

Innovation Happens in Mexico.

It Should and Could Happen More.

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Abstract

Based on an in-depth survey of Mexico's innovation research and semistructured interviews with critical actors of Mexico's innovation ecosystem, this report explores how to encourage innovation in Mexico. It identifies four types of inhibitors to innovation—government, community, infrastructure, and funding—and explains them in detail, providing data-driven evidence of advances and problems. It then proposes the following 15 explicit recommendations for ways to promote innovation-driven entrepreneurship, with specific examples and better practices from private and public institutions around the world:

- 1 Promote education that supports creativity and teamwork.
- 2 Expand English education to support talent and knowledge discovery.
- 3 Teach business skills.
- 4 Promote entrepreneurship awards to solve specific challenges.
- 5 Professionalize technology transfer offices.
- 6 Nurture local firms in Special Economic Zones
- 7 Boost the impact of Mexico's CONACYT (National Council for Science and Technology) metrics of success and introduce demand-driven funding options.
- 8 Pay incubators for creating final products, not firms.
- 9 Nudge corporate venture.

- 10 Use Mexico's "Fund of Funds" for social impact.
- 11 Redesign public funding structures to respond to innovation necessities.
- 12 Develop specialized institutions to design and execute public-private partnerships for innovation.
- 13 Create progressive tax incentives to promote innovation.
- 14 Reduce cumbersome regulations on new businesses.
- 15 Fight corruption by accelerating procedures and designing transparent processes for starting a business.



Executive Summary

Entrepreneurs are not innovating enough in Mexico. Only six percent of Mexican entrepreneurs claim to have a new, innovative product to offer to the market, and 83 percent did not even try to innovate in any of their processes or projects during the last year (ONE 2015a). Mexico is 58th out of 127 countries in the Global Innovation Index (GII), behind other Latin American countries like Chile and Costa Rica (GII 2017).

To be innovative, a country requires four key components for success. First, it needs adequate infrastructure, which includes high-quality entrepreneurial and technological education, efforts to promote skills that encourage innovation, general access to the Internet, and broad availability of information and communication technologies. Second, it must have a solid community to support innovation, with networks that bring together innovators, entrepreneurs, universities, and businesses; incubator programs and innovation clusters that celebrate and promote innovation-driven entrepreneurship; and mentorship ties that encourage knowledge sharing. Third, it requires accessible funding, whether from private or public seed capital, grants, crowd-funding, research competitions, or venture capital and investment. Finally, it should be supported by suitable government policies within a regulatory framework that promotes innovation, risk-taking, trade, and investment; enables healthy financial markets; and supports research and development and patent protections. Mexico has made great advancements in each of these four categories but still has many areas of opportunity.

Mexico's infrastructure inhibits innovation. Education levels are low, quality is poor, the mismatch between education supply and demand is prominent, business education is scarce, and technology access is not guaranteed. Only 16.8 percent of Mexican adults have a university degree, compared to the Organisation for Economic Co-operation and Development (OECD) country average of 35.7 percent (OECD 2016a). Around 55 percent of Mexican students do not achieve basic competences in math, 41

percent in reading, and 47 percent in science (OECD 2012). Furthermore, even if most innovation comes from science, technology, engineering, and mathematics fields, only 24 percent of Mexicans with higher education degrees graduate from such fields, compared to 65 percent in humanities, social sciences, and education (IMCO 2017). Among entrepreneurs, as many as 15 percent consider lack of training to be the most important constraint they faced when starting a new business (ONE 2015a). Finally, only 47.0 percent of Mexican households have access to the Internet at home, and only 45.6 percent own a computer (INEGI 2016a).

To create infrastructure that promotes innovation, Mexico needs to forget rigid, severe, and memory-based education, and instead promote education that supports creativity and teamwork, which includes focusing on developing a broad toolkit of abilities required to innovate and accepting failure as part of the learning process; turn English education from being a privilege of private schools to becoming a democratic door for talent and knowledge discovery; teach business skills that can enhance self-confidence, motivation, and future innovation capacities; and promote entrepreneurship awards to solve specific challenges, dictated by the needs of the market and fulfilled by the creativity of the participants, rather than more traditional prizes.

Mexico does not have a business community that fully promotes innovation. Patents are not often commercialized, firm-to-firm partnerships are scarce, and incubators are not creating effective links between entrepreneurs and markets. The average Mexican technology transfer office, which is intended to bridge the gap between ideas and practical implementation, manages to grant less than two-thirds of its trademark applications (72%), generates income for only a third of its patents (RedOTT 2016), and does less than 1 spin-off and 2.3 technology transfers per year. Furthermore, in 2013, only 10 percent of firms that implemented an innovation project collaborated with another firm (INEGI 2014). Finally, most incubators (85%) do not even care to follow up with the firms they incubated to assess successes and failures after the fact (IMCO 2014).

To create a proper business community that promotes innovation, Mexico needs to professionalize technology transfer offices, improving their negotiation capacity and encouraging them to measure the quality

rather than quantity of their work; nurture local firms to link them with international corporations, focusing in developing local innovation to respond to the needs of corporations, particularly in Special Economic Zones; boost the impact of Mexico's Consejo Nacional De Ciencia y Tecnología (National Council for Science and Technology; CONACYT) as a linker and talent developer, polishing its metrics of success and introducing demand-driven funding options; and pay incubators for the final products they create (and not the firms) or because they have a well-developed capacity to "enable" firms to create products.

Mexico's funding structures inhibit innovation. Traditional private capital is risk-averse, private funding is limited and concentrated, and there is little investment in research and development (private and public) and little information about how to access private capital. In fact, about 65 percent of Mexicans consider lack of funding to be the most important constraint to starting a business (ONE 2015a), and only 1.9 percent of the firms that engaged in an innovation project used government support to finance their project (INEGI 2014). In 2011, 75 percent of private capital investments were concentrated in three Mexican states: Mexico City, Jalisco, and Nuevo León (IMCO 2014). Between 2010 and 2013, only 14 percent of firms initiated innovation projects and only 16 percent have invested in research and development (INEGI 2014). When surveyed, only 53 percent knew that private capital could be a source for funding business growth, and only 3 percent understood how venture capital works. Public funding does not follow the logic of innovation; it is fractured and infested with middlemen (also known as "coyotes") and is focused on quantity, not quality. About 70 percent of entrepreneurs find rules of government programs difficult to understand, only seven percent say that articulation between programs is efficient, and only 3 percent say that programs fulfill entrepreneurs' needs (IMCO 2014). Of the entire public budget assigned to micro, small, and medium enterprises and entrepreneurship in 2013, 31 percent went to "fondo perdido" (sunk cost) funding (ONE 2015a). Furthermore, most Mexican government institutions associated with innovation, including INADEM (Instituto Nacional del Emprendedor; National Entrepreneur Institute) and CONACYT, continue to structure their programs, contests, and public calls to the Mexican federal government's fiscal calendar—a calendar that does not necessarily respond to the needs of entrepreneurs and innovation projects. In 2015, Mexico invested only

0.53 percent of its gross domestic product in research and development, while more advanced economies like Japan and South Korea invested 3.3 percent and 4.2 percent respectively (OECD 2015a). Finally, there are no innovation public-private partnerships; even though these partnerships have been legally permitted since 2012, they have never been used for innovation purposes (Urbina 2016).

To create funding that promotes innovation, Mexico needs to nudge corporate venture to allow Mexican companies and corporations to become relevant agents in funding technology and knowledge development; use Mexico's "Fund of Funds" to generate innovation that will have a larger social impact; redesign public funding structures to respond to innovation needs with funding not tied to the government's fiscal year, provide better information and better indicators of results, and pay more attention to avoid crowding out funding; develop specialized institutions to design and execute public-private partnerships for innovation; and create progressive tax incentives to promote innovation. Regarding the last recommendation, tax exceptions targeted to small firms or social bonds could complement government's programs for innovation.

The Mexican government inhibits innovation. It has created excessive and cumbersome legislation, does not protect property rights, lacks rule of law, and is corrupt. A Mexican firm spends an average of 286 hours to pay taxes, while the average for OECD countries is only 163.4 hours, almost 50 percent less time (Doing Business 2016c). Mexico scored 4.0 out of 7 points in terms of intellectual property rights protection in the Institutions pillar of the Global Competitiveness Ranking (WEF 2017), and was 88th out of 113 countries in the World Justice Project's Rule of Law Index 2016 (WJP 2016). On the 2015 Corruption Perceptions Index, a measure based on expert opinions about the perceived levels of public sector corruption, Mexico was ranked 123rd of 176 countries, alongside countries such as Azerbaijan, Djibouti, Honduras, Laos, Moldova, Paraguay, and Sierra Leone—and 27th out of 32 countries in Latin America and the Caribbean (Transparency International 2017).

To create a government that promotes innovation, Mexico needs to reduce cumbersome regulations that increase the procedures and costs required to open a business, and fight corruption by reducing discretionary

processes. Requiring licensing, certificates, or permits to open a business creates conditions for bribery, whether to expedite the associated processes or circumvent other restrictions. Thus, accelerating procedures, designing transparent processes, and openly publishing the expected time periods for each procedure can eliminate an environment that fosters corruption. Procedures that require approval by a public agent and that can be done online should be offered through a single webpage with free and open access. Specific areas of attention to reduce corruption and promote innovate include promoting the use of a public broker (a practice that costs 26 percent less than requiring attesting officials) or making the use of attesting officials optional; reducing the registration fees owed to the Public Registry of Commerce; and eliminating operating licenses for low-impact business lines or substitute such licenses with a notice on commencement (Doing Business 2016a).

Courses of Action

1. Educate to innovate (at all levels).
2. Teach English.
3. Develop entrepreneurship programs for the young.
4. Eliminate “entrepreneurial prizes” to embrace “entrepreneurial challenges.”
5. Professionalize TTOs for quality.
6. Nurture local firms to link them with international corporations.
7. Boost CONACYT’s impact as a linker and talent developer.
8. Pay incubators for success.
9. Encourage corporate venture.
10. Use Mexico’s FdF to generate innovation that will have a larger social impact.
11. Redesign public funding to respond to innovation necessities.
12. Develop public-private partnerships for innovation.
13. Create progressive tax incentives to promote innovation.
14. Reduce cumbersome red tape and costs required to open a business.
15. Fight corruption by reducing discretionary processes.



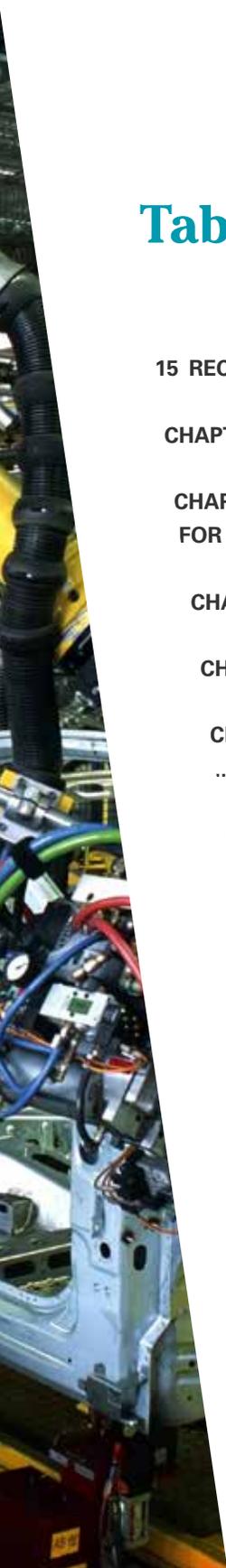


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Although entrepreneurship has increased rapidly in Mexico, innovation has not followed suit. From 2011 to 2015, total early-stage entrepreneurial activity¹ almost doubled, reaching 21 percent of the adult population and exceeding the Latin American average of 19.9 percent (GEM 2014). Yet only 6 percent of Mexican entrepreneurs claim to have a new, innovative product to offer to the market, and 83 percent did not even try to innovate in any of their processes or projects during the previous year (ONE 2015a). Indeed, in Mexico it is more common to become an entrepreneur in order to gain independent employment (50 percent of surveyed cases) or a better income (10 percent) than to develop a groundbreaking product or innovation (ONE 2015a).

Based on an in-depth survey of Mexico's innovation research and semistructured interviews with critical actors in Mexico's innovation ecosystem, this report explores the factors that are behind the puzzling lack of innovation in Mexico. It identifies the critical factors that are inhibiting innovation in the country and provides explicit recommendations on how to promote innovation-driven entrepreneurship. In this report, chapter one explains the status of innovation in Mexico and provides a framework to classify the factors that inhibit or promote innovation. This framework is based on analyzing the four components of the "innovation ecosystem": government, community, infrastructure, and funding. Subsequently, chapters two through five provide quantitative evidence of the type and magnitude of problems that each of the four components of the innovation ecosystem face in Mexico. These sections provide solid quantitative data to explore the problems in an objective way. Each section also proposes concrete recommendations to promote innovation in Mexico, emphasizing the institutions and actors that need to induce such change. Examples and best practices from private and public institutions illustrate how such recommendations have been implemented in the international context. Finally, the report concludes by summarizing the lessons learned from this study and seeding ideas for a future research agenda to better promote innovation in Mexico.

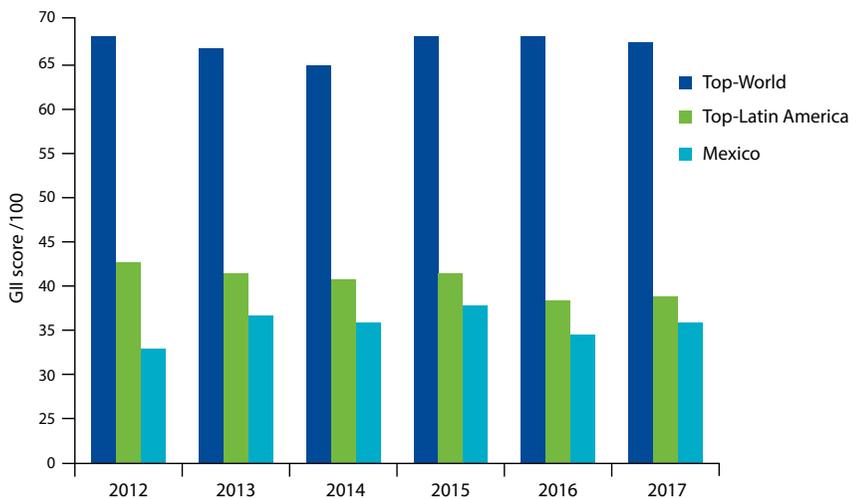
1

The Status of Innovation in Mexico

Mexico lags in innovation and entrepreneurship. It comes in 58th out of 127 countries in the Global Innovation Index (GII), one of the most important measures of innovation competence and results in the world.² Mexico is behind other Latin American countries like Chile and Costa Rica, which occupy positions 46 and 53, respectively. In the past

four years, Mexico has been ranked 62nd on average (GII 2017), which is slightly above average worldwide.³ Graph 1 presents a comparative look at Mexico's position in the GII from 2011 through 2016.

Graph 1. GII scores for the best ranked countries in the world, in Latin America, and in Mexico⁴



Source: GII 2012 through 2017.



As Graph 1 shows, Mexico is fast approaching the Latin American leader in terms of innovation (Chile). In 2017, the difference in the GII score is only 2.9 (35.8 Mexico, 38.7 Chile). Yet, Mexico is still way below the top-performer in terms of innovation, Switzerland, with a 67.7 score in 2017.

The strongest feature that Mexico has to promote innovation is its market sophistication. It is considered among the seven best economies in the world in terms of trade, competition, and market scale. Besides this, there is no other feature, among the subpillars measured by the GII, in which Mexico ranks at the top 25 percent of the sample. Yet Mexico's intangible assets have shown greater improvements over the past three years. Owing to increases in the number of utility applications, intangible assets has moved 13 positions per year and now ranks in 64th. At this pace, it will only take three years for Mexico's knowledge creation to be at the top 25 percent of the world.

The feature that inhibits Mexico's innovation the most is business sophistication. The country is 71st, below countries like Honduras and Colombia. Particularly worrisome is knowledge absorption, the feature that has had a significant fall in the last years. Owing to a lower score in ICT services imports, Mexico's knowledge absorption ranking has fallen by 4.3 positions per year and now ranks 54th. At this pace, it will take ten years for Mexico's knowledge absorption to be in the bottom 25 percent of the world.

Table 1. Mexico's Innovation Components

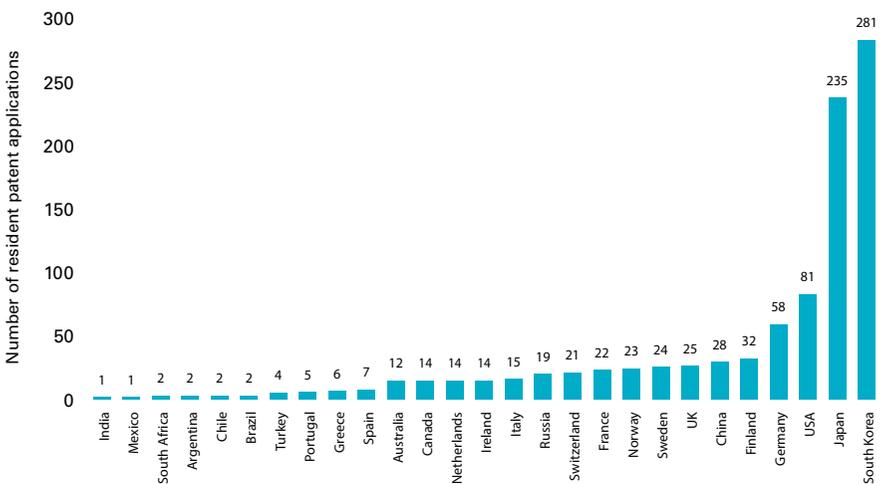
Pillars	Sub-pillars	Ranking (2017)	Average Yearly Change ⁵ (2014-2017)	Best Latin American Country (2017)
Innovation Competences				
Institutions	Political Environment	82	1.0	37 (Uruguay)
	Regulatory Environment	84	27	45 (Chile)
	Business Environment	51	-8	51 (Mexico)
Human and Capital Resources	Education	80	3	33 (Costa Rica)
	Tertiary Education	72	-10	44 (Argentina)
	Research and Development	41	2*	29(Brazil)
Infrastructure	ICT's	42	2.3	34 (Uruguay)
	General Infrastructure	67	0	4 (Panama)
	Ecological Sustainability	58	0.7	13 (Colombia)
Market Sophistication	Credit	63	11	15 (Peru)
	Investment	86	2.3*	47 (Honduras)
	Trade, Competition and Market Scale	7	5.3	7 (Mexico)
Business Sophistication	Knowledge Workers	75	2.3	38 (Peru)
	Innovation Linkages	84	7.7	8 (Guatemala)
	Knowledge Absorption	54	-4.3	17 (Costa Rica)
Innovation Results				
Knowledge and Technology Outputs	Knowledge Creation	70	6	50 (Brazil)
	Knowledge Impact	70	6	52 (Chile)
	Knowledge Diffusion	49	-4	22 (Costa Rica)
Creative Outputs	Intangible Assests	64	13	12 (Paraguay)
	Creative Goods and Services	31	3*	15 (Costa Rica)
	Online Creativity	73	-5.3*	44 (Uruguay)

**Components of this pillar have changed over time and are not completely comparable.
Source: GII 2017.*

As Table 1 shows, Mexico has slightly better innovation competences than results. The GII can be divided into two subindex groups: inputs and outputs. Innovation input is a measure of innovation competences, meaning how good institutions, human capital, research, infrastructure, markets, and business sophistication contribute to create new ideas. Innovation output is a measure of results or of how much innovation is actually produced in the form of knowledge, technology, and creativity (GII 2017). Currently, Mexico ranks 54th on innovation input and 60th on innovation output.⁶

Innovation production in Mexico is low. For every patent application made by a Mexican in Mexico per hundred thousand inhabitants per year, South Koreans made 281 in their country (World Bank 2014a). In 2016, patent applications made by Mexicans represented 7.5 percent of all the patent applications in Mexico (IMPI 2017a). Comparing Mexico with other Latin American countries, Mexico performs a little better. In the past decade, Mexicans have made more patent applications than Argentines and Colombians. However, on average, Argentines, Chileans, and Brazilians made one more application per hundred thousand inhabitants than Mexicans per year (World Bank 2014a). Graph 2 presents comparative patent application data.

Graph 2. Number of resident patent applications per hundred thousand inhabitants

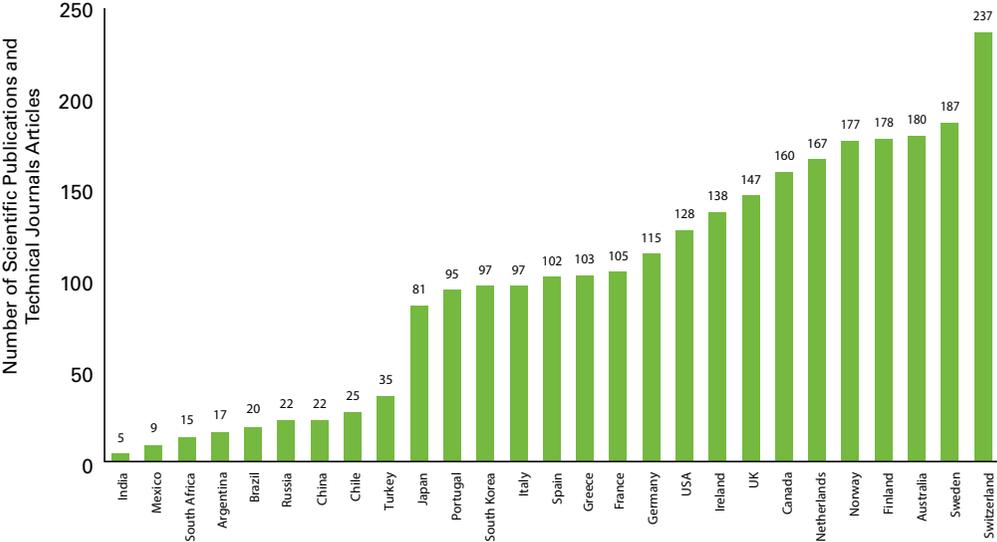


Note: Refers to the average number of resident patent applications in the past decade.

Source: World Bank 2014a.

For every scientific publication and technical journal article published in Mexico per hundred thousand inhabitants per year, Switzerland produced 25 publications (World Bank 2014b). Considering other Latin American countries, Mexico produced 16 percent of all the scientific and technical journal articles published by Latin America and Caribbean countries in the past decade, well behind Brazil (55%). Even worse, when considering rates per thousand inhabitants, Chile, Brazil, and Argentina report higher publication rates than Mexico, with Chile producing more than three times as many publications per year (27 percent to Mexico's 9 percent). Graph 3 presents comparative scientific publication data.

Graph 3. Number of scientific publications and technical journal articles per hundred thousand inhabitants.

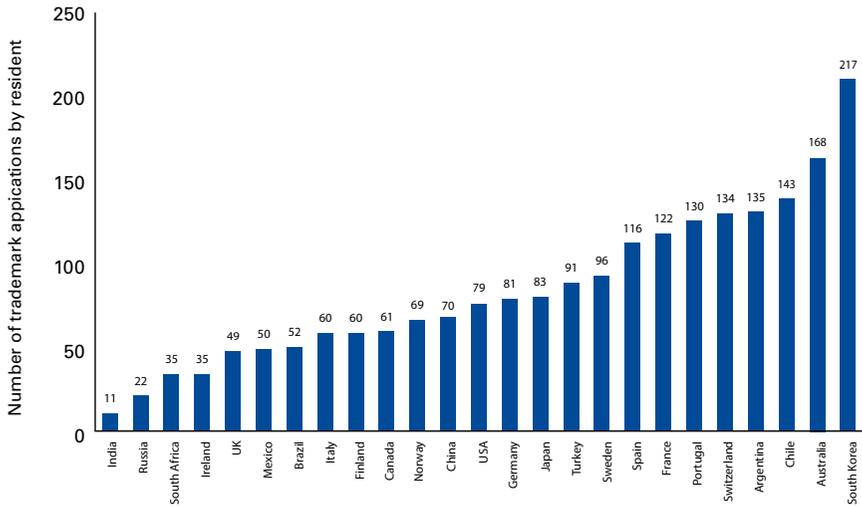


Note: Refers to the average number of scientific publications and technical journal articles in the past decade.

Source: World Bank 2014b.

While Mexico had 50 applications per 100,000, South Korea had 217 (World Bank 2014c). Among other Latin American countries, Chile, the best-performing country in this matter, had three more resident applications per year than Mexico. Graph 4 presents comparative trademark application data.

Graph 4. Number of trademark applications by residents per hundred thousand inhabitants.



Note: Refers to the average number of trademark applications in the past decade.

Source: World Bank 2014c.

Mexico's innovation creation has lagged that of other countries because the country lacks a healthy "innovation ecosystem" (Wood et al. 2014), meaning an environment in which groundbreaking discoveries can be developed and commercialized. A healthy "innovation ecosystem" has four components:

- 1 Adequate infrastructure:** High-quality entrepreneurial and technological education, efforts to promote skills that encourage innovation, general access to the Internet, and broad availability of information and communication technologies.
- 2 Solid community:** Networks that bring together innovators, entrepreneurs, universities, and businesses; incubator programs and innovation clusters that celebrate and promote innovation-driven entrepreneurship; and mentorship ties that encourage knowledge sharing.
- 3 Accessible funding:** Private or public seed capital, grants, crowd-funding, research competitions, or venture capital and investment.
- 4 Suitable government policies:** A regulatory framework that promotes innovation, risk-taking, trade, and investment; enables healthy financial markets; and supports research and development (R&D) and patent protections.

Mexico's innovation ecosystem is in the process of being developed but still faces important challenges in all four components. The following chapters describe each component and its associated challenges in detail, providing up-to-date quantitative information and timely recommendations.



2

From Insufficient to Strategic Infrastructure for Innovation

To thrive, innovation requires a basic “infrastructure,” meaning human capital and technology. Advancing and commercializing a new product requires human capital to produce knowledge and technological equipment to develop market products that can be tested and sold. Having access to such infrastructure has become increasingly pressing as recent technological advances have elevated the skills and qualifications required to be competitive and productive in most industries. Firms that do not have access to information and communications technology, for example, struggle to increase their productivity and engage in innovation processes.

Advances

Mexico’s innovation infrastructure has improved over the years, and the country is now more educated and technologically savvy than ever. In the 2015 Program for International Student Assessment (PISA) evaluations, which assess the reading, math, and science literacy skills of a country’s 15-year-old students, Mexico was among the few countries with improvements in quality. Although its performance remains below the Organisation for Economic Co-operation and Development (OECD) average in science and mathematics, Mexico has achieved improvements in these areas (OECD 2017a). Mexico has introduced mandatory full-time education for all children ages 4 to 15 and has a goal to get universal education coverage by 2022.⁷



Among the most important advances Mexico has had in terms of infrastructure development is the approval of telecommunications, competition, and education reforms in 2013. These reforms were critical steps toward creating a legislative framework to further improve education quality and access to technology. As a result, Mexico is now implementing training and evaluation procedures for basic education teachers with the goal of improving public education quality. In the 2015–16 cycle, 27,682 public teachers—about 95 percent of total public teachers in the country—were evaluated (SEP 2016a).

The reforms have also pushed telecommunications prices to historic lows. After the reforms were implemented in 2013, prices fell 23 percent by 2015. The telecommunications sector⁸ grew 10 percent in 2015 alone, almost two times the average growth of the previous five years, and more than four times the growth of Mexico's economy in general (INEGI 2015a). The percentage of wireless mobile broadband subscribers reached 57 percent in the second quarter of 2016, up from 1.2 percent in 2010 (OECD 2017b). It is estimated

that Mexican Internet users spend 7 hours and 14 minutes a day on the Internet, 17 percent more time than in 2014, and 74 percent of them say that Internet usage has modified their habits (AMIPCI 2016).

Yet fully implementing these reforms will not be easy, particularly the education reform. In the south of the country, protests have been launched by unionized teachers who refuse to be evaluated before being trained. Indeed, the final results of these structural reforms may take decades to take effect.

Remaining Problems

Even with all the advances and improved legislation, Mexico has still insufficient innovation infrastructure.

Education levels are low. Only 16.8 percent of Mexican adults have a university degree, compared to the OECD average of 35.7 percent (OECD 2016c). Among entrepreneurs, figures are slightly better (33%) but still far from the ideal (ONE 2015a). Mexican entrepreneurs attribute their lack of innovation to not having properly trained personnel (24%), and Mexican corporate leaders regularly point to the difficulties of finding people trained in basic skills such as written communication, reading comprehension, and public speaking—not to mention in more sophisticated tasks like negotiation, argumentation, and problem-solving (CIDAC 2015).

Education quality is poor. Basic education shows important deficiencies in mathematics, science, and reading. Mexican students score 416 points in science, 423 points in reading, and 408 points in mathematics, all below the OECD average (OECD 2017a) and close to countries like Bulgaria, Costa Rica, Colombia, Montenegro, and Trinidad and Tobago. Lack of quality may well be related to the fact that Mexico's public spending on primary and secondary education per student is US\$2,801, still far behind the average among OECD countries (US\$8,882 per student)⁹(OECD 2015d).

Education supply and demand are mismatched. Mexico's higher education institutions are not supplying the skills that firms need to innovate (CIDAC 2015). Even if most innovation comes from fields related to STEM, only 24 percent of Mexicans with higher education degrees

graduate from such fields, compared to 65 percent in humanities, social sciences, and education (IMCO 2017). In countries like China and Germany, the percentages of STEM graduates are 40 percent and 28 percent respectively (OECD 2015e). Currently, Mexico has more business managers, accountants, and lawyers (3,531,823) than STEM graduates (2,596,884) (IMCO 2017), most likely due to a lack of information about expected economic returns in these professions. Although STEM professionals are paid more than social science professionals, there is no STEM degree among the top five¹⁰ university degrees by enrollment. Moreover, graduates with degrees in STEM fields such as chemistry are paid on average three times what business managers and accountants are paid. However, there are 74 times more business and accounting graduates than chemists in Mexico. Furthermore, it seems that this rate will remain unchanged as current student enrollments in both groups of degrees follow the same rates (IMCO 2017).

Business education is scarce. Mexico's universities are not motivating students to become innovation-driven entrepreneurs, but rather to search for jobs in traditional industries. Most universities "train their students to be good employees, not to create their own jobs," according to Alberto Beltrán, chief executive officer of Kuruchu Soft, an internationally prized education innovation project from Mexico City (Beltrán 2016). As a result, even among university degree holders, basic business concepts such as financial statements or business governance and transparency are misunderstood or openly unknown (IMCO 2014). Actually, among entrepreneurs, as many as 15 percent consider lack of training to be the most important constraint they faced to start a new business (ONE 2015a). Weak business/entrepreneurial education is a handicap particularly when to-be-entrepreneurs try to apply for funding. "Many entrepreneurs are not clear about when their business needs to start looking for funding and what their options are," notes Christopher Wilson, deputy director of the Wilson Center's Mexico Institute. Moreover, Mexican private and public financial institutions generally find that applicants do not know how to properly elaborate a down-to-earth innovative business plan. Applicants "do not know how to explain the ways in which their product is innovative," says Norma Mondragón, director of innovation at Mexico's INADEM (Instituto Nacional del Emprendedor; National Entrepreneur

Institute). However, some private institutions are following the correct path, as Christopher Wilson highlights: “Business education is strong in places like ITESM [Instituto Tecnológico y de Estudios Superiores de Monterrey; Monterrey Institute of Technology and Higher Education], the second-largest university system in Mexico. You cannot graduate from ITESM without taking a class on entrepreneurship and going through the steps to study a market and learn how to launch a product.”

Technology access is not guaranteed. Unequal technology access is common in Mexico. Only 47 percent of Mexican households have in-home access to the Internet, and 45.6 percent own at least one computer (INEGI 2016a). Most Internet access in Mexico is still skewed toward those who have a smart phone. Among micro, small, and medium enterprise owners, access to technology is not better. About 30 percent of entrepreneurs do not have access to a phone, 33 percent do not have Internet, and 10 percent do not even have electricity or water in their business (ONE 2015a). Increasing access to technology could bring great benefits. On average, firms with computer equipment hire 13 more employees, generate 70 percent more value added per employee, and paid 67 percent more than firms without it (INEGI 2014).

Recommendations

Course of Action #1: Educate to innovate (at all levels).

Forget rigid, severe, and memory-based education. Promote education that supports creativity and teamwork, which includes focusing on developing a broad toolkit of abilities required to innovate and accepting failure as part of the learning process.

The overall way in which knowledge is acquired in Mexico must change. Education must be more a process of discovery than a process of acquiring previously digested knowledge. Teachers must be taught to be moderators and knowledge extractors more than knowledge conveyers. In 2016, Mexico’s Ministry of Education (Secretaría de Educación Pública; SEP) started developing new basic education curricula “placing emphasis on free exploration and divergent thinking” with the goal of “incorporating collaborative learning strategies” (SEP 2016b).¹¹ This is a step in the right direction, yet the SEP has been unclear about how such goals could

actually be achieved. It has mentioned that curricular changes like teaching visual and plastic arts, music and sound experiments, and theatre and corporal expression could help, but there is no clear evidence of the impact of such programs.

Furthermore, educational institutions and universities should inform students about areas that are in higher demand in the labor market, particularly those that are innovation drivers. Students have to be educated for the jobs that will exist, considering that technological advances are forcing many professions to disappear or change dramatically (WEF 2016a). Future jobs will mainly require skills such as complex problem-solving, critical thinking, and creativity (WEF 2016a). Increasing the use of Escoge Tu Carrera (Choose Your Career), a digital tool developed by the Mexican Institute for Competitiveness (Instituto Mexicano para la Competitividad; IMCO) to understand the demand and supply of different careers, would be a good step in that direction.

Box 1. Creative Partnership Program – Creativity, Culture and Education, England

A good example of changing curricula to better develop innovation skills is what the Creativity, Culture and Education (CCE) foundation has accomplished with its Creative Partnership program in England.

The goal of CCE is to plan, design, develop, and deliver programs that promote the value of creativity in education. Its most successful and recognized program is Creative Partnership, an approach to bring arts, culture, and creativity into classrooms. From 2002 until 2011, CCE worked with one in four schools in England, which included 900,000 teachers and over 1 million students. The Department for Culture, Media and Sport and the Department for Education financed the program, which meant that Creative Partnership had to serve both education and art objectives. Since then, CCE has designed an online version of Creative Partnership to reach schools all over the world and has opened some offices in other countries.

Creative Partnership was initially targeted at schools in highly disadvantaged areas to bring creative agents (artists, musicians, dancers, architects, and scientists) to work with teachers to include

creativity in their curricula and help students to learn through innovative ways. To fund these agents, Creative Partnership gave a £3000 grant per school, and the school contributed another £1000. Each school worked with their creative agents over a one-year period.

CCE was awarded the 2011 World Innovation Summit for Education award. Among the tangible results of the program were that teachers reported students to be more enthusiastic and committed to learning, and also showed soft skills improvement, particularly in citizenship, teamwork, collaboration, and negotiation (CCE 2012).

Course of Action #2: Teach English.

Turn English education from being a privilege of private schools to becoming a democratic door for talent and knowledge discovery.

English education is a critical skill to access better market opportunities, because science and technology speaks English as its universal language. About 80 percent of all journals listed in SCOPUS, the largest abstract and citation database of peer-reviewed literature, are published in English. Almost 50 percent of articles in the field of physical sciences are published in English, while only 13 percent are published in Spanish (Van Weijen 2012). Moreover, 70 percent of the top 100 best universities in the world are located in native English-speaking countries (THE 2016).

English has become the global language of business and technology commercialization. One in every four people in the world speaks English and more than 56 percent of the content on the Internet is in English (HBR 2015). Given that multinational companies use English as their mandatory corporate language, speaking English is the only way to improve links between Mexican entrepreneurs and international markets (HBR 2014a). As América Padilla, coordinator of the Technology Transfer Office at CINVESTAV (Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional; Center for Research and Advanced Studies of the National Polytechnic Institute), a research and innovation center in Mexico, has said, “Over the past several years, we have realized that we need to

commercialize our products outside of Mexico, in English [specific laws and regulations], to English-speaking firms. Yet, many times we are there and find ourselves unable to keep up with the pace of the conversation.” The ability to speak English is a valuable asset for labor markets in general. For instance, only 11 percent of jobs with a yearly salary lower than US\$4,079 require the ability to speak English, while half of the jobs with a yearly salary greater than US\$40,789 require it (Mexicanos Primero 2015).

Improving Mexicans’ English communication skills is a long-term process that must start by developing a national plan with clear short- and long-term goals and incentives for teachers (Mexicanos Primero 2015). The federal government should begin by selecting a single educational institution to promote the country’s National English Program in Basic Education.¹² The selected institution must be guaranteed the necessary resources to implement the plan, and must be constantly evaluated by external entities to provide updated information on coverage, access, investment, teacher quality, and learning achievements. Teachers that currently have good performance ratings could be selected to be trained to teach English and be paid better salaries as an incentive for extending their curricula offer. Once sufficient teachers are qualified, public education programs could evolve to include substantive courses that would be taught in English, beyond mere language-learning courses. Pedagogic research shows that the best way to master a language is not to learn the language itself but to learn other topics using the language as a medium, or a communication tool.

Box 2. Teaching English as Lingua Franca – Singapore

Singapore is a multicultural country with four official languages: Malay, Mandarin, Tamil, and English. Just after its independence in 1965, the Singaporean government established several policies to promote the use of English as a lingua franca to allow inhabitants from the country’s different cultures to communicate. In Singapore’s schools, mathematics, history, and sciences have been taught in English since the 1980s, together with an exclusive English class in primary and secondary education. Other classes are taught in students’ native languages.

To strengthen the country's bilingual education system, Singapore created a meticulous teacher-training program. English teacher candidates have to prove their speaking and writing skills. Those selected are given intensive training to acquire the necessary skills to teach. The objective of the program is not only training them to better speak English but teaching them to teach it. Teachers also are supplied with continuing education tools depending on their strengths, weaknesses, and interests.

Singapore's multilingual education has been very successful. As of 2014, 80 percent of the country's literate population of 15 years or older know how to speak and write English. Furthermore, cognitive research has shown that multilingualism has elevated students' cognitive competences, which has helped make Singapore a leader of several international education rankings like PISA, the Progress in International Reading Literacy Study (PIRLS) and the Trends in International Mathematics and Science Study (TIMSS) (Mexicanos Primero 2015).¹³

Course of Action #3: Develop entrepreneurship programs for the young.

Teach business skills that can enhance self-confidence, motivation, and capacities to innovate in the future.

Mexicans' confidence in their ability to start a business has been decreasing, going from 65 percent in 2010 to 50 percent in 2014, eight percentage points lower than the Latin American average (GEM 2014). Although the diffusion of stories of successful entrepreneurs can help promote innovation-driven entrepreneurship, only 40.5 percent of Mexican entrepreneurs say that the media covers stories about entrepreneurial successes, far behind the average of 64 percent in other Latin American countries (GEM 2015).

Universities must also change their approach to the development of young professionals, placing greater emphasis on developing their entrepreneurial/business capacities. Examples of such efforts include developing workshops where students can simulate how to create a firm; giving grants to students for entrepreneurship contests or courses; and including courses on business skills such as the distribution and commercialization of

technological products, management, finance, and access to venture capital and private equity. All of these approaches help create the critical knowledge and training required to promote entrepreneurship (IDEA 2013; Rodov & Truong 2015).

Box 3. MicroSociety Program – Talbot Hill Elementary, Washington State, United States

A successful international practice in entrepreneurship education is the Talbot Hill Elementary School’s MicroSociety program. This school in Renton, WA, creates a fantasy “functioning MicroSociety” where elementary students run businesses, banks, a marketplace, and a government with branches for taxation and licensing. Each student earns “cool cash,” which can be used to purchase goods made by students at the marketplace (Talbot Hill Elementary 2016).

The program requires elementary students to dedicate three hours per week to work in one of the MicroSocieties. Younger students (first and second years) work on activities assigned by their “employer” with their teacher in classroom. Older students (third through fifth years) can do jobs assigned by their employer or run their own small business. To run their own business, students need to develop a business and budget plan (Hoffer and Tofflon 2009).

The program has operated in more than 200 schools in 40 U.S. states. Schools that offer the program are funded with the budget assigned by the school district and with grants and awards from venture capital funds, tech companies, and foundations. Students in the program have shown academic improvement. In particular, 14.3 percent displayed better achievement in math and 11.6 percent in reading. Furthermore, the program boosted students’ empowerment and understanding of real-world business applications (Hoffer and Tofflon 2009).

Course of Action #4: Eliminate “entrepreneurial prizes” to embrace “entrepreneurial challenges.”

Promote entrepreneurship awards to solve specific challenges, dictated by the needs of the market and fulfilled by the creativity of the participants, rather than more traditional prizes.

Hackathons, codefests, entrepreneurship awards, and TED Talk–type events populate the world of Mexico’s entrepreneurs without creating much tangible innovation. INADEM, for example, annually awards a “National Prize to the Entrepreneur” for educational institutions or organizations that have successfully promoted entrepreneurial vocation. Also, the Consejo Nacional De Ciencia y Tecnología (National Council for Science and Technology; CONACYT) annually presents an award to a researcher from an institution in Central or South America, the Caribbean, Spain, or Portugal who has made a contribution to universal knowledge, technological development, or social sciences, with a direct impact in the region.

All these events rightly promote creativity but generally fail to promote innovation, as they lack guidance and clear objectives. At hackathons, computer programmers and tech-type entrepreneurs rush to deliver partial software developments with prototype interface designs that many times cannot be introduced in the market. TED Talks help motivate entrepreneurs, but are too short or casual to deliver any meaningful learning. Furthermore, by their very nature TED Talks highlight single-person endeavors, and tend to obscure the importance of teamwork and resilience. Entrepreneurship prizes can also create perverse incentives. INADEM’s National Prize to the Entrepreneur, for example, is generally awarded to incubator or accelerator institutions based on the number of firms they create, not on the firms’ profitability or innovation (IMCO 2014).

To create innovation, entrepreneurship events, awards, and contests must be designed with the right incentives. INADEM’s and other government contests would be much more valuable if they picked a problem to be solved and awarded monetary prizes to teams that provide the best solution. This would help match the needs of the private sector and the market with the creativity of fresh entrepreneurs.¹⁴ Likewise, TED Talks must emphasize teamwork, rather than solitary achievements. Events should be minimized unless the meetings have a goal; simply networking or raising awareness may not be reason enough.

Box 4. Sunshot Initiative – U.S. Department of Energy

The Sunshot Initiative is a program of the U.S. Department of Energy that has successfully created challenge awards with the main goal of reducing the cost of solar electricity to US\$0 to US\$60 per kilowatt-hour. Challenges are aimed to promote the production of faster, easier, and affordable solar energy to allow U.S. households to consume it (DOE 2016a).

Through the challenges, the Sunshot Initiative works with universities, private companies, state and local governments, nonprofit organizations, and national laboratories to cofund projects that help achieve the cost-reduction target. Awards share the costs with the awardees: a 20 percent cost-share for R&D and 50 percent for demonstration and commercial application activities. Challenges relate to different aspects of the solar energy industry and market, such as concentrating solar power technologies; increasing efficiency; development, and commercialization; reducing production costs; opening new markets; strengthening supply chains, and developing a well-trained workforce for the industry (DOE 2016a).

An example of a challenge award is the SunShot Prize: Race to 7-Day Solar, which was launched in May 2016. Teams were asked to provide a solution to shorten the time it takes to get solar energy into a home. Over 18 months, five teams competed to cut the “permit-to-plug-in” time for small solar energy systems up to 100 kilowatts, with the Department of Energy awarding scores for time, performance, and replicability (DOE 2016b).

Five years after its launch, the Sunshot Initiative has achieved 70 percent of the cost-reduction target established. Solar energy is already price competitive with traditional energy in 14 U.S. states. Moreover, it is estimated that achieving Sunshot’s goal could save US\$400 billion in health and environmental benefits by 2050 (DOE 2016a).

3

From an Unlinked to a Solid Community

Innovation requires connecting ideas with market needs. This does not only mean connecting innovators with private firms, and thinkers with doers, but incubating innovation by promoting networks of mentorship, and developing relationships between peer firms.

Advances

The Mexican federal government has led efforts to promote the connection of ideas and markets by reforming its Law of Science and Technology (Ley de Ciencia y Tecnología, LCyT) in 2015.¹⁵ The reform allowed Mexican academics and researchers to connect with private industry and commercialize technologies they had developed. Before this change, academics ran the risk of being removed from their posts for commercializing patents or intellectual property developed at state or federally funded education institutions.

CONACYT, the decentralized and autonomous federal institution that is in charge of developing laws and programs on science and technology in Mexico, has created an ambitious agenda to increase connections between the private sector and academia in order to transfer knowledge and technology into marketable applications and to push universities to develop firms to commercialize technology. As part of the government's linkage efforts, in 2010 CONACYT and Mexico's economic ministry (Secretaría de Economía, SE) created technology transfer offices (TTOs). A TTO is an institution that links



academia with the private sector by offering advice to help academics transform their research into marketable products. TTOs typically complement their services by providing assistance on intellectual property protection, conducting viability studies, and giving funding advice (Innovar Para Crecer 2016). TTOs are funded through Mexico's Sectorial Innovation Fund (Fondo Sectorial de Innovación, FINNOVA).¹⁶ In 2013, the Licensing Executives Society International (LESI), a nonprofit, nonpartisan organization of 32 national and regional member societies interested in technology transfer and intellectual property licensing, named FINNOVA the best national policy for intellectual protection and technology transference. LESI recognized the certification of 76 TTOs, and 120 projects benefited from the innovation bonuses scheme (SE 2014a). Currently, there are 117 certified TTOs (RedOTT 2016).

Mexico's government has also been proactive in promoting the creation of business incubators. This effort has been championed by INADEM. INADEM certifies incubators, and only certified incubators can apply for funding notices. Incubators can be

certified in the following categories: basic incubators, high potential incubators, accelerators, and network spaces (SE 2014b). By 2016, 302 incubators—179 basic incubators, 70 high potential incubators, 50 accelerators, and 3 network spaces—were certified by INADEM.¹⁷ Since 2015, INADEM has established a program for online incubation, where entrepreneurs are assigned an online advisor to follow the project and a credit of up to US\$8,152;¹⁸ this program registered 111,000 entrepreneurs, of which 30 percent received funding (SE 2016).

Remaining Problems

These changes have made important advances, but Mexico still needs to create a more solid network to connect thinkers and doers, and to do it efficiently.

Patent commercialization is scarce. Commercialization of academic research and patents is still scant, which raises red flags with respect to the performance of TTOs. Because CONACYT has not systematically documented its results or operations, it is not clear whether TTOs have been effective. CONACYT sends TTOs a survey to report their results, but this survey is only options. From the survey information, taken from 76 of 133 TTOs¹⁹ (which may come only from the best TTOs, those incentivized to tell CONACYT their results), the numbers do not seem promising. TTOs managed to grant less than two-thirds of the trademark applications submitted (72%), employed on average 9 workers for 10 researchers, generated income for only five of the 15 patents related to the energy sector, and performed less than one spin-off and 2.3 technology transfers per TTO (RedOTT 2016). Furthermore, the quality of the service and attention that TTOs provide to researchers varies widely. The Mexican government does not evaluate TTOs' operating procedures, nor does it regulate the conditions under which technology can or cannot be commercialized. TTOs are not forced to ensure that universities keep part of the commercialization profits in order to fund other projects. As América Padilla, TTO coordinator at CINVESTAV, has pointed out, "CINVESTAV is a high-quality TTO because we want to be, not because CONACYT forces us to be. We have worked with TTOs of such poor quality that we had to rescind their services" (Padilla 2016). Jonathan Pinzón, former

administrative support unit coordinator of the Mexico–United States Entrepreneurship and Innovation Council, agrees with Padilla and adds, “Many TTOs are incentivized by *bajar recursos* [accessing public funding] rather than by commercializing technology, they want to milk the state instead of feeding it resources to further promote innovation projects” (Pinzón 2016).

There are few firm-to-firm partnerships. In 2013, only 10 percent of firms that implemented an innovation project collaborated with another firm (INEGI 2014). Mexican firms do not tend to participate in networks, associations, or chambers. In a 2015 survey, only 20 percent of micro enterprises and 45 percent of small enterprises reported that they have participated in a network, association, or chamber (ONE 2015a). Moreover, few Mexican firms have managed to innovate in their processes in order to connect with international corporations. Apart from the automotive, aerospace, and agricultural sectors, few other industries have successfully developed innovations to turn small and medium enterprises into purveyors for large international companies.

Incubators do not create effective links between entrepreneurs and markets. Public funds are given to incubators and accelerators depending on the number of enterprises created, not on their profitability. This incentivizes the creation of firms regardless of their viability and quality (IMCO 2014). Most incubators (85%) do not even care to follow up with the firms they incubated (IMCO 2014). Furthermore, many incubators are not sufficiently professionalized. They have managers and counselors that lack real-world business experience and specialization, and most work on a variety of topics on which they are not necessarily experts. The fact that the majority of the incubators belong to educational institutions has partially contributed to such negative outcomes because the academics in charge of incubators generally do not have private-sector experience (AMEXCAP, INADEM, CIEE, & EY 2015). Incubators thus have weak links with entrepreneurs, clients, partners, investors, and financing sources.

Recommendations

Course of Action #5: Professionalize TTOs for quality.

Improve negotiation capacity and go for quality rather than quantity.

A Mexico with a few smart TTOs that have data-proven results and strong state support is better than one with many weak TTOs surviving through a trickle-down of state resources. To get there, TTOs need to be trained, professionalized, and evaluated for results.

TTOs must be required to answer an annual evaluation survey from CONACYT reporting their results; responding to the survey must not be optional. Evaluation cannot be performed only by counting the number of firms, innovation projects, patents, and technology transfers that TTOs create or enable, but also must count their profitability and impact on creating social solutions.²⁰ The state must support only the most effective TTOs. The definition of effectiveness must be that it increases social welfare, not market value.²¹ Currently, FINNOVA expects that “inefficient TTOs will be eliminated by market forces,” according to an interview with Teresa de León Zamora, CONACYT’s director of commercialization, yet the market will not be able to act if government institutions keep creating awards and grants that can be accessed only by TTOs.

Among the most critical skills to develop when professionalizing TTOs are the organizations’ negotiating skills. According to América Padilla, TTOs are currently learning to commercialize their products on their own, but they frequently mistakenly sell their innovations at lower values than they could receive if they “knew how markets work and who the key players are” (2016). To best help Mexico and its people, the government should focus on creating an obligatory mechanism for all TTOs and incubators to determine patents’ commercial potential and help the patent holders negotiate terms with private industry.

CIMAV—Centro de Investigación en Materiales Avanzados, or Center for Advanced Materials Research—is a good example of effectively linking academics with the private sector. In 2015, CIMAV developed 56 percent of its projects with CONACYT funds; the rest were funded exclusively by the private sector. CIMAV also offers networking opportunities, laboratory space, patent counseling, and business courses to academics who want to participate in the business sector (CIMAV 2016).

Box 5. Association of University Technology Managers – United States

The Association of University Technology Managers (AUTM) has launched a successful policy to coordinate TTOs and improve their quality. The AUTM is a nonprofit organization funded by the state and member fees that looks to enhance technology transfer by providing academics and researchers with information and counseling to productively participate in the private sector. Currently, AUTM is a network of 3,200 managers of intellectual property from 300 different universities, research institutions, and teaching hospitals.

AUTM helps their members get information regarding all aspects of technology transfer. Particularly recognized is the organization's Technology Transfer Manual, a report where universities can find information to understand the business world and businesspeople can learn about the most basic procedures of commercialization through the academic sector. The manual was written by experienced attorneys, director-level technology transfer experts, and recognized consultants. AUTM also organizes an annual convention to update technology transfer institution managers about current conditions and tendencies, and has frequent webinars where managers can approach experts with questions. Each year, AUTM conducts a survey to quantify national technological transfer statistics. The survey generates valuable and extensive data about patent applications, spin offs (including earnings and jobs created), commercialization of products created in universities, and case studies (AUTM 2016).

Course of Action #6: Nurture local firms to link them with international corporations.

Focus on developing local innovation to respond to the needs of corporations, particularly in Special Economic Zones.

Mexico recently enacted a federal law to create Special Economic Zones (SEZs) in four of the poorest regions of the country.²² An SEZ is a geographically delimited area designed to attract foreign direct

investment by providing tax incentives, trade facilities, duty-free customs benefits, infrastructure development prerogatives, and easier regulatory processes.²³ The initiative has the goal of reducing unequal levels of development inside Mexico, particularly since the North American Free Trade Agreement (NAFTA) has created a set of wealthy, internationally connected northern states and left an agricultural south without much economic gain.

SEZs pose a unique opportunity for the development of added-value chains and innovating supplier firms in Mexico. In countries like China, SEZs have served as incubators for knowledge, innovation, and technology generation (Zeng 2015), and Mexico cannot be an exception.²⁴ To develop innovation among Mexican local suppliers, the government must provide specialized funding programs for suppliers—credit with better interest rates and coverage levels—consistent with their needs and conditions (ONE 2015a). The government also needs to encourage the formation of specialized human resources and technological enhancement processes, and provide information to local suppliers about market conditions and new domestic and international business opportunities.



Box 6. Center for the Development of the Automotive Industry – Mexico

An interesting and successful case of promoting innovation in local suppliers is Mexico's Center for the Development of the Automotive Industry (CeDIAM). CeDIAM is a program that brings together public, private, and academic sectors to boost suppliers' innovation and productivity by training them in quality systems, manufacturing, maintenance systems, operational leadership, logistics, and information and communication technologies. The center also takes advantage of the national presence of ITESM, the institution in charge of CeDIAM, to promote local impact through many centers in different states.

CeDIAM programs have been successfully implemented to generate suppliers for General Motors. In only 18 months of training, the program helped the company's suppliers to increase parts' level of acceptance, reduce the rejection percentage, and boost their quality. More than 2,000 people in 17 different states have been trained, increasing the number of suppliers by 250 percent. CeDIAM's success has prompted interest in the training program from 35 other automotive companies operating in Mexico, including BMW and Toyota (ITESM 2015).

Course of Action #7: Boost CONACYT's impact as a linker and talent developer.

Polish CONACYT's metrics of success and introduce demand-driven funding options.

CONACYT measures its impact as a technology linker by measuring the number of intellectual property protection applications, spin-outs, innovation projects, and technology packages transferred. These metrics are not sufficient because there is no way to identify how many patents are actually generating income, providing social benefits, or even just being commercialized. Also, the survey that provides these metrics is not obligatory; in 2015, indicators show only 63 percent of TTOs responded to the CONACYT survey (RedOTT 2016).

It is critical for CONACYT to transform its metrics in order to promote the right incentives inside the academic community. It must use the quality, not quantity, of academic spin-outs, publications, and patents to determine the amount of resources to give to academics and public institutions. Currently, the Sistema Nacional de Investigadores (National System of Researchers; SNI) evaluates Mexican academics according to the number of “products” they manufacture, including publications, conferences, classes, theses, and books. As a result, Mexican academics spend much of their time developing bulky curriculum vitae that focus on reporting numbers, writing as much as they can independent of the quality of the work, and avoiding the risks of developing innovative research that may not lead to publications. Under current rules, a prominent academic with a single book would be expelled from the system for low productivity, even if the book changed the discipline forever (Aguilar Rivera 2011). CONACYT must also give academics flexibility to leave tenured positions to participate in innovation spin-outs regardless of their success.

In addition, as an institution, CONACYT could focus its resources on solving concrete problems, instead of only providing broader guidance of areas of research as it does now. As part of its plan of operation, CONACYT picks critical areas of research development,²⁵ yet such targeting is sometimes too macro. Instead, CONACYT could use its power as a convener of talent to target specific problems that Mexican private industries need to solve, and provide funding to do so.²⁶



Box 7. I-Corps – United States

I-Corps is a program of the U.S. National Science Foundation (NSF) that helps focus scientists' priorities beyond the academic sphere. The main goal is to translate discoveries into applications with tangible and short-term impact on the economy and society (NSF 2016). It is a concrete example of how well-coordinated and well-designed government programs can strengthen the relationship between academia and the marketplace.

The program creates I-Corps teams composed of an academic investigator, an entrepreneurial advisor, and a NSF mentor. The team works together for six months to identify valuable product opportunities in academic research. They rely on their experience and the advice of previously successful entrepreneurs to figure out what resources will be needed to commercialize an innovation, whether any current solutions in the market could compete with it, and what its specific added value might be. Projects that can be profitable and feasible are transferred to the private sector to get advice and support from strategic partners and investors (NSF 2016). NSF also offers the I-Corps methodology to all beneficiaries of government Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR)²⁷ seed capital scheme (Blank 2016).

The results have been impressive. As of 2014, more than 500 I-Corps teams have been created. About 95 percent of I-Corps academics find a scalable business model for their products, 98 percent find a product/market fit for their discovery, and close to 50 percent get new ideas for their teaching (Blank 2013).

Course of Action #8: Pay incubators for success.

Government-funded business incubators must be paid because they (and not firms) create the final products, or because they have a well-developed capacity to "enable" firms.

Incubators should receive support based on the impact of incubated firms: for example, in terms of revenues, patents, or job creation after some years of being in the market. This reward system will lead incubators

to transform into “enablers,” places where start-ups are provided with a team of specialized consultants that help them turn their ideas into market-profitable products. Incubators must stop being regarded merely as co-working spaces and start specializing by sector and specialty, with the capacity to reach universities, researchers, and markets (IMCO 2014). They will be more effective if they have extensive networks with the private sector and investment funds, as well as clear performance and monitoring mechanisms (AMEXCAP, INADEM, CIEE, & EY 2015). Finally, incubators must be information hubs, with extensive and updated knowledge about INADEM’s offers for entrepreneurs and of start-ups’ international best practices (AMEXCAP, INADEM, CIEE, & EY 2015). The resources given to incubators could also be used to hire experienced entrepreneurs as counselors, or to develop predesigned products such as websites, apps, and other tools that entrepreneurs can use at no cost.

Box 8. Pier 9 – San Francisco, United States

In 2013, Autodesk, a multinational corporation that makes software for architecture, engineering, construction, manufacturing, media, and entertainment industries, launched Pier 9 to turn software ideas into real-world applications. Pier 9 is a perfect example of an incubator that provides artists, engineers, and architects with the necessary tools to transform their ideas into reality. It is meant to be a place where artists can engage in all the steps required to make things happen.

Pier 9 is a co-working space fully equipped with machinery and tools to eliminate boundaries between software and reality. Some of the features are textile shops, a 3-D print shop, an electronics laboratory, a metal shop and a wood shop, and a test kitchen. Artists apply to have access to Pier 9 for a four-month residence period. Those who are selected get a monthly stipend of US\$2,000 and advice/inspiration from experts (Autodesk 2016a). During their residency at Pier 9, artists are guaranteed the ownership of all products created during their residency but are required to publish their work online (www.instructables.com). Some innovative projects successfully developed include a machine that listens, a concrete 3-D printer, and a sundial watch (Autodesk 2016b).



4

From Traditional to Smart Funding

Innovative firms require funding that responds to their own needs, with higher risk tolerance, lower profit margins, and more flexibility with respect to short-term results. Funding can come from private capital (e.g., informal, traditional, venture, crowd funding), public sources (e.g., international organizations, federal/local governments), or a mixture of both in the form of public-private partnerships.

Advances

Mexico has had many advances in increasing the sources and magnitude of innovation funding. It has expanded its private credit and venture capital; it also has seen the development of many public funding programs with institutions such as INADEM, NAFIN (Nacional Financiera Banca de Desarrollo; Nacional Financiera Development Bank), CONACYT, and SE, along with the legal framework to develop public-private partnerships for innovation.

1. Private Funding

In terms of private capital, access to credit as a percentage of GDP has increased significantly in Mexico, from 36 percent in the first quarter of 2010 to 50.1 percent in the second quarter of 2017 (Banxico 2017a; INEGI 2017a). Additionally, interbank interest rates have diminished from 8.7 percent²⁸ in 2009 to 7.4 percent in 2017 (Banxico 2017b).



Legally, one of the most important advances to increase the availability of private capital was a 2009 reform that allowed Mexican pension funds to invest in risk capital. Mexico created the Structured Equity Securities (Certificados de Capital de Desarrollo; CKD) assets with the goal of providing capital to firms and infrastructure projects (AMEXCAP, INADEM, CIEE, & EY 2015). As a result, by the end of 2015 a total of 53 CKDs were registered, with total investment of US\$5.7 billion.²⁹ In 2015 alone, pension funds made a historic investment in CKDs, participating in 16 different certificates with a total of US\$901 million (CONSAR 2015). The existence of these certificates in Mexico is important because worldwide pension funds are one of the most relevant players in private capital investment. In the United States, for example, pension funds represent 40 percent of total investment in private capital (AMEXCAP, INADEM, CIEE, & EY 2015).

With respect to access to venture capital, Mexico is developing quickly. At least 55 venture capital funds operated in Mexico in 2015, compared to only 9 in 2010 (LACVA 2016a; AMEXCAP, INADEM,

CIEE, & EY 2015). Between 2011 and 2015, venture capital investments in Mexico represented US\$260 million, about 12.5 percent of all the venture capital investments in Latin America. Mexico has become the second most active venture capital market in Latin America, behind Brazil, mainly due to a growing community of seed capital investors. Four of the ten most active venture capital funds of Latin America are in Mexico, and, in terms of size, the sixth largest venture capital fund in the region is Mexican, behind some funds from Brazil and Argentina. Venture capital is also more diversified in Mexico than in other countries. Mexican venture capital funds invest in health care, energy, retail, and real estate, whereas in Brazil 99 percent of venture capital goes to a single sector, technology (LAVCA 2016a).

Overall, compared to other Latin American countries Mexico is well positioned in its access to venture capital. According to the ranking scorecard on the Private Equity/Venture Capital Environment in Latin America of the Latin American Private Equity & VA Association (LACVA),³⁰ Mexico has the third-best access to venture capital in the region, behind Chile and Brazil. Mexico scores 65 out of 100 points, two points lower than the score registered in 2013.³¹ However, according to LACVA, Mexico has maintained its position as third best in the region because it has a more efficient bankruptcy procedure, more developed capital markets, and better protections of minority shareholder rights (LAVCA 2016b).

2. Public Funding

In Mexico, the main public funders are CONACYT, SE, and NAFIN. They are in charge of managing public funds intended to promote innovation and entrepreneurship, and they deliver these funds through several programs:

2.1. INADEM

The SE created INADEM, an institution in charge of administrating the National Entrepreneur Fund (Fondo Nacional Emprendedor, FNE) with the goal of enhancing the entrepreneurial ecosystem in Mexico. In 2017, FNE represented 39 percent of the budget³² assigned to SE and 0.1 percent of the total federal budget (SHCP 2017).

In 2015, a total of 31 notices benefited 20,587 projects and

represented more than half of FNE's budget (US\$265.6 million) (SHCP 2015). Apart from notices, FNE promotes and funds entrepreneurship through its incubators and accelerators program, direct funding, investment vehicles, and networking programs like Red del Emprendedor and Semana del Emprendedor, among others. In terms of investment vehicles, INADEM has managed to double the number of fund managers in Mexico by co-investing up to 50 million pesos with a capped return, and allowing investors to share return remnants. As of 2015, about 65 percent of the total venture capital operating in Mexico has received INADEM funding (AMEXCAP, INADEM, CIEE, & EY 2015).

2.2. SE-NAFIN

NAFIN and SE coordinate SE-NAFIN, an investment vehicle that promotes seed and venture capital in Mexico. In 2015, SE-NAFIN invested in three seed capital funds (for 37 firms) and in 15 start-ups (direct investment). Furthermore, the program registered a successful enterprise sale (of the start-ups with direct investment) only five months after the initial investment. It also has contributed to the development of fund managers through the Senior Management in Private Capital program by providing technical assistance and networking for projects seeking investor funding (NAFIN 2016).

2.3. Guarantee Program

NAFIN and SE promote small and medium enterprises' access to bank credit through its Guarantee Program (Programa de Garantías). The main goal is to reduce payment uncertainty by endorsing these enterprises' requests for commercial bank credit. To do so, NAFIN and SE share the credit risks of the financial intermediaries. A firm backed by the government has access to a greater amount of more competitive credit. During 2015, financial intermediaries granted small and medium enterprises a total of US\$15.5 billion in credit with the government's guarantee (NAFIN 2016).

2.4. PEI

CONACYT created the Stimulus Program for Innovation (Programa de Estímulos a la Innovación; PEI), as part of government's innovation efforts. PEI incentivizes firms to invest in innovation

by providing complementary economic resources. The program is aimed at enterprises that are part of the National Registry of Scientific and Technological Institutions or Firms (Registro Nacional de Instituciones Científicas y Tecnológicas, RENIECYT) that engage in R&D or technological development activities, alone or with an academic institution.³³ There has been great success in terms of linkages with academic institutions, as 90 percent of the projects work with state universities, CONACYT research centers, or private institutions. Between 2009 and 2014, a total of 3,813 projects received PEI resources, primarily in the information and communications technologies, automobile, agribusiness, and chemical sectors (PEI 2016).

2.5. FINNOVA and FIT

CONACYT and SE coordinate FINNOVA, Mexico's Sectorial Fund for Innovation, whose goal is to convert innovative ideas into business projects. In 2015, FINNOVA had four notices that benefited 93 projects with a total of US\$3 million. Also, as mentioned in chapter 2, FINNOVA is in charge of creating and strengthening TTOs to promote business links with universities and academic institutions. Finally, FINNOVA provides direct funding to biotechnology projects. CONACYT and SE also coordinate the Fund for Technology Innovation (Fondo de Innovación Tecnológica, FIT), which promotes innovation among technology-driven micro, small, and medium enterprises. FIT also funds projects that aim to include highly specialized academics or laboratories equipped for technology innovation in their firms. In 2015, FIT selected 59 projects to receive a total of US\$11.8 million (CONACYT 2016b).

2.6. Mixed Funds

In an effort to promote science, technology, and innovation at the state and municipal levels, CONACYT created the Mixed Funds. The program is designed to enable co-investments between federal (represented by CONACYT) and local governments. Currently, there are 35 mixed funds, 32 at the state level and 3 at the municipal level. From the program's creation in 2001 through 2016, CONACYT has contributed 58 percent of the resources. The northeast region states have benefited the most from this funding, with 24 percent of total

contributions, while the southeast region states received the least with 10.3 percent. Moreover, 36 percent of the received proposals have been approved; Guanajuato and Tamaulipas have been the states with the most approved projects (CONACYT 2016c).

3. Mixed Funding

Mexico has taken the first steps toward using mixed funding by regulating the existence of public-private partnerships in 2012. Public-private partnerships are the only legal mechanism capable of formalizing government/private relations; ensuring long-term relationships between investors; and supporting co-investment guarantees, transparent distribution of risks, and social welfare maximization.³⁴ Innovation public-private partnerships aim to develop projects that will have productive investment, applied research, and technologic advancement (DOF 2012).

Problem

Even if Mexico has increased private and public funding for entrepreneurs and innovators, much needs still to be done. About 65 percent of Mexicans consider lack of funding to be the most important constraint to starting a business (ONE 2015a), and only 1.9 percent of the firms that engaged in an innovation project used government support to finance their project (INEGI 2014). High demand for funding is evident; during the first trimester of 2016, INADEM funded only about 5 percent of all those who applied for funding (14 percent of the total amount requested) (SE 2016). Moreover, only 19 percent of entrepreneurs³⁵ received funding, from which the main sources were private banking (33%) and friends and family (24%), while only 4.1 percent came from public funding (INEGI 2014).

1. Private Capital

Traditional capital is risk averse. Mexican private banks are reticent to fund entrepreneurial and innovation projects owing to its higher risk nature. Although 71 percent of private established businesses receive private funding, only 57 percent of entrepreneurs get such funding (ONE 2015a).

Large Mexican investors prefer to invest in traditional sectors rather than in start-ups (HBR 2014b). Venture capital is a young market in Mexico and fund managers do not have an established successful reputation for their investment decisions, which generates uncertainty among investors (Serebrisky 2015). As a result, the lack of investors' confidence discourages more experienced talent in Mexico from working in a young venture capital industry where income is uncertain (Harvard Business Review 2012).

Private funding is limited and concentrated. Venture capital still struggles to have a competitive market. Many government programs invest directly in enterprises, creating enormous competition for the few private funds that are available and dependence on public resources (Serebrisky 2015). Also, private capital is limited to certain regions of Mexico. In 2011, 75 percent of private capital investments were concentrated in three Mexican states: Mexico City, Jalisco and Nuevo León (IMCO 2014). Finally, terms offered by venture capitalists are not beneficial for entrepreneurs, as the chief executive officer of Bitso has expressed: "I tried to get Mexican venture capital, but could not. Local investors were giving me bad terms. I went to Silicon Valley and received funding and much better terms. The moment locals saw I had U.S. money, they became interested in Bitso and offered me exactly the same terms that I got in the United States."

Little investment has been made in R&D. From 2010 to 2013, only 14 percent of firms initiated innovation projects and only 16 percent invested in R&D (INEGI 2014). Among those that did engage in innovation projects and/or R&D activities in Mexico, investment is quite limited, on average US\$250,000 annually per firm (INEGI 2014). In countries like South Korea, 80 percent of R&D investment comes from the private sector; in Mexico the percentage is 36 percent (OECD 2014b).³⁶

Entrepreneurs and business owners lack information about how to secure capital. The existence of private capital is not widely known by entrepreneurs and business owners in Mexico. When surveyed, only 53 percent knew that private capital could be a source for funding

business growth, and only 3 percent understood how venture works. Information is difficult to spread because entrepreneurs find the language and concepts of venture capital difficult to understand and generally have not mastered the necessary financial and legal skills (see chapter 2), but also because venture capital funding sources are not compiled in a single directory (AMEXCAP, INADEM, CIEE, & EY 2015).

2. Public Capital

Public capital does not follow the logic of innovation. INADEM, CONACYT, and most government institutions adjust their programs, contests, and public calls to the federal government's fiscal calendar, a calendar that does not necessarily respond to the needs of entrepreneurs and innovation projects. Public funds are required to be delivered and spent during the same fiscal year, a practice that many longer-term innovation projects find impossible to fulfill. Taxes are also an issue because, as Alberto Saracho, director of C230 Consulting has explained, "the Mexican government monthly collects a 16 percent value added tax [VAT]. VAT is refunded to firms without positive balances but only a year after, and with much restrictions. This represents a cost of operation of 16 percent during the difficult first year of operations of any new entrepreneurial project." Moreover, government agencies constantly adjust their priorities depending on electoral calendars or other unknown considerations. During the past few years, for example, many INADEM funding programs have appeared and disappeared in matter of weeks, creating confusion and uncertainty among entrepreneurs (IMCO 2014).

Public funding for innovation is fractured and infested with "coyotes."

In 2016, close to US\$776.5 million³⁷ was assigned as part of Mexico's federal budget to promote entrepreneurship and innovation (SHCP 2016).³⁸ In spite of this designated amount, entrepreneurs generally think that there are not enough financial instruments to create high-tech and innovative start-ups, and complain that support for engineering and other sciences is quite low (GEM 2015). This discrepancy of opinion can be partially explained by the fracture of government funding. At the federal level, at least seven programs³⁹ fund and promote innovation, and there are many more at the state-level. Fracture inhibits coordination, prevents economies of scale from being created, and complicates access to public

funding. Indeed, 70 percent of entrepreneurs find the rules of government programs difficult to understand, and only 7 percent say that articulation between programs is efficient and 3 percent say that programs fulfill entrepreneurs' necessities (IMCO 2014). Obtaining information about how all government programs work is so complicated for inexperienced entrepreneurs that they end up making use of middlemen or "coyotes" to apply for public funding. "Coyotes" charge a share of the public funding obtained by entrepreneurs in exchange for application consulting. This extra charge not only reduces up to 30 percent of the funding directly benefiting the entrepreneur, but also inflates the size of the projects—coyotes have incentives to ask for larger pools of money. Many government programs may also be inefficiently distorting private funding markets and creating dependence on public resources.

Public funding is focused on quantity, not quality. INADEM is evaluated according to how many firms, projects, and funds it creates, not according to the efficiency or productivity of these projects. This feeds a perverse incentive to fund more projects rather than to fund smart one, ignoring investment quality. INADEM does not have a method to verify if the information given by funding applicants is truthful, to systematically follow up on achievements, or to avoid crowding out private funding. Many programs even fund firms directly, distorting private funding markets and creating dependence on public resources, particularly because public institutions do not require entrepreneurs to pay back a sunk cost (*fondo perdido*).⁴⁰ From the entire budget assigned to micro, small, and medium enterprises, and entrepreneurship in 2013, 31 percent went to sunk cost funding (ONE 2015a). Furthermore, some government programs designed to fund small and medium enterprises do not have clear exit mechanisms, and so the new or growing established enterprises are left dependent on public funds (IMCO 2014).

Public funding is characterized by insufficient investment in R&D.

In 2015, Mexico invested only 0.53 percent of GDP in R&D, while more advanced economies like Japan and South Korea invest 3.6 percent and 4.2 percent respectively (OECD 2015a). Moreover, gross expenditure in R&D has increased only 1.1 percent on average in the past 10 years, maintaining levels far below OECD average expenditure (OECD 2015a). Additionally, there has been less funding to promote science, technology

and innovation at the state and municipal levels. The number of projects funded by CONACYT mixed funds went from 741 in 2009, to 100 in 2015 (CONACYT 2016d). Low state-level tax collection is partially behind this trend because mixed funds require co-investment by federal and local government (Urbina 2016).

3. Mixed Funding

There are no innovation public-private partnerships. Even if public-private partnerships have been legally permitted since 2012, they have never been used for innovation purposes (Urbina 2016). This could be related to the fact that CONACYT does not have a specialized structure that promotes public-private partnerships as a mechanism to carry out large-scale innovation projects. Instead, other less suitable legal schemes for the association between the public and private sector—such as trusts, public-private enterprises, and the Law of Public Works (Ley de Obras Públicas), all of which have fewer benefits—are commonly used (Ethos 2015). Trusts offer the flexibility for resources to be managed in multiannual schemes and involve low bureaucratic burden, but they do not require legal elements that guarantee the best economic and social return. Public-private enterprises allow the government to resolve economic and social issues with the participation of the private sector in investment and decision-making, but the government itself remains the majority shareholder. The Law of Public Works is a useful scheme to develop long-term infrastructure projects as it allows for multiannual planning, and the government can choose private partners strategically. However, multiannual planning resources do not have the same guarantees as public-private partnerships and the public sector undertakes the majority of the project's risks (Ethos 2015).

Recommendations

Course of Action # 9: Encourage corporate venture.

Big Mexican companies and corporations must become relevant agents in funding technology and knowledge development.

World-recognized Mexican companies could promote innovation through the creation of a venture capital arm dedicated to fund high-tech and knowledge applications. CONACYT, INADEM and other public research institutions could help find promising start-ups whose operations connect with their needs. The Mexican government could then act not as a funder or co-financer of these “corporate venture” endeavors, but rather as a convener, the participant that links big corporations with agents doing advanced research in order to identify and exploit synergies. Corporate venture has an advantage over regular venture capital because corporations know markets and technologies in detail, and thus can be strategic. This will require a shift in the culture of corporations to stop the focus on short-term rewards for long-term objectives.

Box 9. BBVA Corporate Venture – United States and Europe

BBVA's corporate venture arm is a successful example of corporate venture. In 2013, BBVA launched a \$100 million venture fund, focused on the United States, to make strategic investments and acquisitions to add new offerings and capabilities faster and easier than the bank could accomplish by their own.

BBVA has used its venture capital arm to engage in a digital innovation for traditional banking (BBVA 2014). For example, the acquisition in 2014 of Simple, an online banking platform, expanded BBVA's U.S. presence by adding an innovative mobile money management application for their clients. Simple's mobile app allowed users to know their monthly expenses, design monthly expenditure plans, and establish savings goals. BBVA operates Simple as a separate subsidiary with the same management team, since a traditional bank cannot easily follow the entrepreneurial culture of a start-up (Groenfeldt 2016).

In 2015, BBVA increased its financial technology fund to \$250 million and announced a partnership with Propel Venture Partner (Propel). BBVA will invest its corporate venture funds in Propel's funds as a limited partner

and Propel will manage the investment independently and will continue to invest in digital financial services start-ups. This was a response to the fact that some start-ups were reluctant to work with a corporate venture fund as they expressed fears that they would not be a priority for the big corporation (BBVA 2016).

BBVA also has successfully engaged in on-demand acquisition of innovation. By organizing contests for high-tech innovation, the bank has invited developers to create mobile apps based on anonymous card transaction data. Prizes have gone to many developers' apps, including Qkly, which helps users plan their time by estimating when a place will be crowded. Another competition by BBVA and Google awarded prizes for apps that tackle problems experienced by small businesses in BBVA banks in Madrid. Winners were given a cash prize and several were hired by BBVA (Groenfeldt 2016).

Course of Action #10: Use Mexico's FdF to generate innovation that will have a larger social impact.

Fondo de Fondos (FdF), or Fund of Funds, is a company created by the Mexican government in 2006 to perform private equity investment. Its goal is promoting the culture of private equity and venture capital in Mexico in the areas of attention specified by the Mexican government, and stimulating changes in the legal frameworks that are appropriate for this purpose. Its original capital comes from combining isolated private equity commitments made by Mexican Public Bank institutions (NAFIN, Focir, Banobras, and Bancomext) totaling US\$134 million. Currently, FdF manages commitments of more than US\$900 million (around 50 percent comes from other institutional investors).

Mexico's FdF could be more aggressive and ambitious in promoting innovation with social impact and more focused on job development. At present, its economic impact has been somewhat limited. In 10 years, FdF has supported 528 Mexican firms, creating only 90,000 direct jobs and 195,000 indirect jobs. For an initial investment of US\$134 million dollars a decade ago, this means the creation of only 9,000 direct jobs per year. FdF should be more explicit in investing in companies and technologies that create more and better jobs, and set more ambitious and targeted goals

to contribute to the social objectives of the Mexican state—avoiding, for example, financing industries whose gains come more from capital than from job creation. FdF should also design a public strategy to return its original capital to the Mexican state. The financial success of FdF seems to be secure now that it manages commitments five times its original size. Returning its original capital to Mexico’s Public Banking would allow the Mexican government to attempt to replicate the success of FdF with other funds and promote competition in venture capital markets.

Box 10. Acumen – United States

Acumen is an organization that has been successful in using venture capital to help alleviate poverty through investment in social-oriented companies dedicated to solving issues related to agriculture, education, energy, financial inclusion, health, housing, water, and workforce development. It operates by raising funds to invest in companies, leaders, and ideas that are changing the way the world tackles poverty (Acumen 2016a).⁴¹ It has invested US\$8.4 million in 10 companies, generating an impact on 2.1 million people.

One of Acumen’s identified areas of impact is access to safe water. In India, this is an extremely worrying issue, as 170 million people lack access to clean drinking water. Also, diseases related to unsafe water consumption cost US\$600 million in production losses and medical treatment every year. Acumen created the WaterHealth International (WHI) program to provide scalable, safe, and affordable water solutions through an innovative business model in India. As of now, Acumen’s total investment in WHI totals US\$4.3 million.

WHI uses cost-effective technology designed for the poor to help water marketing and distribution. To achieve this, WHI develops and runs WaterHealth Centers, sustainable water purification plants that provide access to safe, affordable, pure drinking water. It maintains a centralized real-time monitoring and quality control system to guarantee an immediate response to any system or water quality issues. WHI also educates rural communities on the importance of safe drinking water through its “Dr. Water” brand and marketing. The company now also operates in other Asian countries and in Africa.

As a result of India's WHI, clean water is now sold to Indian consumers for less than US\$0.01 per liter, and in some areas delivery is available. WHI has 500 water systems with over 500,000 low-income individuals who purchase safe water on a regular basis. Furthermore, WHI has become a catalyst for an entire sector of enterprises that deliver clean water in India. Community water providers have established approximately 700 systems serving another 500,000 people. (Acumen 2016b)

Course of Action #11: Redesign public funding to respond to innovation necessities.

Funders should not be tied to the government's fiscal year, should provide better information and indicators of results, and should pay more attention to avoid crowding out funding.

Mexico's Ministry of Finance (Secretaría de Hacienda y Crédito Público; SHCP) should design a strategy to allow multiyear innovation programs that are not constrained by the government's fiscal year. Innovation is a risky investment with long-term horizons; thus, programs to promote innovation require specialized government officials, methodologies, and instruments (Kessler & Saracho Martínez 2006).

Most critically, SHCP must demand more ambitious and innovate indicators to measure the results of INADEM and CONACYT. Indicators of the Matrix of Indicators for Results (MIR) and Mexico's Innovation Development Plan (Programa de Desarrollo Innovador; PRODEINN) are generating perverse incentives that favor quantity over quality investment and ultimately inhibit innovation. INADEM should consider focusing on supporting fewer entrepreneurs with better quality and results. For example, a mechanism to verify that the information provided by entrepreneurs in their application is truthful would require significant resources but may well be worth it if the quality of entrepreneurial funding increases. Moreover, there are no national or local metrics to identify the extension, benefits, and challenges of a particular innovation, and how those have changed over time as a result of government policies. Instead, government programs are evaluated independently, without considering the innovation ecosystem as a whole. Some efforts are being developed

now. In 2016, Mexico’s economic ministry made a tender to create a regional-level entrepreneurship observatory called the Observatorio Regional PYME. This observatory tries to resemble Mexico’s National Entrepreneurship Observatory (Observatorio Nacional del Emprendedor; ONE), which works to compile information and statistics regarding the four pillars of the entrepreneur ecosystem (SE 2016). However, not much is known about this project or the scale of it. Currently, there is one Observatorio Regional Pyme operating. It is called Alianza del Pacifico and comprises Chile, Colombia, Peru and Mexico. Its main objective is to exchange information relevant for entrepreneurs and enhance cooperation between these countries (Alianza del Pacifico 2017).

Table 2 shows how the Mexican government currently measures impact in its programs to promote innovation and entrepreneurship, and presents concrete proposals for how these indicators could be changed.

Table 2: Current Government Performance Indicators to Evaluate Public Programs that could be modified

Indicator	Program	Comments
Percentage of funds granted with respect to funds requested	PEI, FINNOVA	Creates incentives to grant more funding just to achieve established goals. Instead, the indicator should measure the program’s ability to fund better proposals, meaning those with the largest social impact.

Expenditure in scientific research and experimental development executed by higher education institutions as a percentage of GDP ⁴²	PEI, FINNOVA	The indicator should not measure all expenditure by higher education institutions, since expenditure can be affected by other factors besides these programs. Instead, the indicator should measure the amount of resources dedicated to R&D in participating higher education institutions compared with that of nonparticipating higher education institutions.
Sum of new investment vehicles in relation with previously existing investment vehicles	FNE	Since size is not considered, this evaluation creates incentives to form many small investment vehicles just to achieve goals. Instead, the indicator should measure the number of successful investments made by seed capital and venture capital funds where INADEM co-invested. Such indicator would better reveal INADEM's ability to select capable and productive private capital funds. ⁴³
Percentage of government funded micro, small, and medium enterprises that innovated in order to produce new products.	FNE	The indicator should not measure the number of micro, small, and medium enterprises but rather should measure the resources granted to them; it must also indicate whether the new product was commercialized.
Changes in supported micro, small, and medium enterprises' total factor productivity	FNE	A previous indicator (percentage of supported micro, small, and medium enterprises that increased their productivity in relation to all the supported enterprises) seemed to be a better target, yet it was changed in 2014.

Source: *Transparencia Presupuestaria 2016*.

In terms of tax schemes, the government could also consider VAT refunds to be made monthly, rather than yearly, to provide of an additional 16 percent capital to innovation-driven entrepreneurs (Saracho 2016). This may be cumbersome. Other alternatives, like not retaining VAT at all, could also be considered.

The government should be careful to not crowd out private funding by directly investing in enterprises. Instead, they should work together with private funds to increase the supply of private capital, especially venture and seed capital. The government can help enhance the market of private capital by creating a website where all credit information is in a single place for entrepreneurs, by collecting information about all investments carried out to increase the sector's efficiency and trustworthiness, and by generating information to create indicators to measure the effects of venture capital funds in terms of the number of jobs generated, wages, patents, and revenues (AMEXCAP, INADEM, CIEE, & EY 2015).

Finally, the government must simplify processes and gather public and private capital information into a single network for better diffusion, transparency, and evaluation in order to effectively reduce the demand for "coyotes." Better program planning, such as extending periods of calls for funding, will allow firms and entrepreneurs to have enough time to conduct all necessary procedures to apply without third-party help. INADEM has made great advances in conglomerating information, but it seems that a simpler platform is still required. A strategy to monitor middleman companies (coyotes) that help entrepreneurs access resources should be also created, with clear penalties to those who inflate the prices of their proposals.

Box 11. ARPA-E – United States

A great example of government funding that encourages innovation is the Advanced Research Projects Agency–Energy, or ARPA-E. Its goal is to promote and finance the R&D of advanced energy technologies that otherwise might not be pursued due to their high failure risk (ARPA-E 2016).

To receive funding from ARPA-E, projects are required to have potential for transformational technological innovation and a clear path from technological research to commercialization, but be too high-risk or in too early of a stage of development to secure private funding. Selected projects must also prove that they will have an impact on improving energy efficiency, reducing dependence on energy imports, or reducing harmful energy emissions, and that they do not duplicate the work of other federal agencies (ARPA-E 2016).

From 2009 to the end of 2015, ARPA-E has invested US\$1.3 billion in 475 energy technology projects, from which 36 have become private companies and 60 have partnered with other government agencies for further development. Commercialized products include a one-megawatt silicon carbide transistor the size of a fingernail and a near-isothermal compressed air energy storage system.

Course of Action #12: Develop public-private partnerships for innovation.

Develop specialized institutions to design and execute public-private partnerships for innovation.

Public-private partnerships will protect innovation developments from crises in public finances (Ethos 2015). Rather than fully relying on subsidies, public-private partnerships will set a minimum floor for risks assigned to the public and private sector (Kessler & Saracho Martínez 2006). Furthermore, public-private partnerships where private agents assume all risks related to failure will ensure better control of the use of resources (Ethos 2015).

Box 12. Hollings Manufacturing Extension Partnership – United States

An example of a high-impact public-private partnership is Hollings Manufacturing Extension Partnership (MEP). It was created in 1988 with the goal of enhancing productivity and technological performance of U.S. manufacturing. MEP is a public-private partnership dedicated to supporting small and medium-size manufacturers (NIST 2016).

MEP's foundation is built on its ability to create centers where information for manufacturers can be disseminated. In these centers, manufacturers can connect with government agencies, trade associations, universities, research laboratories, and state and federal initiatives. Also, manufacturers are provided with technical advisors to help them grow and reduce costs (NIST 2016). The key strategies followed by MEP are (1) to have at least one center in every state; (2) to promote flexible federal, state, and municipal alliances; (3) to provide a clear cost distribution policy for all agents involved; and (4) to design programs focused on addressing market necessities (Ethos 2015). Also, MEP is designed to be a cost-share program. The U.S. government pays one-third to create the center and the rest is obtained with client fees. Federal funding is offered on a competitive basis to nonprofit, state, or local organizations that want to develop and manage the centers.

Since its foundation through the end of 2015, MEP has greatly contributed to the development of the U.S. manufacturing sector. MEP has worked with 86,620 manufacturers to generate US\$96 billion in sales and save US\$15.7 billion in costs. Furthermore, MEP has contributed to creating and retaining more than 797,994 jobs (NIST 2016).

Course of Action #13: Create progressive tax incentives to promote innovation.

Tax exceptions targeted to small firms or social bonds could complement government programs for innovation.

Before 2012, Mexico used to provide tax exemptions to promote innovation. With the tax exemption program (Programa de Estímulos Fiscales a la Innovación), 30 percent of the resources spent by a firm in R&D were granted as fiscal credit. The program was directed at firms that were registered as a scientific and technological enterprise (RENIECYT) and paid taxes. The tax exemption program was ended in 2009 for being regressive. About 75 percent of the resources were given to large companies, which were better positioned to make large investments in R&D than small and young enterprises (Calderón 2009). The program was first replaced with the Fund of Technological Innovation (FIT) and then with PEI, both designed to give direct economic resources to firms that engage in innovation projects.

The impacts of programs like PEI are clearly more focused and smart than simple tax exemptions but that does not mean that programs should be the only mechanism to promote innovation. Global trends show the opposite. Overall tax support in OECD countries for innovation purposes has increased in the past decade, and only Mexico⁴⁴ and New Zealand have abolished their tax exemption schemes (OECD 2014a).

To avoid the negative results of previous tax incentives, better-designed strategies that include business size differentiation and transparency may help successfully promote innovation. Some other tools to consider are volume-based R&D tax credits applied to expenditure and offered to small and medium enterprises across sectors (European Commission 2014). Mexico could also promote the use of innovative financial instruments such as social impact bonds (Bonos de Impacto Social) to achieve social impact.

Box 13. Efficient Risk Distribution between Private and Public Sector – United Kingdom

The United Kingdom is a strong example of a country where the public and private sectors have worked together and distributed risks efficiently with a scheme of tax exemptions. The Enterprise Investment Scheme (EIS), launched in 1994, was created to help small and risky enterprises receive funding. The program gives angel investors the opportunity to become the first financing fund for a micro or small (up to 50 employees) enterprise, and a 30 percent tax exemption if they invest more than £500,000 and acquire a share of the funded firm. The government makes a co-investment of the same amount made by angel investors, and angel investors commit to keep their shares for at least three years. When surveyed, 53 percent of angel investors said that if they had not had the tax exemption, they would have reduced their investments by 24 percent (UK Business Angels Association 2016).

Since 1994, 22,900 companies have received investment with EIS, and over £12.2 billion has been raised. The tech sector represents the highest proportion for businesses using EIS, with more than 650 companies using the scheme in 2015 (Committed Capital 2016).

A successful tech company that has benefited from the EIS scheme is Intamac. It is Europe's largest provider of Internet of Things technology. Internet of Things connects devices such as fire alarms, boilers, thermostats, and washing machines so that they can be monitored, controlled, and accessed remotely through apps. Since 2002, Intamac has been part of the EIS, which helped it find its first and long-term investors (Great Business 2016).



5

From Inefficient to Effective Government

Government creates the conditions for entrepreneurs to operate and for innovation to emerge.

Factors such as the quality of regulations, the certainty of intellectual property rights, the elimination of corruption, and the strengthening of rule of law, affect the productivity of firms and researchers and ultimately inhibit or promote innovation.

Advances

Mexico's government has made improvements in creating a regulation framework that is more fertile for innovation and more capable of fighting corruption, as well as in creating a more transparent government.

Mexico's regulatory environment is currently the best in Latin America. It is 47th out of 190 economies in the Doing Business Index,⁴⁵ a well-recognized measure of the effectiveness and enforcement of business regulations (Doing Business 2016c). In 2016, Mexico moved down two places from 45th in 2015. Yet, overall, Mexico has improved its regulatory environment solidly over the years. In 2011, it introduced an online one-stop shop for initiating business registration. In 2012, it secured transactions by implementing a centralized collateral registry with an electronic database that is accessible online. In 2013, it eliminated the minimum capital requirement for limited liability companies, making it easier to open a business. In 2014, it created small claims courts, with oral



proceedings, to hear civil and commercial cases faster and more efficiently (Doing Business 2014).

The Mexican Institute of Intellectual Property Protection (Instituto Mexicano de Protección a la Propiedad Intelectual; IMPI), has implemented several procedures to strengthen intellectual property rights. In 2016, efforts aimed at protecting intellectual property resulted in 3,437 applications for administrative declarations of invalidity, expiration, revocation, cancellation of intellectual property rights, and copyright infringement, which were responded to within the established response time (1.5 months). Moreover, IMPI makes inspection visits to check for alleged intellectual property infringements and piracy. In 2016, there were 4,527 inspections, of which 36 percent resulted from piracy complaints, and a total of 2.4 million products were seized (IMPI 2017b). IMPI also has a mailbox on its webpage where individuals can report piracy, and it has 25 observers in customs offices to detect and deter importation of goods that may infringe on intellectual property rights (IMPI 2016a).

The Mexican government has also become more transparent. According to the World Justice Project's Rule of Law Index,⁴⁶ a measure of how rule of law is enforced in 113 countries, Mexico is positioned among the top 50 countries with respect to open government. Yet apart from open government or transparency, there is no other feature among the eight pillars of the Rule of Law Index in which Mexico ranks in the top 50 of the sample.

Important advances have also been made in terms of fighting corruption with the recent approval of Mexico's anticorruption reform. The reform provides the necessary tools to sanction and punish corruption at all government levels, gives auditing institutions autonomy to investigate, and provides civil society with critical positions inside and outside the government to be able to overview and take part in anticorruption institutions (Rios 2016a).

Remaining Problems

In spite of these advances, Mexico's government still has much opportunity to improve.

Excessive and cumbersome red tape still restricts innovation. The cost of starting a business as a percentage of per capita income in Mexico is six times higher than the OECD average. According to the Doing Business Index, Mexico ranks fairly low (93rd out of 190 countries) in terms of how easy it is to open a business. This is because, among many other issues,⁴⁷ it takes an average of 8 procedures to open a business in Mexico;⁴⁸ this is 3.2 more procedures than in high-income countries in the OECD and 0.3 less than the Latin American Average (Doing Business 2016a). Mexico is positioned among the worst countries in terms of how difficult it is to pay taxes (114th out of 190 countries) (Doing Business 2016b). A Mexican firm spends an average of 286 hours paying taxes, while the average for OECD countries is only 163 hours (57 percent lower) (Doing Business 2016c). Entrepreneurs report spending 30 percent of their income on lawyers and accountants just to deal with tax regulation during the first two years in business (IMCO 2014).

Uncertain property rights affect business rankings. Mexico ranks 116th out of 138 countries in the Institutions pillar of the Global Competitiveness Ranking.⁴⁹ Its low score in terms of property rights can explain this ranking, especially when focusing on intellectual property rights. Mexico scored 4.2 out of 7 points in terms of intellectual property rights protection. Switzerland, the highest-ranked country in property rights, scored 6.5 of 7 points. Among Latin American countries, the highest-ranked country in property rights (35th), Uruguay, scored 4.8 of 7 points (WEF 2016b).

Absence of the rule of law harms perceptions of Mexico's business environment. Mexico still has a weak rule of law. It occupies the 88th position out of 113 countries in the World Justice Project's Rule of Law Index 2016. Among the Latin American and Caribbean countries, Mexico⁵⁰ is ranked 25th out of 30 countries. Particularly worrisome are factors such as civil justice (101st of 113) and criminal justice (108th of 113), in which Mexico ranks in the bottom 15 percent of the world.

Corruption continues to be a critical issue. There are many measures that show that one of the most important problems of Mexico's government is corruption. Mexico is 95th out of 167 countries in the Corruption Perceptions Index,⁵¹ a measure based on expert opinions about the perceived levels of public sector corruption. This leaves Mexico in the 15th position out of 24 countries in Latin America (Transparency International 2016). Also, in the Rule of Law Index, Mexico is ranked in the bottom 20 percent in terms of absence of corruption (99th of 113 countries), with the worst scores in legislative corruption (22/100 points) and police/military corruption (32/100 points) (WJP 2016). Finally, considering measures in the 2016–17 Global Competitiveness Index, Mexico is 103rd out of 138 countries in terms of irregular payments and bribes, and 124th place in favoritism in decisions of government officials (WEF 2016a).

Corruption is unacceptably common in Mexico. On average, 7.4 percent of micro, small, and medium enterprises encounter corruption while interacting with key government institutions for entrepreneurial activity. Specifically, the highest percentage of corruption encounters are with the fiscal agent (Servicio de Administración Tributaria; SAT) (10%) and with the Ministry of the Economy (9.3%). Corruption encounters with other

agencies like INADEM and CONACYT report percentages of 6.5 percent and 5.8 percent, respectively (ONE 2015a). Moreover, Mexicans are aware of the presence of corruption in INADEM and the harm it represents for entrepreneurship. As Christopher Wilson from the Wilson Center has expressed, “in face of these issues [corruption accusations] there is no option but reform [INADEM] or kill it. Entrepreneurship is too important to be killed. To abandon entrepreneurship and innovation would be abandoning the future of the Mexican economy” (La Jornada 2016).

As a result, the costs of corruption are huge. Worldwide, businessmen identify corruption as the most problematic factor for doing business (WEF 2016b). Among Mexican adults, 50.9 percent believe that corruption is the most important problem faced by their state, second only to crime (66.4%), and 88.1 percent believe that corruption is either very frequent (48.9%) or frequent (39.9%). Furthermore, if considering only Mexican adults that have had contact with authorities in the last year, 12.5 percent reported that they experienced at least one act of corruption (ENCIG 2015).

By far, the most worrisome issue about corruption costs is that it most deeply impacts the most vulnerable, making it a form of regressive tax. About 14 percent of household income is used for informal payments, which amounts to 33 percent of the total annual income of households that live on a minimum wage (MCCI 2016). Corruption affects new and small businesses the most, because they do not have the money to cover the associated costs (IMCO 2014). In fact, while only 30 percent of large companies perceive that corruption is an obstacle for business, those figures increase to 33 percent and 35 percent when surveying medium and small firms, respectively (ONE 2015a).

Even in INADEM, mishandling of procedures and resources is common. According to Mexico’s Supreme Audit Institution (Auditoría Superior de la Federación; ASF), only 0.3 percent of all grant applications that INADEM received were reviewed, and no clear reasons were given as to why INADEM selected some and not others. Furthermore, ASF reports that among those applications that were reviewed, 98 percent missed at least one of the application requirements (ASF 2014). Furthermore,

INADEM funded 14 percent more projects than the total projects that were approved for their technical, financial, and business viability. Finally, even though INADEM reported that 24,549 projects received support, ASF declared that with the available information it would be impossible to determine the total number of projects that were given a monetary subsidy (ASF 2014).⁵²

Recommendations

Course of Action #14: Reduce cumbersome red tape and costs required to open a business.

According to the Doing Business Index 2017, the fastest way to reduce the costs for doing business would be to find a way to reduce the need for third-party professional services (such as the “coyotes” mentioned in chapter 4) to open a business. The need to involve third-party professionals adds bureaucratic burden and imposes a cost that may inhibit entrepreneurship. Worldwide, third-party involvement accounts for most of the costs of starting a business and can drive entrepreneurs to choose to operate in the informal sector (Doing Business 2016a). Specific areas of attention should include promoting public brokers (which cost 26 percent less than attesting officials) or making the use of attesting officials optional,⁵³ reducing the registration fee for the Public Registry of Commerce,⁵⁴ and eliminating operating licenses for low-impact business lines or substituting them with a notice on commencement (Doing Business 2016a).

Creating smarter regulation in Mexico is possible, as the variance between Mexican states proves. In Quintana Roo, one of the worst states for doing business, it takes one more procedure and 34.5 more days to open a business than in Aguascalientes, the best state for doing business in Mexico. The main difference between these states is in the process required to register a business, depending on whether attesting officials register the firm and process the operating license online or in person (Doing Business 2016a).

Box 14. Easier Business Practices – Chile

Since 2013, entrepreneurs in Chile are able to register limited liability companies through an electronic, unified company registry that is accessible from anywhere, free of charge. This online company registry has made the incorporation process faster and more convenient, eliminating the presence of intermediate agents such as notaries in the registry process. This change also reduced the time it takes to have company statutes registered by notaries from two days to one day. Starting a new business in Chile now takes only 5.5 days, 24 days less than the Latin American and Caribbean average and 3 days less than the OECD average (Doing Business 2016a).

As a result of this change, by the end of 2015, 138,880 firms have been created through the online system, which means an average of 140 per day. The majority of entrepreneurs that use the system are young; 41.5 percent of the owners are between 25 and 35 years old. Furthermore, 80.8 percent of the firms registered in the online system initiated activities, from which 40 percent generated income in the following month after the registration and after a year 90 percent had generated income. Regarding the size of firms registered in the online system, 73 percent are micro, 16 percent small, 0.4 percent medium, and 0.1 percent large (IIS 2016).

Course of Action #15: Fight corruption by reducing discretionary processes.

Requiring licensing, certificates, or permits to open a business creates conditions for bribery. Accelerating procedures, designing transparent processes, and exhibiting required time periods for each procedure can eliminate an environment that fosters corruption. In fact, the procedures where most micro, small, and medium enterprises report encountering corruption are licensing, municipality permits, land-use permits, and water and electricity sourcing (ONE 2015a). Since 63 percent of Mexican business considers that corruption is just “business as usual” in Mexico (Harvard Business

Review 2014b), tackling corruption would signify larger savings and profits for firms (Kaiser and Rios 2016).

Procedures that require approval of a public agent and that can become online procedures should be offered in a single webpage with free access. This change could significantly decrease the chances for public servants to be corrupt. Furthermore, transparency must be assured in all stages of the bidding procedure. Before selection, information about the total number of applications received, the total budget assigned to the notice, the number of grants to be given, and the exact time that the selection process will take must be provided. After the selection process, feedback must be provided to all denied applications, along with a period to appeal selection decisions (ONE 2015a).

Box 15. Independent Commission against Corruption – Hong Kong

A successful case of a government institution that reduced corruption is the Independent Commission against Corruption (ICAC). It was created in the 1970s to fight all forms of corruption. It emerged because the government was under increased social pressure as corruption was immersed in every aspect of daily life, including in hospitals, firefighters, transit, and the police (IMCO 2015). Since its creation, ICAC's main goals have been centered on investigating, preventing, and educating about corruption, with three specific departments fulfilling each of these objectives.

There are three clear factors in each of these goals that converted ICAC into one of the most successful institutions against corruption. First, government determination and support became the key element to investigate corruption. Hong Kong's government acknowledged that the fight against corruption was essential to foster economic prosperity and competitiveness. To support this, the government provided the ICAC with the necessary financial and human resources to ensure its independence and qualification. Second, strong legislation became the key factor to

sanction and prevent corruption. ICAC investigators are given the ability to examine bank accounts and business documents. Also, ICAC officers are given powers similar to the police to arrest without a warrant any person suspected of committing corruption. Third, the ICAC developed a strategy to create awareness about corruption. In addition to using the mass media, the ICAC developed specific programs for targeted sectors of the community like youth and businesspeople. The general approval of Hong Kong society has been vital for its success (ICAC 2016).

Thanks to the work of ICAC, Hong Kong is now ranked as one of the 20 least corrupt countries in the world (Transparency International 2016). Also, the United Nations and other international agencies frequently recommend ICAC as a model to fight against corruption (IMCO 2015).

Conclusion

Innovation and entrepreneurship are critical to advancing competitiveness and productivity in today's world. Although Mexico has seen significant investment in recent decades in manufacturing capacity and transportation infrastructure, it still lags in building an ecosystem that will support innovative behavior and the entrepreneurial spirit. It is clear that much work has yet to be done before Mexico can see the flourishing of an innovation ecosystem that encourages a culture of R&D, start-ups, and creative thinking. Some of the challenges are specific to the area of innovation: funding, infrastructure, community, and innovation-friendly public policy. Other issues are common to Mexico's overall development story, such as corruption, red tape, and the rule of law.

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Endnotes

- 1 Early-stage entrepreneurial activity is the percentage of the working-age population that is about to start an entrepreneurial activity or that has started one within the past three-and-a-half years (GEM 2014).
- 2 The GII is a measure of innovation capacity co-published by Cornell University, INSEAD (the European Institute of Business Administration), and the World Intellectual Property Organization. The index quantifies many aspects related to innovation to rank countries’ innovation competences and results. The GII 2017 is the tenth edition of this measure and includes 127 countries, which represents 92.5 percent of the world’s population and 97.6 percent of the world’s gross domestic product. In 2017, Switzerland was ranked first while Yemen was ranked last; considering only Latin American countries, Chile was ranked highest (46th) and Bolivia was lowest.
- 3 In 2016, Mexico was ranked 61st, and in 2017 it increased three positions because of its strength in graduates in science and engineering (19th). Mexico’s weaknesses are tertiary inbound mobility (99th) and PISA scales in reading, math, and science (GII 2017).
- 4 Switzerland was ranked first in the world for all years. Among Latin American countries, Chile was ranked highest in all years, except for Costa Rica in 2013.
- 5 Positive values refer to a better ranking, while negative values refer to a lower ranking.
- 6 On the innovation input subindex, Singapore was ranked first while Yemen was ranked last; for Latin American countries only, Chile was ranked highest (402nd) and Bolivia lowest (107th). On the output innovation subindex, Switzerland was ranked first while Togo was ranked last; for Latin American countries only, Costa Rica was ranked highest (50th) and El Salvador lowest (105th) (GII 2017).

- 7 To achieve this goal, the government has promoted the FullTime Schools Program, which was supposed to be implemented by 2018 (OECD 2015b) but whose funding was reduced by 12 percent in 2017 (SHCP 2016b).
- 8 Rates of growth refer to Sector 51, “Massive Media Information,” in Mexico’s economic census; 90 percent of this sector is composed of the telecommunications sector (IFT 2016).
- 9 Public spending on education (primary to tertiary education) as percentage of GDP is 5.2 percent; the OECD mean is 5.2 percent as well (OECD 2015c).
- 10 The top five best-paid degrees, in order, are chemists; transportation; physics; mining; finances, banking and insurance. The top five university degrees by enrollment are business administration, metallurgical and mechanical engineering, law, accounting, and psychology (IMCO 2017).
- 11 SEP remarks that this document is still a proposal. The final model to be implemented will be complemented with the results gathered from the Consulta del Nuevo Modelo Educativo (New Educational Model discussion forums), which ended in September 2015. (Interview with Otto Granados, SEP undersecretary of planning, assessment, and coordination.)
- 12 This national plan will gradually incorporate English courses into preschool and primary education and to middle-school courses with English teaching international standards. Results will be measured in terms of national coverage, not quality (Coneval 2014). The program is a step forward in terms of curriculum development (Mexicanos Primero 2015); however, according to Otto Granados, the SEP undersecretary of planning assessment and coordination, SEP considers the lack of English teachers as one of its main obstacles.
- 13 People who speak a second language since early ages create better connections between neurons and cerebral hemispheres (Cook 2012).
- 14 According to Guadalupe Itzel Villa Salinas, INADEM’s director of high-impact entrepreneurship, INADEM has a program called Retos INADEM, in which members of the public or private sectors suggest specific problems to the entrepreneurial community.
- 15 Each year, the Wilson Center’s Mexico Institute hosts its High-Level Innovation Forum for Mexican Policymakers, where policymakers discuss ideas and best practices to implement in Mexico. The Forum’s first major success came with the passing of the new Law of Science and Technology in the Mexican Congress. Ruben Felix Hays, then-chairman of the Science and Technology Commission in the Chamber of Deputies and a participant to past editions of the Forum, stated in his address to Congress, “I cannot fail to mention the High-Level Innovation Forum for Policymakers organized by Fundación IDEA and the Wilson Center for the last two years in Washington, DC. To all who participated in the organization of those forums, my deepest appreciation and gratitude. This reform is because of you. The science, technology, and innovation reform will be for the benefit of our common goal that is Mexico.

- 16 Besides promoting TTOs, the program funds research and development projects and activities (particularly on biotechnology), and enhances seed capital and angel investment markets (CONACYT 2016b). Since 2012, FINNOVA subsidizes TTOs' innovation consulting services for start-ups or small and medium enterprises.
- 17 This number is the total of all certified incubators by state on the INADEM webpage (<https://redincubadoras.inadem.gob.mx/>). In previous years, INADEM had been loose about incubator certifications, however in 2013 it selected a group of experts to review the list of incubators and maintain only those with structure, planning, and proven results in firm creation.
- 18 At an exchange rate of 18.4 pesos per dollar (150,000 pesos).
- 19 Of the 133 TTOs, 117 are already certified and 14 are in the certification process.
- 20 Regional institutions and universities would need to develop homogenized information about their patents, licenses, and spin-outs in order to be part of a TTO and/or FINNOVA programs. All information can be collected by Mexico's National Association of Universities and Institutes of Higher Education (Asociación Nacional de Universidades e Institutos de Educación Superior) (OECD 2012).
- 21 This metric of success must be explicit particularly for private TTOs, which may have different incentives.
- 22 The SEZs will be created in Lázaro Cárdenas port (Michoacán and Guerrero states), the Isthmus of Tehuantepec (Veracruz and Oaxaca states), Puerto Chiapas (Chiapas), and the Corridor Coatzacoalcos/Ciudad del Carmen (Campeche). The goal is to have at least one anchor firm operating in each SEZ by 2018, the last year of current administration (Rios 2016b).
- 23 The first SEZ was opened in Shannon, Ireland, in 1959, yet it was not until the 1970s that East Asian and Latin American countries started designing SEZs to attract investment in labor-intensive manufacturing from multinational corporations (Farole & Akinci 2011). Current estimates identify 4,000 SEZs that account for more than US\$200 billion in global exports and directly employ at least 40 million (FIAS 2008; The Economist 2015).
- 24 China's success is attributed to the creation of dense concentrations of qualified personnel and R&D from foreign companies, and the states' proactive efforts to attract technology-intensive industries (Zeng 2015).
- 25 For example, it has identified as its objectives to develop information and communication technologies, biotechnology, and manufacture designing and processing, among others.
- 26 It must be careful to avoid conflict of interest with private industries; for an example, see Lajous and López-Ridaura (2015).

- 27 Government seed funding program for start-ups that have not been able to get funding from venture capital. In 2014, SBIR/STTR programs made 6,400 seed investments (Blank 2016).
- 28 Interbank interest rate (January 2009 through October 2017).
- 29 The end-2015 exchange rate was 17.22 pesos per dollar.
- 30 LACVA publishes a biannual ranking of the private equity and venture capital environment based in several indicators such as taxation, minority shareholder rights, restrictions on institutional investors, and capital markets development. The first edition was published in 2006. The 2015–16 edition ranks 11 countries, with Chile first and Argentina last. (LAVCA 2016b).
- 31 The score reduction is explained by a 2014 tax reform that increased the tax burden on private equity and venture capital funds.
- 32 In 2015, FNE represented 42 percent of the budget assigned to SE and 0.2 percent of the total federal budget (SHCP 2'15). The budget assigned in 2016 followed similar rates. The FNE budget was 7,200 million pesos, or 50 percent of the SE budget and 0.2 percent of the total federal budget (SHCP 2016a). In 2015, FNE budget was cut in more than half.
- 33 The program has three modalities: INNOVAPYME for SMEs, INNOVATEC for large firms, and PROINNOVA for innovation projects that have the participation of at least two academic/research institutions.
- 34 The law establishes that public-private partnerships are characterized by (1) a long-term contractual relation between the government and private sector (minimum 3 years; maximum 40 years), (2) adequate risk distribution based on each actor's capacity to operate in the most efficient way, (3) financing assumed almost entirely by the private sector with a possible complement support from the public sector, and (4) a common objective that results in a social benefit for the public sector and income generation for the private sector.
- 35 It refers to recently created firms, up to two years old.
- 36 Considering the OECD average, the private sector invests 33 percent more than the public sector in R&D development.
- 37 The average monthly exchange rate in 2016 was 18.03 pesos per dollar.
- 38 The money was assigned to the mixed funds (Fondos Mixtos; Fomento Regional de las Capacidades Científicas, Tecnológicas y de Innovación), sectoral funds (Fondos Sectoriales; Fortalecimiento Sectorial de las Capacidades Científicas, Tecnológicas y de Innovación), PEI (Innovación Tecnológica para Incrementar la Productividad de las Empresas), and National Entrepreneur Fund (Fondo Nacional del Emprendedor).
- 39 Other smaller programs aimed for innovation are PROSOFT (SE) and PROIAT (SE).

- 40 In 2013, sunk cost funds alone were 70 percent of the total number of government-offered programs (ONE 2015a).
- 41 Also known as social venture capital, this approach targets investment in companies that are looking to provide real social change. It is focused on companies that want to solve environmental and social issues, but still emphasizes returns (Cleverism 2016)
- 42 The indicator “Expenditure in scientific research and experimental development as a percentage of Mexico’s GDP” to evaluate PEI and FINNOVA follow the same logic.
- 43 According to Guadalupe Itzel Villa Salinas, INADEM’s director of high-impact entrepreneurship, INADEM is already planning to apply this measure, however due to its nature it will be a medium/long term indicator.
- 44 President Enrique Peña Nieto announced in 2016 that the Ministry of Finance, Ministry of Economics, and CONACYT are planning to design a new program of tax incentives to promote innovation (CONACYT 2016d).
- 45 The Doing Business Index is an annual World Bank report measuring the regulatory system, the efficacy of the bureaucracy, and the nature of business governance in different countries. The Doing Business 2017 is the 14th edition of this measure and includes 190 countries. In 2017, New Zealand was ranked first while Somalia was last; considering only Latin American countries, Mexico was ranked highest (47th) and Venezuela lowest (190th). Data on Mexico are based on two cities: Mexico City and Monterrey (Doing Business 2016a).
- 46 The World Justice Project Rule of Law Index is an annual report to measure rule of law based on perceptions of the general public (based on answers drawn from a representative sample of 1,000 respondents in the three largest cities in each country) and in-country experts. The 2016 Rule of Law Index is the 6th edition and includes 113 countries. In 2016, Denmark was ranked first while Venezuela was ranked last; considering only Latin American countries, Uruguay was ranked highest position (20th) and Venezuela lowest (113th).
- 47 In other aspects that help promote a safer and more secure business environment, Mexico has achieved mixed results. It is ranked in the 40th in terms of enforcing contracts, but in terms of resolving disputes it is well positioned, taking almost half as many days as the Latin American average. When evaluating the quality of Mexico’s judicial processes, Mexico scores 9.5 out of 18 points, 1.5 point less than the OECD average and 0.9 points more than the Latin American average (Doing Business 2016c).
- 48 This is considering the subnational average. However, the Doing Business 2017 rankings consider only Mexico City and Monterrey.
- 49 The Global Competitiveness Index is a biannual assessment of the competitiveness landscape of 138 economies that provides insight into the drivers of productivity and prosperity published by the World Economic Forum. It is measured

based on 12 components: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation. In the 2016–17 edition, Switzerland was ranked first while Yemen was ranked last. Considering Latin American and Caribbean countries, Chile is ranked highest (33rd) and Venezuela is ranked lowest (130th). Mexico is ranked 51st, having moved up seven places in relation to the 2015/16 Index (WEF 2016b).

- 50 Mexico's ranking is based on Mexico City, Monterrey, and Guadalajara.
- 51 The Corruption Perception Index is a measure of the perceived levels of public sector corruption in 168 countries, published by Transparency International. In 2015, Denmark was ranked first while Somalia was ranked last; considering only Latin American countries, Uruguay was ranked highest (21st) and Venezuela lowest (158th).
- 52 ASF also remarks the existence of beneficiaries that lack Constitutive Acts, registration for tax payments, and bank account numbers where the subsidy was supposed to be transferred (ASF 2014).
- 53 Currently there are only 427 brokers and 4,208 attesting officials in Mexico (Doing Business 2016a).
- 54 Twelve states in Mexico charge a fee proportional to the firm's initial capital. However, the best-ranked countries to do business in have low and fixed fees to register. Moreover, Puebla eliminated the cost of the registry for some type of firms and is positioned as the second-best state to open a business in Mexico.



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