suelen ser los propósitos que persigue cada organización, los beneficios que se podrían obtener de celebrarse dicha colaboración, los recursos que aportan cada uno, la influencia de las condiciones del entorno tales como el acceso a recursos públicos, así como, lo relacionado a los niveles de confianza y comunicación entre las partes (Barbero et al., 2014). Respecto a las políticas públicas orientadas a incentivar la innovación, la literatura reconoce que esta es una práctica que se aplica en la mayoría de las economías y que en el caso de las economías emergentes se intensifica por el peso que los gobiernos otorga a las universidades como agentes responsables de la implementación de dichas iniciativas (Dimos y Pugh, 2016). En estos casos, los gobiernos promueven la vinculación universidad-empresas como un requisito para acceder a recursos públicos. Sin embargo, a la fecha no existe un consenso sobre el efecto real de los subsidios en la actividad innovadora (Greco et al., 2016: Hall et al., 2016). A partir de este argumento, en esta tesis se proponen una serie de hipótesis sobre el papel de las universidades en la generación de actividades innovadores a partir de su relación con empresas existentes.

- En *cuanto al OE3*, para explorar el papel de las organizaciones de educación superior como impulsoras de las actividades empresariales, este estudio está basado en el emprendimiento de base tecnológico, el emprendimiento naciente (Mosey y Wright, 2007), los ecosistemas de innovación y de emprendimiento, y la orientación estratégica (Mosey et al., 2016). El emprendimiento de base tecnológico de aquellos emprendedores nacientes generalmente suele estar condicionado por las características de los ecosistemas innovadores y emprendedores. Por lo general, en economías en los que sus ecosistemas existentes dotan de apoyos a la innovación, al emprendimiento, y,

en concreto, al emprendimiento de base tecnológica mediante infraestructuras físicas, apoyos legales de protección intelectual o subsidios existirá una propensión hacia la creación de empresas basadas en la innovación o tecnologías desarrolladas en las universidades o centros tecnológicos (Block et al., 2012). A nivel individual, los emprendedores o promotores de estas iniciativas suelen poseer un cualificado capital humano dotado de experiencias, conocimientos y habilidades que han ido adquiriendo en su formación universitaria (Carter et al., 2003). Asimismo, a nivel organizacional y estratégico, estas iniciativas presentan amplias aspiraciones de crecimiento y de penetración en nuevos mercados en los que puedan llegar a ser los pioneros y líderes (Beckman et al., 2012 a,b). A partir de estos argumentos, en esta tesis se presentan una serie de hipótesis que tratan de aproximar a una mejor comprensión sobre el rol de las universidades en el desarrollo de actividades emprendedoras con un amplio componente tecnológico.

- *Respecto al OE4*, para explorar la influencia de las organizaciones de educación superior en los resultados de la innovación, este estudio adopta bases teóricas relativas a los subsidios de I+D, la innovación abierta, los comportamientos de colaboración/oportunismo, y los resultados de la innovación (Greco et al., 2016; Gianiodis et al., 2016). A partir de los marcos conceptuales analizados en los objetivos específicos anteriores, en este objetivo específico se incorpora un elemento adicional para tratar de aproximarnos al impacto que puede generar la universidad a partir de su papel en el desarrollo de iniciativas emprendedoras e innovadoras. Al respecto, autores como Perkmann y Walsh (2007) han identificado diversas formas de colaboración abierta entre las organizaciones de educación superior y otros agentes externos (empresas, gobierno, otras organizaciones) tales como acuerdos de colaboración en temas de I+D, servicios de consultoría, desarrollo/explotación de

tecnologías basadas en invenciones de académicos, transferencia/formación de recursos humanos, comercialización de derechos de propiedad vía licencias e incluso la publicación de artículos científicos. Bajo esta perspectiva, mecanismos de innovación abierta permite a las organizaciones de educación superior no sólo hacerse llegar de recursos/capacidades que le son necesarios sino también incrementar de forma significativa su vinculación a redes inter-organizacionales, a la co-creación, transferencia y comercialización del conocimiento. Sin embargo, algunos autores también reconocen la existencia de comportamientos oportunistas en los agentes que forman parte de un acuerdo de colaboración (Gianiodis et al., 2016); particularmente cuando en economías emergentes la vinculación universidad-empresa suele ser un requisito para acceder a subsidios (Guerrero y Urbano, 2016). A partir de estos argumentos, en esta tesis se combinan las diversas bases teóricas con una perspectiva de comportamiento colaborador u oportunista entre los agentes al momento de definir sus estrategias y resultados.

iv. Aproximaciones metodológicas

Estudios previos sobre el tema reconocen que uno de los principales retos a los que se enfrentaron es el proceso de recopilación de información ya sea por fuentes primarias (encuestas realizadas) o secundarias (bases de datos de fuentes oficiales). Por lo anterior, esta tesis no estuvo exenta de la dificultad que estriba en el acceso a la información. Además teniendo en cuenta que en economías emergentes, como la mexicana, a pesar de que se tiene conocimiento de la existencia de información no existe un compromiso o normativa legal que promueva su difusión o facilite acceso a través de mecanismos públicos como la ley de transparencia. Ello implicó una multitud de solicitudes a las diversas organizaciones que se

encargan de recopilar la información requerida en esta investigación. Sin embargo, en algunos casos no fue posible disponer de dicha información por su inexistencia o por los tiempos de respuesta. En este sentido, dada la naturaleza de esta investigación y las dificultades en la obtención de información, en esta tesis se adopta una metodología mixta como una estrategia adecuada para analizar y comprender un fenómeno complejo (Gartner y Birley, 2002).

- *Para alcanzar el OE2 y el OE3*, este estudio adoptó un enfoque metodológico cuantitativo para testar las hipótesis propuestas. El proceso de recolección de información se realizó a partir de bases de datos existentes obtenidas por organizaciones de alto prestigio y caracterizadas por la aplicación de metodologías robustas como lo es el INEGI y el consorcio GEM. *En el primer caso*, las hipótesis propuestas sobre el papel de las universidades en la actividad innovadoras de las empresas mexicanas se testaron a partir del análisis de una *cross-section* base de datos integrada por 10167 empresas mexicanas entrevistadas en 2012 mediante la encuesta bianual sobre investigación y desarrollo tecnológico (ESIDET). Dada la naturaleza de las variables y las limitaciones de acceso a la información por criterios de confidencialidad del INEGI, el modelo de regresión multinomial proporcionó evidencia para una mayor comprensión sobre los principales motivadores (estratégicos o el acceso a subsidios de I+D) que llevan a las empresas a colaborar con las universidades en el desarrollo de iniciativas innovadoras (ej., incrementales o radicales). En *el segundo caso*, las hipótesis propuestas sobre el papel de las universidades en la actividad emprendedora se testaron a partir del análisis de una *cross-section* base de datos integrada por 4453 emprendedores nacientes entrevistados en 2008 mediante la encuesta dirigida a la población adulta (APS) y complementada con la información obtenida en la encuesta dirigida a expertos (NES) del proyecto

GEM. Dada la naturaleza de información y los diversos niveles de análisis incorporados (estrategias organizacionales y las condiciones del entorno), un modelo de regresión logística multinivel proporcionó evidencia para una mejor comprensión sobre el papel de las universidades (mediante la formación universitaria o capacitación en emprendimiento) en la creación de empresas nacientes de base tecnológica.

- *Para dar cumplimiento al OE1 y al OE3,* en esta tesis de adoptó un enfoque metodológico cualitativo. Esta metodología es recomendada cuando los límites entre el fenómeno analizado y su contexto son muy complejos (Yin, 1989). Es decir, que la ausencia de evidencia sobre el fenómeno no se debe a que no sea de interés académico sino debido a la complejidad y dificultad de acceder a información recogida en fuentes secundarias. De esta manera, es posible explorar en profundidad fenómenos a partir de diversas fuentes de información como lo son las entrevistas, informes oficiales, información publicada en páginas web, entre otras. De esta manera, triangulando dicha información es posible evidenciar y comprender los fenómenos analizados. En el caso de esta tesis, el análisis cualitativo ha permitido analizar el papel de las universidades en el ecosistema emprendedor e innovador mexicano (estudio de casos simple), así como, los comportamientos, los resultados e impactos que hay detrás de la colaboración entre empresas y universidades en el contexto mexicano (estudios de casos múltiples).

v. Contribuciones e implicaciones esperadas

Con base en los resultados obtenidos de esta investigación, se esperan las siguientes contribuciones e implicaciones:

- *A nivel académico,* los resultados obtenidos pueden contribuir al debate académico sobre los impactos de las universidades en economías emergentes (Guerrero et al., 2015), en la configuración y su relevancia en los ecosistemas de emprendimiento e innovación (Autio et al., 2014) desde la perspectiva de la cuádruple hélice (Miller et al., 2016), en la vinculación universidad-empresa, innovación abierta, desempeño de la innovación (Capon et al., 1990; Greco et al., 2016; Gooding y Wagner, 1985; Perkmann y Walsh, 2007; Rosenbusch et al., 2011) y en la eficacia de las subvenciones a la I+D orientadas a la promoción de la innovación y el emprendimiento a través de relaciones obligatorias universidad-empresa (Dimos and Pugh, 2016; García-Quevedo, 2004).

- *A nivel Universidad,* los resultados podrían ayudar a reconocer y legitimar el papel relevante de las universidades en el desarrollo de iniciativas emprendedoras e innovadoras en una región/país. Por lo tanto, la evidencia también apoyará el desarrollo de ecosistemas universitarios de emprendimiento e innovación, así como, el fortalecimiento de las relaciones de las universidades con otros agentes (gobierno, industria, centros de investigación). En suma, contribuir en el fortalecimiento de sus capacidades de emprendimiento e innovación.

- *Para los promotores de políticas,* los resultados proporcionaría evidencia sobre el nivel de interconexión de las organizaciones de educación superior con sus grupos de interés; en particular, en las economías emergentes, se evidenciaría la eficacia de sus estrategias en el fomentar la innovación y el emprendimiento mediante subsidios dirigidos a la participación obligatorias de relaciones universidad-empresa.

vi. Estructura de la tesis

Alineada a los cuatro objetivos específicos, la Figura 1.2 describe la estructura de la investigación.

Figura i.ii: Estructura de la tesis

Fuente: Elaboración propia

El Capítulo II explora el papel de las universidades en los ecosistemas de innovación y emprendimiento (OE1). En este sentido, el capítulo analiza teóricamente los principales elementos y potenciales interconexiones entre ambos ecosistemas. A partir de las aproximaciones teóricas aportadas por la literatura de Sistemas Nacionales de Innovación y de Ecosistemas emprendedores, el análisis del caso mexicano es analizado utilizando la metodología del estudio de caso. De esta manera se evidencia el rol de los principales agentes así como el papel de las universidades mexicanas como potenciales agentes que facilitan el desarrollo y flujo de iniciativas emprendedoras e innovadoras entre ambos ecosistemas.

El Capítulo III explora el papel de la universidad en las actividades de innovación (OE2). Adoptando las bases teóricas de la innovación abierta, subsidios y colaboración universidad-empresa, el capítulo presenta una serie de hipótesis sobre los factores que motivan a las empresas a colaborar con las universidades en el desarrollo de actividades de innovación. Utilizando información secundaria obtenida en la encuesta ESIDET 2012, las hipótesis son analizadas a partir de un modelo multinomial. A pesar de las limitaciones vinculadas a las variables contenidas en la encuesta y a la normativa de confidencialidad, la evidencia obtenida proporciona algunos indicios respecto al tipo de innovaciones generadas en la colaboración de universidades y empresas mexicanas.

El Capítulo IV explora el papel de la universidad en las actividades de emprendimiento (OE3). Adoptando las bases teóricas del emprendimiento naciente de base tecnológica y los componentes de los ecosistemas innovador/emprendedor que facilitan esa tipología de emprendimiento, el capítulo presenta una serie de hipótesis sobre los factores que determinan la creación de empresas de base tecnológica y, en particular, la influencia de la formación universitaria y en emprendimiento en este proceso. Utilizando información secundaria obtenida en las encuestas APS y NES del GEM en 2008, las hipótesis son analizadas a partir de un modelo multinivel. A pesar de las limitaciones vinculadas a las variables contenidas en la encuesta, la evidencia obtenida proporciona algunos indicios respecto a la importancia de la formación universitaria y en emprendimiento en la creación de empresas de base tecnológica en economías desarrolladas y en las economías emergentes.

El Capítulo V explora impacto de la universidad en los resultados de la innovación (OE4). En este sentido, el capítulo presenta una serie de proposiciones argumentadas con las diversas aproximaciones teóricas de los capítulos anteriores más la incorporación del análisis de la

literatura sobre comportamientos colaboradores u oportunistas. Debido a la complejidad en la medición de impactos, la metodología utilizada fue estudio de casos múltiples de empresas mexicanas que han colaborado con universidades y que se vinculan a sectores prioritarios en la economía mexicana. A partir de una serie de entrevistas semi-estructuradas, la evidencia obtenida revela la duplicidad de comportamientos (colaborador/oportunista) en las colaboraciones universidad-empresa al momento de definir las estrategias y resultados.

El Capítulo VI presenta las conclusiones generales que se han obtenido en esta investigación, así como, se detallan las limitaciones y la agenda de investigación que emerge de dichas áreas de oportunidad. Finalmente, una serie de implicaciones se proponen para los diversos agentes relacionados con el tema de esta investigación.

CHAPTER I:

RESEARCH MOTIVATIONS

1.1. Problem statement

Economies show different levels of growth[4] because of different production factors or drivers (World Economic Forum, 2014); in particular, factors such as human capital (Solow, 1956), knowledge capital (Romer, 1990) or entrepreneurial capital (Audretsch, 2014). The configuration of each production factor is associated with the quality and evolution of the institutions, or "rules of the game," in the society (North, 1990). During the past decades, the majority of economies have aspired to develop favorable scenarios for the generation, diffusion and exploitation of knowledge (Audretsch, 2014; Stephan, 2012).

Applying this perspective, universities have been relevant contributors toward achieving these goals. Traditionally, higher education organizations have been considered primarily as a source of human capital (first mission), then as a source of knowledge generation and technology transfer (patents, licenses, start-ups, etc.) (second mission). In recent decades, a third mission has also been incorporated within universities in order to foster entrepreneurship and contribute to socioeconomic development (Guerrero and Urbano, 2012). Universities have not only transformed themselves into more entrepreneurial organizations but also developed their own entrepreneurial and innovative ecosystems to support the university community (students, academics, staff and alumni) (Kirby et al., 2011).

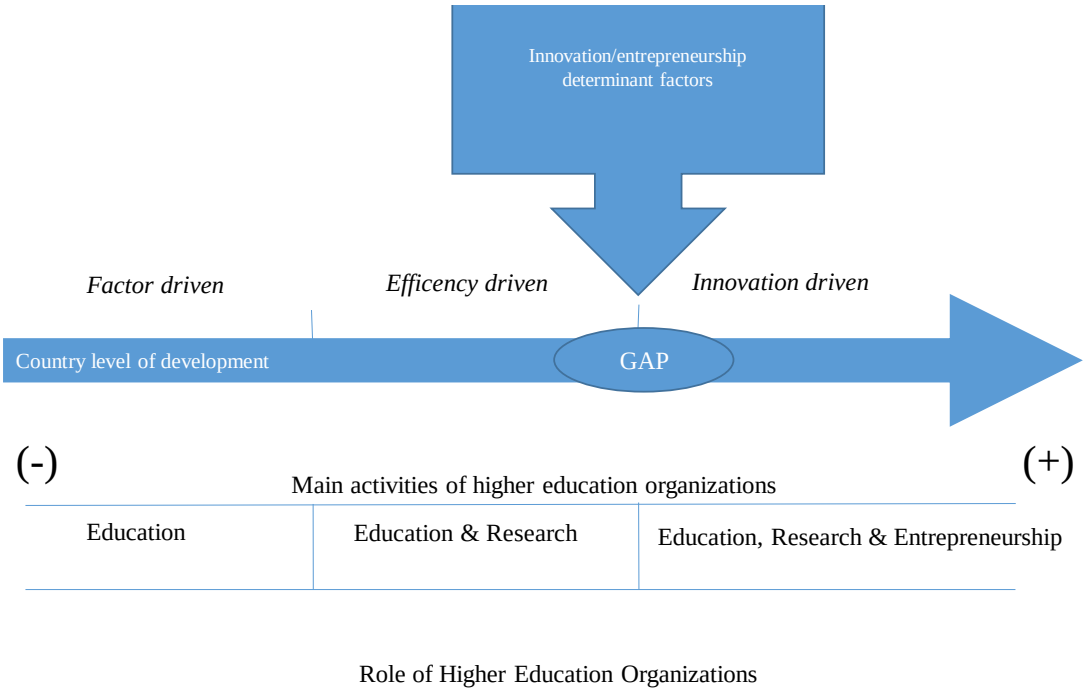
Policy makers, university managers and the academic community have paid attention, exploring this phenomenon in-depth. At the academic level, this interest has been shown in

[4] According to the level of development of the factors of production of each country, the World Economic Forum classifies them as: *factor-driven*, when economy is based on the primary factors of production (land, labor, capital); *efficiency-driven*, when economies are oriented to efficiency through specialized production factors such as human capital; and *innovation-driven*, when economies are directed toward innovation through factors of production such as knowledge and/or entrepreneurial capital.

the increase of publications and special issues published in renowned journals in recent years, such as *Journal of Technology Transfer* (2001, 2003, 2013, 2014), *Research Policy* (2003, 2004, 2005, 2011), *Small Business Economics* (2016) and *Technovation* (2016). Major conferences focusing on the entrepreneurship field have included several tracks on the role of universities promoting entrepreneurship (e.g., *Academy of Management Conference* in the United States; *RENT Conference—Research in Entrepreneurship and Small Business* in Europe; CLADEA Conference in Latin America, among others). Previous studies have examined internal and external determinants as well as the impact associated with the entrepreneurial evolution of universities in the United States (Audretsch, 2014); Germany (Audretsch and Lehmann, 2005), Italy (Colombo and Grilli, 2006; Colombo et al., 2010), the United Kingdom (Guerrero et al., 2015); and Spain (Guerrero and Urbano, 2012), among others.

However, research about the role of universities in developing and emerging economies is limited (Marozau et al., 2016). It is a relevant research gap in the context in which the role of universities has been linked to the implementation of government programs to foster innovation and/or entrepreneurship as a part of a national development strategy. In this regard, Figure 1.1 shows how universities' activities (teaching, research and entrepreneurship) are associated with each level of economic development. Universities play a relevant role in the generation of human capital (graduates, alumni), knowledge capital (exploitation, exploration, transfer and commercialization) and entrepreneurship capital (graduates, entrepreneurs, intrapreneurs and academic entrepreneurs).

Figure 1.1: Role of higher education organizations by level of economic development



Source: Adapted from Marozau et al. (2016).

Another relevant gap observed in the literature review is the notion that entrepreneurship ecosystems (Mason and Brown, 2014) and innovation systems (Carlsson et al., 2002) are completely distinct and separate (Autio et al., 2014). Interestingly, if a triple- or quadruple-helix perspective is adopted (Miller et al., 2016), both systems have strong similitudes and share the same agents, such as government, university and industry. Under this assumption, universities could be considered a bridge that could contribute to the development of entrepreneurial and innovation activities.

1.2. Research objectives

Due to the important role of universities in societal, economic and technological development, the **main objective** of this thesis is provide a better understanding about the role of universities as drivers of innovation and entrepreneurship activities in economies transitioning toward innovation- and entrepreneurship-based economies. Thus, the **specific objectives** of the research are the following:

SO1: To understand the role of higher education organizations in innovation systems and entrepreneurial ecosystems

SO2: To explore the role of higher education organizations as drivers of innovation activities

SO3: To explore the role of higher education organizations as drivers of entrepreneurial activities

SO4: To explore the influence of higher education organizations on innovation outcomes

Given the nature of this phenomenon, the Mexican economy is a relevant context in which to develop this research because Mexico is an emerging economy that during the past three Mexican administrations has tried to transition from an efficiency economy toward an innovation-based economy. As a consequence, these administrations have implemented several strategies to reinforce innovation and entrepreneurship. Table 1.1 shows the key indicators associated with socioeconomic conditions, innovation and entrepreneurial activity in Mexico.

Table 1.1: Understanding the Mexican economy

General aspects	Numbers	References
Geographic distribution /(2014)	32 states	INEGI, 2015
GDP *per capita* (US dollars 2012)	$9.749	The World Bank, 2014
National population (2013)	119.713.203	CONAPO, 2014
Entrepreneurial activity rate (2013)	14.8 %	Amorós & Bosma, 2014
Economic units[1] (2008)	3.724.019	INEGI, 2015
Higher education organizations[2]/(2012)	2.882	SEP, 2012
Public	68,3 %	SEP, 2012
Private	31,7 %	SEP, 2012
Enrolled at ANUIES	180	ANUIES, 2015
Researches enrolled in SNI[3] (2013)	2.359	CONACYT, 2014
Scientific-technological organizations[4] (2013)	6.880	CONACYT, 2014 b
Patent applications (2012)	6.030	IMPI, 2014
Of research centers	642	IMPI, 2014
Of Higher Education Organizations	957	IMPI, 2014

Notes:

1 According to the National Institute of Statistics and Geography (INEGI), economic units are an approximate measure of the number of existing companies in the country that were identified in the economic censuses conducted every four year.

2 According to the Ministry of Public Education (SEP), higher education organizations comprises of universities, technological institutes, technological universities, polytechnic universities, intercultural universities, research centers, normal schools, art schools and military schools.

3 Researchers who are part of the national system of researchers (SNI) recognized and evaluated by the Mexican National Council of Science and Technology (CONACYT)

4 Organizations that carry out scientific and technological activities in the country recognized by the Mexican National Council of Science and Technology (CONACYT)

Source: Author

1.3. Theoretical approaches, methodological design and expected contributions

To achieve the general and specific research objectives, based on previous studies, this thesis adopted several theoretical and methodological approaches.

- *Theoretical approaches*: Regarding SO1, to understand the role of higher education organizations in innovation systems and entrepreneurial ecosystems, this thesis adopted the theoretical bases of national innovation systems (Carlsson et al., 2002) as well as entrepreneurial ecosystems (Mason and Brown, 2014; Autio et al., 2014). Regarding SO2, to explore the role of higher education organizations as

drivers of innovation activities, this thesis adopted evidence from several research lines, such as open innovation collaboration (van de Vrande et al., 2009), university–enterprise partnerships (Perkmann and Walsh, 2007) and government R&D subsidies and strategy (Dimos and Pugh, 2016). Regarding SO3, to explore the role of higher education organizations as drivers of entrepreneurial activities, this thesis is supported by the bases from technology-based entrepreneurships, nascent entrepreneurship (Mosey and Wright, 2007), innovation and entrepreneurial ecosystems, and strategic orientation (Mosey et al., 2016). Regarding SO4, to explore the influence of higher education organizations on innovation outcomes, this thesis adopted theoretical bases from R&D subsidies, open innovation, collaborative/opportunism behaviors and innovation outcomes (Greco et al., 2016; Gianiodis et al., 2016).

- *Methodological approaches*: Given the nature of this research, Gartner and Birley (2002) suggest a mixed methodological approach, such as an adequate strategy to analyze in-depth and understand a complex phenomenon. To achieve SO2 and SO3, this thesis adopted a quantitative methodological approach; in particular, testing the proposed hypotheses with secondary datasets from INEGI and GEM and using different economic models (e.g., multinomial regression and multi-level logistic regression, respectively). To achieve SO1 and SO3, this study adopted a qualitative methodological approach; particularly, analyzing the Mexican case and multiple case studies, respectively.

Based on the results obtained from this research, the following contributions and implications are expected:

- *At the academic level*, the results obtained could contribute to the ongoing academic debate in the context of emerging economies about the impact of universities (Guerrero et al., 2015), the configuration and relevance of entrepreneurial and innovative ecosystems (Autio et al., 2014), as well as of the role of universities in the quadruple-helix perspective (Miller et al., 2016), university–enterprise partnerships, open innovation, innovation performance (Capon et al., 1990; Greco et al., 2016; Gooding and Wagner, 1985; Perkmann and Walsh, 2007; Rosenbusch et al., 2011) and the effectiveness of R&D subsidies in the promotion of innovation and entrepreneurship via compulsory university–enterprise partnerships (Dimos and Pugh, 2016; García-Quevedo, 2004).

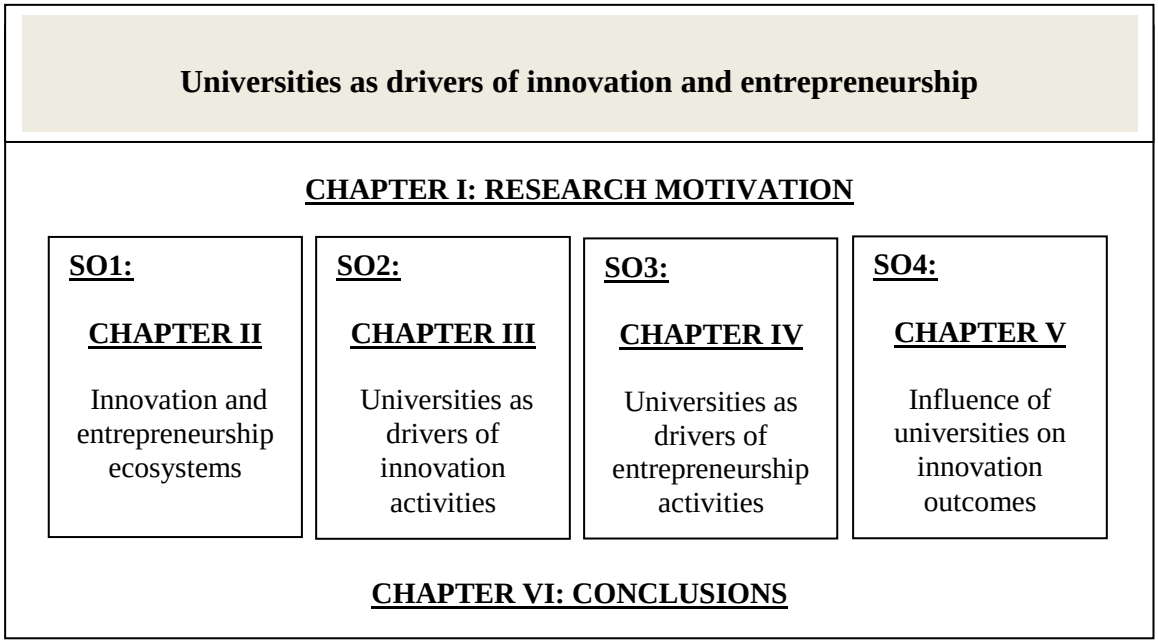
- *At the university level*, the results could help to recognize and legitimize the relevant role of universities in the development of entrepreneurial and innovative initiatives in the region/country. Therefore, evidence will also support the development of entrepreneurial and innovative university ecosystems as well as the reinforcement of university relationships with external agents (government, industry, research centers). In sum, the results could contribute to fostering entrepreneurship and innovation capabilities.

- *For policy makers*, the results could provide evidence about the level of interconnection of higher education organizations with their stakeholders; in particular, in emerging economies, the effectiveness of their strategies for fostering innovation and entrepreneurship by subsidies with compulsory university–enterprise partnerships.

1.4. Structure of the thesis

Figure 1.2 describes the structure of the thesis in relation to the specific objectives. SO1 focuses on innovation and entrepreneurship ecosystems (Chapter II), SO2 focuses on the role of universities in innovation activities (Chapter III), SO3 focuses on the role of universities in entrepreneurial activities (Chapter IV), and SO4 focuses on the impact of universities on innovation outcomes (Chapter V). Finally, Chapter VI presents a summary of conclusions, implications, limitations and future research lines.

Figure 1.2: Structure of the thesis



Source: Author

CHAPTER II:

EVOLVING ENTREPRENEURSHIP AND INNOVATION ECOSYSTEMS: THE MEXICAN EXPERIENCE

2.1. Introduction

During the past few decades, the configurations of new knowledge-intensive environments have required fertile settings for innovative and entrepreneurial activities. Both types of activities play a crucial role in the economy, and many studies have examined the factors that influence these activities (Autio et al., 2014). Despite innovation and entrepreneurship being multidimensional processes, empirical studies continue to employ models that presume that these phenomena occur at a single point in time (McMullen and Dimov, 2013). Those facts explain why the triple- or quadruple-helix concepts have been operationalized in different ways (e.g., with/without government intervention, closed/opened, administrated/entrepreneurially, etc.) in different spaces (e.g., global, national, regional, local) and in different contexts (e.g., organizational, technological, social, etc.).

Because of this diversity, there has been growing interest in the study of how organizations transform their roles and practices in the development and strengthening of national innovation and entrepreneurial ecosystems (Etzkowitz and Leydesdorff, 2000). According to Autio et al. (2014), in both temporal and spatial contexts, entrepreneurial innovation is the result of a variety of elements that compare the attributes of national innovation systems, entrepreneurship, contextual influences and the main benefits for the actors involved in this process. Applying this perspective, how different agents operate, collaborate, make decisions, identify benefits or transform their roles is still an interesting research area (Cunningham and Link, 2015); particularly in emerging or transitional economies (Wright et al., 2005). For instance, these types of economies comprise countries[5] that face a rapid pace of development

[5] According to Hoskisson et al. (2000), some countries identified as emerging or transitional economies are (in alphabetical order): Albania, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Cote d'Ivoire, Croatia, Czech Republic, Ecuador, Egypt,

and government policies that favor economic liberalization and the transition from centrally planned economies (Wright et al., 2005).

In general, emerging economies invest in more productive capacity and adopt a free market or mixed economy to move toward an innovative economy (Meyer et al., 2009). In these scenarios, governments create subsidies to promote entrepreneurship innovation through compulsory university partnerships as a strategy to stimulate regional economic development (Cohen et al., 2002; Thompson, 1999). Therefore, questions about how institutions influence organizational/individual entrepreneurial and innovative decisions have been relatively unexplored (Hoskisson et al. 2000; Meyer et al. 2009); particularly in emerging economies, where there is significant organizational heterogeneity represented by incumbent enterprises (primarily business groups, state-owned enterprises and privatized firms), entrepreneurial start-ups, and foreign entrants. Based on those arguments, the purpose of this research is to provide a better understanding about the micro-foundations of entrepreneurial and innovation ecosystems explained through their main actors; particularly, exploring the role of higher education organizations. To achieve this objective, adopting institutional economic theory and case study approach, we analyzed the case of the drivers of the Mexican innovation and entrepreneurship ecosystems.

This chapter is organized as follows. Section 2.2 presents the link between entrepreneurship and innovation. Section 2.3 integrates the methodological design. Section 2.4 describes the main agents that allow for the understanding of the entrepreneurship and innovation

---

Estonia, Georgia, Ghana, Greece, Hungary, India, Indonesia, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Korea, Kyrgyzstan, Latvia, Lithuania, Macedonia, Malaysia, Mauritius, Mexico, Moldova, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Slovakia, Slovenia, South Africa, Sri Lanka, Taiwan, Tajikistan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan, Venezuela, and Zimbabwe.

ecosystem of an emerging economy (Mexico), as well as of the role of higher education organizations such as drivers of innovation and entrepreneurship ecosystems in the light of previous studies. Finally, section 2.5 summarizes the concluding remarks.

2.2. Theoretical framework

Entrepreneurship and innovation have always been strongly related. According to Schumpeter (1912), creative destruction is present when entrepreneurs introduce radically new products, services and processes to the marketplace. Baumol (2002) also argues that entrepreneurship and innovation was the true source of national competitive advantage because new ventures broke the established development paths and undermined established competencies. In this regard, associating entrepreneurship with innovation, many nations, regions and states have adopted policies to stimulate innovation by entrepreneurial firms with the aim to facilitate economic growth (Autio et al., 2014). For instance, several policies include local, regional and national initiatives to promote technology-based entrepreneurship (Mustar and Wright, 2010; Grimaldi et al., 2011).

Based on this perspective, we assume that institutions, defined as the rules of the game in the society, not only encourage the formal and informal factors (policies, culture, etc.) but also are linked to the drivers of each socioeconomic transformation process in the society (North, 1990). In this regard, Zahra and Wright (2011) argues that the innovation literature, and especially the National System Innovation (NSI) literature was mostly about structure and organizations while the entrepreneurship literature has been mostly about the individual or the firm. For one side, NSI focused on the complex relationships

of cooperation, communication, and feedback among organizations in both the process of innovation and the innovative performance across countries (Carlsson et al., 2002). This orientation has been criticized because the existing literature provides only limited insights into the drivers and mechanisms that can explain their evolution and growth over time (Castellacci and Natera, 2013). For the other side, the entrepreneurship literature traditionally focused on independent ventures as well as on the organizational mode within which entrepreneurial initiatives took place intrapreneurship (Parker, 2011). Based on this theoretical gap, Autio et al. (2014) propose that the concept of entrepreneurial innovation ecosystems distinguish between the different types of contexts that influence it such as industrial, organizational, and social contexts -overlain by temporal and spatial contexts.

An entrepreneurial and innovation ecosystem could be understood as a set of interconnected actors (potential and existing), entrepreneurial organizations (e.g., firms, venture capitalists, business angels, banks, public sector agencies), innovative organizations (e.g., universities, research centers) and entrepreneurial and innovative processes (e.g. business birth, high growth firms, serial entrepreneurs, degree of entrepreneurial and innovative mentality within firms, and levels of ambition) that formally and informally coalesce to connect, mediated by government initiatives oriented to the performance of the local entrepreneurial environment (Mason and Brown, 2014, p. 5). Generally, an entrepreneurial and innovation ecosystem emerges in locations that have place-specific assets/attributes. It represents a shift from traditional economic thinking on firms/markets (management societies) to new economic thinking involving different agents in the society, market, and organizations (entrepreneurial societies) (Audretsch and Thurik 2004). Typically, successful ecosystems have emerged under a

unique set of pre-existing circumstances as well as with subsequently created conditions. For instance, Isenberg (2010) identified certain pillars that comprise a successful entrepreneurial innovation ecosystem, including accessible markets (both domestic and foreign), talented human capital and a qualified workforce, access to private/public sources of funding, an adequate support system and regulatory frameworks and cultural support, among others. Nevertheless, these optimal conditions or pillars are not presented in all types of economies.

Within an emerging economy, policy makers usually try to translate successful formulas applied by developed economies, such as fostering ecosystems to promote innovation and entrepreneurship as the best transitional instrument (Wright et al., 2005). Traditionally, in a scenario characterized by several constrains, governments have eschewed a linear model encouraging universities and government laboratories to embrace the cause of innovation and technology commercialization (Cohen et al., 2002). In other words, in response to the widespread view that public research is too distant from industry in most sectors (with notable exceptions), they have called on universities and government R&D labs to implement their science and engineering strategies (Cohen et al., 2002, p. 2). In many developed countries, collaborative research is subsidized by public policy programs that provide resources for projects involving universities and enterprises (Caloghirou et al., 2001; Almus and Czarnitzki, 2003; Grimaldi et al., 2011). Astrom et al. (2008) have defended the important role of public subsidies in supporting all types of collaboration, but in emerging economies, where the compulsory character of university-enterprise partnerships for access to subsidies allows for an effective exchange of knowledge, this type of collaboration is the most widespread (Boschma, 2005). In addition, there is evidence to support the existence of long-standing partnerships between

universities and enterprises, and the fact that universities continue to aggressively seek industrial sponsorship. These partnerships persist despite the fact that government subsidies and grants create strong administrative burdens for companies, as government support is considered to be highly inflexible since it does not allow for the change of partners and the programs cannot end before a given date (van de Vrande et al., 2009; Urbano and Guerrero, 2013).

As a result, the university's significance increases in terms of its impact on the economy (Audretsch, 2014). As universities are located in the intersection of the education, research and transference processes, they are considered a key access agent in any entrepreneurship and innovation ecosystem. Traditionally, universities tend to be large organizations that by nature are not very entrepreneurial in their focus; however, the incorporation of an entrepreneurial orientation into a university's missions could change this convention (Hannan and Freeman, 1984; Kirby et al., 2011). The core activities of universities have been universally recognized as teaching and research, but currently universities have undergone internal transformations in order to adapt to external conditions and to legitimize their role in the economy, giving place to a new kind of university: the entrepreneurial university (Guerrero and Urbano, 2012, 2014; Guerrero et al., 2015).

2.3. Methodology

2.3.1. Case study approach

This chapter uses a qualitative perspective to investigate the complex phenomenon of the entrepreneurship innovation ecosystems, where the interaction between the phenomenon

and the context is unclear (Yin, 1984). In particular, we take a single case study approach (Yin, 1984; Eisenhardt 1989, 2007) with the purpose of understanding the knowledge concerning the role of higher education organizations as drivers of entrepreneurship and innovation ecosystems. As a result, case study research involves the examination of a contemporary phenomenon in its natural setting (Yin, 1984), and it is especially appropriate for research for providing the analysis of a phenomenon in a specific setting. Adopting the theoretical criteria to identify emerging economies (Hoskisson et al., 2000; Wright et al., 2005), the case of the Mexican entrepreneurial and innovation ecosystems was selected to analyze this contemporary phenomenon in-depth within its real-life context, especially when the boundaries between this phenomenon and the university role are not clearly evident (Eisenhardt, 1989; 2007; Yin, 1984).

Mexico is an interesting example of an emerging economy, as classified by the International Monetary Fund (2015).[6] Since the first editions of the Global Competitiveness Index, Mexico is classified as an efficiency-driven country (Porter and Schwab, 2008, p. 9). This means that the country's main advantage comes from producing more advanced products and services highly efficiently. Heavy investment in efficient infrastructure, business-friendly government administration, strong investment incentives, improving skills and better access to investment capital allow for major improvements in productivity. The trade of products and services and human capital movements between countries has enormous effects on an economy's productivity and efficiency, especially for efficiency-driven countries such as Mexico. However, the challenge is to reinforce the ability to produce innovative products and services at the global technology frontier using the most advanced methods to become the dominant source of competitive advantage (Solleiro and Castañón, 2005); in other words, a

[6] For further details, [http://www.imf.org/external/pubs/ft/weo/2008/01/weodata/groups.htm#oem]

transformation of an *efficiency-driven economy* to an *innovation-driven economy*. In this context, Mexican higher education organizations are characterized by law, rules and conditions that are introduced within a legal, economic, cultural and social context of each country; and these are influenced by the level of development achieved (factor-efficiency-innovation driven). Mexicans face a big challenge for higher education organizations because many problems and gaps must be solved beforehand. In the past three decades, governmental agencies have been introducing supporting programs to promote collaboration between enterprises and knowledge-creation agents in order to improve innovation and knowledge transfer and to achieve a higher development state. Therefore, it is important to analyze that Mexico needs to improve the drivers to economic development, especially human capital (Solow, 1956), knowledge capital (Romer, 1990) and entrepreneurship capital (Audretsch, 2014).

Data were gathered by different methods and tools applying the concept of triangulation proposed by Yin (1984). In particular, we collected data using secondary sources such as the International Monetary Fund, World Bank, Mexican Government (National Development Plans -from 1983 to 2018-, Diario Oficial, Presidency, Chamber of Deputies), National Council for Science and Technology (CONACYT), Ministry of Economy, INADEM, Fondo PYME, Ministry of Education (SEP), Nacional Association of Universities and Higher Education Organizations (ANUIES), Global Entrepreneurship Monitor (GEM), World Economic Forum (WEF), National Institute of Statistics and Geography (INEGI), World Intellectual Property Organization (WIPO), Organisation for Economic Co-operation and Development (OECD), Times Higher Education, and the Financiero. The data collection was conducted over a six-month period (September 2015 to March 2016). Regarding data analysis, procedures suggested by Yin (1984) and

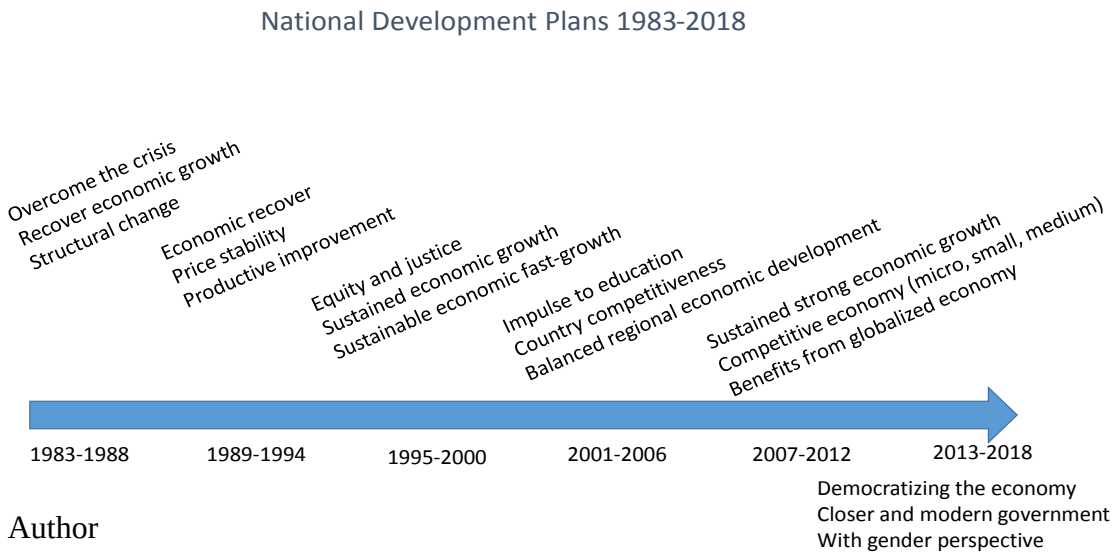
Eisenhardt (1989, 2007) were adopted. In particular, we used a general analytic approach that prioritizes information through the development of categories of data and the examination of similarities.

2.3.2. Understanding the Mexican entrepreneurship and innovation strategies

During the past 32 years, Mexico has experienced a deep process of transformation. After the 1982 financial crisis created very critical conditions for the Mexican economy, it was necessary to introduce structural changes to design and apply economic policies in order to drive stability and development for Mexico and Mexicans. According to the World Bank Indicators, Mexico's economy, politics and society have rapidly transformed from an efficiency-driven economy to an innovation-driven economy. The Mexican government has implemented certain strategies to stimulate regional economic development and the transition from an efficiency economy to an innovation economy. Figure 2.1 shows the government's economic development objectives during the past three decades.

The first initiative was the National Development Plan applied during the Miguel de la Madrid Hurtado administration (1983–1988). The main challenge during this period was maintaining and reinforcing the independence of the nation (Gobierno de la República, 2015 b). Its focus was to build a society under the principles of the state's rights and to guarantee individual and collective freedom in an integral democratic system with social justice conditions (pp. 3–4). Based on these challenges, the economic and social development strategy was oriented to an economic restructuring and a structural change.

Figure 2.1: Evolution of National Development Plans



Source: Author

The second initiative was the modernization plan implemented during the Carlos Salinas de Gortari administration (1989–1994). In this period, the main focuses were the defense of sovereignty, the expansion of democratic scenarios, the recovery of the economy and the improvement of productivity (Gobierno de la República, 2015 c). However, after a five-year period of stability and national recovery, another crisis occured during the last year of this administration. As a consequence, during the Ernesto Zedillo Ponce de Leon administration (1995–2000), the main challenge was to face the most severe crisis in Mexico. In this scenario, strategies were devised to reinforce national sovereignty, to consolidate a social harmony, to build a complete democratic development system, to improve socioeconomic development and to promote a sustained/sustainable economic fast growth (Gobierno de la República, 2015 d).

Mexico started a new political era with the Vicente Fox Quezada administration (2001–2006). Its main strategy was to launch Mexico toward an accelerated growth through collaborative public relationships including education, social cohesion, human development, economic

course, competitiveness and public security, among others (Gobierno de la República, 2015 e). The following Felipe Calderón Hinojosa administration (2007–2012) focused on sustainable human development based on five axes: law enforcement and security; competitive job creation and equal opportunities; environmental sustainability; effective democracy; and responsible foreign policy (Gobierno de la República, 2015 f). December 2012 saw the start of the Enrique Peña Nieto administration, with its general objective to lead Mexico to its full potential and achieve the central idea that Mexico is a place where each person is able to write his/her own successful story and be happy (Gobierno de la República, 2015 a). Peña Nieto's planning was based on inclusion, peace, prosperity, qualified education and worldwide responsibility, with productivity, modernization and gender perspectives as transversal strategies.

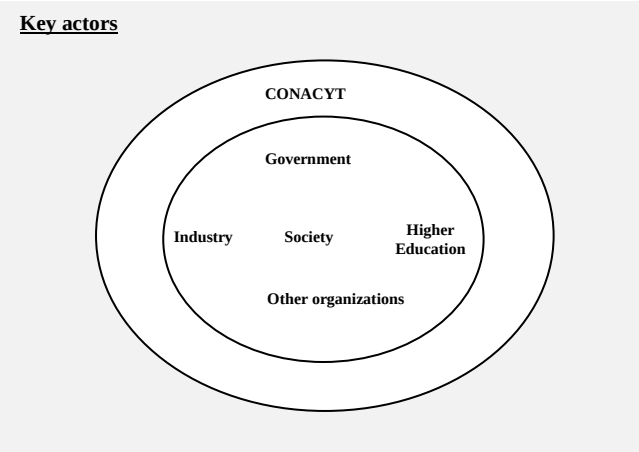
Based on our review of those National Development Plans, we confirm that Mexico is trying to implement strategies to move from a factor-driven economy to an efficiency-driven economy and is now oriented to introduce an innovation economy to achieve the status of an innovation-driven economy (Global Entrepreneurship Monitor, 2015). Today, economic development is characterized by a deeply competitive international environment and a knowledge-based economy. Mexico is classified by the World Economic Forum (2014) as an efficient-based economy. According to the National Development Plan 2013–2018 (Gobierno de la República, 2015 a), Mexico is searching for a strategy and processes to enhance this level and achieve a new development level based on innovation and knowledge. Therefore, this evolutionary perspective helps us to understand the configuration of the Mexican entrepreneurship and innovation ecosystems that will be explained in the next section.

2.4. Results and discussions

2.4.1. Mexican innovation ecosystem

Supported by the Innovation Law (Diario Oficial, 2014), the Mexican Science, Technology and Innovation System is integrated by: (i) the National Council for Science and Technology (CONACYT); (ii) the Mexican government; (iii) the Mexican industry; and (iv) higher education systems. Figure 2.2 shows the main agents involved in the Mexican Science, Technology and Innovation System (Diario Oficial, 2014).

Figure 2.2: Mexican Science, Technology and Innovation System



Source: Diario Oficial (2014).

***National Council for Science and Technology**:* The first agent is the National Council for Science and Technology (CONACYT), which is a decentralized public organization responsible for the design, development and implementation of the main scientific and technological policies. Since its foundation in 1970, based on the national priorities and in collaboration with all the other agents, CONACYT promotes the reinforcement of human

capital (scholarships and evaluation of national researchers), the development of scientific/technological activities (research funding, supporting innovative enterprises, etc.) in strategic areas (e.g., communication, biotechnology, advanced materials, manufacture design, socioeconomic development, social innovations) and the implementation of each administration (CONACYT, 2015 a).

CONACYT was involved with the development and implementation of the Scientific and Technological Research Law in 1999 and the Science and Technology Law in 2002 (Pérez-Hernández and Calderón-Martínez, 2014). During the Calderón administration (2007–2012),[7] the Mexican Science, Technology and Innovation System faced a decentralization strategy across the 31 states that integrate Mexico. According to the INEGI (2016), the exercised budget by CONACYT was 202 million pesos in 1990 and 18,421 million pesos in 2013. As a result, during the past decade, Mexican knowledge production—measured by the number of patents of Mexican residents, trademarks and industrial designs—has increased from 1% in 2000 to 3% in 2014 (WIPO, 2016). The distribution of those patents has been primarily in pharmaceutical, engineering and medical areas, and the 2014 top higher education applicants were the UNAM and the ITESM.

In this regard, CONACYT has implemented several initiatives to foster innovation throughout the collaboration among different agents (enterprises, research centers, higher education organizations). Some examples include innovation incentives such as the Programa de Estimulos a la Innovación (PEI), with three modalities (Innovapyme, Finnova and Innovatec) and an investment of more than 7,447 million pesos since 2009, and programs such as the

[7] Gobierno de los Estados Unidos Mexicanos (2007). Plan Nacional de Desarrollo 2007-2012. Mexico: Presidencia de la República [http://pnd.calderon.presidencia.gob.mx/pdf/PND_2007-2012.pdf], last access October 2015.

Mixed Founding (FOMIX), the Technological Modernization Program (PMT), the Technological Consultant Register (RCCT), and the Innovation and Technology International Fund (FONCICYT), among others. It is important to note that the results obtained during the past decade from those supporting programs were lower than expected because they have also been influenced by factors such as the lack of collaboration from enterprises, the lack of human capital, the lack of trained employees and higher cost in production factors. Simultaneously, CONACYT has implemented incentives for the development of human capital, including Sistema Nacional de Investigadores (SNI) and Sabatic stancies in foreing institucions (CONACYT, 2015 b).

Government: The second agent is represented by the Mexican government, which has implemented programs to facilitate the development of basic/applied research, technology and innovation. According to the Diario Oficial (2014) and OECD (2010 and 2012), during the Calderón administration, Mexico spent 378,021 million pesos to develop scientific activities and technology that represented around 37% of the gross domestic product (GDP). In general terms, federal government expenses in science and technology increased from 2,035 million pesos (28% of GDP) in 1990 to 68,317 million pesos (42%) in 2013 (INEGI, 2016). Typically, the distribution of expenditures for national science and technology has been 56.5% toward research and development of experimental activities, 23.9% toward education and training for scientists and technicians and 19.5% toward the services of science and technology. The main funders have been the government (49.3%), private sector (44.5%) and universities (6.2%).

Industry: The third agent is represented by more than 3 million economic units. In general, small and medium enterprises (SMEs) represent more than 99% of all Mexican firms. They

have accounted for more than 70% of all employment since 1993, and they generate more than 50% of the GDP (Hausmann et al., 2009). Mexico is also characterized as one of the world's most entrepreneurial countries in terms of the percentage of its population who has started or is in the process of starting a new venture (Flores et al., 2013). Yet there is evidence that Mexico is not friendly to entrepreneurs. It is estimated that between 60% and 90% of new ventures are started in the informal sector. While job growth expectations and realizations arguably constitute the most visible medium-term impact of entrepreneurship, innovative orientation impacts structural renewal in the long-term. Mexico has made room for entrepreneurship, but it does not seem to foster the kind of entrepreneurship required for economic growth. In terms of innovation, only one-third of new entrepreneurs identified in the total entrepreneurial activity develop new products or services for their customers, when in innovation-driven economies it is almost one-half of new entrepreneurs (Flores et al., 2013).

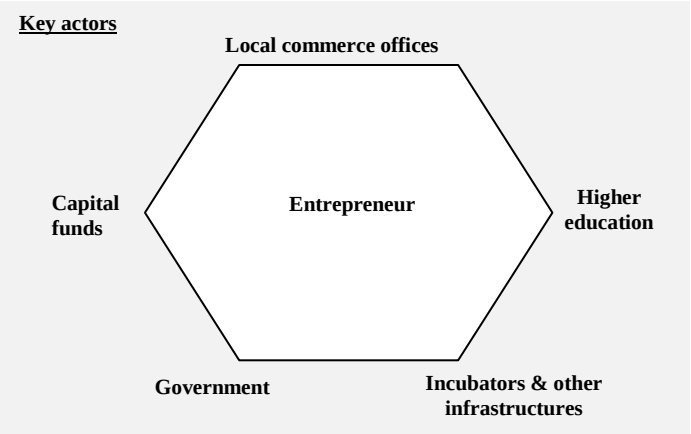
Higher education organizations: The last agent is represented by higher education systems, comprising technological institutes, technological universities, intercultural universities, polytechnic universities, federal public universities, regional public universities, higher teacher education universities, private universities and public research (SEP, 2012). Therefore, Mexican higher education systems are characterized by diversity and heterogeneity as well the normative of the Mexican Ministry of Education (SEP, 2015a, 2015b). The laws and regulations associated with Mexican higher education systems are article 3 of the Constitution, article 38 of the Organic Law of Federal Public Administration, the General Law of Education, the Science and Technology Law (SEP, 2015a), the local laws from each state of the country and specific organic laws and regulations of each local organization. There are also some associations such as the ANUIES (Nacional Association of Universities

and Higher Education Organizations) that include 179 members (ANUIES, 2015). Interestingly, the origin of higher education' resources are from private organizations (31.7%), from autonomous organizations (31.2%) and from public founding distributed by the federation (13.4%) and the states (17.8%) (SEP, 2012). In addition, according to Silas Casilla (2005), the Mexican private education system has shown three tendencies since 2000: (i) diversification and growth; (ii) differences in contributions, impact and quality with respect to public organizations; and (iii) the focus to attend to the demands of poor people who have not got any place in a public university. In terms of quality, according to the Times Higher Education, World University Ranking 2014–2015, Mexican universities are not found in the first 400 positions (Education Times Higher, 2015). However, in the classification presented by the Shanghai Ranking in the Academic Ranking of World Universities (Top 500), the National Autonomous University of Mexico (UNAM) is found only in the 201–300 range and within the best 400 worldwide only in 2014 (Ranking Shangai, 2015).

2.4.2. Mexican entrepreneurship ecosystem

In Mexico, an entrepreneurial ecosystem is a system integrated by a set of economic agents linked and working to create, develop and consolidate conditions to promote entrepreneurial activity and micro, small and medium enterprise (MiPyME) development (INADEM, 2015). According to the INADEM (2015), the Mexican entrepreneurial ecosystem is integrated by: (i) private and public sources of funds, such as venture capitalists, banks, subsidies, and so on; (ii) chambers of commerce; (iii) higher education organizations and research centers; (iv) public and private incubators and accelerators; and (v) other public/private organizations (Figura 2.3). Similar to an innovation ecosystem, the entrepreneurial ecosystem works across the 31 states and with the support of universities.

Figure 2.3: Mexican entrepreneurial ecosystem



Source: INADEM (2015).

Chambers of commerce: These organizations and entrepreneur associations play a relevant role in any entrepreneurial ecosystem because they know the main needs and have strong channels of communication among the agents. In other words, these organizations are the main translators between the enterprises and local agents such as the government, universities and employee associations.

Capital funds: Funding tends to be the main element associated with the creation and growth of new/established ventures. For this reason, venture capitalist, business angels, crowdfunding and banks are some of the most common sources of funding. Any entrepreneurial ecosystem requires strong financial mechanisms that allow entrepreneurs access not only to start-up capital but also capital for growth. Some examples include the creation of investors clubs or networks, the establishment of loan programs to support entrepreneurial activity (e.g., programs developed by Santander Bank, BBVA Bancomer, Nacional Financiera, Banamex, Banregio and Banorte), the development of co-inversion modalities (public-private) and the creation of crowdfunding platforms.

Higher education organizations: Many higher education organizations contribute to entrepreneurial ecosystems by providing talent, resources and capabilities through their activities as well as supporting infrastructures (technology transfer offices, incubators and accelerators). In this regard, Pérez-Hernández and Calderón-Martínez (2014) have shown that the support of higher education organizations contributes to the development of innovation as well as knowledge transfer and commercialization, where the efficiency of technology transfer offices (OTT) has been fundamental. For instance, many entrepreneurship educational programs and infrastructures developed by higher education organizations are classified/registered/certified by the INADEM according to the level of impact produced (e.g., university incubators and accelerators).

Incubators and accelerators: With its integration of a national network of incubators and accelerators, INADEM tries to ensure solid entrepreneurial support; in particular for the different stages of the entrepreneurial process. For instance, INADEM's records shows 196 basic incubators registered, including 24 high-impact incubators and 24 accelerators (INADEM, 2014). The creation and operation of incubators across the country are an important factor in obtaining successful start-up rates. INADEM classifies these infrastructures into high-impact of basic-impact categories. In general, there are two models proposed by the Instituto Politécnico Nacional and the Tecnológico de Monterrey are examples of that.

Government: Over the past three decades, the Ministry of Economy has been responsible for the strategies associated with the creation and development of ventures. In the current Peña

Nieto administration (2013–2018)[8], the main focus has been to foster economic development via innovation and new/established enterprises, with strategies in place to reinforce several elements of the Mexican entrepreneurial ecosystem, such as governmental supports, financing, entrepreneurial capabilities and culture, and technology. With this aim, this administration has created the National Institute of the Entrepreneur (INADEM), which is linked to the Ministry of Economy, as well as modifying existing legislation (e.g., education, foreign investment, telecommunications, tax system and labor) to develop the entrepreneurial ecosystem.

During the Fox and Calderón administrations, the main program in support of entrepreneurship was the Small and Medium Enterprise Fund (Fondo PYME),an important advancement to improve entrepreneurial capabilities in Mexico managed by Ministry of Economy between 2004 and 2012. During this time, many higher education organizations were important actors offering support via knowledge, experience and networking. In the current Peña Nieto administation (2013–2018), two programs have been designed as the platform to encourage entrepreneurship: the Entrepreneurial Development Program (Programa de Desarrollo Empresarial) and the Entrepreneur and Financing Program (Programa de Emprendedores y Financiamiento). These mechanisms were introduced to improve entrepreneurial activity and increase the value of Mexican products and services (Secretaría de Economía, 2016a, 2016b, 2016c). As a result, between 2004 and 2012, a total of 76,087 enterprises were created, with an employment generation of 395,674 and with the support of more than 32,015 million pesos (Fondo PyME, 2016).

[8] Gobierno de los Estados Unidos Mexicanos (2013). Plan Nacional de Desarrollo 2013-2018. Mexico: Presidencia de la República. [http://pnd.gob.mx/wp-content/uploads/2013/05/PND.pdf], last access October 2015.

Between 2014 and 2016, INADEM has invested more than 26,968 million pesos (El Financiero, 2016).

2.4.3. The role of higher education organizations as drivers of entrepreneurship and innovation activities in Mexico

In the majority of socioeconomic scenarios, universities play a relevant role in entrepreneurial innovation processes, not only by reinforcing a governmental strategy to stimulate economic development (Hoskisson et al., 2000; Guerrero et al., 2015) but also by providing adequate environments in which the university community can develop innovative and entrepreneurial initiatives (Audretsch, 2014; Guerrero et al., 2015). In this regard, several authors such as Guerrero and Urbano (2012), Urbano and Guerrero (2013), and Audretsch (2014) have shown the current higher education organizations' missions: education and training to community members, knowledge generation and transference, and fostering entrepreneurship and innovation.

In this regard, our previous section provides some insights into the relevant role and alignment of universities in the evolution of Mexican innovation and entrepreneurship ecosystems. Some of those insights have also been shown in previous studies about the interaction channels between universities and industry in Mexico (De Fuentes and Dutrénit, 2012). However, in-depth analysis is still required of the efficiency/productivity relationships among the agents involved in both innovation and entrepreneurial ecosystems; particularly, how Mexican universities are facing their roles/strategies to drive entrepreneurial innovations. Nevertheless, we also need to take into account that in emerging economies, the participation

of universities as the promoter of entrepreneurial innovations has been limited and it is not homogenous.

In the Mexican case, higher education organizations have a relevant presence in both innovation and entrepreneurship processes. According to INEGI (2015), there are 5,739 higher education organizations, 443 research centers and 21,259 business units in Mexico that provide other linked services, such as professional, scientific and technical services. Unfortunately, not all those higher education organizations are working simultaneously toward the three missions (teaching, research, transference and commercialization) or their transformation process. Only 10% of higher education organizations and 17% of research centers are registered in the National Register for Scientific and Technological Organizations and Enterprises (CONACYT, 2015 c).

Figure 2.4: Entrepreneurial ecosystems heat map by country. Pillars most important

Pillar	US - Bay Area	US - Other Cities	United States	United Kingdom	Switzer-land	Ireland	Spain	Singa-pore	Pakistan	India	Australia	Mexico
Accessible Mar-kets	92%	83%	86%	82%	89%	79%	67%	70%	78%	72%	71%	52%
Human Capital Workforce	93%	87%	90%	79%	67%	74%	90%	50%	92%	72%	79%	65%
Funding and Fi-nance	91%	76%	82%	68%	61%	53%	43%	65%	22%	44%	67%	52%
Mentors/Advisers/ Support Systems	91%	72%	79%	68%	56%	53%	29%	40%	58%	28%	54%	48%
Regulatory Frame-work/ Infrastructure	67%	57%	61%	57%	61%	63%	48%	80%	31%	28%	54%	52%
Education and Training	80%	62%	70%	61%	61%	37%	62%	40%	39%	22%	33%	30%
Major Universities as Catalysts	88%	67%	75%	68%	67%	37%	38%	65%	22%	11%	38%	35%
Cultural Support	90%	64%	75%	50%	39%	42%	24%	40%	25%	17%	29%	22%
Average Score	86%	71%	77%	67%	63%	55%	50%	56%	46%	37%	53%	45%

Heat Map Key
- Highest % of Respondents
- Approximately Half % of Respondents
- Lowest % of Respondents

Source: World Economic Forum (2013, p. 13)

Applying the World Economic Forum benchmarking approach,[9] in comparison with other ecosystems from more advanced economies, Figure 2.4 shows that the Mexican entrepreneurial ecosystem suffers from several deficits in the majority of the pillars; particularly, in cultural support, education/training, and universities such as catalysts of entrepreneurship (World Economic Forum, 2013). Therefore, in order to develop human capital, generate knowledge and foster innovative/entrepreneurial initiatives (Guerrero et al., 2015), Mexican higher education organizations need to introduce diversified support mechanisms (Bramwell and Wolfe, 2008); to act proactively in the entrepreneurship innovation, enhancing links with all the agents involved in those ecosystems (Mian, 1997; Etzkowitz, 2003; Mueller, 2007; Perkemann and Walsh, 2007); and to generate more competitive collaborations for value creation (Chesbrough et al., 2006). Definitely, higher education organizations could bring competitive advantages (resources and capabilities) to drive entrepreneurship innovation activity in Mexico. Those competitive advantages could be encouraged by talent, human capital, incubators, accelerators, open innovation collaborations, generation and transference of knowledge as well as value creation for socioeconomic development.

2.5. Conclusions

The analysis of the involvement of Mexican higher education organizations in innovation and entrepreneurship ecosystems reflects the existence of incentives to accomplish their triple mission but also a poor participation in the involvement of innovation and entrepreneurial activities. A plausible explanation is that the Mexican higher education system context is

[9] The World Economic Forum (2013) recognizes the importance to create and operate an entrepreneurial ecosystem as well as proposes some pillars to the growth/success of ventures such as accessible markets, human capital, funding, support systems, regulatory framework, education/training, and cultural support.

complex, diverse and contrasting. In addition, the majority of Mexican higher education organizations are only attending to teaching and only some of them are also focused on research. As a result, only a few universities are using their resources/capabilities to transform themselves into competitive organizations that contribute to the generation of talent and qualified people, higher quality research, strong knowledge transfer and commercialization, and value creation (Amit and Schoemaker, 1993; Barney, 1991; Boyd, 1991; Grant, 1991; Wernerfelt, 1984). Successful examples include the CINVESTAV, the IPN, the Tecnológico de Monterrey and the UNAM.

Based on this evidence, the main implication of this chapter is oriented toward policy makers. Of course, the efforts made by CONACYT and the Ministry of Economy in the configuration of the Mexican innovation and entrepreneurship ecosystems is recognized. However, the obtained results are not sufficient due to the lack of participation among enterprises, higher education organizations and research centers. It is necessary that each participant works together systematically and systemically, using an open innovation approach, to capitalize in a complementary way on each other's resources and capabilities to generate entrepreneurial innovation activity. Both the Ministries of Education and Economy must recognize the relevant role of universities and encourage, motivate and involve universities in the development and implementation of innovation and entrepreneurship strategies.

This chapter only explores the role of higher education organizations in innovation and entrepreneurship activities. Therefore, this chapter also illuminates a good research opportunity to continue the exploration of this phenomenon using different theoretical/methodological approaches. Particularly, to understand why Mexican higher education organizations are only attending to teaching and training activities; to identify

which factors that influence the main outcomes of innovation and entrepreneurship supporting programs; to recognize which are the best practices of most representative Mexican entrepreneurial universities to understand the reasons and factors that drive their success; and finally to determine which types of collaboration among production agents and knowledge agents are more adequate to stimulate economic development by government agencies.

In this regard, the following chapters explore the role of Mexican higher education organizations in innovation practices (Chapter III), entrepreneurship practices (Chapter IV), and impacts on outcomes (Chapter V).

CHAPTER III:

DO HIGHER EDUCATION ORGANIZATIONS MATTER IN ENTREPRENEURSHIP PRACTICES? LOOKING INSIDE MEXICAN UNIVERSITY-ENTERPRISE PARTNERSHIPS' STRATEGIC AND INNOVATION PURPOSES

3.1. Introduction

Chapter II explores the relevance of Mexican higher education organizations on national innovation systems. In this regard, the literature has traditionally explained that innovation practices in enterprises are motivated by potential outcomes in terms of innovation performance (Hagedoorn, 1993), technological evolution (Rosenkopf and Nerkar, 2001), product introduction (Laursen and Salter, 2006) and the types of collaborations they engage in (Tsai and Wang, 2009). However, in order to identify the key motivational conditions of innovation practices, it is essential to understand the enterprises' structures and strategies.

In line with these arguments, a growing number of enterprises are starting to implement innovation practices in which they employ both internal/external flows of knowledge in order to explore/exploit innovation in collaboration with commercial or scientific agents (Yasmin and Otto, 2004; van de Vrande et al., 2009). Within this context, universities play a significant role in entrepreneurial innovation processes (Audretsch, 2014; Shane, 2003), by providing fertile knowledge-intensive environments to support the exploration and exploitation of innovative and entrepreneurial ideas (Grimaldi et al., 2011; Guerrero et al., 2014a, 2014b, 2015; Guerrero and Urbano, 2012; Kirby et al., 2011; O'Shea et al., 2005; O'Shea et al., 2007; Rothaermel et al., 2007; Urbano and Guerrero, 2013; Wright et al., 2007), especially in emerging economies, where governments have created subsidies to promote enterprise innovation through compulsory university partnerships as a strategy to stimulate regional economic development and the transition from an efficiency economy to an innovation economy (Cohen et al., 2002).

As a consequence, in both developed and developing economies, public research has been oriented to industry's needs and public resources have been conditioned by the new rules of the game whereby universities contribute to social and economic development (Grimaldi et al., 2011). In this context, universities attempt to transform their business models by taking into account the needs, priorities and capabilities of all stakeholders (Miller et al., 2014). However, in emerging economies, university transformation is slow because there is not a strong base to build upon and obtain high-quality research outcomes, while enterprises interested in partnerships usually face challenges in terms of communication, expectations and agreements.

To date, limited attention has been given to the importance of university–enterprise partnerships in transforming emerging economies into innovative economies in which the generation, transfer and commercialization of knowledge becomes a pillar of economic development. The main reason for this is the lack of databases or other sources of information, as well as the emerging stage of applied and non-applied research designed to generate economic value. If we compare developed economies and transitional economies, we observe some similarities and differences. For instance, improving the performance of the labor market, the productive potential of the economy, and social cohesion are common objectives in most developed and transitional economies (Quintini and Martin, 2014, p. 9). Despite these common goals, previous studies (Souto-Otero and Whitworth, 2016) have highlighted how the challenges faced by both types of economies are somewhat different in terms of demographic trends; labor market; educational enrolment; organizations supporting; social attitudes; and the quality vs. the quantity of innovations.

In this regard, Mexico is a relevant country in the global context because of the size of its economy and its leadership position in Latin America (World Economic Forum, 2009), and where universities currently play a major role in the development of an innovation ecosystem, the transition to the knowledge economy (Guerrero and Urbano, 2012). As a consequence, the university business model is also in a state of transition, whereby knowledge transfer and innovation processes are evolving into primarily innovation processes (Chesbrough, 2003; Miller et al., 2014), with multiple stakeholders trying to exert an influence on the process (Alsos et al., 2011). Based on these ideas, the purpose of this chapter is to provide a better understanding about the role of universities on enterprises' innovation practices in emerging economies. In particular, in the context of an emerging economy, we explored the enterprises' motivations to collaborate with universities in terms of innovation purposes (exploration and exploitation) or alternatives to access to public funds (compulsory requirement of being involved in a university partnership).

The chapter is organized as follows: Section 3.2 presents a review of the literature on universities' involvement in enterprises' innovation practices, and the proposed conceptual model. Section 3.3 describes the methodological design, including data collection and statistical analysis. Section 3.4 presents the results obtained and discusses them in the light of previous studies. Finally, Section 3.5 contains the concluding remarks, including the limitations and implications of our study, and avenues for further research.

3.2. Theoretical framework

Exploitation practices involve the refinement and extension of existing knowledge while exploration practices refer to a learning process or acquisition of new external knowledge

(Alcalde and Guerrero, 2016). The selection of innovation practices depends on the ability to exploit/explore innovative capabilities that in some cases involves creating markets for intellectual property that was owned by the enterprises but not exploited by them (Arora and Fosfuri, 2003; Kim and Kogut, 1996). Following this assumption, enterprises collaborate in order to facilitate direct and systematic use of external resources (Becker and Dietz, 2004). However, each type of collaboration involves different transaction costs due to information asymmetry, asset specificity, opportunistic behavior, and uncertainty regarding the appropriation of the income produced (Nieto and Santamaría, 2007). In this regard, enterprises determine the feasibility of collaborations on the basis of opportunities and risks associated with each type of collaboration.

In order to understand the importance of universities' partnership within enterprises' innovation practices, it is necessary to address services, achievements, beneficiaries, expected results as well as understand that this process will be influenced by the environment, profiles of individuals/partner and purposes (Barbero et al., 2014). In general, university support is highly effective in the creation and survival of knowledge-based enterprises (McAdam and McAdam, 2008; Romanelli, 1989) because of sharing unique sets of valuable and imperfectly imitable resources (financial and phyiscal) and capabilities (human and organizational) (Kirby et al., 2011). However, in emerging countries, universities faces numerous limitations in quality and quantity of those resources and capabilities (Guerrero et al., 2014b). Nevertheless, universities are still key pillars in government efforts to reinforce the innovation ecosystem via subsidies designed to make science more relevant to industry's needs (Cohen and Klepper, 1996; Cohen et al., 2002; Herrera et al., 2016; Guerrero et al., 2016). Based on these arguments, this section focuses on discussing the role of universities in partnership with enteprises in innovation practices.

3.2.1. Motivated by strategic purposes

Depending on strategic purposes, enterprises usually collaborate with science-based, commercial and mixed organizations (Alcalde and Guerrero, 2016).

First, enterprises with an orientation towards radical innovations are involved in science-based collaboration with universities (Kenney and Mowery, 2014; O'Connor and De Martino, 2006). Traditionally, rather than intrapreneurial and commercial innovation practices, enterprise-university partnerships are characterized by an absorptive capacity of inflow knowledge as well as possible access to R&D public funding, qualified/specialized personnel and technological capabilities (Belderbos et al., 2004; Colombo et al., 2004; Astrom et al., 2008; Olazarán et al., 2009). In this sense, the strategic purposes behind university-enterprise partnerships are learning/acquiring new external knowledge, technological regeneration, absorption of new skills, and development of radical or long-term innovations, through, for example, networking or outsourcing (Bonaccorsi et al., 2013; Kenney and Mowery, 2014; Gassmann, 2006; Grimaldi et al., 2011; Nambisan et al., 2012).

Second, enterprises with an orientation toward incremental innovations usually are involved in commercial collaborations with different partners associated with the subsidiaries or with the industrial value chain (outflows of knowledge). Traditionally, rather than science-based innovation practices, commercial innovation practices are characterized by a fast return on investment, risk reduction and enhancing flexibility, quality and market adaptability (Chung et al., 2003; Tether, 2002). In this regard, these innovation practices may also pursue non-technological objectives such as the identification of opportunities and expansion of the companies' markets, through internationalization or entry into new markets (Anthony, 2012;

Bayona et al., 2001; Tether, 2002). Evidence suggests some advantage behind this type of innovation practice such as reduction of market uncertainty, outward licensing of intellectual property, capitalization of initiatives and return of investment (Lichtenthaler and Ernst, 2007; Ritala and Hurmelinna-Laukkanen, 2013; van de Vrande et al., 2009).

Third, in an effort to achieve an effective exploration/exploitation of innovation, enterprises usually adopt diversified collaboration patterns. In this case, the purpose is a combination of partnerships that facilitates the generation of radical and incremental innovations (Alcalde and Guerrero, 2016). Consequently, having a variety of commercial and scientific partners has a greater positive impact on the degree of novelty in products than collaboration with only one type of partner (Nieto and Santamaría, 2007), especially within prosperity contexts. In emerging economies, limited access to various financial sources may generate negative enterprise dynamics due to insufficient entry of innovative enterprises in the market (Nanda and Rhodes-Kropf, 2011); for this reason, mixed collaborations facilitate the building of sustainable competitive advantages and support innovation performance (Laursen and Salter, 2006), particularly for enterprises that are fighting for organizational survival, because optimal combinations of commercial and technical (scientific) skills reduce market uncertainty (Damanpour, 1991).

Intuitively, in scenarios with unpredictable market conditions, enterprises will try to collaborate with several partners simultaneously in order to be competitive and innovative while sharing potential challenges and risks.

Hypothesis 3.1: Innovative enterprises are more likely to collaborate with universities to develop radical innovations than to develop incremental innovations.

Hypothesis 3.2: The role of universities in exploratory innovation is more significant in science-based collaborations than in mixed collaborations with other agents.

3.2.2. Motivated by government subsidies

Governments around the world have created subsidies or incentive innovation programs to promote knowledge exchange (Bozeman, 2000); especially, in emerging economies, where university-enterprise partnership is compulsory as a strategy to stimulate regional economic development (van de Vrande et al., 2009). In certain scenarios characterized by several constraints, the main policy makers' assumption is to transfer to universities and government research centers responsibilities linked to innovation and commercialization practices (Marzo et al., 2008) as well as to pay attention to industry's needs (Cohen et al., 2002). Even these policy makers intentions, subsidies or incentive innovation programs also represent for universities and enterprises an excellent opportunity to develop subsidized innovation (de facto lowering of the costs for all the participants in these initiatives) (Guerrero and Urbano, 2016) as well as a risk to adopt an university-industry opportunist when the relationship is relatively fragile and tends to be discontinued when the public funds for the initiative dry up (Gianiodis et al., 2016) or with the existence of opportunism from intermediaries when governments use them as a bridge between enterprises and public funding (Armanios et al., 2016). Overall evidence on university-enterprise innovation practices is thinly spread and

further research and analysis is warranted (Feller, 2005; Parkmann et al., 2013). Neither theoretically nor empirically, is there a definitive justification or evidence of the effectiveness of public R&D subsidies in stimulating private/collaborative R&D as well as resulting in significant and tangible outcomes (Greco et al., 2016; Hall, 2005; Hall et al., 2016).

The proponents of R&D programs consider that subsidies enhance firm productivity, reinforce domestic economic growth, generate spillovers and increase private R&D expenditures (Dimos and Pugh, 2016). In this point of view, subsidies give the opportunity to an individual enterprise or a collaboration partnership to turn an unprofitable project into a profitable one or complete an existing project. Enterprises may view public funds as a relatively cheap way to finance their R&D projects, especially when application costs are low and the probability of selection is high compared with alternative financing sources (Aschhoff, 2009; Aschhoff and Sofka, 2009). As a result, subsidies reduce the fixed costs of other current and future research projects and increase their probability of being completed or undertaken (Benavente et al., 2007).

The opponents of R&D programs argue that subsidies are not diverted to the best firms because the selection of subsidized firms could be influenced by pressure groups (Hall et al., 2016) or that the information asymmetry between firms and investors generates difficulties in measuring the private and social returns of R&D projects (Callahan et al., 2012). Some studies also recognized that the majority of subsidized firms are selected more on the basis of achieving political, economic and strategic government's purposes than on the basis of the project quality (Sissoko, 2011). However, evidence also supports the existence of long-standing partnerships between universities and enterprises and the fact that universities continue to aggressively seek industrial sponsorship. These partnerships persist despite the

fact that government subsidies and grants create strong administrative burdens for companies, as government support is considered to be highly inflexible since it does not allow for the change of partners and the programs cannot end before a given date (van de Vrande et al., 2009).

Given these perspectives, subsidies provide resources for the development of projects involving universities and enterprises; examples include the European Commission framework programs (Caloghirou et al., 2001); federally funded schemes such as the Advanced Technology Program in the United States (Hall et al., 2001); funding instruments provided by research councils and government departments in the United Kingdom (Howells et al., 1998); federal university–industry projects in Germany (Almus and Czarnitzki, 2003; Czarnitzki et al., 2003), among others. In fact, Bellucci and Pennacchio (2015) analyzed university–enterprise partnerships across European countries and found that environmental context explains the effectiveness of those innovation practices as well as confirms that enterprises are more likely to collaborate with universities when they are looking for radical innovations.

Similarly, previous studies have estimated the effect of public subsidies on the promotion of R&D activities and university–enterprise cooperation (Segarra-Blasco and Arauzo-Carod, 2008) and have concluded that enterprises with access to such public subsidies tend to cooperate with one another (Cassiman and Veugelers, 2002). Current research in the field is focusing more on university–enterprise partnerships across emerging economies, which is providing interesting insights into the dilemmas experienced in university–enterprise partnerships for innovation purposes in Brazil (Bastos et al., 2014); exploring the role of intermediaries in the innovation process in China (Armanios et al., 2016); investigating the

partnership intensity influenced by the technological change and expected profitability translation of innovative efforts in Vietnam (Santarelli andTran, 2016); and identifying elements such as reputation and national priorities that define the incentives that drive innovation partnerships in South Africa (Kruss and Visser, 2017).

Based on these arguments, in emerging economies where public subsidies are oriented to reinforce university–enterprise partnerships, we expected to find that these government interventions allow for an effective exchange of knowledge, the generation of radical innovations, and spillover effects (Astrom et al., 2008; Boschma, 2005; Brenes et al., 2016; Perkmann and Walsh, 2007; Perkmann et al., 2013). Indeed, this expected effect will be reinforced when enterprises develop mixed innovation practices simultaneously with universities and other enterprises (Alcalde and Guerrero, 2016).

Hypothesis 3.3: The access to government subsidies with compulsory university partnerships is greater in exploratory innovation practices than in exploitative innovation practices.

Hypothesis 3.4: The access to government subsidies with compulsory university partnership is greater in mixed collaborations than in exclusively science-based collaborations.

3.3. Methodology

3.3.1. Data collection

Aligned with the purpose of this research and previous researchers (Herrera et al., 2016; Guerrero and Urbano, 2016, Santiago et al., 2016), we used the 2012 Research and Technological Development Survey (ESIDET, Encuesta sobre investigación y desarrollo tecnológico). This is a cross-section dataset that contains 10,167 enterprise-level data collected by the Mexican Institute of Statistics (INEGI) [10] to enhance the statistical information on enterprise innovation activities. According to ESIDET' methodology, the population of enterprises is identified in the Mexican economic censes. Based on this information, a probabilistic and stratified sample (enterprises with 20 or more employees distributed by productive levels and by Mexican geography) with an assumed statistical error of less than 5% or 8% is estimated. This survey is biannual and the main respondents are the owners/managers of those enterprises. Based on this methodological design, INEGI ensures the enterprises' selecting process without a previous distinction in the development of innovating or non-innovating activities. This avoids bias in the results obtained with this dataset as suggested previous studies (Alcalde and Guerrero, 2016; Bayona et al., 2001; Fritsch and Lukas, 2001).

3.3.2. Description of variables

In order to analyze the importance of universities' partnerships in enterprises' innovation processes, and on the basis of previous studies (Alcalde and Guerrero, 2016; Bellucci and Pennacchio, 2016; Herrera et al., 2016; Nieto and Santamaría, 2007; Yasmin and Otto, 2004), we created a categorical dependent variable (Collaboration) that takes the following values: 1 if the enterprise does not collaborate with any type of agents; 2 if it collaborates only with intrapreneurial agents (subsidiaries or corporate units); 3 if it collaborates only with

[10] According to articles 37, 38 and 45 of the Mexican Law on National Statistics System and Geographic Information, the Mexican statistical data collected by the Mexican Institute of Statistics (INEGI) is strictly confidential and mandatory

commercial agents (enterprises); 4 if it collaborates with scientific agents (universities); 5 if it collaborates with both types of partners. The reference group was category 1 integrated by those enterprises that do not collaborate with any type of agents. In addition, these categories also allow us to do the analysis by exploitation processes (represented by collaborations with intrapreneurial and commercial agents) and exploration processes (linked to collaborations with scientific agents).

Concerning the *independent variables*, following De Fuentes and Dutrénit (2016) and Ritala and Hurmelinna-Laukkanen (2013), the first set of independent variables are called "incremental and radical orientation." Given survey design, we used a proxy to identify the enterprises' orientation toward the development of incremental innovations (substituting current products, improving product quality, entering into new markets, improving the production process) or radical innovations (new product lines). In particular, these proxies were measured using a Likert Scale (1 = lower orientation and 4 = higher orientation). Moreover, as was explained in sections 2 and 3, a traditional way to foster innovation in emerging economies such as Mexico is via public subsidies or incentive programs (Cohen et al., 2002; Czarnitzki et al., 2007; Dimos and Pugh, 2016; García-Quevedo, 2004; Perkmann et al., 2013; Perkmann and Walsh, 2007). In this line, the second set of variables, called "subsidies granted," takes into consideration the relevance of access to public subsidies for innovation practices and whether these subsidies require compulsory university partnerships (Gob support with Universities) or not (Gob support individually without any partnership). The 2012 ESIDET survey includes a list of public innovation support programs, and this allows us to build these two variables according to the number of subsidies received from the government.

Regarding *control variables*, based on the data available for this study, we used control variables related to certain firm-level strategic and structural characteristics (Perkmann et al., 2013; Perkmann and Walsh, 2007).

First, one of the main criticisms of the dynamic capabilities concept is that these capabilities are difficult to measure empirically, and the same is true for underlying operational processes such as innovation practices (Ambrosini et al., 2009; Eisenhardt and Martin, 2000; Helfat and Peteraf, 2003). In this study, we controlled the "strategic characteristics" using proxies that could represent the capabilities that enterprises require to grow and survive, based on their objectives, resources and barriers (Dutrénit et al., 2010; Easterby-Smith et al., 2009; Narayanan et al., 2009; Scuotto et al., 2016). In the ESIDET survey, measured with a Likert Scale (1 to 4), we identified some proxies that captured the relevance of certain objectives for enterprises' innovation practices (e.g., to reduce variable costs, reduce fixed costs, reduce damage to the environment, comply with standards and regulations, and reduce the use of inputs) as well as the identification of certain obstacles for enterprises' innovation practices (e.g., economic risks, high innovation costs, access to financial sources, internal rigidity, lack of qualified personnel, lack of technology updates, lack of market information, legislative obstacles, and lack of customer responsiveness).

Second, we also included several variables related to the structural characteristics that determinate enterprises' innovation practices according to the product life cycle, access to resources and the barriers (Aldrich and Auster, 1986; Alcalde and Guerrero, 2016; De Fuentes et al., 2012; Dutrénit et al., 2010; Hewitt-Dundas, 2013; Santiago et al., 2016): *Enterprise's age*, measured with a dummy variable that indicates that the enterprise was less than 5 years old (1) or more than 5 years old (0); *Availability of innovation resources*, measured by the

investment in R&D expressed in pesos and the number of qualified personnel; *Enterprise size*, measured as the number of employees and expressed in logarithms; *Exports*, measured by means of a dummy variable where 1 represents those enterprises that have exported and 0 otherwise; *Company group*, measured by a binary variable that takes a value of 1 if the enterprise is a part of a company and value 0 if it is a single-unit enterprise; *Technological sector*, using a binary variable to identify if enterprise innovates influenced by technological sectors or not; and finally, we also controlled the location, including the entrepreneurial density of the state where the enterprises developed their economic activities.

3.3.3. Data analysis

Based on the categorical nature of our dependent variable, we estimated a multinomial logistic regression model (Greene, 1992). In particular, the categorical dependent variable is defined in such a way that it has five different values (1 for no collaboration; 2 for intrapreneurial collaboration; 3 for commercial collaboration; 4 for scientific collaboration, and 5 for mixed collaboration). A multinomial logistic regression requires careful consideration of the sample size and examination of the outlying cases. Therefore, given the low number of companies that generate innovation in emerging economies, our reference group has no collaboration, as follows:

$$\Pr(y = k) = \frac{\exp\left(\propto + \beta' X_{ij}\right)}{\sum_{j=1}^{5} \exp\left(\propto + \beta' X_{ij}\right)} \quad k = 1,2,3,4,5.$$

Table 3.1: Descriptive statistics

Variables	Entire sample [n=10200]				No collaboration [n=9251]		Intra collaboration [n=667]		Commercial collaboration [n=66]		Scientific collaboration [n=147]		Mixed collaboration [n=67]	
	Min	**Max**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Gob support (universities)	0	7	0.068	0.381	0.037	0.279	0.183	0.577	0.119	0.409	0.905	0.978	1.224	1.613
Gob support (individually)	0	14	0.134	0.503	0.115	0.459	0.208	0.593	0.134	0.457	0.554	0.935	1.000	1.624
II1_Subsitute current products	1	4	2.541	1.170	2.585	0.117	2.135	0.110	2.284	0.966	1.973	0.109	1.985	0.961
II2_Improve product quality	1	4	1.582	0.973	1.615	0.999	1.249	0.594	1.299	0.523	1.311	0.627	1.254	0.503
II6_Entry into new markets	1	4	1.642	1.033	1.682	0.106	1.262	0.652	1.313	0.528	1.203	0.494	1.194	0.529
RI3_Create new product lines	1	4	1.979	1.097	2.026	0.111	1.531	0.779	1.701	0.798	1.439	0.702	1.433	0.763
O1_Flexible production process	1	4	1.912	0.108	1.939	0.110	1.610	0.815	1.731	0.750	1.709	0.793	1.701	0.779
O2_Reduce variable costs	1	4	1.521	0.947	1.541	0.970	1.315	0.682	1.313	0.608	1.372	0.652	1.343	0.538
O3_Reduce fixed costs	1	4	1.591	0.994	1.600	0.101	1.487	0.815	1.463	0.611	1.554	0.921	1.567	0.821
O4_Social responsibility	1	4	1.662	1.056	1.670	0.107	1.543	0.890	1.627	0.813	1.682	0.100	1.642	0.933
R1_ Economic risks	1	4	1.900	1.057	1.910	0.107	1.841	0.906	1.746	0.823	1.696	0.788	1.672	0.842
R2_ Higher cost of innovation	1	4	1.868	1.064	1.885	0.108	1.739	0.851	1.701	0.798	1.574	0.691	1.687	0.820
R3_Access to financial sources	1	4	2.045	0.110	2.052	0.111	2.000	0.104	2.104	0.971	1.757	0.870	2.179	0.903
R4_Internal rigidity	1	4	2.448	1.082	2.429	0.109	2.615	0.103	2.493	0.102	2.703	0.102	2.687	0.100
R5_Lack of qualified personnel	1	4	2.335	1.109	2.322	0.112	2.481	0.106	2.343	0.930	2.399	0.101	2.522	0.959
R6_Lack of technology updates	1	4	2.320	1.123	2.305	0.113	2.480	0.105	2.463	0.100	2.405	0.104	2.493	0.104
R7_Lack of market information	1	4	2.357	1.111	2.356	0.112	2.373	0.106	2.403	0.938	2.324	0.104	2.373	0.967
R8_Legislative obstacles	1	4	2.155	0.114	2.147	0.115	2.268	0.109	2.104	0.105	2.149	0.104	2.149	0.108
R9_Lack of new customers	1	4	2.369	1.104	2.377	0.111	2.312	0.105	2.403	0.970	2.108	0.927	2.254	0.106
HGE_Total sales >20%	0	1	0.224	0.417	0.217	0.412	0.294	0.456	0.254	0.438	0.324	0.470	0.269	0.447
HGE_Personnel >20%	0	1	0.111	0.315	0.109	0.311	0.141	0.348	0.104	0.308	0.142	0.350	0.134	0.344
Less than 5 years old	0	1	0.084	0.278	0.086	0.281	0.061	0.240	0.075	0.265	0.095	0.294	0.030	0.171
R&D investment	0	2900867	1823.610	38.203	7770.027	20281.180	10799.510	118.969	8288.209	3088.539	11804.310	41518.840	35924.3	137.281
Number of qualified personnel	0	0.533	0.002	0.016	0.001	0.011	0.006	0.033	0.004	0.016	0.014	0.054	0.011	0.044
Size	0	5.168.93	2037.704	0.700	2025.308	0.695	2121.553	0.710	2387.155	0.722	2107.095	0.789	2409.916	0.775
Exports	0	1	0.273	0.445	0.255	0.436	0.436	0.496	0.493	0.504	0.453	0.499	0.507	0.504
Company group	0	1	0.282	0.450	0.272	0.445	0.352	0.478	0.537	0.502	0.385	0.488	0.418	0.497
Number of establishments	1	2.427.00	5.578	4.693	5.028	4.177	8.498	6.701	4.440	2.127	9.878	3.994	4.239	7.182
Technological sector	0	1	0.215	0.411	0.196	0.397	0.411	0.492	0.209	0.410	0.439	0.498	0.463	0.502
Entrepreneurial density	0.007	0.126	0.047	0.036	0.047	0.036	0.052	0.037	0.061	0.040	0.046	0.035	0.052	0.034

Source: Author

Table 3.2: Multinomial regression analysis (all Mexican enterprises)

	Exploitation								Exploration				Exploitation & Exploration			
	Intra collaboration vs no collaboration				Commercial collaboration vs no collaboration				Scientific collaboration vs no collaboration				Mixed collaboration vs no collaboration			
	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR
Incremental or radical orientation																
II1_Subsitute current products	0.160	0.043	***	0.852	0.106	0.110		0.900	-0.259	0.097	**	0.772	0.205	0.128		0.815
II2_Improve product quality	0.263	0.100	***	0.768	0.160	0.235		0.852	-0.015	0.198		0.985	0.285	0.237		0.752
II3_Entry into new markets	0.261	0.094	***	0.770	0.293	0.336		0.746	-0.555	0.217	**	0.574	0.782	0.323	**	0.457
II4_Improve the production process	-0.070	0.058		0.932	0.052	0.160		1.054	0.045	0.144		1.046	0.042	0.197		1.043
RI3_Create new product lines	-0.262	0.065	***	0.769	-0.157	0.160		0.855	0.349	0.157	**	0.706	0.453	0.227	**	0.636
Subsidies granted																
Gob support (universities)	0.603	0.112	***	1.827	0.634	0.290	*	1.885	1.441	0.139	***	4.225	1.484	0.171	***	4.410
Gob support (individually)	0.005	0.100		1.005	-0.082	0.272		0.921	-0.121	0.197		0.886	-0.083	0.225		0.920
Innovation purposes																
O2_Reduce variable costs	-0.112	0.093		0.894	-0.156	0.295		0.856	-0.051	0.200		0.950	-0.243	0.223		0.785
O3_Reduce fixed costs	0.278	0.079	***	1.320	0.028	0.214		1.028	0.211	0.166		1.235	0.311	0.259		1.364
O4_Reduce damage to environment	0.243	0.078	***	1.275	0.309	0.200		1.363	0.345	0.131	**	1.412	0.159	0.263		1.173
O5_Comply with standards	0.011	0.082		1.011	0.024	0.247		1.024	-0.086	0.164		0.917	0.159	0.217		1.173
O6_Reduce the use of inputs	0.001	0.069		1.001	0.022	0.175		1.022	0.124	0.121		1.132	0.347	0.186	*	1.415
Innovation Obstacles																
R1_ Economic risks	0.107	0.066		1.112	-0.037	0.196		0.964	0.018	0.145		1.018	-0.292	0.213		0.746
R2_ Higher cost of innovation	-0.122	0.070	*	0.885	-0.169	0.183		0.845	-0.200	0.152		0.818	-0.078	0.221		0.925
R3_Access to financial sources	-0.070	0.061		0.933	-0.029	0.173		1.029	0.256	0.126	**	0.774	0.248	0.170		1.281
R4_Internal rigidity	0.199	0.054	***	1.221	0.153	0.143		1.165	0.406	0.112	***	1.501	0.242	0.151		1.274
R5_Lack of qualified personnel	0.139	0.060	**	1.149	-0.135	0.157		0.874	0.138	0.106		1.148	0.243	0.144	*	1.275
R6_Lack of technology updates	0.219	0.071	***	1.244	0.268	0.212		1.308	0.044	0.138		1.045	0.071	0.218		1.073
R7_Lack of market information	-0.179	0.070	**	0.836	-0.039	0.189		0.962	0.025	0.150		1.026	0.126	0.191		0.881
R8_Legislative obstacles	0.236	0.053	***	1.266	-0.066	0.171		0.937	0.245	0.110	**	1.277	0.093	0.169		1.097
R9_Lack of customer responsiveness	-0.112	0.058	**	0.894	0.071	0.145		1.073	0.318	0.106	***	0.728	0.187	0.149		0.829
Structural variables																
Less than 5 years old	-0.297	0.182	*	0.743	0.166	0.476		1.180	0.161	0.318		1.175	-0.816	0.754		0.442
R&D investment	0.000	0.000		1.000	0.000	0.000		1.000	0.000	0.000		1.000	0.000	0.000		1.000
Number of qualified personnel	9.956	0.259	***	21073	1.015	0.352	***	2557	1.150	0.343	***	9905	1.233	0.399	***	2265
Size	-0.019	0.071		0.981	0.244	0.187		1.276	0.030	0.152		1.030	0.589	0.222	**	1.803
Exports	0.585	0.097	***	1.794	0.774	0.284	***	2.169	0.575	0.199	***	1.777	0.574	0.275	**	1.775
Company group	-0.006	0.105		0.994	0.724	0.284	**	2.062	0.123	0.224		1.131	-0.403	0.341		0.668
Number of establishments	0.001	0.001		1.001	0.002	0.001	**	1.002	0.002	0.001	**	1.002	-0.008	0.006		0.992
Technological sector	0.675	0.093	***	1.965	-0.389	0.327		0.677	0.665	0.202	***	1.944	0.704	0.289	**	2.021
Entrepreneurial density	2.992	0.113	***	19919	8.026	0.306	**	3060	-1.242	0.264		0.289	3.151	0.342		23361
_cons	-2.612	0.203	***		-5.891	0.561	***		-4.113	0.466	***		-6.412	0.799	***	

Year	2012
Observations	10160
Wald chi2(120)	1012.46
Prob > chi2	0.0000
Pseudo R2	0.1598
Log pseudo likelihood	-33.720.383

Level of statistical significance: *** $p \leq 0.000$, ** $p \leq 0.05$, † $p \leq 0.10$.

Table 3.1 shows the main descriptive analysis for all the variables. During 2011 and 2012, only 9% of the Mexican enterprises surveyed implemented collaborative innovation practices. The majority of these enterprises collaborated with intrapreneurial partners, such as subsidiaries or companies in the same group. By contrast, in a developed economy like Spain, on the basis of a similar sample of enterprises, the percentage of innovative collaborating enterprises is about 35% (Segarra-Blasco and Arauzo-Carod, 2008; Barge-Gil, 2010). A robustness test was also developed to ensure that our results are similar to, and consistent with, the enterprises' performance profiles, and, on the basis of the criteria to identify high-growth entrepreneurship (Audretsch, 2012; OECD, 2007, 2010)[11], we tested the model with two sub-samples: (i) enterprises that did not grow by more than 20% in either total sales or personnel during 2011-2012 (7,339 enterprises), and (ii) enterprises that grew by more than 20% in terms of both total sales and personnel during 2011-2012 (1,684 enterprises)

3.4. Results and discussion

Table 3.2 presents the main results obtained from the multinomial regression model. In the case of non-innovative enterprises, the probability that an enterprise has science-based collaboration agreements with universities increases by 0.70 when the enterprise is interested in developing radical innovations associated with new product lines (0.349; $p < 0.050$), whereas the probability decreases by 0.77 and 0.52 when it is primarily interested in substituting current products (-0.259; $p < 0.050$) and entering into new markets (-0.555; $p < 0.050$), respectively. When we analyze the control variables, science-based collaboration increases when the enterprises have lower access to financial sources or face internal rigidity,

[11] The OECD-Eurostat Manual on Business Demography Statistics (2007) defines a high-growth enterprise as an enterprise with an average annualized growth greater than 20% per annum, over a three-year period, and with 10 or more employees at the beginning of the observation period. Growth is thus measured by the number of employees and by turnover. We used a proxy for this concept because we only had information available from the previous and the current year.

legislative obstacles or a lack of customer responsiveness. Then, having an absorptive capacity facilitates the implementation of radical innovations because this enables the exchange of existing knowledge and a combination with the new knowledge provided by the universities (Kenney and Mowery, 2014). These results are consistent with previous studies, which have shown that science-based practice focuses not only on supporting final product innovation but also provides a new scientific knowledge base aimed at radical innovations (O'Connor and De Martino, 2006). University–enterprise partnerships allow for access to new/advanced knowledge and technological resources required exploring new opportunities and initiatives for achieving radical innovation' strategies (Guerrero et al., 2016). In fact, Dutrénit et al. (2010) and Cárdenas et al. (2012) also show similar channels of knowledge transfer and collaboration strategies between Mexican universities and enterprises. Similar to developed economies, motivations and aspirations are comparable inside university–enterprise partnerships but generally benefits are observed in the long-term (De Fuentes and Dutrenit, 2012) and depend on geographic proximity (De Fuentes and Dutrénit, 2016).

The probability of developing incremental innovations increases by between 0.77 and 0.85 when an enterprise engages in intrapreneurial partnerships; particularly when it is focused on substituting its current products/services (0.160; $p < 0.001$), improving the quality of its current products (0.263; $p < 0.001$) and entering into new markets (0.261; $p < 0.001$). This type of collaboration provides valuable sources of information for developing/improving products and enhancing flexibility, product quality and market adaptability (Chung et al., 2003). The analysis of control variables shows the lack of qualified personnel and technological updates, and the existence of legislative obstacles increases the probability of developing internal collaborations. These results confirm the findings of previous studies, which have demonstrated that a lack of financial resources encourages exploiting innovation

practices with commercial partners rather than with scientific partners (e.g., purposive outflows of knowledge) (Lichtenthaler and Ernst, 2007; van de Vrande et al., 2009). Therefore, the evidence supports hypothesis H3.1. Taking non-innovative enterprises as a reference, the evidence suggests that the probability that Mexican enterprises collaborate with both universities and other internal/external agents increases by 0.457 (0.782; $p < 0.050$) when the enterprises have an incremental innovation orientation (exploitation with other agents) and by 0.636 (0.453; $p < 0.050$) when they have a radical innovation orientation (exploration with universities). Mixed collaboration allows for the effective exploration/exploitation of new opportunities (Alcalde and Guerrero, 2016), entails great benefits for enterprises with innovation patterns, and encourages the creation of novel products (Becker and Dietz, 2004). Control variables showed that enterprises choose this type of collaboration when they are interested in reducing the use of inputs and lack qualified personnel. In the case of Mexico, enterprises faced several challenges particularly associated with the lack of qualified human resources, funds and productivity (Cárdenas et al., 2012). These enterprises belong to the technological sectors and have an exporting profile. Under these conditions, diverse collaborations facilitate building sustainable competitive advantages, because they provide an effective combination of commercial and technical (scientific) skills, thereby reducing market uncertainty (Laursen and Salter, 2006). As compared with science-based collaboration, the probability of university involvement in exploratory innovation with enterprises and other agents is lower than for involvement in exclusively scientific-based partnerships. This evidence supports hypothesis H3.2.

In regard to compulsory university–enterprise partnerships as a condition to receive government subsidies, and taking non-collaborative enterprises as the reference group, the results show that compulsory university–enterprise partnerships increase by 1.827 (0.603; p

< 0.001) the probability to collaborate with intrapreneurs, by 1.885 (0.634 p < 0.001) with commercial agents, by 4.22 (1.441; p < 0.001) with scientific agents, and by 4.41 (1.484; p < 0.001) with mixed agents. These results support hypotheses H3.3 and H3.4. According to Cohen et al. (2002), this government strategy is aimed at reorienting university research toward the needs and realities of enterprises. In this scenario, the direct positive effect behind these strategies is that universities reinforce and legitimize their role in social and economic development (Guerrero et al., 2015) and enterprises obtain access to otherwise scarce financial resources for innovation (Caloghirou et al., 2001), as well as knowledge transfer and successful innovation processes (Boschma, 2005). Indirect effects may include the generation of spillovers (Perkmann et al., 2013; Perkmann and Walsh, 2007) and long-standing partnerships (van de Vrande et al., 2009). Therefore, any financial decision represents a higher cost/risk for enterprises and the main innovation constrain in emerging economies (Álvarez and Crespi, 2015; Crespi and Zúñiga, 2012). In particular, Mexican enterprises are more likely to use internal innovation funds (e.g., retained earnings and parents' support) than external sources (e.g., other enterprises) (Guerrero and Urbano, 2016). In fact, Autio et al. (2014) argue that radical innovations among university–enterprise partnerships use multiple and combined sources of funding (public/private). Therefore, government subsidies with compulsory university partnership are other enterprises' motivation and contribution from universities in the development of explorative innovation projects.

3.4.3. Robustness check

The prior literature suggests that the main motivations for enterprises engaging in collaborations are the potential innovation outcomes that may be obtained in terms of performance (Hagedoorn, 1993; Klomp and van Leeuwen, 2001), technological evolution

(Rosenkopf and Nerkar, 2001), and new product introduction (Laursen and Salter, 2006). On the basis of this argument, and in order to corroborate our findings, Tables 3.3 and 3.4 include a robustness check.

We tested our model in two sub-samples built by following the criteria of high-growth entrepreneurship proposed by the OECD (2005 and 2010). The main purpose was to understand the role of universities in enterprises that did not grow as compared with enterprises that grew by > 20% in terms of sales and personnel. In general, the results obtained in these robustness tests confirmed our hypotheses. In fact, we identify that universities play a relevant role in emerging economies because produce positive effect on enterprises' innovation and it is reinforced when these enterprise have a high-growth orientation (Delmar et al., 2003; Friar and Meyer, 2003). This means that the group of enterprises with a strong orientation to growth in both employees/sales is influenced by university relationships that motivate to develop more entrepreneurial and novel innovations as suggested by Autio et al. (2014). Interestingly, Latin American emerging economies are characterized by a limited number of high-growth orientation enterprises as a result of several environmental restrictions to create knowledge-based enterprises (Acs and Amorós, 2008; Acs and Audretsch, 1991; Moreno and Casillas, 2007).

Table 3.3: Robustness test with multinomial regression analysis: Mexican enterprises without a growth patterns of >20% in either total sales or number of personnel in the 2011-2012 period

	Exploitation								Exploration				Exploitation & Exploration			
	Intra collaboration vs no collaboration				Commercial collaboration vs no collaboration				Scientific collaboration vs no collaboration				Mixed collaboration vs no collaboration			
	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR
Incremental or radical orientation																
II1_Subsitute current products	0.133	0.052	**	1.142	0.101	0.143		1.106	-0.155	0.117		0.856	0.054	0.153		0.947
II2_Improve product quality	0.132	0.120		1.141	0.048	0.253		1.049	-0.125	0.266		0.882	0.177	0.276		0.838
II3_Entry into new markets	0.303	0.129	**	1.354	0.078	0.348		1.081	-0.386	0.222	*	0.680	0.480	0.397		0.619
II4_Improve the production process	0.140	0.072	*	0.869	0.000	0.201		1.000	0.041	0.179		1.042	0.199	0.243		1.220
RI3_Create new product lines	0.259	0.083	***	1.296	0.091	0.183		1.095	0.258	0.196		0.773	0.840	0.317	***	0.432
Subsidies granted																
Gob support (universities)	0.514	0.140	***	1.672	0.245	0.620		1.278	1.417	0.170	***	4.125	1.516	0.213	***	4.554
Gob support (individually)	-0.015	0.121		0.985	0.016	0.373		1.016	-0.220	0.205		0.803	-0.178	0.271		0.837
Innovation purposes																
O2_Reduce variable costs	-0.074	0.119		0.929	-0.646	0.404		0.524	0.103	0.240		1.108	-0.260	0.266		0.771
O3_Reduce fixed costs	0.277	0.103	**	1.319	-0.091	0.266		0.913	0.115	0.222		1.122	-0.076	0.316		0.927
O4_Reduce damage to the environment	0.276	0.100	**	1.318	0.430	0.208	**	1.537	0.627	0.138	***	1.872	0.332	0.339		1.394
O5_Comply with standards and regulations	-0.034	0.103		0.967	-0.130	0.262		0.878	-0.088	0.205		0.916	0.349	0.257		1.418
O6_Reduce the use of inputs	0.022	0.084		1.022	0.163	0.192		1.177	0.076	0.160		1.079	0.375	0.235		1.455
Innovation Obstacles																
R1_ Economic risks	0.129	0.081		1.138	-0.101	0.224		0.904	-0.123	0.193		0.884	-0.066	0.252		0.936
R2_ Higher cost of innovation	-0.057	0.085		0.945	-0.024	0.200		0.976	-0.243	0.214		0.784	-0.106	0.278		0.899
R3_Access to financial sources	-0.102	0.079		0.903	-0.237	0.204		0.789	0.266	0.157	*	1.305	0.104	0.234		1.110
R4_Internal rigidity	0.156	0.064	**	1.169	0.156	0.179		1.169	0.346	0.151	**	1.413	0.277	0.195		1.319
R5_Lack of qualified personnel	0.246	0.073	***	1.279	-0.201	0.183		0.818	-0.043	0.136		0.958	0.329	0.199	*	1.390
R6_Lack of technology updates	0.331	0.085	***	1.392	0.183	0.217		1.201	0.095	0.182		1.100	0.268	0.218		1.307
R7_Lack of market information	-0.322	0.083	***	0.725	-0.127	0.184		0.881	-0.011	0.195		0.989	-0.354	0.206	*	0.702
R8_Legislative obstacles	0.282	0.065	***	1.326	-0.162	0.228		0.850	0.318	0.149	**	1.374	0.313	0.226		1.368
R9_Lack of customer responsiveness	-0.168	0.071	**	0.845	0.194	0.197		1.214	-0.207	0.142		0.813	-0.267	0.202		0.766
Structural variables																
Less than 5 years old	-0.546	0.267	**	0.579	0.204	0.635		1.226	0.144	0.483		1.155	-3.022	0.819	***	0.049
R&D investment	0.000	0.000	*	1.000	0.000	0.000		1.000	0.000	0.000		1.000	0.000	0.000	*	1.000
Number of qualified personnel	8.456	0.300	**	47030	1.144	0.400	***	3.139	8.516	0.346	**	49940	8.761	0.525	*	63800
Size	-0.040	0.084		0.961	0.369	0.240		1.446	0.086	0.185		1.090	0.637	0.279	**	1.891
Exports	0.568	0.123	***	1.765	0.736	0.344	**	2.088	0.638	0.254	**	1.893	0.478	0.337		1.613
Company group	-0.057	0.134		0.945	0.652	0.332	**	1.919	0.198	0.263		1.219	0.070	0.436		1.073
Number of establishments	0.001	0.001		1.001	0.002	0.001	**	1.002	0.001	0.001	**	1.001	-0.010	0.007		0.990
Technological sector	0.762	0.117	***	2.143	-0.333	0.403		0.717	0.537	0.276	**	1.711	0.540	0.387		1.716
Entrepreneurial density	2.183	0.143		8873	8.071	0.370	**	32000	-1.639	0.338		0.194	9.354	0.415	**	11544
_cons	-2.627	0.236	***		-5.891	0.655	***		-4.168	0.605	***		-7.528	0.877	***	

Year	2012
Observations	7339
Wald chi2(120)	4669.55
Prob > chi2	0.0000
Pseudo R2	0.170
Log pseudo likelihood	-2210.800

Level of statistical significance: *** $p \leq 0.000$, ** $p \leq 0.05$, † $p \leq 0.10$.

Table 3.4: Robustness test with multinomial regression analysis: Mexican enterprises with a growth patterns of >20% in terms of both total sales and personnel in the 2011-2012 period

	Exploitation								Exploration				Exploitation & Exploration			
	Intra collaboration vs no collaboration				Commercial collaboration vs no collaboration				Scientific collaboration vs no collaboration				Mixed collaboration vs no collaboration			
	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR	Robust Coef.	Std. Err.	P>|z|	RRR
Incremental or radical orientation																
II1_Subsitute current products	0.130	0.097		1.139	0.397	0.208	*	1.487	-0.401	0.202	*	0.670	0.603	0.320	*	0.547
II2_Improve product quality	0.638	0.232	***	1.893	0.031	0.400		1.031	-0.574	0.254	**	1.775	0.135	0.585		1.145
II3_Entry into new markets	0.238	0.194		0.788	1.737	0.768	**	0.176	-1.243	0.613	**	0.289	1.328	0.717	*	0.265
II4_Improve the production process	0.051	0.127		1.052	0.423	0.328		1.527	0.058	0.317		1.060	0.125	0.362		0.882
RI3_Create new product lines	0.321	0.138	**	1.379	0.007	0.271		1.007	0.436	0.340		0.647	0.601	0.409		0.548
Subsidies granted																
Gob support (universities)	0.554	0.249	**	1.740	1.589	0.393	***	4.899	1.182	0.344	***	3.261	1.607	0.373	***	4.988
Gob support (individually)	0.350	0.201	*	1.419	-0.519	0.151		0.595	0.798	0.242	***	2.221	0.619	0.489		1.857
Innovation purposes																
O2_Reduce variable costs	-0.128	0.190		0.880	1.067	0.523	**	2.907	0.085	0.386		1.089	-0.708	0.555		0.493
O3_Reduce fixed costs	0.528	0.171	***	1.696	0.668	0.442		1.950	0.459	0.303		1.582	1.715	0.513	***	5.557
O4_Reduce damage to the environment	0.244	0.166		1.276	0.573	0.406		1.774	0.358	0.340		1.430	0.819	0.469	**	2.268
O5_Comply with standards and regulations	-0.017	0.205		0.983	0.304	0.467		1.355	-0.258	0.395		0.773	0.529	0.352		1.697
O6_Reduce the use of inputs	-0.149	0.157		0.862	-0.449	0.473		0.638	0.020	0.287		1.020	-0.109	0.360		0.897
Innovation Obstacles																
R1_ Economic risks	-0.132	0.151		0.876	-0.549	0.628		0.578	0.316	0.301		1.372	-0.951	0.702		0.386
R2_ Higher cost of innovation	-0.182	0.171		0.834	-0.173	0.489		0.841	-0.361	0.301		0.697	-0.164	0.817		0.849
R3_Access to financial sources	0.096	0.130		1.101	-0.020	0.292		0.980	-0.128	0.268		0.880	0.722	0.265	***	2.059
R4_Internal rigidity	0.299	0.136	**	1.349	-0.308	0.364		0.735	0.738	0.190	***	2.092	-0.273	0.327		0.761
R5_Lack of qualified personnel	-0.154	0.136		0.857	0.087	0.436		1.091	0.347	0.288		1.415	0.242	0.361		1.274
R6_Lack of technology updates	0.068	0.164		1.070	0.430	0.575		1.537	-0.020	0.273		0.980	0.157	0.489		1.170
R7_Lack of market information	0.050	0.157		1.051	0.189	0.356		1.208	0.173	0.362		1.189	0.404	0.314		1.498
R8_Legislative obstacles	0.235	0.119	**	1.265	-0.044	0.350		0.957	0.013	0.205		1.013	-0.775	0.349	**	0.461
R9_Lack of customer responsiveness	-0.089	0.137		0.915	-0.794	0.322	**	0.452	-0.484	0.213	**	0.616	-0.035	0.253		0.966
Structural variables																
Less than 5 years old	0.093	0.336		1.097	0.143	0.129		1.154	-0.501	0.723		0.606	-0.036	0.901		0.965
R&D investment	0.000	0.000		1.000	0.000	0.000		1.000	0.000	0.000		1.000	0.000	0.000	*	1.000
Number of qualified personnel	8.452	1.386		46840	-2.325	0.177		0.098	8.386	0.160		4385	7.439	0.154		17010
Size	0.070	0.161		1.073	0.285	0.525		1.330	-0.133	0.380		0.875	0.649	0.621		1.914
Exports	0.710	0.215	***	2.034	1.317	0.727	*	3.732	0.728	0.415	*	2.071	1.400	0.564	**	4.055
Company group	0.047	0.231		1.048	0.777	0.502		2.175	0.362	0.525		1.436	-1.524	0.875	*	0.218
Number of establishments	0.010	0.004	**	1.010	-0.046	0.050		0.955	0.011	0.006	*	1.011	-0.114	0.127		0.892
Technological sector	0.528	0.202	***	1.696	-1.379	0.102		0.252	0.514	0.418		1.672	1.556	0.671	**	4.740
Entrepreneurial density	1.566	2.644		4787	9.679	0.524	*	15978	-3.489	0.527		0.031	-1.079	0.990		0.340
_cons	-2.563	0.486	***		-5.798	0.155	***		-3.721	0.114	***		-3.815	0.252	***	

Year	2012
Observations	1684
Wald chi2(120)	890.020
Prob > chi2	0.0000
Pseudo R2	0.239
Log pseudo likelihood	-61.892.33

Level of statistical significance: *** $p \leq 0.000$, ** $p \leq 0.05$, † $p \leq 0.10$

3.5. Conclusions

The purpose of this exploratory research was to provide a better understanding about the role of universities on enterprises' innovation practices in emerging economies (explained in Chapter II). To achieve this objective, in the context of an emerging economy, we explored the enterprises' motivations to collaborate with universities in terms of innovation purposes (exploration and exploitation) or alternative access to public funds (compulsory requirement of being involved in a university partnership).

In general, Mexican innovative enterprises are more likely to collaborate with universities in the development of radical innovations than in the development of incremental innovations (H3.1), that the role of universities is greater when the enterprises are involved in science-based collaborations than when they are involved in mixed collaborations (H3.2), that access to government subsidies with compulsory university partnerships is greater when the enterprise is more interested in exploratory practices than in exploitative practices (H3.3), and that the involvement of universities in government subsidy programs is greater in mixed collaborations than in exclusively science-based collaborations (H3.4). In this regard, Berge-Gil et al. (2011) explain this fact by the existence of obstacles in terms of response to the initiatives (universities do not follow the same market times as enterprises because they have more bureaucratic burdens), understanding (universities and enterprises do not speak the same language), and knowledge about the existence of grants (only a limited number of enterprises have access to information about the programs). However, in contrast to current studies in emerging economies (Armanios et al., 2016; Bastos et al., 2014; Kruss and Visser, 2017; Santarelli and Tran, 2016) that continue to pay attention to those emerging economies' negative conditions (obstacles, dilemmas and challenges) that limit university–enterprise

partnerships, this chapter aims to contribute to the debate about the contribution of universities in the radical innovation process of enterprises motivated by a direct enterprise's interest for strategic purposes as well as by an indirect enterprise's interest of covering the government requirements for accessing R&D subsidies. Examples include elements in agendas of research lines such as university technology transfer, quadruple-helix perspective (Miller et al., 2016), university–enterprise relationships, open innovation, innovation performance (Gassmann, 2006; Greco et al., 2016; Perkmann and Walsh, 2007; Van de Vrande et al., 2009) and effectiveness of R&D subsidies (Dimos and Pugh, 2016; García-Quevedo, 2004).

This study has several limitations and several unanswered or unexplored questions that are interesting directions for future research. The first limitation is related to the database used. As a result of the INEGI's confidentiality rules, we only had access to the data at its facilities. We did not have access to all the variables, and their treatment/analysis was limited by the statistical resources available. Therefore, we used several proxies, such as the measures adopted to coding university partnerships based on the available data of a sample of Mexican enterprises. In this regard, following the ideas from Autio et al. (2014), a natural extension of this study could be to continue exploring our sample with a longitudinal perspective in order to understand the real effect or impact of university–enterprise partnerships on innovation performance as well as spillover effects in their location. This will require taking into account the implementation of control groups (e.g., comparison across enterprises that have not collaborated with universities as well as not have received subsidies). A real challenge could be doing this analysis across emerging economies. The second limitation was related to the proxies used to test the models, which need to be improved. One example is the analysis of the environmental level. According to Feldman (2014), as the agents who recognize

opportunities, mobilize resources and create value, entrepreneurs are the key to the creation of organizations and the building of capacities to sustain regional economic development. Entrepreneurs benefit from their location, but they are also agents of change who can transform their local communities. A natural extension of this study would be to explore the influence of location, in particular regional differences that may have a significant influence on innovation and entrepreneurial activities. In the line of Guerrero et al. (2016) and Miller et al. (2016), it is still necessary to provide an in-depth analysis about the transmutation of university–enterprise business models into a new configuration of sustained entrepreneurial and innovation ecosystems adopting a social and economic perspective. The third limitation was the proxies used in the analysis of compulsory university–enterprise partnerships to access public innovation incentives. Based on Dimos and Pugh (2016), it is still necessary to continue to explore the effectiveness of R&D subsidies in stimulating a collaborative behavior instead of opportunistic behavior on university–enterprise R&D as well as the generation of tangible outcomes (Galende and de la Fuente, 2003).

Depsite those limitations, however, some implications for the main actors involved in the Mexican innovation system emerge from our study. For policy makers, the study presents evidence of two motivations and determinants behind innovation practices of university–enterprise partnerships. In other words, this study presents some direct and indirect outputs but it is still necessary to consider the valuation of outcomes. If policy makers wish to promote a transition toward a knowledge-based economy, they must reinforce the innovation system as well as the entrepreneurial ecosystem (investment market, educational system, labor market, security and stable regulations for SMEs, among others). For enterprise managers, this study also offers several insights that need to be taking into account in the configuration of innovation practices with different agents (commercial, scientific and

mixed). In particular, insights about the development of radical or incremental innovation strategies. However, these aspects could be used as reference, but in the end ,each partnership requires time, trust and common objectives. For university managers, the entrepreneurial university model is a good example to follow in their transformation processes. In this regard, Chapter IV analyzes the role of higher education organizations in entrepreneurial initiatives.

CHAPTER IV:

DO HIGHER EDUCATION ORGANIZATIONS MATTER IN ENTREPRENEURSHIP PRACTICES? LOOKING INSIDE TECHNOLOGY BASED NASCENT ENTREPRENEURSHIP ACROSS COUNTRIES

4.1. Introduction

Chapter II explored whether higher education organizations have a relevant role in innovation (evidenced in Chapter II) and entrepreneurship ecosystems (analyzed in this chapter). In this regard, this chapter analyzes the role of universities in technology-based entrepreneurship. Technology-based nascent entrepreneurs are individuals who are involved in creating new businesses that are based around and oriented toward technology. In this regard, well-recognized projects such as the Global Entrepreneurship Monitor (GEM) and the Panel Study of Entrepreneurial Dynamics (PSED) have brought to light the dynamics and the diversity of entrepreneurship, expressed as the rate of nascent entrepreneurship, or the prevalence of young enterprises, across nations (Mueller, 2006; Parker and Belghitar, 2006; Wennekers et al., 2005). Focusing on these arguments, nascent entrepreneurship literature has tried to explain and understand this variance, paying attention to each stage of the entrepreneurial process based on: (i) the influence of certain environmental conditions such as government intervention/promotion of new business start-ups as well as the degree of economic/technological development of each country (Hechavarria and Reynolds, 2009; Honig and Karlsson, 2004; Van Stel et al., 2007); and (ii) the influence of balanced skills and characteristics of the nascent entrepreneurs analyzed based on their social and human capital, their attitudes, their career reasons and their perceptions (Arenius and Minniti, 2005; Caliendo et al., 2009; Carter et al., 2003; Davidsson and Honig, 2003; Delmar and Davidsson, 2000; Dimov, 2010; Honig, 2004).

Based on these insights, interactions among individual, organizational and environmental levels are still unexplored (Busenitz et al., 2014) and yet are necessary to understand the patterns and gestational process among tech and non-tech nascent entrepreneurs (Liao and Welsch, 2008) or across time (Mosey and Wright, 2007). In this regard, according to Mosey

et al. (2016), technology-based nascent entrepreneurship literature is looking forward to analyze/conceptualize the individual–organizational level nexus in order to understand the organizational context within which technology entrepreneurship is enabled or constrained as well as to highlight how different organizational arrangements can therefore be valid for different external conditions and enhance the effectiveness in their interaction. Based on those perspectives, the main purpose of this chapter is to provide a better understanding of the role of higher education in technology-based nascent entrepreneurship.

Following this introduction, section 4.2 describes the theoretical background and the conceptual model. In section 4.3, the methodological design is explained. In section 4.4, the main results obtained are presented and discussed in the light of the literature in the field. Finally, section 4.5 includes the main conclusions, implications, limitations and future research lines.

4.2. Theoretical framework

4.2.1. Environmental conditions

According to Lundvall (1992) and Nelson (1993), national innovation systems are based on an economic perspective that encapsulates the potential to identify factors of relevance to the performance of technology-acquiring companies. In this regard, several studies have shown the relevance of both innovation and entrepreneurial ecosystems fostering technology-based entrepreneurship (Guerrero and Urbano, 2016; Schmitz et al., 2016). In general, the positive/negative effect will be associated with the quality of those conditions in each country/region because it determines the generation of productive or un-productive

entrepreneurial innovations (Baumol, 1990). In sum, the transformation of ideas into new technologies depends not only on how knowledge diffuses through entrepreneurial activities (Guerrero and Urbano, 2013) but also on the certain spaces and time in which development occurs (Autio et al., 2014).

Adapting this point of view, the patterns of new technologies during the venture gestation process by nascent entrepreneurs are influenced by certain conditions associated with the innovation ecosystem in each country. First, we assume that appropriate scientific and technological governmental support stimulates and reinforces the development of new technology by nascent entrepreneurs (Block et al., 2012; Honig and Karlsson, 2004; van Stel et al., 2007; Welter and Smallbone, 2011). Similarly, adequate intellectual property rights are conditions that also increase the propensity of technology-based entrepreneurship. In other words, countries/regions where venture/investor rights are recognized and respected are associated with knowledge spillover practices and higher density of technological enterprises (Acs et al., 2004). In addition, the existence of financial support programs for nascent entrepreneurs could also reinforce the involvement in R&D activities (Lundvall, 1992; van Stel et al., 2007). In this regard, Parker and Belghitar (2006) found that nascent entrepreneurs are more likely to be in high-tech when they receive external finance.

Based on those arguments, we propose the following hypothesis:

Hypothesis 4.1: Nascent entrepreneurs are more likely to develop new technologies when they are involved in supported innovation ecosystems (e.g., financial, governmental support and IPR) than those who are in non-supported ecosystems.

4.2.2. Strategic orientation

According to Carter et al. (2003), prior research has shown that several individual reasons for becoming nascent entrepreneurs are associated with certain accomplishments, such as innovation, financial success, independence, recognition, roles and self-realization. Directly or indirectly, those individual goals are strongly related to the strategic orientation of the new venture because they increased the probability of achieving those goals (Gaba and Bhattacharya, 2012; Lundvall, 1992). In this sense, the adoption of a technological or a non-technological pattern before/during/after the gestation process of nascent entrepreneurs will depend on adequate alienation among those personal and organizational orientations (Liao and Welsch, 2008). In this regard, we apply this alienation to explore three strategic orientations.

First, those nascent entrepreneurs who adopt an entrepreneurial orientation characterized by innovativeness, risk taking and pro-activeness have a higher propensity to be involved in the development of new technologies (Beckman et al., 2012a, b; Bosma et al., 2010; Guerrero and Peña-Legazkue, 2013). *Second*, those nascent entrepreneurs who are interested in exploring new markets based on certain diversification strategies have a higher propensity to be involved in the development of new technologies (Block et al., 2012; Christensen, 1997; Christensen, 2002; Gans and Stern, 2003; Liao and Welsch, 2008; Mosey et al., 2016). *Third*, nascent entrepreneurs who are risk takers and oriented to wealthier growth tend to operate in high-tech start-ups (Caliendo et al., 2006; Parker and Belghitar, 2006; Wong et al., 2005).

Based on those arguments, we propose the following hypothesis:

Hypothesis 4.2: Nascent entrepreneurs are more likely to develop new technologies when they are implementing strategic orientations (e.g., entrepreneurial, diversification, high-growth) than those who have non-defined strategies.

4.2.3. Higher education

Previous studies have identified a strong positive relationship between human capital and the propensity of becoming technology-based entrepreneurs (Mosey and Wright, 2007). In this regard, several measures of human capital have been adopted, such as higher education, entrepreneurship education and prior managerial/entrepreneurial experience, among others (Arenius and Minniti, 2005; Carter et al., 2003; Davidsson and Honig, 2003; Delmar and Davidsson, 2000; Dimov, 2010; Edelman et al., 2008; Galloway and Brown, 2002). In this chapter, we are interested in exploring the moderation effect that could place higher education in the nexus between environmental conditions and strategic orientations with the development of new technologies by nascent entrepreneurs. The main argument behind this idea is associated with the nascent entrepreneur's opportunity confidence, which is configured by the individual's human capital and is linked with the early planning actions put toward the pursuit of new technological opportunities (Dimov, 2010).

Taking into account that universities are also transforming themselves in order to provide adequate skills, capabilities and support to technology transfer, the possession of a university degree would act in this process as a support to the individual's opportunity confidence (Audretsch & Keilbach, 2007; Guerrero and Urbano, 2014). Therefore, we assume that nascent entrepreneurs with higher education are looking to reinforce their human capital via

specialized training or experimenting with entrepreneurship (creating a new venture or investing in a new venture). Additionally, in the case of technology development, nascent entrepreneurs with higher education will assume or react to environmental conditions based on the potential opportunities that those conditions bring to the development of new innovations. This argument is also applied in the design and implementation of mechanisms that allow nascent entrepreneurs to achieve both personal and organizational goals.

Based on those arguments, we propose the following hypothesis:

Hypothesis 4.3a: In the case of nascent entrepreneurs with higher education, the effect of supportive innovation ecosystems on the development of new technologies is intensified.

Hypothesis 4.3b: In the case of nascent entrepreneurs with higher education, the effect of strategic orientations on the development of new technologies is intensified.

4.3. Methodology

4.3.1. Data collection

We use the 2008 Global Entrepreneurship Monitor (GEM) datasets. In particular, the Adult Population Survey (APS) provided us with information on 4,453 nascent entrepreneurs and the National Experts Survey (NES) provided us with information concerning the ecosystems

across the 27 countries[12] that participate in GEM. In this sample, included in emerging economies, Mexico contributes to the APS sample with 325 nascent entrepreneurs and with the NES conditions. We pay attention to 2008 for two reasons: (a) this year included several questions associated with the special issue about entrepreneurship education; and (b) this year allowed us to maintain "control" of the macroeconomic effects or uncertainties produced by the recent financial crisis and economic recession.

4.3.2. Description of variables

Concerning the *dependent variables*, we applied a dichotomous variable where 1 indicates the development of new technologies by nascent entrepreneurs (new technology-based nascent entrepreneurship) and 0 otherwise (Reynolds et al., 2005).

Regarding the *explanatory variables*, our main proxies are associated with strategic orientations identified at the organizational level and ecosystem conditions identified at the country level that foster both innovation and entrepreneurship. In the first case, at the organizational level, we identify three proxies in the APS GEM dataset that help us to understand the strategy associated with developing new technology inside organizations: (i) entrepreneurial orientation, a dichotomous variable that represents if the nascent venture was developed by employees of one organization as part of their daily work (Bosma et al., 2010; Hagedoorn and Narula, 1996; Guerrero and Peña, 2013), (ii) diversified orientation, a dichotomous variable that measures if the nascent venture adopted a strategy oriented to new markets (Li and Atuahene-Gima, 2001; Parker, 2011); and (iii) high-growth orientation, a

[12] Argentina, Brazil, Bolivia, Bosnia, Chile, Colombia, Croatia, Denmark, Dominica, Ecuador, Egypt, Finland, Germany, Greece, Ireland, Iran, Italy, Jamaica, Korea, Macedonia, Mexico, Peru, Slovenia, Serbia, South Africa, Spain, Turkey, Uruguay.

dichotomous variable that measures if this nascent venture has the intention to create more than 20 jobs in the next five years (Wong et al., 2005). In the second case, based on the NES Survey, we introduced some conditions associated with both innovation and entrepreneurship ecosystems, such as the existence of property rights; the existence of programs that support science and technology; and the existence of financial structures that support the creation of technological ventures. These measures represent the average obtained from the opinion of 36 experts interviewed per year in each country using a Likert scale (Reynolds et al., 2005). These variables are built based on confirmatory factor analysis; therefore, the mean is 0 and the standard deviation is equal to 1.

Regarding the *moderation*, we used higher education (if the nascent entrepreneur has mentioned he or she has a bachelor degree) to understand if the nexus of explanatory variables with the dependent variable is reinforced or not when the nascent entrepreneurs had a higher education. In addition, this moderation was also tested splitting the sample of nascent entrepreneurs with higher education by emerging and non-emerging economies. Finally, based on previous studies, we included several control variables, such as the entrepreneur-specific human capital (entrepreneurship education, entrepreneurial and investor experience), organizational profile (size measured by number of employees and owners, technological sector defined by transformative sectors—mining, manufacturing—and non-transformative sectors—agriculture, retail, financial, personal), and other conditions associated with entrepreneurial ecosystems (perception of the entrepreneurs and culture in the society, infrastructures, etc.). Concerning the context, we included controls such as the country.

4.3.3. Data analysis

Regarding data analysis, we deployed a hierarchical logistic regression model in keeping with our having combined organizational-level (strategic orientation) and country-level measures (ecosystem conditions) (Wong and Mason, 1985). Since our dependent variable was dichotomous, we applied a multilevel logistic regression to estimate the influence of innovation ecosystem conditions and strategic orientation on the development of new technology. Table 4.1 presents the main characteristics of the entire sample and the correlation matrix of all variables. This table also conveys how the variables are not highly correlated.

Table 4.1: Descriptive statistics and correlation matrix

	Nascent	Obs.	Mean	Std.	Min	Max	1	2	3	4	5	6	7
1	New-technologies	6233	0.124	0.330	0	1	1						
Moderator													
2	Higher_education	5389	0.455	0.498	0	1	0.0173	1					
Innovation ecosystem													
3	Finantial_support	27	2.342	0.307	1.79	3.05	0.0439	0.1614	1				
4	Govern_support	27	2.475	0.390	1.68	3.43	0.0229	0.1660	0.6964	1			
5	IPR_support	27	2.513	0.493	1.63	3.85	0.0341	0.1232	0.6232	0.6898	1		
Strategic Orientations													
6	Entre_orientation	6177	0.243	0.429	0	1	0.0544	0.0466	0.0978	0.0794	0.0701	1	
7	Diver_orientation	6233	0.316	0.465	0	1	0.1039	0.0912	0.0593	0.0226	0.0809	0.0406	1
8	HGrow_orientation	6233	0.0825	0.275	0	1	0.0597	0.0627	-0.0341	0.0025	0.0224	0.0459	0.0775
Controls													
9	Entrepre_training	6233	0.367	0.482	0	1	0.0335	0.1308	0.0697	0.0502	0.0454	0.0355	0.0814
10	Investor_experience	6217	0.125	0.330	0	1	0.0475	0.0260	-0.0681	-0.0726	-0.0474	0.0630	0.0288
11	Entrepre_experience	6207	0.125	0.331	0	1	0.0296	-0.0629	-0.1174	-0.0956	-0.0522	0.0287	0.0160
12	Size_owners	6233	1.863	1.435	1	10	0.0163	0.0766	-0.0101	0.0250	0.0080	0.0768	0.0546
13	Sectors_transformative	5294	0.237	0.426	0	1	-0.0209	0.0283	-0.0037	0.0014	0.0607	0.0019	0.0486
14	Emerging_economies	27	0.408	0.491	0	1	-0.0060	-0.1278	-0.7182	-0.5574	-0.4362	-0.0938	0.0163
15	Entreduc_programs	27	1.897	0.244	1.31	2.59	-0.0029	0.0481	0.3973	0.2681	0.4983	-0.0037	0.0847
16	Phy_infrastructure	27	3.499	0.314	2.74	4.30	0.0509	0.1555	0.2842	0.2870	0.4475	0.0373	0.0815
17	Profe_infrastructure	27	2.827	0.251	2.26	3.42	0.0014	0.0879	0.5145	0.3265	0.6493	0.0414	0.1157
18	Culture_valuation	27	2.706	0.360	2.15	3.53	-0.0131	0.0122	-0.0404	0.2608	0.3711	-0.0621	0.0544
19	Entre_valuation	27	3.321	0.357	2.68	4.06	0.0558	-0.0469	-0.1302	0.0581	0.3257	-0.0465	0.0307

	Nascent	8	9	10	11	12	13	14	15	16	17	18	19
1	New-technologies												
Moderator													
2	Higher_education												
Innovation ecosystem													
3	Finantial_support												
4	Govern_support												
5	IPR_support												
Strategic Orientations													
6	Entre_orientation												
7	Diver_orientation												
8	HGrow_orientation	1											
Controls													
9	Entrepre_training	0.0463	1										
10	Investor_experience	0.0374	0.0312	1									
11	Entrepre_experience	0.0047	-0.0113	0.1334	1								
12	Size_owners	0.2141	0.0265	0.0415	-0.0247	1							
13	Sectors_transformative	-0.0439	-0.0119	0.0087	0.0219	-0.0484	1						
14	Emerging_economies	0.0354	0.0004	0.1100	0.1563	-0.0341	0.0338	1					
15	Entreduc_programs	0.0499	0.1171	-0.0356	-0.0492	0.0007	-0.0270	-0.2590	1				
16	Phy_infrastructure	0.0203	0.0527	-0.0105	-0.0366	0.0233	-0.0180	-0.0841	0.1463	1			
17	Profe_infrastructure	-0.0453	0.0286	-0.0483	-0.0584	-0.0317	0.0290	-0.4635	0.5073	0.3896	1		
18	Culture_valuation	0.0609	0.0019	-0.0273	0.0029	-0.0181	-0.0037	0.0411	0.3607	0.1510	0.1677	1	
19	Entre_valuation	0.0466	-0.0621	0.0290	0.0764	-0.0276	0.0410	0.2440	0.0171	-0.0962	0.0256	0.6355	1

4.4. Results and discussions

At the *country level of analysis,* Model I in Table 4.2 shows the main results regarding the nexus of innovation ecosystem conditions and organizational strategies on the development of new technologies by all nascent entrepreneurs. Concerning the conditions in the ecosystem linked to innovation, we did not found evidence of the influence of financial and governmental programs on technology-based nascent entrepreneurs. In the case of the role of existence and efficiency of property rights legislation, the results evidenced a negative effect on the development of new technologies by nascent entrepreneurs (-0.644; $p \leq 0.10$). The first explanation behind these numbers could be associated with a lower valuation of the experts in each country. On average, the valuation of this condition was 2.5 of 5.0 Likert scale. Intuitively, experts believe that IPR legislation still requires reinforcement to support/respect the rights of the inventors/entrepreneurs in their respective countries. Therefore, this condition has a negative effect in the development of new technologies (Liao and Welsch, 2008). Another plausible explanation behind this effect could be in the types of countries involved in this sample. In particular, 40% of the sample comprises countries with higher levels of income and categorized by innovation-driven economies (Reynolds et al., 2005). This means that the majority of countries included in this analysis are associated with economies with lower level of development. In this context, technology-based nascent entrepreneurs could face more barriers associated with the level of socioeconomic evolution of the institutions (Baumol, 1990), and these difficulties reduce the probability to becoming a technological entrepreneur. As a result, we did not find support for H4.1.

At the *organizational level of analysis,* Model I also presents the nexus of three types of strategic orientations with the development of new technologies by nascent entrepreneurs.

Concerning entrepreneurial orientation, we did not find evidence about the relationship of this strategy with technological-nascent entrepreneurs. Based on our previous findings and characteristics of the sample, it is not surprising because non-innovation-driven economies have higher levels of entrepreneurship by necessity (Reynolds et al., 2005) and lower levels of employee entrepreneurial activity (Bosma et al., 2010; Bosma et al., 2013; Guerrero and Peña-Legazkue, 2013). On the other hand, ours results show a positive and significant effect of diversification strategies (0.565; $p \leq 0.001$) and high-growth orientation (0.394; $p \leq 0.05$) on the development of new technologies by nascent entrepreneurs. These results are aligned with previous studies that have found a strong relationship between the orientation to new markets and growth on the propensity to be involved in technology-based entrepreneurship (Beckman et al., 2012a, b; Block et al., 2012; Gans and Stern, 2003). As a result, we find support for H4.2.

Concerning the moderation role of higher education, Model II shows the results obtained by groups of nascent entrepreneurs (with and without a college degree). On average, 43% of nascent entrepreneurs with higher education are located in innovation-driven economies. Therefore, the representativeness of both subsamples is confirmed. Regarding the conditions of the ecosystems associated with innovations, we observe that the effect obtained in the previous test is reinforced when nascent entrepreneurs have a college degree (e.g., the effect of government support is positive and significant), increasing the probability that they be involved in the development of new technologies. Similar to Model I, the effect of IPR is negative, but this effect is reinforced too. Based on those results, we assume that individuals with higher education are more attractive to technological activities when the ecosystem provides elements that support innovation than those without college degrees (Parker and Belghitar, 2006; Parker, 2011; Stuetzer et al., 2013). It is aligned with the opportunity

confidence of individuals with strong human capital who become nascent entrepreneurs based on the propensity of opportunities that they are able to identify according to their experience, knowledge and contacts, among others (Dimov, 2010).

If we also observe the individual control variables linked to other variables associated with specific human capital (entrepreneurial education, previous entrepreneurial and investor experiences), we also confirm the significant effect of those control variables with the probability to be involved in technology activities. As a result, we find support for H4.3a. On the other hand, concerning the organizational strategies, Model II also shows the reinforcement in the effect of each measure included in the analysis when the nascent entrepreneur has a college degree. Particularly, in contrast with the subsample of individuals without higher education, the entrepreneurial orientation (0.323; $p \leq 0.05$), diversification strategies (0.553; $p \leq 0.001$) and high-growth orientation (0.398; $p \leq 0.05$) have a positive effect on the development of new technologies by nascent entrepreneurs with higher education. These results are aligned with previous studies that found that these types of orientations are also linked with technology entrepreneurship (Parker and Belghitar, 2006; Wong et al., 2005). As a result, we find support for H4.3b. Interestingly, when we controlled by emerging and non-emerging, we observed that the effect of university is poor in emerging economies in contrast with more advanced economies where the role of university is evidenced (Model III). These results are aligned with previous studies such as Hoskisson et al., 2000 and Guerrero and Urbano, 2016.

Table 4.2: Statistical model

	Model I. All Nascent Entrepreneurs			Model II. Moderation of higher education					
				Nascent Entrepreneurs with higher education			Nascent Entrepreneurs without higher education		
New technologies	**Coefficient**	**S.D.**	**P>|z|**	**Coefficient**	**S.D.**	**P>|z|**	**Coefficient**	**S.D.**	**P>|z|**
Environmental conditions									
Finantial_support	.536	.435		-.156	.577		.965	.476	**
Govern_support	.230	.367		1.423	.553	***	-.241	.429	
IPR_support	-.644	.313	*	-1.915	.555	***	-.070	.418	
Strategic orientations									
Entre_orientation	.149	.101		.323	.149	**	-.035	.146	
Diver_orientation	.565	.092	***	.553	.140	***	.578	.129	***
HGrow_orientation	.394	.147	**	.398	.108	**	.331	.228	
Controls									
Entrepre_training	.205	.093	**	.279	.130	**	.235	.101	*
Investor_experience	.319	.125	**	.421	.185	**	.253	.177	
Entrepre_experience	.100	.127		-.268	.230		.166	.166	
Size_owners	-.000	.030		.059	.043		-.023	.044	
Sectors_tech orientation	.129	.103		.318	.157	**	-.013	.145	
Entreduc_programs	.761	.454	*	2.258	.619	***	-.202	.538	
Phy_infrastructure	.961	.305	***	1.259	.386	***	.860	.339	**
Profe_infrastructure	-.315	.488		-.157	.633		-.144	.555	
Culture_valuation	-1.292	.402	***	-1.981	.545	***	-.868	.459	**
Entre_valuation	1.818	.412	***	2.440	.537	***	.131	.048	**
Country	-.0753	.332		-.114	.445		-.169	.368	
Constant	-9.119	2.153	***	-12.050	.277	***	-8.008	2.482	***
country var(_cons)|	.133	.056		.121	.072		.127	.075	
Fixed-effects	-17.178			-71.426			-91.831		
Mixed effects									
obs	4453			1940			2513		
groups	27			27			27		
per group	46			16			5		
avg	167.2			71.9			93.1		
max	950			493			433		
Integration points	7			7			7		
Wald chi2(15)	90.53			67.73			52.96		
Log likelihood	-17.047			-71.011			-91.541		
Prob > chi2	***			***			***		
LR test vs. logistic regression:									
chibar2(01)	26.14			8.30			5.79		
Prob>=chibar2	***			***			***		

Note: Level of statistical significance: *** p≤ 0.01; ** p≤ 0.05; * p≤ 0.10

Continue

Nascent Entrepreneurs	Model III. Moderation of higher education					
	Nascent Entrepreneurs with higher education in emerging economies			Nascent Entrepreneurs with higher education in non-emerging economies		
New technologies	**Coefficient**	**S.D.**	**P>|z|**	**Coefficient**	**S.D.**	**P>|z|**
Environmental conditions						
Finantial_support	-.164	.841		-1.257	1.239	
Govern_support	1.792	1.278		-1.508	1.080	
IPR_support	-.117	1.260		-3.395	.964	***
Strategic orientations						
Entre_orientation	.281	.222		.325	.216	
Diver_orientation	.311	.205		.793	.205	***
HGrow_orientation	.260	.290		.695	.320	**
Controls						
Entrepre_training	.329	.105	*	.253	.208	
Investor_experience	.292	.258		.568	.293	*
Entrepre_experience	-.453	.331		-.241	.357	
Size_owners	.067	.063		.098	.040	*
Sectors_tech orientation	.227	.221		.517	.128	**
Entreduc_programs	1.229	1.504		3.078	.964	***
Phy_infrastructure	1.025	.775		1.992	1.128	**
Profe_infrastructure	2.449	1.815		1.002	1.200	
Culture_valuation	-.287	1.245		-2.383	.459	**
Entre_valuation	-.581	1.871		3.257	.882	***
Country	-.114	.445		1.215	.567	**
Constant	-15.630	9.426	*	-15.688	6.958	**
country var(_cons)|	.055	.076		.001	.001	
Fixed-effects	-359.753			-354.313		
Mixed effects						
obs	870			1070		
groups	14			13		
per group	15			18		
avg	62.1			82.3		
max	198			493		
Integration points	7			7		
Wald chi2(15)	26.66			64.76		
Log likelihood	-353.081			-345.87		
Prob > chi2	**			***		
chibar2(01)	0.81			0.79		
Prob>=chibar2	*			***		

Note: Level of statistical significance: *** p≤ 0.01; ** p≤ 0.05; * p≤ 0.10

4.5. Conclusions

Our results detail interesting trends regarding technology-based nascent entrepreneurs (with and without higher education). The insights show how some conditions associated with innovation and entrepreneurial ecosystems enhance the probability of developing new technologies (government programs and financial supports), while others simultaneously reduce the likelihood (e.g., property rights). In addition, insights also show how some

strategic orientation of nascent entrepreneurs could enhance the probability of developing new technologies (e.g., entrepreneurial orientation, diversification and high-growth orientation). The main differences stem from Model II regarding the moderation effect of higher education reinforcing the systems and the organizational nexus over technology-based nascent entrepreneurs.

Based on these results, this study provides a conceptual model and a methodological design appropriate to understanding the nexus of certain ecosystem conditions and organizational strategic orientations in the development of new technologies by nascent ventures (Busenitz et al., 2014) as well as some insights about the contribution of new university models in this phenomenon (Guerrero et al., 2016). Three managerial implications emerge from this study. *First*, we believe that our findings will aid entrepreneurs in developing entrepreneurial innovations through the influence of certain innovation and entrepreneurial ecosystems (Autio et al., 2014) as well as focusing on individual–organization–environmental interactions (Mosey et al., 2016). *Second*, this study also helps to understand the role played by certain conditions of both innovation and entrepreneurship ecosystems and allows policy makers to redefine them in order to find a balance between the rates of technological and non-technological nascent entrepreneurs. *Third*, this paper highlights the relevant emphasis of universities as drivers of entrepreneurship innovation and how university managers could reinforce the role of their universities in the technological development of their societies. This study also presents several limitations associated with the cross-section dataset that covers only certain countries and with the limited information about organizational/venture dimensions. Therefore, metrics and methods applied need to be improved. Therefore, new surveys, longitudinal samples and multiple case studies are required to explore in-depth the entrepreneur–organization–ecosystem interactions and their nexus with technology-based

nascent entrepreneurs. Previous chapters have shown the role of universities in the development of innovation and entrepreneurship activities. In case of emerging economies, this role has been promoted by government initiatives. In this regard, Chapter V explores the influence and impact of Mexican universities on innovation outcomes.

CHAPTER V:

DO HIGHER EDUCATION ORGANIZATIONS MATTER IN INNOVATION IMPACTS? LOOKING INSIDE BEHAVIORS AND R&D OUTCOMES OF MEXICAN ENTERPRISE-UNIVERSITY PARTNERSHIPS

5.1. Introduction

The technology transfer literature conceptualizes university technology transfer in terms of technology disclosure, patent filing and licensing (Bradley et al., 2013). This paradigm not only overlooks a diversity of practices by technology transfer offices, but it also neglects other innovative practices or conceptualizations relating to the creation and exchange of new knowledge (Link et al., 2007). In the Bradley et al. (2013, 47) proposed model, we observe diverse paths of technology transfer practices/channels to exchange ideas/knowledge with existing enterprises (e.g., consulting, research contracts, the establishment of joint labs, and other partnerships). This type of technology transfer relationship produces collaborative behavior and results in benefits for both agents. For academics, this type of relationship over time ensures work with enterprises in developing innovations and bringing them to market (Perkmann et al., 2013). For enterprises, open innovation collaborations with several agents allow enterprises to access and explore/exploit both internal/external flows of knowledge to obtain financial and economic benefits (Yasmin and Otto, 2004).

Given the relevance of knowledge transfer for social and economic development (Baumol, 1990; Grimaldi et al., 2011), governments around the world have created subsidies or programs to promote knowledge exchange (Bozeman, 2000), especially in emerging economies where university-enterprise partnerships are compulsory as a strategy to stimulate regional economic development and the transition from efficiency economies to innovation economies (van de Vrande et al., 2009). In these scenarios, for the partnership of universities with enterprises is an excellent opportunity to develop innovation with public funds because de facto it lowers the costs and risk among the participants in these initiatives. However, authors such as Perkmann (2007) and Gianiodis et al. (2016) also recognize certain degrees of

opportunistic within university-industry partnerships; particularly, when these relationships are relatively fragile and tend to be discontinued when the public funds for the initiative dry up. R&D cooperation can face opportunistic behavior or moral hazard problems when single efforts are not directly observable and partners tend to focus on their own profit when choosing their level of R&D investment (Becker and Dietz, 2004). Evidence on open innovation practices inside university-enterprise partnerships is thinly spread and further research and analysis is warranted (Feller, 2005); in particular, how different agents operate, collaborate, make decisions, identify benefits, or transform their roles or behaviors are interesting research areas. According to subsidies literature, collaborative and opportunistic behaviors could be observed in the inputs and outputs (Dimos and Pugh, 2016). In this study, we try to analyze it during the innovation process to generate enterprises' R&D outcomes (economic and social).

Based on those arguments and adopting several theoretical bases (open innovation, transactional cost, resource-based view), we propose a conceptual model to explore the influence of subsidies and open innovation on enterprise-university partnerships' collaborative/opportunistic behaviors and R&D outcomes. To achieve this objective, we explored the Mexican case for two main reasons: (a) the past three government administrations have established several subsidies[13] to reinforce innovation and knowledge transfer via enterprise-university partnerships. It has been a relevant strategy in the transformation process of an emerging economy toward an innovative economy; and (b) Mexican enterprises and universities have implemented several open innovation practices to exchange resources/knowledge. Methodologically, we used a qualitative methodology

[13] During 2006–2012, administrated by CONACYT (Mexican Council of Science and Technology, Mexican enterprises had access to several R&D programs and incentives -some of them with the requirement of a compulsory partnership with universities- (Guerrero and Urbano, 2016).

(Eisenhardt, 1989, 2007; Yin, 1984) that allows us to explore in-depth the collaborative or opportunist behaviors inside four subsidized enterprises enrolled in priority sectors for the Mexican government.

The chapter is organized as follows: Section 5.2 develops the conceptual framework. Section 5.3 describes the methodological design used in this paper. Section 5.4 presents and discusses the results obtained. Finally, Section 5.5 presents the main conclusions of the study, the implications for decision makers, and future lines of research.

5.2. Literature review

Extant studies have justified R&D subsidies to the private sector with the idea of failures in the markets for innovation (Nelson, 1959; Arrow, 1962). According to Clarysse et al. (2009, p. 1517), market failure is caused by leakages and spill-overs that prevent the private sector that undertakes innovative activities from fully capturing the benefits of their investments. As a consequence, the private sector does not have an optimal incentive to invest in R&D, and government intervention is thus needed to compensate for that R&D underinvestment. Adopting a theoretical economic rationale, governments around the word have introduced a variety of policy instruments to promote innovation (e.g., public subsidies including grants, low-interest loans, etc.) and to incentivize private enterprises to perform research and development (García-Quevedo, 2004; Autio et al., 2008; Clarysse et al. 2009; Edler and James, 2015; Dimos and Pugh, 2016; Kochenkova et al., 2016; Torres-Bareto et al., 2016). In contrast to the indirect support for R&D (e.g. tax credits), public subsidies for R&D programs constitute a direct support measure widely implemented by public authorities in both developed and developing economies; particularly, in emerging economies where the role of

R&D programs has gained preeminence in the public policy and has become a central topic in the competitiveness agenda of multilateral organizations such as the Inter-American Development Bank (IDB), the World Bank (WB), and the Organization of American States (OAS) (Hall and Maffioli, 2008).

Since the 1990s, policy makers in emerging economies have instituted and expanded a number of R&D programs supporting university-enterprise partnerships with the aim to regain competitiveness (Mahmood and Rufin, 2005; Guo and Guo, 2011; Guerrero and Urbano, 2016). In this context, governments have implemented certain enterprises' innovation subsidies with a compulsory university partnership such as a strategy to stimulate regional economic development, develop abortive capacities, and transition toward an innovative economy (Cohen and Levinthal, 1990; Cohen et al., 2002). Subsidy policies have been designed not only to maximize externalities but also to promote collaborative research (Takalo and Tanayama, 2010). It is important to understand the link between governments' policies and open innovation practices (Zeng et al., 2010; Kovacs et al., 2015) and explore why enterprises would consider open innovation practices such as a strategy to perform/retain/exploit knowledge inside/outside their boundaries (Chesbrough, 2003) as well as to access R&D subsidies. According to the literature (Carayannis et al., 2000; Hottenrott and Lopes-Bento, 2016), open innovation partnerships represent an organizational form designed to integrate disparate pools of intellectual capital, different competences, capabilities and organizational contexts (McGrath et al., 1995). In this regard, an open collaboration partnership comprises by knowledge exchange and knowledge sharing (Carayannis et al., 2000) that allow enterprises to gain new technologies, and entry to new markets, improve process and achieve innovation performance (Whitley, 2002). Depending on the purposes, enterprises' characteristics and trusted relationships, enterprises encourage open innovation

practices (commercial with other private organizations, scientific with universities and research centers or mixed) to determine how the cooperation is managed, and what kind of innovation/outcomes could be achieved (Nieto and Santamaría, 2007).

Following this vein, enterprises located in emerging economies engage R&D open innovation practices not only because they provide complementary resources for innovation and the minimization of risk but also for access to R&D funds. As a consequence, in the context of emerging countries, it is important to examine the effect of governments and their policies on the various open collaboration practices (Zeng et al., 2010). In this regard, we propose the following proposition:

> *Proposition 5.1: The access to R&D subsidies influences the configuration of enterprises' open innovation practices (commercial, scientific and mixed).*

Neither theoretically nor empirically is there a definitive justification or evidence of the effectiveness of public R&D subsidies in stimulating private/collaborative R&D as well as resulting in significant and tangible outcomes (Clarysse et al., 2009; Greco et al., 2016; Hall et al., 2016). Based on those arguments, several researchers argue that government could promote a collaborative behavior but also an opportunistic behavior in the subsidized organizations as well as in partnerships. The proponents of R&D programs consider that subsidies enhance enterprise productivity, reinforce domestic economic growth, generate spillovers and increase private R&D expenditures (García-Quevedo, 2004; Dimos and Pugh, 2016). In this sense, subsidies give the opportunity to an enterprise or a partnership to turn an unprofitable project into a profitable one or complete an existing project (Gruber and Henkel, 2006; Gruber et al., 2008). Indeed, from the enterprise's point of view, public funds are a

relatively cheap way to finance its R&D projects, especially when application costs are low and the probability of selection is high compared with alternative financing sources (Aschhoff, 2009; Aschhoff and Sofka, 2009). Therefore, subsidies reduce the fixed costs of other current and future research projects and increase their probability of being completed or undertaken (Benavente et al., 2007). However, the opponents of R&D programs argue that subsidies are not diverted to the best enterprises because the selection of subsidized enterprises could be influenced by pressure groups (Hall et al., 2016) or by the asymmetry of information between enterprises and investors, generating difficulties in measuring the private and social returns of R&D projects (Callahan et al., 2012). Moreover, several studies recognized that the majority of subsidized enterprises are selected more on the basis of achieving political, economic and strategic government's purposes than on the basis of the project quality (Sissoko, 2011).

A recent meta-regression analysis of R&D subsidies literature has evaluated the effects that subsidies have on enterprises' R&D inputs/outputs (Dimos and Pugh, 2016, pp. 798–800). These authors identify three possible effects: the additionality effect (crowding-in), the non-effect and the crowding-out effect. Adopting this criteria, in this chapter we can assume the existence of a collaborative behavior with the existence of an additionality effect that decreases costs and increases the expected profitability of funded R&D projects. Thus, it gives an incentive for subsidized enterprises/universities to invest in R&D activities over and above the counter-factual levels that enterprises/universities would have undertaken without public support. Therefore, additionality representing the R&D subsidy triggers additional enterprise-financed R&D spending beyond the amount of the subsidy (Buisseret et al., 1995; Autio et al., 2008; Clarysse et al., 2009). Moreover, the learning and knowhow gained from subsidized projects will spill over the success to other current and future research projects

(Benavente et al., 2007). Indirectly, crowding-in could produce a signaling effect about the quality of the project/team, reducing information asymmetries and increasing external supply of private funding (Lerner, 1999). Nevertheless, assuming that government does not have the ability to identify the enterprises that can undertake R&D without grants, the subsidized enterprises could display an opportunistic behavior (Baldwin and Robert-Nicoud, 2007; Wallsten, 2000; Rossi et al., 2016).

Following this perspective, we assume that the existence of a crowding-out effect is a sign of opportunistic behavior. This effect happens when enterprises consider the R&D subsidies as a perfect substitute of private R&D expenditures. In other words, enterprises may stop investing their funds in R&D during the subsidized years because subsidies allow for the continuation of ongoing projects as well as the refinancing of R&D activities. Theoretical perspectives suggest a partial effect when a part of the subsidy amount is used in place of its own R&D expenditures (which become less than they would have been without the subsidy); a full effect is observed when enterprise-financed R&D expenditures decrease by the full amount of the subsidy; and an over-full effect is presented when enterprises decrease enterprise-financed R&D expenditures by more than the amount of the subsidy (Dimos and Pugh, 2016). In the case where the public funds for R&D crowd out the private R&D expenditures, the results on productivity or performance can be biased. For instance, a crowding-out effect may also come from open innovation strategies with the sharing of R&D expenditures among the members of the same collaborative research (Fölster, 1995; Irwin & Klenow, 1996; Chen et al., 2002). Therefore, we believe that R&D subsidies could influence the behaviors of enterprises that are interested in developing innovation, and we propose the following propositions:

Proposition 5.2: Access to R&D subsidies influences enterprises' behaviors toward R&D outcomes.

P5.2a: Enterprises with a collaborative behavior evidenced a crowding-in effect.

P5.2b: Enterprises with an opportunistic behavior evidenced a crowding-out effect.

Based on the literature, open innovation strategies produce an economic impact at the enterprise level and a socioeconomic impact at the regional level. Enterprises engage in R&D open innovation practices not only because they provide complementary assets, capabilities and knowledge but also to achieve innovation performance (Belderbos et al., 2004). At the enterprise level, the most common economic measures of impacts are the turnover share deriving from (radical/incremental) innovations operationalized by verifying the successful introduction of an innovation regardless of its novelty (Trigo and Vence, 2012). To achieve these impacts, in emerging economies, commercial, scientific and mixed open innovation strategies require a well-founded common ground with a harmony of interests, values, goals and obligations (Nieto and Santamaría, 2007; Li and Kozhikode, 2009). According to transaction cost economics, open collaboration is a kind of relational contracting that copes with a high degree of asset specificity (e.g., causing switching costs), creates less uncertainty about specifying and monitoring partners' performance, internalizes spillovers, balances the partners' contributions and deters opportunistic behavior (e.g., mutual hostage situation) (Hill, 1990; Bogers, 2011). On the other hand, adopting a research-based view, open collaborations can be used to exploit resource complementarities and economies of scale, gaining low-cost new market entry, cost and risk management, tacit collusion and capability building and learning (Bogers, 2011). Here, we argue that organizations exhibiting opportunistic behavior

will produce a sharing effect within open innovation collaboration, positively affecting their goals and benefits.

Whether it be transaction costs or resource-based arguments, open innovation practices also have certain boundaries (Conner and Prahalad, 1996; Bäck and Kohtamäki, 2015; Frishammar et al., 2015). Specifically, open innovation collaborations could encompass moral hazard problems when partners are more focused on their profits than the success of their project (Torres-Bareto et al., 2016) or exhibit other opportunistic behaviors, such as when one partner attempts to be more competitive and appropriates other partners' resources/capabilities for his or her own benefit, or when certain university–enterprise partnerships develop an open collaboration to apply for and receive available funds (Sutz, 2000; Klerkx and Aarts, 2013). Those types of problems generate inefficiencies that increase the cost of coordination/monitoring and decrease the benefits of open collaborations. Previous research has shown that the pursuit of self-interest at the expense of the partner as well as the important costs of deterring such opportunistic behavior can constitute a major cause of partnership instability (Williamson, 1987). For instance, Hottenrott and Lopes-Bento (2016) found that the relationship between collaboration intensity and innovation follows an inverted-U shape and, on average, costs start to outweigh benefits if an enterprise pursues more than about two-thirds of its R&D projects in collaboration. These authors also found that for enterprises with higher collaboration complexities (in terms of different partners and different stages of the R&D process at which collaboration takes place), their returns start to decrease already at lower collaboration intensities. Therefore, we argue that organizations exhibiting opportunistic behavior will generate an appropriation effect within an open innovation collaboration, negatively affecting their goals and benefits. Based on these arguments, we propose the following propositions:

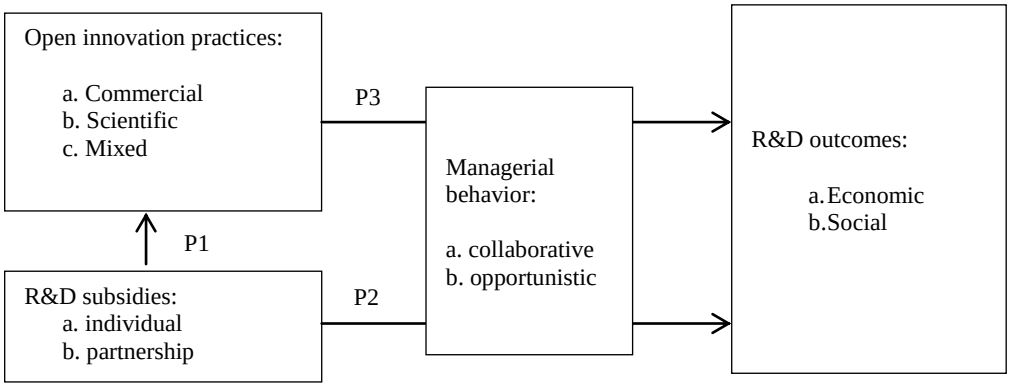
Proposition 5.3: The access to open innovation practices influences enterprises' behaviors toward R&D outcomes.

P5.3a: Enterprises with a collaborative behavior evidenced a sharing effect.

P5.3b: Enterprises with an opportunistic behavior evidenced an appropriation effect.

Based on the literature, Figure 5.1 shows the proposed conceptual framework.

Figure 5.1: Conceptual framework



Source: Author

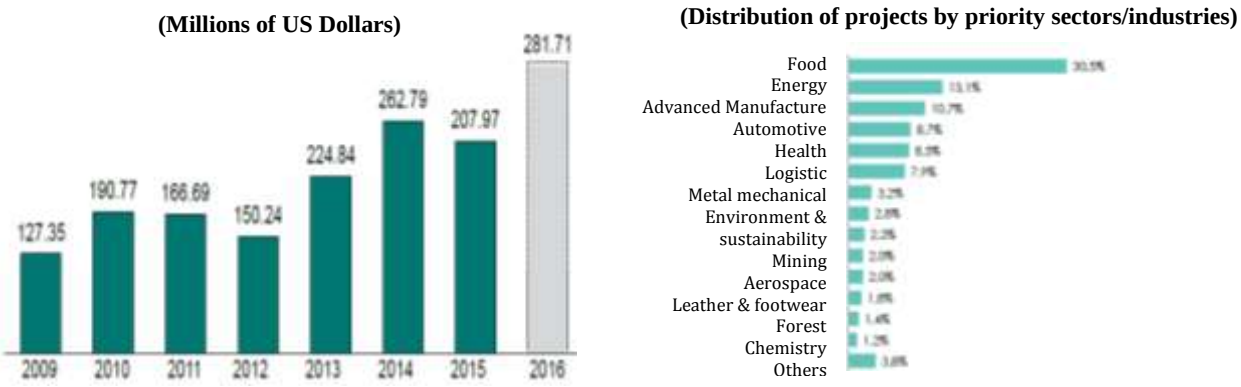
5.3. Methodology

5.3.1. Contextualization

According to the OECD's Science, Technology and Industry Scoreboard (OECD, 2013), the Mexican economy evidenced the highest percentage of product and/or process innovative enterprises receiving direct public subsidies for innovation between 2008 and 2010. Figure 5.2 shows that Mexico had investments of more than 2,932 million U.S. dollars (54% from private funds and 45% from public funds) between 2009 and 2016 in the Incentive Program

for Innovation, the R&D investment per year, as well as the distribution of subsidized projects per priority industries.

Figure 5.2: Investment in the Incentive Program for Innovation



Source: CONACYT

According to CONACYT,[14] the Incentive Program for Innovation supports enterprises that are registered at the National Register of Scientific Organizations and Technological Enterprises (RENIECYT) for conducting research and investing in the development of new technology and innovation, individually or in association with a public/private university or research center at the national level. Specifically, the main aim of this incentive is to encourage growth, competitiveness, and links between enterprise and scientific organizations (universities & research centers); to incorporate specialized human capital; to generate innovations (new products/services, process) with value added to strategic sectors; and to contribute to the creation/protection of intellectual property. The Incentive Program for Innovation has included three modalities: (a) INNOVAPYME (Technological Innovation for Micro, Small and Medium Enterprises), oriented toward projects promoted by SMEs both individually or/and in collaboration with a university/research center; (b) INNOVATEC

[14] For further information, visit [http://conacyt.gob.mx/index.php/fondos-y-apoyos/programa-de-estimulos-a-la-innovacion].

(Technological Innovation for Large Enterprises), oriented toward projects promoted by large enterprises both individually or/and in collaboration with a university/research center; and PROINNOVA (Projects Innovation-Oriented Network), oriented toward proposals that are submitted in collaboration with at least two universities or two research centers or one university and one research center.

5.3.2. Case study design

Similar to previous studies and given the nature of the research, this study adopts a multiple case study approach (Yin, 1984; Eisenhardt, 1989, 2007). Furthermore, heterogeneity of the cases was needed to comparatively analyze them. An initial exploration of official datasets was conducted to identify relevant and representative case studies linked to priority industries subsidized by the Incentive Program for Innovation (INNOVAPYME, INNOVATEC and PROINNOVA). In this initial stage, based on the objectives of this research, we adopted three criterions of selection: (i) subsidized enterprises between 2009 and 2015 in the modality of individual or/and with compulsory partners; (ii) enterprises involved in open collaboration practices (commercial, scientific or mixed); and (iii) the identification of at least two enterprises per priority industries.

Afterwards, we developed a protocol based on the literature review. In the semi-structured interviews, as part of the case study and interview protocol, the main themes discussed were: (a) background of the interviewee; (b) enterprise characteristics (age, size, financial results, growth aspirations) and orientation[15] (entrepreneurial and innovativeness); (c) innovation (knowledge exploration/exploitation/retention, resources/capabilities, etc.); (d) R&D

[15] Using the scales of entrepreneurial orientation

subsidies (types, number of projects, modality, % private/public investment); (e) open innovation practices (types, purposes, obtained results, positive/negative experiences, continuity); (d) opportunistic behaviors (open question); and outcomes associated with innovation (financial, intellectual and social).

During May 2016 and January 2017, we conducted semi-structured interviews with managers of those enterprises—ranging from national to multinational—located across Mexico. In general, 11 enterprises from diverse industries signed confidential agreements to be recorded and interviewed for 90 minutes. Complementary information obtained from secondary sources such as annual reports, official statistics, and other sources (e.g., websites) was triangulated with the interviews (Yin, 1984).

5.3. Description of cases selected by priority industries

Given the nature of this research, we focused only on two priority industries for the Mexican government: the automotive industry and the leather and footwear industry. In order to include in the analysis at least two enterprises per priority sector, we selected four enterprises (by confidential agreements, we use anonymous names): two enterprises from the automotive industry (AutoIn1 and AutoIn2) and two enterprises from the leather and footwear industry (LeFoIn1 and LeFoIn2).

Automotive Industry: The automotive industry is one of the most relevant and representative industries for the Mexican economy. According to the Instituto Nacional de Estadística y Geografía (INEGI) (2016), this industry produced products valued at approximately 614,621 million pesos in 2014, representing 47% of total national production, 3.2% of Mexican GDP

and 18.3% of manufacturing GDP. In terms of foreign direct investment (FDI), this industry received around 39,319 million U.S. dollars, which represented 9.7% of total Mexican FDI in 2015 (HSBC, 2015). According to the Mexican Automotive Industry Association (AMIA), Mexico's automotive industry will see its consolidation as one of the top countries in vehicle production and export. Concerning the main characteristics of the selected enterprises in this industry,

- *AutoIn1* was founded in the first decade of the 20th century and operates on the New York Stock Exchange. It is a multi-brand enterprise with a strong influence in the global market, with more than 70 plants around the world. For example, it covers market segments in North America, South America, Europe, Middle East, Africa and Asia Pacific. The core business includes designing, manufacturing, marketing, financing and servicing of diverse vehicles (e.g., cars, trucks, sports, electrified and luxury). The enterprise sold more than 6.6 million units (worth approximately 140.6 million U.S. dollars) during 2015.

- *AutoIn2* was founded in the 19th century and operates on the Frankfurt Stock Exchange. It is a multinational company headquartered in Europe with strong representation in more than 50 countries. Since 1998, when it was acquired by an important Mexican business group, this enterprise has manufactured brake systems, systems and components for powertrains and chassis, instrumentation, infotainment solutions, vehicle electronics, tires and technical elastomers in several plants located in Mexico. In 2015, the enterprise sold goods worth more than 39.2 billion euros and showed an innovation expenditure of approximately 2.4 billion euros.

Leather and Footwear Industry

The leather and footwear industry comprises approximately 80 large enterprises that produce 85% of the industry's total economic value and generate 46% of the industry's employment. According to the INEGI (2016), this industry produced products valued at approximately 51,074 million pesos in 2014. In this sense, the manufacture of Mexican footwear is an important commercial activity in the national economy that generates a highly competitive supply chain. For instance, the footwear industry is the key actor in the leather-footwear-leather goods chain that includes 7,400 establishments representing 68.4% of the total production chain (Secretaría de Economía, 2015). For this reason, the Mexican government has implemented several strategies to promote the productivity and competitiveness of this industry. According to the Mexican Footwear Association, Mexico's footwear manufacturers are ranked ninth in the world. Concerning the main characteristics of the selected enterprises in this industry,

- *LeFoIn1* is a Mexican enterprise with 30 years of experience in the tanned sector, offering leather and skins both in the domestic and international markets. In the 1970s, the enterprise faced several strategic problems that provide for the possibility to innovate and enter several markets, introducing new materials, textures, designs and colors. Applying an innovation ideology, this enterprise has created a development department and invested in both technology and the training of personnel. The enterprise has focused on identifying necessities across industries and adapted its products to those necessities, becoming a key supplier to industries such as automotive and aerospace, among others.

- *LeFoIn2* is a Mexican family enterprise founded in 1994. Currently, it is managed by the third and fourth generations, with strong long-term experience in the tannery business. The enterprise has obtained several recognitions, such as the best tannery in Latin America by *World Leather Magazine*, and has entered into a collaboration agreement with Timberland in 2016. The business core is the production of world-class footwear and as a leather supplier to the automotive industry.

In summary, Table 5.1 shows an overview of the selected cases with a description of the main characteristics.

5.3.4. Validity and reliability

Concerning validity (Eisenhardt, 1989, 2007; Yin, 1984), internal validity (creating correct operational measures for the findings) and external validity (referring to the domain of the findings) were achieved as follows: internal validity was implemented based on an in-depth literature review and the initial exploratory interviews by using a general structure of questions/framework to investigate the multiple cases; and external validity was established through selection criteria that focused on providing insight that contributes to the debate in the field.

Table 5.1: Enterprises' characteristics

Modality	Enterprise	Main characteristics					Subsidies 2009-2015		Open innovation projects (number of collaborations)				Outcomes (in average)		
		Age (years)	Size (employees)	Location	Orientation *	% ownership	Private (%)	Public (%)	No. projects	Commercial	Scientific	Mixed	Innovation performance (annual growth)	Intellectual	Social
INNOVATEC	AutoIn1	31	> 500	Centre & North	EO= Moderate risk & pro-activeness; Internal autonomy (new factories, product lines)	100% Foreign 95% sales from foreign	70%	30%	17 (11 individual & 6 in collaboration with scientific organizations)	2 (1 supplier & 1 alliance with an enterprise)	4 (3 national universities & 1 international university)	-	3% in sales 6% in employees (35% of sales from innovations)	3 patents, 4 utility models, 1 property rights & 3 theses	30 new employees
	AutoIn2	12	> 500	Centre	EO= Moderate risk & pro-activeness; Internal programs & incentives (new factories)	100% Foreign 88% sales from foreign	69%	31%	5 (all in collaboration with 3 scientific organizations)	1 (intra – subsidiary)	2 (1 national university & 1 research center)	-	3% in sales 5% in employees (30% of sales from innovations)	6 patents	80 new employees
INNOVAPYME	LeFoIn1	33	230-240	Centre	EO= Higher risk & pro-activeness; Department (new sectors entries)	100% National 0% sales from foreign	51%	49%	2 (all in collaboration with 1 scientific organizations)	-	4 (2 national universities & 2 research centers)	-	20% in sales 15% in employees (80% of sales from innovations)	1 patent, 7 utility models, 3 theses, 2 IPR & introduction in other sector**	42 new employees
	LeFoIn2	22	200	Centre	EO= Low risk, moderate pro-activeness, low participation (new markets and business models)	100% National 50% sales from foreign	50%	50%	1 (all in collaboration with 1 scientific organizations)	-	4 (1 national university & 3 research centers)	-	10% in sales 16% in employees (25% of sales from innovations)	2 patents & 1 utility model	25 new employees

Note: * EO = Entrepreneurial Orientation; ** Aerospace industry supported by PROINNOVA in collaboration with five scientific organizations

Source: Interviews

In addition, by conducting multiple cases, this research attempts to achieve “literal replication” (predict similar results) and “theoretical replication” (predict contrasting results but for predictable reasons). Reliability was implemented by using several sources of information (documents, interviews, datasets, etc.) (Eisenhardt, 1989, 2007; Yin, 1984).

5.4. Results and discussion

Concerning the influence of R&D incentives on open innovation practices, we observe that the three modalities associated with the Incentive Program for Innovation promoted by the CONACYT allow for both the individual and the collaborative submission of proposals. According to CONACYT statistics, almost 90% of subsidized projects between 2009 and 2016 have been developed in collaboration with scientific organizations. Therefore, the probability that an innovation project will be successfully subsidized increases with the collaboration of scientific organizations. Previous studies have shown similar patterns in the strategies developed by policy makers in emerging economies to stimulate regional economic development (Cohen et al., 2002; Mahmood and Rufin, 2005; Guo and Guo, 2011; Guerrero and Urbano, 201). Another interesting pattern identified in this study is that multinational enterprises are more oriented toward collaboration with commercial partners like suppliers or intra-enterprises as well as alliances with other enterprises involved in the same value chain.

Based on the interviews, the four cases analyzed (AutoIn1, AutoIn2, LeFoIn1 and LeFoIn2) have shown the configuration of innovation projects in collaboration with universities and/or research organizations. Moreover, the interviewed managers highlighted the relevant contributions of scientific organizations in the development of innovations. Interestingly, the four cases have continued to participate in other open innovation projects with at least one of

the scientific organizations that also participated with them in the Incentive Program for Innovation. However, the generation of innovation also varies across the enterprises' dimensions and profiles. In our analysis, there is a tendency for multinational companies to use subsidies to improve their processes or to create incremental innovations in collaboration with universities, while national companies access subsidies in order to generate more incremental and radical innovation. For example, LeFoIn1 has collaborated with five scientific organizations in the development of a disruptive innovation in a new sector (energy). An explanation for this is the spillover effect of the learning, knowhow and trust developed during the subsidized project that is transferred to new collaborations (Benavente et al., 2007; Söderblom and Samuelsson, 2013). In the context of these four companies located in developing countries, the interest to access R&D incentives has influenced their configuration and perspective about open collaboration practices. As a result, incentives also change the enterprise behavior linked in a direct (formal) or indirect (informal) way to the learning within the organization (Carayannis et al., 2000).

Regarding the collaborative behavior, given the characteristics of AutoIn1 and AutoIn2 (size, ownership and sector), we observe that private R&D investment is two times higher than public R&D investment. As a result, their R&D costs decrease, as do their innovation achievements (the majority in terms of improvement of processes/methodologies), intellectual results (patents, utility models, property rights) and growth impacts (less than 10% in job creation and sales). For instance, the access/success in one innovation incentive program influenced LeFoIn1's collaboration behavior that thus generated relevant externalities such as participating in the PROINNOVA Program with other scientific organizations to obtain the funds required for a disruptive innovation to operate simultaneously in another sector (aerospace) with greater results than in its current sector (leather and footwear). Based on

previous studies (Buisseret et al., 1995; García-Quevedo, 2004; Autio et al., 2008; Clarysse et al., 2009; Dimos and Pugh, 2016), this evidence could be an insight into the additionally effect; therefore, subsidies could generate a collaborative behavior. It is aligned with the idea that learning gained from subsidized projects will spill over the success to other current research projects (Benavente et al., 2007). Here, the majority of interviewed managers from the selected enterprises have recognized that their main motivation behind these public incentives is the opportunity to decrease R&D investments/costs and minimize risks with other organizations in order to be more competitive. For instance, AutoIn2's manager added that this incentive is also a way to discover/attract talent, which also contributes to the achieving the purposes of the project. In this regard, Clarysse et al. (2009) argue that this type of behavioral change can also be caused by what organizations have learned from knowledge spillovers and/or as a result of their contacts within the scope of an R&D project about the strategies, process and administrative practices of other private and public organizations.

Concerning opportunistic behavior, there are some insights into a partial or full opportunistic effect on enterprises' behavior and the impact of their innovation (Dimos and Pugh, 2016). First, in the case of the leather and footwear industry (LeFoIn1 and LeFoIn2), defined by the nature of the INNOVAPYME Program, the investment in R&D by subsidized projects in collaboration is similar in the amount of private vs. public investment. Second, if we analyze in-depth the nature of the R&D public incentive, we observe that AutoIn1 is more oriented to apply for subsidies alone instead of in collaboration; for instance, the number/orientation of individual subsidized projects (10 oriented to new products, specialized equipment and infrastructure) in comparison with subsidized projects in collaboration with scientific organizations (4 oriented to the development of methodologies). Even though all subsidized projects of AutoIn2, LeFoIn1 and LeFoIn2 were developed in collaboration with universities

and research centers, these enterprises show the same pattern in the orientation toward incremental innovations linked to process/methodologies. As a result, the interviewed enterprises may decrease their R&D expenditures and their results with respect to productivity or performance can be biased (Chen et al., 2002). Third, if we consider that AutoIn1 and AutoIn2 are multinationals located in certain regions of Mexico, the majority of economic and innovation impacts derived from these incentives could occur in their headquarters located in other countries. In fact, we also could observe opportunistic behavior from government that provides incentives for foreign companies with the intention of attracting foreign inversion as well as improving competitiveness indicators. Then, these enterprises face several obstacles to build a competitive advantage in costs (lower labor costs), localization (close to USA) and incentives (taxes and subsidies). In this line, based on public choice theory, government also may adopt opportunistic behavior to improve its reputation because of the effectiveness of its programs and to achieve competitiveness in its strategic sectors (Tripsas et al., 1995; Falk, 2007; Aschhoff and Sofka, 2009; Zeng et al., 2010). Fourth, interestingly, the majority of interviewed managers recognized opportunistic behavior not only in the amount of money received but also in the insertion of a scientific organization as a requirement. In these cases, previous studies recognized that governments should implement mechanisms to control opportunistic behaviors. For example, ex-post funding provides a strong incentive to produce measurable output (and therefore, subsidized organizations are closely monitored in terms of their production) and ex-ante mechanisms allow funders to control what (research projects) and/or who (researchers) is to be supported (Takalo and Tanayama, 2010; Crespi et al., 2011; Aboal and Tacsir, 2016).

For the multinational companies (AutoIn1 and AutoIn2), the main source of new knowledge and technology is internal. The organizational configuration of these enterprises allows for the

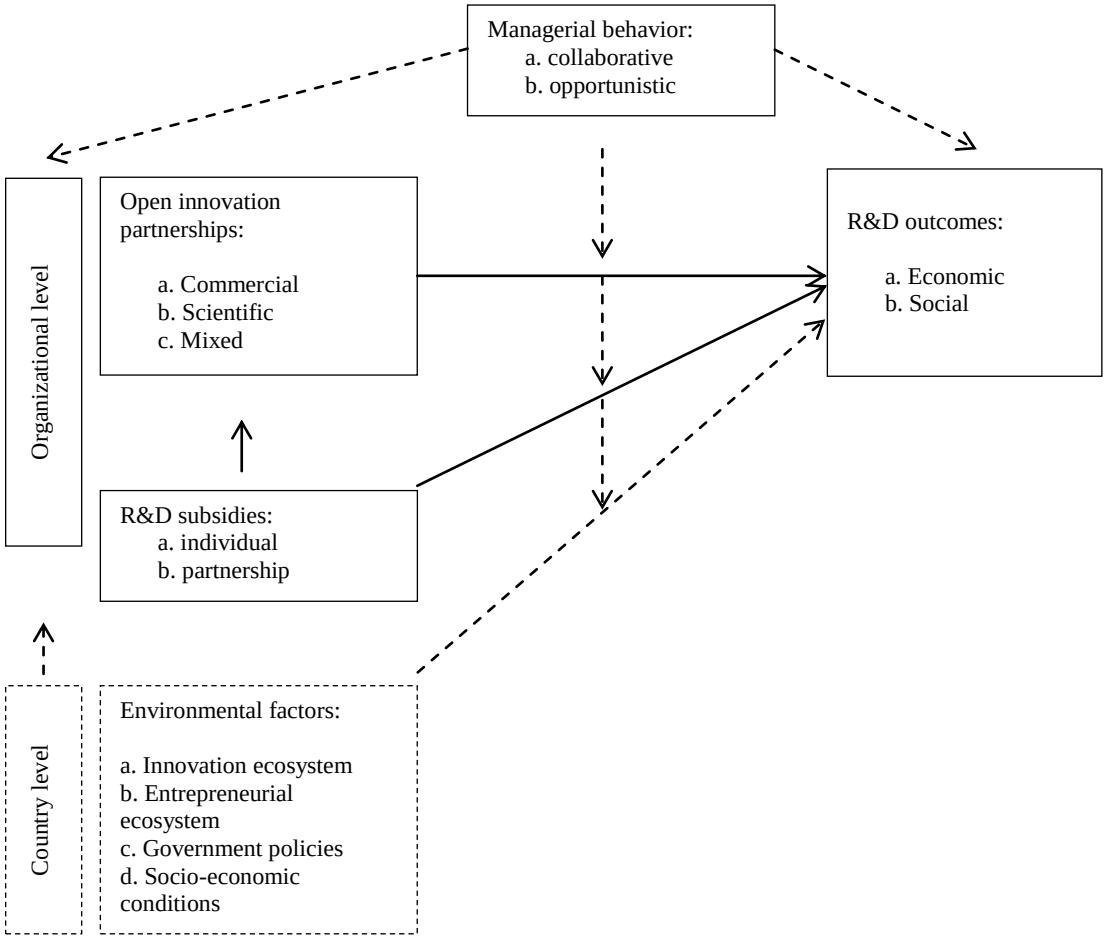
exploration and flow of knowledge across different departments. Furthermore, these companies invest resources in R&D and establish strategies oriented to training and attracting and retaining internal talent. In certain situations, AutoIn1 and AutoIn2 explored new opportunities from other enterprises—alliances and providers—(AutoIn1), universities and research institutes (AutoIn1 and AutoIn2). In this regard, previous studies have identified several alternatives to minimize those inefficiencies, such as carefully choosing the type of alliance, choice of partners, contractual terms, or different types of incentives (Danzón et al., 2005). For example, Carayannis et al. (2000) suggest that those problems could disappear with the configuration of learning alliances that help share costs, spread risk and gain new knowledge. Interestingly, in these types of external practices, the interviewed enterprises are not focused on retaining or directly exploiting the generated knowledge. Particularly, their collaborations are oriented toward developing certain capabilities or improving certain processes. Therefore, AutoIn1 and AutoIn2 defined collaboration contracts or agreements to achieve certain objectives within a time period. The advantages are the domain of the technology and the establishment of controls across the collaboration process, while the disadvantages are the timing of answers. According to their global vision, AutoIn1 and AutoIn2 are interested in continuing to collaborate in commercial and scientific partnerships. In a few cases, they have also collaborated with organizations that participated with them in earlier subsidized projects. Based on the evidence obtained in the cases of interviewed multinational companies (AutoIn1 and AutoIn2), we observe that they create a collaborative environment that reduces the need to monitor for opportunistic behavior, the information and transactional costs (Erridge and Nondi, 1994). Therefore, the partnership is transformed based on trust, experience and long-term performance (Söderblom and Samuelsson, 2013).

In the cases of the SMEs (LeFoIn1 and LeFoIn2), the perception of open innovation collaborations is quite different. First, both internal and external sources of knowledge are relevant and complementary for these interviewed enterprises. In particular, this is the best opportunity to explore/retain/exploit new knowledge-sharing expenditures, spreading risks and benefits among the members of the same collaborative research (Fölster, 1995; Irwin & Klenow, 1996; Chen et al., 2002). Second, in commercial collaborations with suppliers or customers, LeFoIn1 and LeFoIn2 are able to create conditions in which all obtain a benefit. In this sense, the harmony of interests, values, goals and obligations produces a collaborative behavior or sharing effect (Nieto & Santamaría, 2007). Third, in scientific collaborations with well-recognized universities or research institutes, LeFoIn1 and LeFoIn2 are oriented toward sharing costs in the development of prototypes, the implementation of new procedures or the improvement of existing processes. Their idea behind these partnerships is as a learning process, but it is also based on agreements and research contracts (Carayannis et al., 2000). An optimal learning climate respects different opinions, generates collaboration rather than competition and shares information based on mutual trust (Zarraga and Bonache, 2003; Inkpen and Pien, 2006). However, there are members who enjoy the benefits of the collective good without contributing to its establishment and/or maintenance (Dyer and Nobeoka, 2000). This is also referred to as opportunistic behavior, which means that an actor uses new ideas unfairly or takes advantage of the openness of other actors in the network (Teece, 2002, 2007; Teece et al., 1997).

In this context and the multiple case studies analyzed, the evidence provides for several insights into our proposed conceptual model about the influence of R&D subsidies and open innovation on the enterprises' behaviors and R&D impacts (Figure 5.3). The first proposed adjustment is to include a moderation effect of managerial behavior (opportunistic or

collaborative) associated with access to the inputs (directly related to the inputs obtained from access to subsidies as well as to participating in open innovation practices) in the outputs obtained (directly related to the outcomes), as well as during the transformation process of those inputs into outputs. Opportunistic behavior or moral hazard problems occur when partners focus on their own inputs and R&D benefits during the time of the relationship (Becker and Dietz, 2004; Perkmann et al., 2013). The second proposed adjustment is the influence of institutional factors. For instance, previous studies have highlighted the relevance of examining the effect of governments' behaviors, policies and purposes behind the promotion of open collaboration practices in certain R&D subsidies (Dimos and Pugh, 2016; Zeng et al., 2010). In addition, in the context of emerging economies, there are also other conditional factors of innovation and entrepreneurship that need to be considered, such as the intervention of government and other conditions in the configuration of university–enterprise partnerships (Guerrero and Urbano, 2016). Based on those arguments, we introduce a second dimension (the country level) with some institutional factors that could have an effect on the influence of R&D inputs and R&D outcomes. In this regard, this chapter expects to contribute to the debates of R&D subsidies and open innovation strategies in emerging economies.

Figure 5.3: Adjusted conceptual framework



Source: Author

The first adjust proposed is to include a moderation effect of managerial behavior (opportunistic or collaborative) associated to access to the input (directly related with the inputs obtained from the access to subsidies as well as to participate in open innovation practices), in the outputs obtained (directly related with the outcomes) as well as during the transformation process of those inputs in outputs. Opportunistic behavior or moral hazard problems occur when partners focus on their own inputs and R&D benefits during the time of the relationship (Becker and Dietz, 2004; Perkmann et al., 2013). The second adjust proposed is the influence of environmental factors. For instance, previous studies have highlighted the relevance of exanimating the effect of governments' behaviors, policies and purposes behind the promotion of open collaboration practices in certain R&D subsidies (Dimos and Pugh,

2016; Zeng et al., 2010). In addition, in the context of emerging economies, there are also other conditional factors of innovation and entrepreneurship that need to be considered such as the intervention of government and other conditions in the configuration of enterprise-university partnerships (Guerrero and Urbano, 2016). Based on those arguments, we introduce a second dimension (country level) with some environmental factors that could have an effect on the influence of R&D inputs and R&D outcomes. In this regard, this paper expects to contribute to the debates of R&D subsidies and open innovation strategies in emerging economies.

5.5. Conclusions

In emerging economies, university transformation is slow because there is not a strong base to build upon and from which to obtain high-quality research outcomes, while enterprises interested in partnerships usually face challenges in terms of communication, expectations and agreements. Using a multiple case study, this study provides some insights about the effect of R&D subsidies on open innovation practices when governments promote university–enterprise partnerships as a requirement of the Incentive Program for Innovation and as a strategy to reinforce national competitiveness. In particular, our analysis shows how opportunistic/collaborative behavior is not only influenced by the interest behind R&D subsidies and open innovation practices but also by the enterprises' characteristics (age, size, sector and ownership) (Rothwell and Dodgson, 1991). In this regard, this exploratory study contributes to the academic debate about the R&D contribution of university–enterprise partnerships in emerging economies (Mahmood and Rufin, 2005; Guo and Guo, 2011; Guerrero and Urbano, 2016), and the effectiveness of public R&D subsidies in stimulating private/collaborative R&D (Clarysse et al., 2009; Greco et al., 2016; Hall et al., 2016; Hall and Lerner, 2010).

Given the nature of the analysis, this research presents some limitations that provide new research opportunities. The main limitation is associated with the methodology. We recognize that it is difficult to generalize the results of multiple case studies. In this regard, a natural extension of this research is to explore more/longitudinal case studies among different industries/regions until saturation as well as combing primary/secondary data (mixed methods). For instance, an administrated survey will help to categorize interviewed enterprises as subsidized (focus group) or non-subsidized (control group). The second limitation is linked to the measures of collaborative/opportunistic behavior, inputs/outcomes of innovation and institutional factors. Based on the literature review, objective measures help to improve the qualitative analysis of proxies such as additionality. The third limitation is associated with our conceptual framework. Future research will allow us the use of diverse theoretical bases (e.g., resource-based view, opportunity cost, institutional theory, knowledge spillover and open innovation).

Some implications for the main actors involved in the Mexican innovation system emerge from our study. For policy makers, the study presents some insights about the determinants of enterprises' participation in open collaborative innovation models as well as evidence about the effect produced by R&D subsidies on enterprises' outcomes from two priority industries for the Mexican government: the automotive industry and the leather and footwear industry. In case of the automotive industry, the main users of the Incentive Program for Innovation have been multinational companies that, indirectly or directly, have been incentivized to attract foreign direct investment in different regions of Mexico. Recently, as a part of a competitiveness and protectionist strategy, the new U.S. administration has redefined and imposed border taxes for those American companies (most of them enrolled in the automotive

industry) with investments or operations in Mexico. Therefore, policy makers face the challenge of redefining and reincentivizing the productive value chain (Dussel, 2017). For enterprise managers, this study offers insights about the best mechanisms and practices for innovation in collaboration with external public and private partners. For those small national companies, subsidies and open innovation are good strategies to develop R&D as well as to identify the patterns that could be adopted inside a university-enterprise partnership. For the university community, the entrepreneurial university model is a good example to follow in its transformation processes. In this sense, open innovation practices with diverse agents involved in the entrepreneurial and innovative ecosystems will be a good strategy to reinforce their innovation activities as well as to develop entrepreneurial initiatives in the region (Guerrero and Urbano, 2016). In fact, the outcomes of those innovation practices are also relevant to legitimizing their role in society as well as their contribution to regional development.

CHAPTER VI:

CONCLUSIONS / CONCLUSIONES

6.1. Introduction / Introducción

Conclusions, implications, limitations and future research lines have already been presented and discussed in each chapter. Therefore, this chapter offers both general conclusions as well as an integrated summary of main conclusions. Limitations and related future research lines are also integrated in this chapter.

---------- In Spanish / En castellano ----------

Conclusiones, implicaciones, limitaciones y líneas de investigación futuras ya se han presentado y discutido en cada capítulo. Por lo tanto, este capítulo ofrece tanto las conclusiones generales como un resumen integrado de las principales conclusiones por capítulo. Las limitaciones y líneas de investigación futuras relacionadas también se integran también en este capítulo.

6.2. Conclusions / Conclusiones

6.2.1. General conclusions / Conclusiones generales

The general objective of this thesis was to provide a better understanding about role of universities such as drivers of innovation and entrepreneurship activities in the economies transition towards innovation and entrepreneurship based economies. In this regard, the case of Mexico was explored in this thesis. Based on the literature review and evidence obtained, the majority of Mexican universities only fulfilling the first mission (education / training) and showing a lower orientation towards the second (research) and third

(transfer/entrepreneurship) missions derived of the diversity and complexity of higher education system. In fact, only a few universities have oriented their resources/capacities to enhance their evolution and transformation such as entrepreneurial universities.

Concerning innovation activities, the results from university-enterprise partnership evidenced a propensity to collaborate in the development of incremental innovations associated to higher technological sectors and this propensity increases when could access to public incentives. In this regard, the Mexican universities enrollment in the ecosystems of innovation and entrepreneurship is stimulated by the existence of public R&D incentives. However, there is not consensus about the positive or negative effect of subsidies in impacts of innovation. There are some insights that suggest that Mexican subsidies for innovation could be promoting both opportunistic and collaborative behaviors among agents. Regarding entrepreneurial activities, the results from nascent technological based-entrepreneurship evidenced that universities play a relevant role in the generation of talent as well as knowledge in developed economies but not in emerging economies. Therefore, the participation of Mexican universities in the generation and development of entrepreneurial and innovative activities is less than expected. Although in this research is also evidenced the important effort of public bodies (e.g., CONACYT and the Ministry of Economy) in the configuration of Mexican ecosystems of innovation and entrepreneurship, the obtained results are not enough due to the lower levels of participation of enterprises, higher education organizations and research centers.

---------- In Spanish / En castellano ----------

El objetivo general de esta tesis fue obtener un mejor entendimiento sobre el papel de las universidades como impulsoras de las actividades de innovación y emprendimiento en

economías que se encuentran en un estadio de transición hacia economías basadas en la innovación y el emprendimiento. En este sentido, el caso de México fue explorado en esta tesis. A partir de la revisión de literatura y de la evidencia obtenida, la mayoría de las universidades mexicanas tan sólo se concentran en el desarrollo de la primera misión (docencia) y con una baja orientación hacia la segunda (investigación) y tercera (transferencia/emprendimiento) misión derivada de la diversidad y complejidad del sistema universitario mexicano. De hecho, tan sólo algunas universidades han orientado sus recursos/capacidades para fortalecer su evolución y transformación como universidades emprendedoras.

En lo relativo a las actividades de innovación, los resultados evidencian una propensión a la colaboración entre las universidades y las empresas cuando les interesa desarrollar innovaciones incrementales vinculadas a sectores altamente tecnológicos y esto incrementa cuando pueden acceder a subsidios. En este sentido, la participación de dichas organizaciones en los ecosistemas de innovación y emprendimiento es estimulada por incentivos públicos a la I+D. Sin embargo, hay algunos indicios de que en el caso de los subsidios mexicanos a la innovación podrían estar generando comportamientos tanto oportunistas como colaborativos entre los agentes. En lo relativo a las actividades emprendedoras, los resultados al analizar a los emprendedores nacientes de base tecnológica se evidencian el importante papel de las universidades en la generación de talento y conocimiento en economías desarrolladas pero no en las emergentes. Por lo tanto, la participación de las universidades mexicanas en la generación y desarrollo de actividades emprendedoras e innovadoras es más baja de la esperada. Aunque en esta investigación también se evidencia los esfuerzos de los agentes públicos (ej., CONACYT y el Ministerio de Economía) en la configuración del ecosistema

emprendedor e innovador mexicano, los resultados obtenidos no son suficientes debido a la baja participación de las empresas, universidades y centros de investigación.

6.2.2. Specific conclusions / Conclusiones específicas

Aligned with this purpose, four specific objectives were achieved in this thesis:

- SO1: To understand the role of higher education organizations in innovation systems and entrepreneurial ecosystems
- SO2: To explore the role of higher education organizations as drivers of innovation activities
- SO3: To explore the role of higher education organizations as drivers of entrepreneurial activities
- SO4: To explore the influence of higher education organizations on innovation outcomes

In this sense, Table 6.1 summarizes the main findings obtained in each chapter of this thesis.

First, the involvement of Mexican higher education organizations in innovation and entrepreneurship systems reflects the existence of incentives to accomplish their teaching, research and entrepreneurial activities mission; however, given the complexity and diversity, a lower participation in the involvement of innovation and entrepreneurial activities of universities is observed in the Mexican context. This means that only a few universities are using their resources/capabilities to transform themselves into more innovative and entrepreneurial organizations in order to generate talented people, higher quality research, strong knowledge transfer and commercialization, and socioeconomic value creation.

Second, the role of Mexican universities in innovation activities was evidenced by the analysis of university-enterprise partnerships. Interestingly, based on our results, Mexican innovative enterprises collaborate with universities in the development of radical innovations. In fact, the role of universities is greater when the enterprises are involved in science-based collaborations than when they are involved in mixed collaborations. Another relevant contribution of universities to innovative enterprises is associated with the access to R&D subsidy programs; in this case, the influence is higher when enterprises collaborate with universities and other enterprises at the same time.

Third, interesting trends regarding technology-based nascent entrepreneurs (with and without higher education) and environmental conditions associated with innovation and entrepreneurial ecosystems were evidenced. Interestingly, the moderation effect of higher education reinforces the systems and the organizational nexus over technology-based nascent entrepreneurs. However, the scenario in emerging economies is not well aligned with the general trends.

Fourth, a multiple case study provided insights into the influence of universities on enterprises' innovation outcomes; specifically, it evidences opportunistic/collaborative behaviors behind compulsory Mexican university–enterprise partnerships to access R&D subsidies. However, this effect depends on enterprises' characteristics (age, size, sector and ownership). In addition, evidence suggests that university transformation in the Mexican context is slow due to the lack of strong bases on which to generate high-quality research outcomes as well as the fact that enterprises usually face challenges in terms of communication, expectations and agreements when trying to collaborate with universities.

Table 6.1: Main conclusions / Principales conclusiones

SO	Chapter / Capítulo	Theoretical / Teoría	Empirical / Empírico	
			Methodology / Metodología	Findings / Evidencia
SO2	CH3	H3.1 Innovative enterprises are more likely to collaborate with universities to develop radical innovations than to develop incremental innovations / Empresas innovadoras son más propensas a colaborar con universidades en el desarrollo de innovaciones radicales que en el desarrollo de innovaciones incrementales	Quantitative: Multinomial regression applied in a sample of 10167 Mexican enterprises (collected by the INEGI) / Cuantitativa: Regresión multinomial aplicada a una muestra de 10167 empresas mexicanas (recogida por el INEGI)	Supported / Confirmada
		H3.2. The role of universities in exploratory innovation is more significant in science-based collaborations than in mixed collaborations with other agents / El papel de las universidades en innovaciones exploratorias es más significativo en colaboraciones científicas que en colaboraciones mixtas con otros agentes		Supported / Confirmada
		H3.3. The access to government subsidies with compulsory university partnerships is greater in exploratory innovation practices than in exploitative innovation practices / El acceso a los subsidios gubernamentales en colaboración con universidades es mayor en la exploración de innovaciones que en la explotación de prácticas innovadoras		Supported / Confirmada
		H3.4. The access to government subsidies with compulsory university partnership is greater in mixed collaborations than in exclusively science-based collaborations / El acceso a los subsidios gubernamentales en colaboración con universidades es mayor en colaboraciones mixtas que en colaboraciones exclusivamente científicas		Supported / Confirmada
SO3	CH4	H4.1. Nascent entrepreneurs are more likely to develop new technologies when they are involved in supported innovation ecosystems (e.g., financial, governmental support and IPR) than those who are in non-supported ecosystems / Los emprendedores nacientes son más propensos a desarrollar nuevas tecnologías cuando se encuentran apoyados por los sistemas de innovación (p.e., financiación, apoyo gubernamental and PI) que aquellos que no se consideran apoyados en los ecosistemas	Quantitative: hierarchical logistic regression model applied in a sample of 4453 nascent entrepreneurs from 27 countries (collected by GEM project) / Cuantitativa: Regresión Hierarchical logistica aplicada a una muestra de 4453 emprendedores nacientes de 27 países (recogida por el proyecto GEM)	Not strong evidence / No evidencia suficiente
		H4.2. Nascent entrepreneurs are more likely to develop new technologies when they are implementing strategic orientations (e.g., entrepreneurial, diversification, high-growth) than those who have non defined strategies / Los emprendedores nacientes son más propensos a desarrollar nuevas tecnologías cuando implementan una orientación estratégica (p.e., emprendedora, diversificación y crecimiento) que aquellos que no las implementan		Supported / Confirmada
		H4.3a. In the case of nascent entrepreneurs with higher education, the effect of supportive innovation ecosystems on the development of new technologies is intensified / En el caso de los emprendedores nacientes con formación universitaria, los efectos del ecosistema innovador en el desarrollo de nuevas tecnologías se intensifica		Supported / Confirmada
		H4.3b. In the case of nascent entrepreneurs with higher education, the effect of strategic orientations on the development of new technologies is intensified / En el caso de los emprendedores nacientes con formación universitaria, los efectos de una orientación estratégica en el desarrollo de nuevas tecnologías se intensifica		Supported / Confirmada
SO4	CH5	P5.1. The access to R&D subsidies influences the configuration of enterprises' open innovation practices (commercial, scientific and mixed) / El acceso a subsidios de I+D tiene una influencia en la configuración de las prácticas de innovación abierta (comercial, científica y mixta)	Qualitative: Multiple case study approach of four innovative and entrepreneurial Mexican enterprises (collected by interviews and secondary data sources) / Cualitativa: Estudios de casos múltiples en cuatro empresas mexicanas con orientación emprendedora e innovadora (recogidas por entrevistas e información secundaria)	Some insights / Algunos indicios
		P5.2. The access to R&D subsidies influences enterprises' behaviors on R&D outcomes / El acceso a subsidios de I+D tiene una influencia en las conductas de las empresas sobre los resultados de la I+D P5.2a: Enterprises with a collaborative behavior evidenced a crowding-in effect / Empresas que tienen un comportamiento colaborativo evidencian un efecto *crowding-in* P5.2b: Enterprises with an opportunistic behavior evidenced a crowding-out effect / Empresas que tienen un comportamiento colaborativo evidencian un efecto *crowding-out*		Some insights / Algunos indicios
		P5.3. The access to open innovation practices influences enterprises' behaviors on R&D outcomes / El acceso a las prácticas de innovación abierta tiene una influencia en las conductas de las empresas sobre los resultados de la I+D P5.3a. Enterprises with a collaborative behavior evidenced a sharing effect / Empresas que tienen un comportamiento colaborativo evidencian un efecto de compartir P5.3b. Enterprises with an opportunistic behavior evidenced an appropriation effect / Empresas que tienen un comportamiento colaborativo evidencian un efecto de apropiación		Some insights / Algunos indicios

Source: Author / Autor

---------- In Spanish / En castellano ----------

Alineados con el objetivo general, se definieron cuatro objetivos específicos en esta tesis:

OE1: Comprender el papel de las organizaciones de educación superior en los sistemas de Innovación y ecosistemas de emprendimiento

OE2: Explorar el papel de las organizaciones de educación superior como impulsoras de actividades de innovación

OE3: Explorar el papel de las organizaciones de educación superior como impulsoras de actividades de emprendimiento

OE4: Explorar la influencia de las organizaciones de educación superior sobre los resultados de la innovación

En este sentido, Tabla 6.1 resume los principales resultados obtenidos en cada capítulo de esta tesis.

En primer lugar, la participación de las organizaciones de educación superior mexicanas en los ecosistemas de innovación y emprendimiento refleja la existencia de incentivos para llevar a cabo su misión de enseñanza, investigación y actividades de emprendimiento. Sin embargo, dada su complejidad y su diversidad, en el contexto mexicano se observa una menor participación por parte de las universidades en el desarrollo de las actividades de innovación y emprendimiento. Esto significa que sólo unas pocas universidades utilizan sus recursos / capacidades para transformarse en organizaciones más innovadoras y emprendedoras que les permite generar talento, producir investigación de mayor calidad, mayor transferencia y comercialización de conocimiento, y creación de valor socioeconómico.

En segundo lugar, el papel de las universidades en las actividades de innovación se evidenció mediante el análisis de las vinculaciones universidad-empresa. Particularmente, a partir los resultados obtenidos, las empresas mexicanas innovadoras colaboran con las universidades en el desarrollo de innovaciones radicales. De hecho, el papel de las universidades es mayor cuando las empresas participan en colaboraciones científicas que cuando participan en colaboraciones mixtas. Otra contribución relevante de las universidades a las empresas innovadoras es el acceso a los programas de subvención de I+D. En este caso, la influencia es mayor cuando las empresas colaboran con universidades y otras empresas simultáneamente.

En tercer lugar, se evidenciaron las tendencias más interesantes sobre los emprendedores nacientes basados en la tecnología (con y sin educación superior) y las condiciones asociadas con los ecosistemas de innovación y emprendimiento. El efecto de moderación de la educación superior refuerza la intensidad del efecto de los ecosistemas y los aspectos organizacionales sobre los emprendedores nacientes basados en la tecnología. Sin embargo, el escenario en las economías emergentes no está bien alineado con las tendencias generales.

En cuarto lugar, un estudio de casos múltiples proporcionó información sobre la influencia de las universidades en los resultados de la innovación. Específicamente, se evidencia el comportamientos oportunistas/colaborativos que hay detrás de las vinculaciones empresas-universidades obligatorias para acceder a subsidios de I+D. Sin embargo, este efecto depende de las características de las empresas (edad, tamaño, sector y propiedad). Adicionalmente, la evidencia sugiere que la transformación de la universidad en el contexto mexicano se da lentamente debido a la falta de unas bases sólidas para generar resultados de investigación de alta calidad, así como los desafíos que se presentan con las empresas en términos de comunicación, expectativas y acuerdos cuando tratan de colaborar con universidades.

6.3. Limitations and future research lines / Limitaciones y futuras líneas de investigación

This study has several limitations and several unanswered or unexplored questions that are interesting directions for future research. Concerning qualitative analysis, given the nature of this method, this thesis faced the difficulty of generalizing the results obtained from single and multiple case studies. Concerning quantitative analysis, this thesis had two main limitations: (a) a restricted access to relevant variables considered confidential by the INEGI's confidentiality rules (e.g., location and more details about university partnerships) or the design of the variables by GEM. It influenced not only the analysis but also the statistical treatment of this information; and (b) proxies used to explore the role of universities in innovation activities (university–enterprise partnerships motivated by innovation strategies and by covering a requirement to access R&D subsidies), in entrepreneurial activities (nascent entrepreneurs with higher education) and impacts (collaborative/opportunistic behavior, innovation inputs/outcomes).

A natural extension of the research agenda will be oriented toward extending theoretical/methodological approaches. (a) Applying diverse theoretical bases (e.g., open innovation, resource-based view, institutional theory, knowledge spillover, opportunity cost, subsidies, endogenous economic theory, among others). (b) Analyzing in-depth the transmutation of university and enterprises' business models into a new configuration of sustained entrepreneurial and innovation ecosystems using a social and economic perspective (Guerrero et al., 2016; Miller et al., 2016). (c) Adopting a longitudinal perspective, in both qualitative and quantitative approaches, which will help to understand the real impact of universities on innovation and entrepreneurship not only analyzed by university–enterprise partnerships or open innovation collaborations across space/time (Autio et al., 2014) but also

by agents that recognize opportunities, mobilize resources and create value in their regions (Feldman, 2014). (d) Exploring the effectiveness of R&D subsidies, the influence on collaborative behavior instead of opportunistic behaviors and the generation of tangible innovation outcomes (Dimos and Pugh, 2016). (e) An administrated survey will help to categorize interviewed enterprises as subsidized (focus group) and non-subsidized (control group).

In sum, this thesis contributes to the ongoing academic debate about the economic, societal and technological contributions of university (Guerrero et al., 2016), the emergence of entrepreneurial knowledge based opportunities in different context (Busenitz et al., 2014), and the conceptual clarification and connection of entrepreneurial and innovative ecosystems to generate sustainable and high quality initiatives (Autio et al., 2014).

---------- In Spanish / En castellano ----------

Este estudio presenta varias limitaciones y varias preguntas sin respuesta o poco inexploradas que son líneas interesantes para futuras investigaciones. En el análisis cualitativo, dada la naturaleza de este método, esta tesis presenta la dificultad de generalizar los resultados obtenidos a partir de estudios de casos únicos y múltiples. Sin embargo, aún se requiere el análisis de más casos para confirmar los resultados obtenidos. En el análisis cuantitativo, esta tesis presenta dos principales limitaciones: (a) el acceso restringido a variables relevantes consideradas como confidenciales por las reglas de confidencialidad del INEGI (por ejemplo, ubicación y más detalles sobre las colaboraciones universitarias) o el diseño de las variables por GEM (por ejemplo, asociado con las variables y las series temporales de las bases de datos) que influyó no sólo en el análisis sino también en el tratamiento estadístico de esta

información; y (b) *proxies* utilizadas para explorar el papel de las universidades en las actividades de innovación (colaboraciones universidad-empresa motivadas por estrategias de innovación y cubriendo el requisito de acceso a subsidios de I+D), las actividades de emprendimiento (emprendedores nacientes con educación superior)/comportamiento oportunista, insumos/resultados de la innovación).

Una extensión natural de la agenda de investigación se orientará a reforzar los enfoques teóricos/metodológicos. Aplicación de diversas bases teóricas (ej., innovación abierta, recursos y capacidades, teoría institucional, *knowledge spillover*, costo de oportunidad, subsidios, teoría económica endógena, entre otros). Analizar en profundidad la evolución de los modelos empresariales universitarios, desde una perspectiva social y económica, en una nueva configuración de ecosistemas de emprendimiento e innovación más sostenibles (Guerrero et al., 2016; Miller et al., 2016). La adopción de una perspectiva longitudinal, tanto en los enfoques cualitativos como cuantitativos, ayudará a comprender el impacto real de las universidades en la innovación y el emprendimiento, no sólo analizados a través de las vinculaciones universidades-empresas o colaboraciones de innovación abierta a través de espacios/tiempos (Autio et al., 2014) sino también como agentes que reconocen oportunidades, movilizan recursos y crean valor en sus regiones (Feldman, 2014). Explorar la eficacia de los subsidios de I+D, la influencia en el comportamiento colaborativo/oportunista y la generación de resultados tangibles de innovación (Dimos y Pugh, 2016); una encuesta administrada ayudará a controlar las empresas entrevistadas por grupos subsidiados (grupo de enfoque) y no subsidiados (grupo de control).

En resumen, esta tesis contribuye al continuo debate académico sobre la contribución económica, social y tecnológica de las universidades (Guerrero et al., 2016), la identificación

de oportunidad de emprendimiento de base tecnológica en diversos contextos (Busenitz et al., 2014), y a la clarificación sobre la conexión entre los ecosistemas emprendedores e innovadores y su contribución en la generación de iniciativas de calidad y sustentables (Autio et al., 2014).

6.4. Implications / Implicaciones

For *policy makers*, this research shows the effort made by the Mexican government (CONACYT, Ministry of Economy and Ministry of Education) in the configuration of the Mexican innovation and entrepreneurship systems. However, it still requires a systematic and systemic reinforcement to capitalize on resources and capabilities in order to generate entrepreneurial innovation activity. In this sense, if policy makers wish to promote a transition toward a knowledge-based economy, they must continue to reinforce innovation and entrepreneurial systems (investment market, educational system, labor market, security and stable regulations for SMEs, among others). In fact, the CONACYT and the INADEM could use the results generated by this research to align their support programs to stimulate the creation of technology-based ventures; fostering the elements in the ecosystem that enhances the development of innovative and entrepreneurial activity, especially the participation of universities and taking in consideration the type of university-company collaboration. Several conditions of innovation and entrepreneurship ecosystems allow policymakers to redefine the rates of technological and non-technological entrepreneurs. In addition, the evaluation of the outcomes and impacts of R&D programmes are very crucial to avoid opportunistic behaviors.

For *enterprise managers*, this study offers several insights that need to be taken into account in the configuration of (open) innovation practices with different agents (commercial,

scientific and mixed) according to their motivations, strategies and expected outcomes. In the case of R&D subsidies, compulsory partherships require a process of understanding, trust building and defining of common purposes. Another relevant implication is the identification of collaborative / opportunistic behaviors in the development of innovation and technology-based entrepreneurship. Managers could also recognize universities' resources and capabilities that are useful in the generate innovation (incremental / radical) and improvements in competitiveness (efficiency/differentiation).

For *university managers*, the entrepreneurial university model is a good example to follow in their transformation processes or in development of their own entrepreneurial ecosystems. However, it is important to take into account certain organizational bases in different dimmensions: organizational strategy, resources, culture and recognition. In this regard, a relevant implication is linked to the re-allocation of resources and re-orientation of their capabilites to fulfill their missions (teaching, research and technology transfer). It also implies the recognition of open innovation practices with equal benefits for all the participants. Therefore, it is necessary to minimize barriers that discourage them such as bureaucracy, calendars not compatible, etc. At university community level, it is also relevant to reinforce the individual university ecosystem in order to provide the required elements to fostering entrepreneurial innovations.

---------- In Spanish / En castellano ----------

Para *promotores de políticas públicas*, esta investigación evidencia el esfuerzo realizado por el Gobierno Mexicano (CONACYT, Secretaría de Economía y Secretaría de Educación) en la configuración de los ecosistemas mexicanos de innovación y emprendimiento. Sin embargo,

todavía se requiere de un refuerzo sistemático y sistémico para capitalizar recursos y capacidades con el fin de generar actividad de emprendimiento innovador. En este sentido, los resultados evidencian algunos determinantes en las prácticas de innovación entre las universidades y las empresas. Si los responsables de diseñar políticas desean promover una transición hacia una economía basada en el conocimiento, deben seguir reforzando los ecosistemas de innovación y emprendimiento (mercado de inversión, sistema educativo, mercado laboral, seguridad y regulaciones estables para las PYMEs, entre otros). De hecho, el CONACYT y el INADEM podrían utilizar los resultados generados en esta investigación para alinear sus programas de apoyo hacia la creación de empresas de base tecnológica; fortaleciendo los elementos del ecosistema que favorecen el desarrollo de iniciativas emprendedoras e innovadoras con la participación de las universidades y reconociendo las tipologías de vinculaciones entre las universidades y las empresas. Algunas características de los ecosistemas emprendedores e innovadoras ayudan a los *policy makers* en la definición de ratios entre los emprendedores de base tecnológica de los que no los son. Además las evaluaciones de las políticas públicas sobre los incentivos de I+D podrían contribuir a reducir los niveles de oportunismo entre los beneficiarios.

Para los *gerentes de empresas*, este estudio también ofrece varias ideas que deben tenerse en cuenta en la configuración de prácticas de innovación (abiertas) con diferentes agentes (comerciales, científicos y mixtos) a partir de sus motivaciones, sus estrategias (radicales o incrementales) y de los resultados esperados. En el caso de los subsidios a la I+D, las concesiones obligatorias requieren un proceso de comprensión, de confianza y de definición de objetivos comunes. Otra implicación relevante es la identificación de comportamientos colaborativos y oportunistas en el desarrollo de innovaciones y emprendimiento de base tecnológica. Administradores también podrían reconocer los recursos y las capacidades que

son útiles en la generación de innovaciones (incrementales / radicales) y el fortalecimiento de su competitividad (eficiencia / diferenciación).

Para *administradores de universidades*, el modelo de universidad emprendedora es un buen ejemplo a seguir en sus procesos de transformación o en el desarrollo de sus propios ecosistemas de emprendimiento. Sin embargo, es importante tener en cuenta las bases organizacionales en sus diferentes dimensiones: estrategia organizacional, recursos, cultura y reconocimiento. En este sentido, una implicación relevante está vinculada a la re-asignación de recursos y re-orientación de sus capacidades para alcanzar las tres misiones de las universidades (docencia, investigación y transferencia tecnológica). Esto también implica el reconocimiento de prácticas de innovación abierta con beneficios iguales para todos los participantes. Por lo tanto, es necesario reducir barreras como la burocracia, incompatibilidad de calendarios, entre otros. A nivel de la comunidad universitaria, es importante reforzar los propios ecosistemas universitarios para fortalecer el desarrollo de iniciativas de emprendimiento innovador.

REFERENCES

Aboal, D. & Tacsir, E. (2016). The impact of ex-ante subsidies to researchers on researcher's productivity: Evidence from a developing country. *United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).*

Acs, Z. J. & Amorós, J. E. (2008). Entrepreneurship and competitiveness dynamics in Latin America. *Small Business Economics*, 31(3), 305-322.

Acs, Z. J. & Audretsch, D.B. (1991). R&D, firm size and innovative activity. *Innovation and Technological Change: An International Comparison*, 98(2), 451-456.

Acs, Z. J., Audrestch, D. B., Braunerhjelm, P. & Carlsson, B. (2004). The missing link: The knowledge filter and entrepreneurship in endogenous growth. *CEPR Discussion paper 4783, CEPR*, London.

Alcalde, H. & Guerrero, M. (2016). Open business models in entrepreneurial stages: evidence from young Spanish firms during expansionary and recessionary periods. *International Entrepreneurship and Management Journal*, 12(2), 393–413.

Aldrich, H.E. & E.R. Auster. (1986). Even dwarfs started small: Liabilities of age and size and their strategic implications. *Research in Organizational Behavior*, 8: 165–198.

Almus, M & Czarnitzki, D. (2003). The Effects of Public R&D Subsidies on Firms' Innovation Activities: The Case of Eastern Germany. *Journal of Business and Economic Statistics*, 21(2), 226- 236.

Alsos, G. A., Hytti, U. & Ljunggren, E. (2011) Stakeholder theory approach to technology incubators. *International Journal of Entrepreneurial Behaviour and Research*, 17, 607-625.

Álvarez, R. & Crespi, G. A. (2015). Heterogeneous Effects of Financial Constraints on Innovation: Evidence from Chile. *Science and Public Policy* 42(5), 711–724.

Ambrosini, V., Bowman, C. & Collier, N. (2009). Dynamic capabilities: An exploration of how firms renew their resource base. *British Journal of Management*, 20(1), S9-S24.

Amit, R. & Schoemaker, P.J.H. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, 14(1), 33–46.

Amorós, E., & Bosma, N. (2014). Global Entrepreneurship Monitor 2013 Global Report: Fifteen Years of Assessing Entrepreneurship Across the Globe. Global Entrepreneurship Monitor Global Report, 2013: 1-103.

ANUIES (2015). Instituciones de educación superior. *ANUIES*. Accessed September 4, 2015: http://www.anuies.mx/anuies/instituciones-de-educacion-superior/

Arenius, P. & Minniti, M. (2005). Perceptual variables and nascent entrepreneurship. Small business economics, 24(3), 233-247.

Armanios, D. E., Eesley, C. E., Li, J. & Eisenhardt, K. M. (2016). How entrepreneurs leverage institutional intermediaries in emerging economies to acquire public resources. *Strategic Management Journal*, DOI: 10.1002/smj.2575

Arora, A. & Fosfuri, A. (2003). Licensing the market for technology. *Journal of Economic Behavior & Organization*, 52(2), 277–295.

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. *In Nelson, R. (Ed.), The Rate and Direction of Inventive Activity*. Princeton University Press, Princeton.

Aschhoff, B. (2009). The effect of subsidies on R&D investment and success–Do subsidy history and size matter? *ZEW-Centre for European Economic Research Discussion Paper*, (09-032).

Aschhoff, B., & Sofka, W. (2009). Innovation on demand—Can public procurement drive market success of innovations? *Research policy*, 38(8), 1235-1247.

Astrom, T., Eriksson, M.L., Niklasson, L. &Arnold, E. (2008). International Comparison of Five Institute Systems. *Denmark: Forsknings-og Innovationsstyrelsen*, Copenhagen.

Audretsch, D. & Thurik, R. (2004). A model of the entrepreneurial economy. *International Journal of Entrepreneurship Education*, 2(2), 143-166.

Audretsch, D. (2012). Determinants of High-Growth Entrepreneurship. *Report prepared for the OECD/DBA International Workshop on High-growth firms: local policies and local determinants*, Copenhagen, 28 March 2012.

Audretsch, D. (2014). From the entrepreneurial university to the university for the entrepreneurial society. *Journal of Technology Transfer*, 39(3), 313–321.

Audretsch, D. B. & Keilbach, M. (2007). The knowledge spillover theory of entrepreneurship. *Journal of Management Studies*, 44(7), 1242–1254.

Audretsch, D., & Lehmann, E. (2005). Does the Knowledge Spillover Theory of Entrepreneurship hold for regions? *Research Policy*, 34: 1191–1202.

Autio, E., Kanninen, S. & Gustafsson, R. (2008). First-and second-order additionality and learning outcomes in collaborative R&D programs. *Research Policy*, 37(1), 59-76.

Autio, E., Kenney, M., Mustar, P., Siegel, D. & Wright, M. (2014). Entrepreneurial innovation: The importance of context. *Research Policy*, 43(7), 1097-1108.

Bäck, I. & Kohtamäki, M. (2015). Boundaries of R&D collaboration. *Technovation*, 45, 15-28.

Baldwin, R. E. & Robert-Nicoud, F. (2007). Entry and Asymmetric Lobbying: Why Governments Pick Losers. *Journal of the European Economic Association*, 5, 1064-1093.

Barbero, J. L., Casillas, J. C., Wright, M. & Garcia, A. R. (2014). Do different types of incubators produce different types of innovations?. *The Journal of Technology Transfer*, 39(2), 151–168.

Barge-Gil, A. (2010). Cooperation-based innovators and peripheral cooperators: An empirical analysis of their characteristics and behavior. *Technovation*, 30(3): 195-206.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17, 99–120.

Bastos, A. P., Serra, M., Almeida, L. & Diniz, M. J. (2014). University-Enterprise Partnerships in the Brazilian Amazon: Obstacles, Dilemmas and Challenges. *Transnational Corporations Review*, 6(1), 71-85.

Baumol, W. J. (1990). Entrepreneurship: productive, unproductive and destructive. *Journal of Political Economy*, 98(5), 893–921.

Baumol, W. J. (2002). The Free-Market Innovation Machine: *Analyzing the growth miracle of capitalism*. Princeton University Press: Princeton.

Bayona, C., García-Marco, T. & Huerta, E. (2001). Firms' motivations for cooperative R&D: an empirical analysis of Spanish firms. *Research Policy*, 30, 1289–1307.

Becker, W. & Dietz, J. (2004). R&D cooperation and innovation activities of firms-evidence for the German manufacturing industry. *Research Policy*, 33(2), 209-223.

Beckman, C. M., Eisenhardt, K., Kotha, S., Meyer, A. & Rajagopalan, N. (2012a). The role of the entrepreneur in technology entrepreneurship. *Strategic Entrepreneurship Journal*, 6(3), 203-206.

Beckman, C. M., Eisenhardt, K., Kotha, S., Meyer, A. & Rajagopalan, N. (2012b). Technology entrepreneurship. *Strategic Entrepreneurship Journal*, 6(2), 89-93.

Belderbos, R., Carree, M. & Lokshin, B. (2004). Cooperative R&D and firm performance. *Research Policy*, 33(10), 1477–1492.

Bellucci, A. & Pennacchio, L. (2016). University knowledge and firm innovation: evidence from European countries. *The Journal of Technology Transfer*, 41(4), 730-752.

Benavente, J. M., Crespi, G. & Maffioli, A. (2007). Public support to firm-level innovation: an evaluation of the FONTEC program. *Inter-American Development Bank*. Washington, DC.

Block, J. H., Thurik, R. & Zhou, H. (2012). What turns knowledge into innovative products? The role of entrepreneurship and knowledge spillovers. *Journal of Evolutionary Economics*, 10(4), 1–26.

Bogers, M. (2011). The open innovation paradox: knowledge sharing and protection in R&D collaborations. *European Journal of Innovation Management*, 14(1), 93-117.

Bonaccorsi, A., Colombo, M. G., Guerini, M. & Rossi-Lamastra, C. (2013). University specialization and new firm creation across industries. *Small Business Economics*, 41(4): 837-863.

Boschma, R. (2005). Proximity and innovation: a critical assessment. *Regional Studies*, 39(1), 61–74.

Bosma N, Stam E, Wennekers ARM (2010). Intrapreneurship: An international study. *EIM Research Report H201005*. Zoetermeer: EIM

Bosma, N., Wennekers, S., Guerrero, M., Amorós, J. E., Martiarena, A. & Singer, S. (2013). Global Entrepreneurship Monitor Special Report On Entrepreneurial Employee Activity. *Babson College.*

Boyd, B. K. (1991). Strategic planning and financial performance: a meta-analytic review. *Journal of Management Studies*, 28(4), 353-374.

Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research Policy*, 29(4-5), 627-655.

Bradley, S., Hayter, C. S. & Link, A. N. (2013). Methods of University Technology Transfer. *Foundations and Trends in Entrepreneurship*, 9(6), 571-650.

Bramwell, A. & Wolfe, D. (2008). Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy*, 37, 1175–1187.

Brenes, E. R., Camacho, A. R., Ciravegna, L. & Pichardo, C. A. (2016). Strategy and innovation in emerging economies after the end of the commodity boom—Insights from Latin America. *Journal of Business Research*. http://dx.doi.org/10.1016/j.jbusres.2016.03.059

Buisseret, T., Cameron, H. & Georghiou, L. (1995). What difference does it make? Additionality in the public support of R&D in large enterprises. *International Journal of Technology Management*, 10, 587–600.

Busenitz, L. W., Plummer, L. A., Klotz, A. C., Shahzad, A. & Rhoads, K. (2014). Entrepreneurship research (1985–2009) and the emergence of opportunities. *Entrepreneurship Theory and Practice*, 38(5), 981-1000.

Caliendo, M., Fossen, F. M. & Kritikos, A. S. (2009). Risk attitudes of nascent entrepreneurs–new evidence from an experimentally validated survey. *Small Business Economics*, 32(2), 153-167.

Callahan, C. M., Vendrzyk, V. P. & Butler, M. G. (2012). The impact of implied facilities cost of money subsidies on capital expenditures and the cost of debt in the defense industry. *Journal of Accounting and Public Policy*, 31(3), 301-319.

Caloghirou, Y., Tsakanikas, A. & Vonortas, N. S. (2001), 'University-Industry Cooperation in the Context of the European Framework Programmes'. *Journal of Technology Transfer*, 26(1-2), 153-161.

Capon, N., Farley, J.U. & Hoenig, S. (1990). Determinants of financial performance: a meta-analysis. *Management Science*, 36(10), 1143-1159.

Carayannis, E. G., Alexander, J. & Ioannidis, A. (2000). Leveraging knowledge, learning, and innovation in forming strategic government–university–industry (GUI) R&D partnerships in the US, Germany, and France. *Technovation*, 20(9), 477-488.

Cárdenas, S., Cabrero, E., & Arellano, D. (2012). The difficult linkage university-enterprise in Mexico: Towards the construction of the triple helix? *CIDE*, México.

Carlsson, B., Jacobsson, S., Holmén, M. & Rickne, A., (2002). Innovation systems: analytical and methodological issues. *Research Policy*, 31(2), 233–245.

Carter, N. M., Gartner, W. B., Shaver, K. G. & Gatewood, E. J. (2003). The career reasons of nascent entrepreneurs. *Journal of Business Venturing*, 18(1), 13-39.

Cassiman, B. & Veugelers, R. (2002). R&D cooperation and spillovers: some empirical evidence from Belgium. *The American Economic Review*, 92(4), 1169–1184.

Castellacci, F. & Natera, J. M. (2013). The dynamics of national innovation systems: a panel cointegration analysis of the coevolution between innovative capability and absorptive capacity. *Research Policy*, 42(3), 579–594.

Chen, C. C., Peng, M. W. & Saparito, P. A., (2002). Individualism, collectivism, and opportunism: a cultural perspective on transaction cost economies. *Journal of Management*, 28, 567–584.

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. *Harvard Business School Press*: Boston, MA.

Chesbrough, H., Vanhaverbeke, W. & West, J. (2006). Open Innovation: A New Paradigm for Undertanding Industrial Innovation. In *Open Innovation: Researching a New Paradigm* (1-27). *Oxford University Press*: Oxford

Christensen, C.M. (1997). The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. *Harvard Business School Press*: Boston, MA.

Christensen, J. F. (2002). Corporate strategy and the management of innovation and technology. *Industrial and corporate change*, 11(2), 263-288.

Chung, J. W., Bae, Z. T. & Kim, J. S. (2003). Changing patterns of technological cooperation activities of innovative small firms along technological development stages in the Korean telecommunication sector. *Technovation*, 23(2), 163–173.

Clarysse, B., Wright, M. & Mustar, P. (2009). Behavioral additionality of R&D subsidies: A learning perspective. *Research Policy*, 38(10), 1517-1533.

Cohen, W. M. & Klepper, S. (1996). A reprise of size and R&D. *The Economic Journal*, 106(437), 925-951.

Cohen, W. M. & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128–152.

Cohen, W. M., Nelson, R. R., & Walsh, J. P. (2002). Links and impacts: the influence of public research on industrial R&D. *Management Science*, 48(1), 1-23.

Colombo, M. G., Delmastro, M. & Grilli, L. (2004). Entrepreneurs' human capital and the start-up size of new technology-based firms. *International journal of industrial organization*, 22(8), 1183-1211.

Colombo, M., & Grilli, L. (2006). Supporting high-tech start-ups: Lessons from Italian technology policy. *International Entrepreneurship Management Journal*, 2: 189–209.

Colombo, M., Mustar, P., & Wright, M. (2010). Dynamics of Science-based entrepreneurship. *Journal of Technology Transfer*, 35: 1–15.

CONACYT (2015 a). *El CONACYT*. *CONACYT*. Accessed April 14, 2015): http://www.conacyt.gob.mx/index.php/el-conacyt.

CONACYT (2015 b). *Programa de Estímulos a la Innovación*. *CONACYT*. Accessed September 9, 2015: http://www.conacyt.gob.mx/index.php/fondos-y-apoyos/programa-de-estimulos-a-la-innovacion.

CONACYT (2015 c). *RENIECYT*. *CONACYT*. Accessed April 14, 2015: http://www.conacyt.mx/index.php/el-conacyt/registro-nacional-de-instituciones-y-empresas-cientificas-y-tecnologicas-reniecyt.

Conner, K. R. & Prahalad, C. K. (1996). A resource-based theory of the enterprise: Knowledge versus opportunism. *Organization Science*, 7: 477-501.

Crespi, G. & Zúñiga, P. (2012). Innovation and Productivity: Evidence from six Latin American Countries. *World Development*, 40(2), 273–290.

Crespi, G., Maffioli, A., Mohnen, P. & Vázquez, G., (2011). Evaluating the Impact of Science, Technology and Innovation Programmes: a Methodological Toolkit, Impact-Evaluation Guidelines Technical Note Series. *Inter-American Development Bank*, IDB-TN-333, November

Cunningham, J. A., Link, A. N. (2015). Fostering university-industry R&D collaborations in European Union countries. *International Entrepreneurship and Management Journal*, 11(4), 849-860.

Czarnitzki, D., Ebersberger, B. & Fier, A. (2007). The relationship between R&D collaboration, subsidies and R&D performance: empirical evidence from Finland and Germany, *Journal of Applied Econometrics*, 22(7), 1347-1366.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34(3): 555-590.

Danzón, P., Nicholson, S. & Sousa Pereira, N. 2005. Productivity in pharmaceutical-biotechnology R&D: the role of experience and alliances. *Journal of Health Economics*, 24, 317–339.

Davidsson, P. & Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing*, 18(3), 301-331.

De Fuentes, C. & Dutrénit, G. (2012). Best channels of academia–industry interaction for long-term benefit. *Research Policy*, 41(9), 1666– 1682.

Delmar, F. & Davidsson, P. (2000). Where do they come from? Prevalence and characteristics of nascent entrepreneurs. *Entrepreneurship & regional development*, 12(1), 1-23.

Delmar, F., Davidsson, P. & Gartner, W. B. (2003). Arriving at the high-growth firm. *Journal of Business Venturing*, 182, 189-216.

Diario Oficial (2014). Consejo Nacional de Ciencia y Tecnología. Estados Unidos Mexicanos: *Presidencia de la República*. [http://www.fiderh.org.mx/21_ciencia_y_tecnologia.pdf], last access October 2015.

Dimos, C. & Pugh, G. (2016). The effectiveness of R&D subsidies: A meta-regression analysis of the evaluation literature. *Research Policy*, 45(4), 797-815.

Dimov, D. (2010). Nascent entrepreneurs and venture emergence: Opportunity confidence, human capital, and early planning. *Journal of Management Studies*, 47(6), 1123-1153.

Dussel, E. (2017). Efectos del TPP en la economía de México: Impacto general y en las cadenas de valor de autopartes-automotriz, hilo-textil-confección y calzado. *Senado de la República*. Centro de Estudios Internacionales.

Dutrénit, G., De Fuentes, C. & Torres, A. (2010). Channels of interaction between public research organisations and industry and their benefits: evidence from Mexico. *Science and Public Policy*, 37(7), 513-526.

Dyer, J. H. & Nobeoka, K. (2000). Creating and managing a high-performance knowledge sharing network: The Toyota case. *Strategic Management Journal*, 21(3), 345-367.

Easterby-Smith, M., Lyles, M. A. & Peteraf, M. A. (2009). Dynamic capabilities: current debates and future directions. *British Journal of Management*, 20(s1), S1-S8.

Edelman, L. F., Manolova, T. S. & Brush, C. G. (2008). Entrepreneurship education: Correspondence between practices of nascent entrepreneurs and textbook prescriptions for success. *Academy of Management Learning & Education*, 7(1), 56-70.

Edler, J. & James, A. D. (2015). Understanding the emergence of new science and technology policies: Policy entrepreneurship, agenda setting and the development of the European Framework Programme. *Research Policy*, 44(6), 1252-1265.

Education Times Higher (2015). *Times Higher Education*. World University Ranking. Accesed September 9, 2015: https://www.timeshighereducation.co.uk/world-university-rankings/2015/world-university-rankings#/sort/0/direction/asc

Eisenhardt, K. & Martin, J. (2000). Dynamic capabilities: what are they?, *Strategic Management Journal*, 21, 1105–1121.

Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532–550.

Eisenhardt, K. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25–32.

El Financiero. (2016). *Empresas*. *El Financiero*. Accessed January 10, 2016: http://www.elfinanciero.com.mx/empresas/quitan-mil-mdp-a-fondo-emprendedor.html.

Enkell, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. *R&D Management*, 39, 4: 311-316.

Erridge, A. & Nondi, R. (1994). Public procurement, competition and partnership. *European Journal of Purchasing & Supply Management.* 1(3), 169–179.

Etzkowitz, H. & Leydesdorff, L. (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.

Etzkowitz, H. (2003). Research groups as 'quasi-firms': the invention of the entrepreneurial university. *Research Policy*, 32(1): 109-121.

Falk, R. (2007). Measuring the effects of public support schemes on enterprises' innovation activities: Survey evidence from Austria. *Research Policy*, 36(5), 665-679.

Feldman, M. P. (2014). The character of innovative places: entrepreneurial strategy, economic development, and prosperity. *Small Business Economics*, 43(1), 9–20.

Feller, I. (2005). A historical perspective on government-university partnerships to enhance entrepreneurship and economic development. In Shane, S. (ed.), *Economic development through entrepreneurship: Government, university and business linkages*. Cheltenham: Edward Elgar.

Flores, M., Campos, M., Naranjo, E., Lucatero, I. & Lopez, N. (2013). *GEM Mexico 2013 Report*. Mexico.

Fölster, S. (1995). Do subsidies to cooperative R D actually stimulate R&D investment and cooperation?. *Research Policy*, 24(3), 403-417.

Fondo PYME (2016). *Reportes*. *Fondo PYME*. Accessed January 10, 2016: http://www.fondopyme.gob.mx/kardex/2012/reportes/historico_consulta_publica.asp.

Friar, J. H. & Meyer, M. H. (2003). Entrepreneurship and start-ups in the Boston region: Factors differentiating high-growth ventures from micro-ventures. *Small Business Economics*, 212, 145-152.

Frishammar, J., Ericsson, K. & Patel, P. C. (2015). The dark side of knowledge transfer: Exploring knowledge leakage in joint R&D projects. *Technovation*, 41, 75-88.

Fritsch, M. & Lukas, R. (2001). Who cooperates on R&D? *Research Policy*, 30(2), 297–312.

Gaba, V. & Bhattacharya, S. (2012). Aspirations, innovation, and corporate venture capital: a behavioral perspective. *Strategic Entrepreneurship Journal*, 6(2), 178-199.

Galende, J. & de la Fuente, J. M. (2003). Internal factors determining a firm's innovative behaviour. *Research Policy*, 32(5): 715–736.

Galloway, L. & Brown, W. (2002). Entrepreneurship education at university: a driver in the creation of high growth firms?. *Education+ Training*, 44(8/9), 398-405.

Gans, J. S. & Stern, S. (2003). The product market and the market for "ideas": commercialization strategies for technology entrepreneurs. *Research Policy*, 32(2), 333-350.

García-Quevedo, J. (2004). Do public subsidies complement business R&D? Ameta-analysis of the econometric evidence. *Kyklos*, 57 (1), 87–102.

Gartner, W., & Birley, S. (2002). Introduction to the Special Issue on Qualitative Methods in Entrepreneurship Research. *Journal of Business Venturing*, 17: 387-395.

Gassmann, O. (2006). Opening up the innovation process: towards an agenda. *R&D Management*, 36(3), 223–228.

Gianiodis, P. T., Markman, G. D. & Panagopoulos, A. (2016). Entrepreneurial universities and overt opportunism. *Small Business Economics*, 47(3), 609-631.

Global Entrepreneurship Monitor (2015). *Country Profiles*. *GEM Consortium*. Accessed October 29, 2015: http//:www.gemconsortium.org/conuntry-profile/87.

Gobierno de la República (2015 a). *Plan Nacional de Desarrollo 2013-2018*. PND. Accessed December 4, 2015: http://pnd.gob.mx/.

Gobierno de la República (2015 b). *Diario Oficial de la Federación*. Segunda Sección. DOF. Accessed December 7, 2015: www.dof.gob.mx/nota_detalle.php?codigo=4805999&fecha=31/05/1983.

Gobierno de la República (2015 d). *Presidencia*. Zedillo.Presidencia. Accessed December 7, 2015: http://zedillo.presidencia.gob.mx/pages/pnd.pdf.

Gobierno de la República (2015 e). *Planes de Desarrollo*. Diputados. Accessed December 7, 2015: http://www.diputados.gob.mx/LeyesBiblio/compila/pnd.htm.

Gobierno de la República. (2015 c). *Publicaciones*. Orden Jurídico. Accessed December 7, 2015: http://ordenjuridico.gob.mx/Publicaciones/CDs2011/CDPaneacionD/pdf/PND%201989-1994.pdf.

Gobierno de la República. (2015 f). *Presidencia*. Calderon.Presidencia. Accessed December 8, 2015: http://pnd.calderon.presidencia.gob.mx/

Gooding, R. Z & Wagner III, J. A. (1985). A meta-analytic review of the relationship between size and performance: the productivity and efficiency of organizations and their subunits. *Administrative Science Quarterly*, 462–481.

Grant, R. B. (1991). A resource-based theory of competitive advantage: implications for strategy formulation. *California Management Review*, 33, 114–135.

Greco, M., Grimaldi, M. & Cricelli, L. (2016). An analysis of the open innovation effect on firm performance. *European Management Journal*, 34, 501-516.

Greene, W. (1992). Econometric analysis. MacMillan: New York.

Grimaldi, R, Kenney, M, Siegel, D. & Wright, M. (2011). 30 years after Bayh-Dole: Reassessing academic entrepreneurship. *Research Policy*, 40, 1045–1057.

Gruber, M. & Henkel, J. (2006). New ventures based on open innovation–an empirical analysis of start-up firms in embedded Linux. *International Journal of Technology Management*, 33(4), 356-372.

Gruber, M., MacMillan, I. C. & Thompson, J. D. (2008). Look before your leap: market opportunity identification in emerging technology firms. *Management Science*, 54(9), 1652–1665.

Guerrero, M. & Peña-Legazkue, I. (2013). The effect of intrapreneurial experience on corporate venturing: Evidence from developed economies. *International Entrepreneurship and Management Journal*, 1-20.

Guerrero, M. & Urbano, D. (2014). Academics' start-up intentions and knowledge filters: an individual perspective of the knowledge spillover theory of entrepreneurship. *Small Business Economics*, 43(1), 57-74.

Guerrero, M. & Urbano, D. (2016). The impact of Triple Helix agents on entrepreneurial innovations' performance: An inside look at enterprises located in an emerging economy. *Technological Forecasting and Social Change*. doi:10.1016/j.techfore.2016.06.015

Guerrero, M. & Urbano, D., (2012). The development of an entrepreneurial university. *Journal of Technology Transfer*, 37(1), 43–74.

Guerrero, M., Cunningham, J. A. & Urbano, D. (2015). Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom. *Research Policy*, 44(3), 748-764.

Guerrero, M., Urbano, D. & Gajón, E. (2014b). The Internal Pathways that Condition University Entrepreneurship in Latin America: An Institutional Approach. In Sherry Hoskinson & Donald Kuratko (Eds.). *Innovative Pathways for University Entrepreneurship in the 21st Century. Advances in the Study of Entrepreneurship*, Innovation, 89-118.

Guerrero, M., Urbano, D., Cunningham, J. & Organ, D., (2014a). Entrepreneurial universities in two European regions: A case study comparison. *The Journal of Technology Transfer* 39(3), 415–434.

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M. & Mian, S. (2016). Entrepreneurial universities: emerging models in the new social and economic landscape. *Small Business Economics*, 47(3), 551-563.

Guo, B. & Guo, J. J. (2011). Patterns of technological learning within the knowledge systems of industrial clusters in emerging economies: Evidence from China. *Technovation*, 31(2), 87-104.

Hagedoorn, J. & Narula, R. (1996). Choosing organizational modes of strategic technology partnering: international and sectoral differences. *Journal of International Business Studies*, 265-284.

Hagedoorn, J. (1993). Understanding the rationale of strategic technology partnering: interorganizational modes of cooperation and sectorial differences. *Strategic Management Journal*, 14(5): 371–385.

Hall, B. H. & Lerner, J. (2010). The financing of R&D and innovation. *Handbook of the Economics of Innovation*, 1, 609-639.

Hall, B. H. & Maffioli, A. (2008). Evaluating the impact of technology development funds in emerging economies: evidence from Latin America. *The European Journal of Development Research*, 20(2), 172-198.

Hall, B. H. (2005). The financing of innovation. *The Handbook of Technology and Innovation Management*, 409-430.

Hall, B. H., Link, A. N. & Scott, J. T. (2001). Barriers Inhibiting Industry from Partnering with Universities: Evidence from the Advanced Technology Program, *Journal of Technology Transfer*, 26 (1-2), 87-98.

Hall, B. H., Moncada-Paternò-Castello, P., Montresor, S. & Vezzani, A. (2016). Financing constraints, R&D investments and innovative performances: new empirical evidence at

the firm level for Europe. *Economics of Innovation and New Technology*, 25(3), 183-196.

Hannan, M. T. & Freeman, J. (1984). Structural inertia and organizational change, *American Sociological Review*, 29, 149-164.

Hausmann, R., Lozoya, E. & Mia, I. (2009). The Mexico Competitiveness Report 2009. Geneva, *World Economic Forum*.

Hechavarria, D. M. & Reynolds, P. D. (2009). Cultural norms & business start-ups: the impact of national values on opportunity and necessity entrepreneurs. *International Entrepreneurship and Management Journal*, 5(4), 417-437.

Helfat, C. E. & Peteraf, M. A. (2003). The dynamic resource based view: capability lifecycles, *Strategic Management Journal*, 24, 997–1010.

Herrera, F., Guerrero, M. & Urbano, D. (2016). Interconnectivity between academic organizations and established firms for a strategic and knowledge fostering purpose. In Ferreira, J., Dana, L. & Ratten, V. (Eds). *Knowledge Spillover-based Strategic Entrepreneurship*, 207-220, Routledge.

Hewitt-Dundas, N. (2013). The role of proximity in university-business cooperation for innovation. *The Journal of Technology Transfer*, 38(2), 93-115.

Hill, C. W. (1990). Cooperation, opportunism, and the invisible hand: Implications for transaction cost theory. *Academy of Management Review*, 15(3), 500-513.

Honig, B. & Karlsson, T. (2004). Institutional forces and the written business plan. *Journal of Management*, 30(1), 29-48.

Honig, B. (2004). Entrepreneurship education: Toward a model of contingency-based business planning. *Academy of Management Learning & Education*, 3(3), 258-273.

Hoskisson, R. E., Eden, L., Lau, C. M. & Wright, M. (2000). Strategy in emerging economies. *Academy of Management Journal*, 43(3), 249-267.

Hottenrott, H., Lopes-Bento, C. (2016). R&D partnerships and innovation performance: Can there be too much of a good thing?. *Journal of Product Innovation Management*, DOI: 10.1111/jpim.12311

HSBC, 2015. Crecimiento de la industria automotriz e impacto en el PIB. *México: HSBC press*.

INADEM (2014). *Red de Incubadoras*. INADEM. Accessed November 15, 2014: http://www.redincubadoras.inadem.gob.mx/.

INADEM (2015). *Programas*. INADEM. Accessed September 4, 2015: https://www.inadem.gob.mx/templates/protostar/direccion_general_de_programas_de_desarrollo_empresarial.php.

INEGI (2015). *Directorio Estadístico Nacional de Unidades Económicas (DENUE)*. INEGI. Accessed December 9, 2015: http://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx.

INEGI (2016). *Ciencia y Tecnología*. Obtenido de Ciencia y Tecnología.INEGI. Accessed January 10, 2016: http://www3.inegi.org.mx/sistemas/temas/default.aspx?s=est&c=19007

INEGI (2016). Economic Census: 2014 Report. *México: Instituto Nacional de Estadística y Geografía*.

Inkpen, A. C. & Pien, W. (2006). An examination of collaboration and knowledge transfer: China-Singapore Suzhou Industrial Park. *Journal of Management Studies*, 43(4), 779-781.

International Monetary Fund (2015). Data and Statistics. *World Economic and Financial Surveys. World Economic Outlook. Country Composition of WEO Groups*, International Monetary Fund. Accessed October 20, 2015: http://www.imf.org/external/pubs/ft/weo/2008/01/weodata/groups.htm#oem.

Irwin, D. A., Klenow, P. J. 1996. High-tech R&D subsidies Estimating the effects of Sematech. Journal of International Economics, 40(3-4), 323-344

Isenberg, D. J. (2010). How to start an entrepreneurial revolution. *Harvard Business Review*, 88(6), 40-50.

Kenney, M. & Mowery, D. (2014). Public Universities and Regional Development: Insights from the University of California System. *Stanford University Press*, Palo Alto, CA.

Kim, D.J. & Kogut, B. (1996). Technological platforms and diversification. *Organization Science*, 7, 283–301.

Kirby, D. A., Guerrero, M., & Urbano, D., (2011). Making Universities More Entrepreneurial: Development of a Model. *Canadian Journal of Administrative Sciences*, 28(3), 302–316.

Klerkx, L. & Aarts, N. (2013). The interaction of multiple champions in orchestrating innovation networks: Conflicts and complementarities. *Technovation*, 33(6), 193-210.

Klomp, L. & van Leeuwen, G., (2001). Linking innovation and firm performance: a new approach. *International Journal of the Economics of Business*, 8(3), 343–364.

Kochenkova, A., Grimaldi, R. & Munari, F. (2016). Public policy measures in support of knowledge transfer activities: a review of academic literature. *The Journal of Technology Transfer*, 41(3), 407-429.

Kovacs, A., Van Looy, B., Cassiman, B. (2015). Exploring the scope of open innovation: a bibliometric review of a decade of research. Scientometrics, 104(3), 951-983.

Kruss, G. & Visser, M. (2017). Putting university-industry interaction into perspective: a view from inside South African universities. *Journal of Technology Transfer*, DOI: 10.1007/s10961-016-9548-6

Laursen, K. & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, 27(2), 131-150.

Lerner, J. (1999). The government as venture capitalist: the long-run impact of the SBIR program. *Journal of Business*, 72(3), 285–318.

Li, H. & Atuahene-Gima, K. (2001). Product innovation strategy and the performance of new technology ventures in China. *Academy of Management Journal*, 44(6), 1123-1134.

Li, J. & Kozhikode, R. K. (2009). Developing new innovation models: Shifts in the innovation landscapes in emerging economies and implications for global R&D management. *Journal of International Management*, 15(3), 328-339.

Liao, J. J. & Welsch, H. (2008). Patterns of venture gestation process: Exploring the differences between tech and non-tech nascent entrepreneurs. *The Journal of High Technology Management Research*, 19(2), 103-113.

Lichtenthaler, U. & Ernst, H. (2007). Developing reputation to overcome the imperfections in the markets for knowledge. *Research Policy*, 36(1), 37–55.

Link, A. N., Siegel, D. & Bozeman, B. (2007). An empirical analysis of the propensity of academics to engage in informal university technology transfer. *Industrial and Corporate Change*, 16(4): 641-655.

Lundvall, B.A. (1992): National systems of innovation: towards a theory of innovation and interactive learning, Pinter Publishers: London.

Mahmood, I. P. & Rufin, C. (2005). Government's dilemma: The role of government in imitation and innovation. *Academy of Management Review*, 30(2), 338-360.

Marozau, R., Guerrero, M., & Urbano, D. (2016). Impacts of universities in different stages of economic development. *Journal of the Knowledge Economy*, 1-21.

Marzo, M., Pedraja, M. & Rivera, P. (2008). Un modelo de relaciones empresa-universidad. *Revista Europea de Dirección y Economía de la Empre*sa, 17(1), 39-56.

Mason, C. & Brown, R. (2014). Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship. Paper prepared for a workshop of the OECD LEED *Programme and the Dutch Ministry of Economic Affairs*, The Hague, Netherlands, 7th November 2013.

McAdam, M. & McAdam, R. (2008). High tech start-ups in University Science Park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources. *Technovation* 28(5), 277-290.

McGrath, R. G., MacMillan, I. C. & Venkataraman, S. (1995). Defining and developing competence: a strategic process paradigm. *Strategic Management Journal*, 16(4), 251–275.

McMullen, J. S., Dimov, D. (2013). Time and the Entrepreneurial Journey: The Problems and Promise of Studying Entrepreneurship as a Process. *Journal of Management Studies*, 50(8), 1481–1512.

Meyer, K. E., Estrin, S., Bhaumik, S. & Peng, M. W. (2009). Institutions, resources, and entry strategies in emerging economies. *Strategic Management Journal*, 30(1), 61-80.

Mian, S. A. (1997). Assessing and Managing the University Technology Businsess Incubator: An integrative framework. *Journal of Business Venturing*, 12, 251-285.

Miller, K., McAdam, M. & McAdam, R. (2014). The changing university business model: a stakeholder perspective. *R&D Management*, 44(3), 265-287.

Miller, K., McAdam, R. & McAdam, M. (2016). A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. *R&D Management*. DOI: 10.1111/radm.12228

Moreno, A. M. & Casillas, J. C. (2007). High-growth SMEs versus non-high-growth SMEs: a discriminant analysis. *Entrepreneurship and Regional Development*, 19(1), 69-88.

Mosey, S. & Wright, M. (2007). From human capital to social capital: A longitudinal study of technology-based academic entrepreneurs. *Entrepreneurship Theory and Practice*, 31(6), 909-935.

Mosey, S., Guerrero, M. & Greenman, A. (2016). Technology entrepreneurship research opportunities: insights from across Europe. *The Journal of Technology Transfer*, DOI 10.1007/s10961-015-9462-3

Mueller, P. (2006). Entrepreneurship in the region: breeding ground for nascent entrepreneurs?. *Small Business Economics*, 27(1), 41-58.

Mueller, P. (2007). Exploiting Entrepreneurial Opportunities: The impact of entrepreneurship on growth. *Small Business Economics*, 28, 355–362.

Mustar, P. & Wright, M. (2010). Convergence or path dependency in policies to foster the creation of university spin-off firms? A comparison of France and the United Kingdom. *The Journal of Technology Transfer*, 35(1), 42–65.

Nambisan, S., Bacon, J. & Throckmorton, J. (2012). The role of the innovation capitalist in open innovation: a case study and key lessons learned. *Research-Technology Management*, May–June 2012, 49–57.

Narayanan, V. K., Colwell, K. & Douglas, F. L. (2009). Building organizational and scientific platforms in the pharmaceutical industry: A process perspective on the development of dynamic capabilities. *British Journal of Management*, 20(s1), S25-S40.

Nelson, R. (1993): National Systems of Innovation: A Comparative Analysis, Oxford University Press: Oxford, 3-21.

Nelson, R. R. (1959). The simple economics of basic scientific research. *Journal of Political Economy* 67, 148–163.

Nieto, M. J. & Santamaría, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation*, 27(6), 367-377.

North, D. (1990). *Institutions, Institutional Change and Economic Performance.* Cambridge University Press: Cambridge.

O'Shea, R. P., Allen, T. J., Morse, K. P., O'Gorman, C. & Roche, F. (2007). Delineating the anatomy of an entrepreneurial university: The Massachusetts Institute of Technology experience. *R&D Management*, 37(1), 1–16.

O'Shea, R., Allen, T. J., Chevalier, A., & Roche, F. (2005). Entrepreneurial orientation, technology transfer and spin-off performance of US universities. *Research Policy* 34, 994–1009.

O'Connor G.C. & De Martino, R. (2006). Organizing for radical innovation: an exploratory study of the structural aspects of RI management systems in large established firms. *Journal of Product Innovation Management*, 23(6): 475–497.

OECD (2005). The measurement of scientific and technological activities. Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. Paris: *OECD*.

OECD (2007). Eurostat-OECD Manual on Business Demography Statistics, Paris: *OECD*.

OECD (2010). High-Growth Enterprises: What Governments Can Do to Make a Difference, OECD Studies on SMEs and Entrepreneurship, *OECD Publishing*. http://dx.doi.org/10.1787/9789264048782-en.

OECD (2012). Science, Technology and Industry Outlook 2012. Paris: *OECD*.

OECD (2013). *OECD Science, Technology and Industry Scoreboard 2013*, Accessed: 22-05-2015 _www.oecd-ilibrary.org/docserver/download/9213051e.pdf_.

Olazarán, M., Albizu, E. & Otero, B. (2009). Technology transfer between technology centres and SMEs: evidence from the Basque Country. *European Planning Studies*, 17(3), 345-363.

Parker, S. C. & Belghitar, Y. (2006). What happens to nascent entrepreneurs? An econometric analysis of the PSED. *Small Business Economics*, 27(1), 81-101.

Parker, S. C. (2011). Intrapreneurship or entrepreneurship?. *Journal of Business Venturing*, 26(1), 19-34.

Pérez-Hernández, P. & Calderón-Martínez, G. (2014). Analysis of the Technology Commercialization Process in Two Mexican Higher Education Institutions. *Journal of Technology Management & Innovation*, 9(3), 196-209.

Perkmann, M. & Walsh, K. (2007). University–industry relationships and open innovation: Towards a research agenda. International *Journal of Management Reviews*, 9(4), 259-280.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A. & Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research Policy*, 42, 423– 442.

Porter, M. & Schwab, K. (2008). Global Competitiveness Report 2008-2009. Switzerland: *World Economic Forum.*

Quintini, G. & Sébastien M. (2014) Same but Different: School-to-work Transitions in Emerging and Advanced Economies, OECD Social, Employment and Migration Working Papers, No. 154, *OECD Publishing*. http://dx.doi.org/10.1787/5jzbb2t1rcwc-en

Ranking Shangai (2015). *Academic Ranking of World Universities (Top 500)*. Shangai Ranking. Accessed September 9, 2015: http://www.shanghairanking.com/es/ARWU2015.html.

Reynolds, P., Bosma, N., Autio, E., Hunt, S., De Bono, N., Servais, I., Lopez-Garcia, P. & Chin, N. (2005). Global entrepreneurship monitor: Data collection design and implementation 1998–2003. *Small Business Economics*, 24(3), 205–231.

Ritala, P. & Hurmelinna-Laukkanen, P. (2013). Incremental and radical innovation in coopetition—The role of absorptive capacity and appropriability. *Journal of Product Innovation Management*, 30(1), 154-169.

Romanelli, E. (1989). Environments and strategies of organization start-up: effects on early survival, *Administrative Science Quarterly*, 34, 369-387.

Romer, P. (1990). Endogenous Technological Change. *The Journal of Political Economy*, 98(5): S71-S102.

Rosenbusch, N., Brinckmann, J. & Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of Business Venturing*, 26(4), 441-457.

Rossi, F., Caloffi, A. & Russo, M. (2016). Networked by design: Can policy requirements influence organisations´ networking behaviour? *Technological Forcasting & Social Science*, 1-12.

Rothaermel, F. T., Agung, S. D. & Jiang, L., (2007). University entrepreneurship: Taxonomy of the literature. *Industrial and Corporate Change*, 16(4), 691–791.

Rothwell, R. & Dodgson, M. (1991). External linkages and innovation in small and medium-sized enterprises. *R&D Management*, 21(2): 125–137.

Santarelli, E. & Tran, H. T. (2016). Young innovative companies: Are they high performers in transition economies? Evidence for Vietnam. *The Journal of Technology Transfer*, DOI: 10.1007/s10961-016-9475-6

Santiago, F., De Fuentes, C., Dutrénit, G. & Gras, N. (2016). What hinders innovation performance of services and manufacturing firms in Mexico?, *Economics of Innovation and New Technology*, DOI: 10.1080/10438599.2016.1181297

Schmitz, A., Urbano, D., Dandolini, G. A., de Souza, J. A., & Guerrero, M. (2016). Innovation and entrepreneurship in the academic setting: a systematic literature review. *International Entrepreneurship and Management Journal*, 10.1007/s11365-016-0401-z

Schumpeter, J. A. 1934, The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle. *Translated by. Redvers Opie. Harvard University Press:* Cambridge, MA.

Scuotto, V., Del Giudice, M., & Carayannis, E. G. (2016). The effect of social networking sites and absorptive capacity on SMES'innovation performance. *The Journal of Technology Transfer*, DOI: 10.1007/s10961-016-9517-0

Secretaría de Economía (2016 a). *Antecedentes*. Fondo PYME. Accessed January 10, 2016: www.fondopyme.gob.mx/docs/Antecedentes_Fondo_Pyme.ppt

Secretaría de Economía (2016 b). *Fondo PYME*. 2006-2012.Economia. Accessed January 10, 2016: http://www.2006-2012.economia.gob.mx/mexico-emprende/fondo-pyme-int.

Secretaría de Economía (2016 c). *Conoce-INADEM*. INADEM. Accessed January 10, 2016: https://www.inadem.gob.mx/index.php/conoce-inadem

Secretaría de Economía, (2015). Leather and Footwear Industry Facts. Mexico: *Secretaría de Economía Press.*

Segarra-Blasco, A. & Arauzo-Carod, J. M. (2008). Sources of innovation and industry–university interaction: Evidence from Spanish firms. *Research Policy*, 37(8), 1283-1295.

SEP (2012). Mexican Educational System, 2011-2012 Indicators. Mexico, *Secretary of Public Education of Mexico.*

SEP (2015 a). *Normatividad*. SES. SEP. Accessed September 9, 2015: http://www.ses.sep.gob.mx/acerca-de-la-ses/normatividad

SEP (2015 b). *Instituciones de Educacion Superior*. SES. SEP. Accessed September 4, 2015: http://www.ses.sep.gob.mx/instituciones-de-educacion-superior

Shane, S. (2003). Academic entrepreneurship: University spinoffs and wealth creation. *Edward Elgar Publishing*: USA.

Silas Casilla, J. C. (2005). Realidades y tendencias en la educación superior privada mexicana. *Perfiles Educativos*, 27(109-110), 7-37.

Sissoko, A. (2011). R&D Subsidies and Firm-Level Productivity: Evidence from France. *IRES Discussion Papers*.

Söderblom, A. & Samuelsson, M. J. (2013). Outcome Additionality of Early Stage Subsidies: Short-term Resources and Long-term Performance. *Academy of Management Proceedings*, 1, 12-39.

Solleiro, J.L. & Castañón, R. (2005). Competitiveness and innovation systems: the challenges for Mexico's insertion in the global context. *Technovation*, 25(9), 1059-1070.

Solow, R. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, 70(1), 65-94.

Souto-Otero, M. & Whitworth, A. (2016). Adult participation in higher education and the 'knowledge economy': a cross-national analysis of patterns of delayed participation in higher education across 15 European countries, *British Journal of Sociology of Education*, http://dx.doi.org/10.1080/01425692.2016.1158639.

Stephan, P. E. (2012). How economics shapes science. *Harvard University Press*: Cambridge, MA.

Stuetzer, M., Obschonka, M. & Schmitt-Rodermund, E. (2013). Balanced skills among nascent entrepreneurs. Small Business Economics, 41(1), 93-114.

Sutz, J. (2000). The university–industry–government relations in Latin America. *Research Policy*, 29(2), 279-290.

Takalo, T. & Tanayama, T. (2010). Adverse selection and financing of innovation: is there a need for R&D subsidies?. *The Journal of Technology Transfer*, 35(1), 16-41.

Teece, D. J. (2002). Managing intellectual capital: Organizational, strategic, and policy dimensions. *Oxford University Press*: London.

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.

Teece, D.J., Pisano, G. & Shuen A. A. (1997). Dynamic capabilities and strategic management, *Strategic Management Journal*, 18, 504–534.

Tether, B. S. (2002). Who co-operates for innovation, and why: an empirical analysis. *Research Policy*, 31(6), 947–967.

Thompson, J. L. (1999). A strategic perspective of entrepreneurship. *International Journal of Entrepreneurial Behavior & Research*, 5(6), 279-296.

Times Higher Education (2015). *World Univerity Ranking*. Times Higher Education. Accessed September 9, 2015: https://www.timeshighereducation.co.uk/world-university-rankings/2015/world-university-rankings#/sort/0/direction/asc

Tripsas, M., Schrader, S. & Sobrero, M. (1995). Discouraging opportunistic behavior in collaborative R D: A new role for government. *Research Policy*, 24(3), 367-389.

Tsai, K. H. & Wang, J. C. (2009). External technology sourcing and innovation performance in LMT sectors: an analysis based on the Taiwanese technological innovation survey. *Research Policy*, 38(3), 518–526.

Urbano, D. & Guerrero, M., (2013). Entrepreneurial Universities Socioeconomic Impacts of Academic Entrepreneurship in a European Region. *Economic Development Quarterly*, 27(1), 40–55.

Van de Vrande, V., De Jong, J. P., Vanhaverbeke, W. & De Rochemont. M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, 29(6), 423-437.

Van Stel, A., Storey, D. J. & Thurik, A. R. (2007). The effect of business regulations on nascent and young business entrepreneurship. *Small Business Economics*, 28(2-3), 171-186.

Wallsten, S. J. (2000). The Effects of Government-Industry R&D Programs on Private R&D: The Case of the Small Business Innovation Research Program. The *RAND Journal of Economics*, 31(1), 82-100.

Welter, F. & Smallbone, D. (2011). Institutional perspectives on entrepreneurial behavior in challenging environments, *Journal of Small Business Management*, 49(1), 107-125.

Wennekers, S., Van Wennekers, A., Thurik, R. & Reynolds, P. (2005). Nascent entrepreneurship and the level of economic development. *Small Business Economics*, 24(3), 293-309.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171–180.

West, J., Salter, A., Vanhaverbeke, W., & Chesbrough, H. (2014). Open innovation: The next decade. *Research Policy*, 43: 805–811.

Whitley, R. (2002). Developing innovative competences: the role of institutional frameworks. *Industrial and Corporate Change*, 11, 497 528.

Williamson, O. E. (1987). Transaction cost economics: The comparative contracting perspective. *Journal of Economic Behavior & Organization*, 8(4), 617-625.

Wong, G. Y., & Mason, W. M. (1985). The hierarchical logistic regression model for multilevel analysis. Journal of the American Statistical Association, 80, 513-524.

Wong, P. K., Ho, Y. P. & Autio, E. (2005). Entrepreneurship, innovation and economic growth: evidence from GEM data. *Small Business Economics*, 24 (3), 335–350.

World Economic Forum (2013). *Entrepreneurial Ecosystems Around the Globe and Company Growth Dynamics. Report Summary for the Annual Meeting of the New Champions 2013.* World Economic Forum. Accessed January 10, 2016: http://www3.weforum.org/docs/WEF_EntrepreneurialEcosystems_Report_2013.pdf

World Economic Forum (2014). *Global Competitveness Report 2012-2013. Schwab, K.- Full Data Edition.* World Economic Forum. Acessed January 20, 2016: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf

Wright, M., Clarysse, B., Mustar, P. & Lockett, A., (2007). Academic entrepreneurship in Europe. *Edward Elgar Publishing*: Massachusetts.

Wright, M., Filatotchev, I., Hoskisson, R. E. & Peng, M. W. (2005). Strategy research in emerging economies: Challenging the conventional wisdom. *Journal of Management Studies*, 42(1), 1-33.

Yin R. (1984). Case study research design and methods. *Sage*: California.

Zahra, S. A. & Wright, M. (2011). Entrepreneurship's next act. *Academy of Management Perspectives*, 25, 67–83.

Zarraga, C. & Bonache, J. (2003). Assessing the team environment for knowledge sharing: An empirical analysis. *International Journal of Human Resource Management*, 14(7), 1227-1245

Zeng, S. X., Xie, X. M. & Tam, C. M. (2010). Relationship between cooperation networks and innovation performance of SMEs. *Technovation*, 30(3), 181-194.