



OECD Reviews of Innovation Policy

Knowledge-based Start-ups in Mexico



OECD Reviews of Innovation Policy

Knowledge-based Start-ups in Mexico

This work is published on the responsibility of the Secretary-General of the OECD. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the Organisation or of the governments of its member countries.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

ISBN 978-92-64-19378-9 (print)
ISBN 978-92-64-19379-6 (PDF)
<http://dx.doi.org/10.1787/9789264193796-en>

Series: OECD Reviews of Innovation Policy
ISSN 1993-4203 (print)
ISSN 1993-4211 (online)

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Corrigenda to OECD publications may be found on line at: www.oecd.org/publishing/corrigenda.

© OECD 2013

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of the source and copyright owner is given. All requests for public or commercial use and translation rights should be submitted to rights@oecd.org. Requests for permission to photocopy portions of this material for public or commercial use shall be addressed directly to the Copyright Clearance Center (CCC) at info@copyright.com or the Centre français d'exploitation du droit de copie (CFC) at contact@cfcopies.com.

Foreword

This review of the Mexican knowledge-based start-up sector was requested by the Mexican authorities, represented by the National Council for Science and Technology (CONACYT). It was carried out by the OECD Directorate for Science, Technology and Industry (DSTI). It is in direct continuation of the review of Mexico's innovation policy which was published by the OECD in 2009; it updates the innovation review's diagnostics and deepens its analysis of innovative entrepreneurship. The review was also requested in the context of the LACII (Latin American and Caribbean Countries Initiative on Innovation), a high-level policy dialogue on innovation in Latin America, launched in 2010. Ministers in charge of innovation in Latin American countries met in Guanajuato, Mexico in March 2011 and decided to base their dialogue in the future on background studies analysing the actual experience of Latin American countries with various aspects of innovation policy. Hence this report was commissioned as part of this broader effort to feed into the high-level LACII discussions.

This study draws on a number of key inputs:

- An analysis of the main programmes aimed at small and medium-sized enterprises and at entrepreneurship implemented over the past decade, as well as those planned in the framework of the National Innovation Plan approved in 2011.
- Interviews with a number of stakeholders (e.g. policy makers at federal and regional levels, higher education institutions, executives at new technology-based firms, public and private, as well as financial sector representatives), held in the context of a fact-finding mission which took place from 28 February to 9 March 2012.
- International comparisons regarding “good practices” implemented in various OECD countries.

Daniel Malkin, senior consultant to the OECD, is the main author of this report and co-ordinated its preparation. Dmitri Fujii Olechko, Professor of Economics at the Panamerican University in Mexico City and former Director of Business Innovation at CONACYT, contributed to the drafting of Chapter 2 devoted to the review and assessment of current policies in support of knowledge-based start-ups. Liliana Estrada Galindo prepared background information on intermediary institutions and synthesised the information collected during the interviews.

In the preparation of this report, the OECD team benefitted from valuable support and assistance from CONACYT officials, particularly Leonardo Ríos Guerrero, Deputy Director General, Technological Development and Business Innovation, Luis Mier y Terán, Deputy Director General, Planning, Evaluation and International Cooperation, Miguel Chavez Lomeli, Director, Business Innovation and Alejandro Carlos Farias, Deputy Director for Technological Business, as well as from Leopoldo Rodríguez Sánchez, former President of the Mexican Association of Directors of Applied Research and Technological Development (ADIAT). Ambassador Agustín García López and Minister-Counsellor Sergio Lozoya, from the Permanent Delegation of Mexico to the OECD, and Christian Gonzales, were instrumental in facilitating the co-ordination of the review.

Table of contents

ACRONYMS	7
EXECUTIVE SUMMARY	11
INTRODUCTION	15
Growing policy interest in the knowledge-based start-up sector across OECD countries	16
The creation of new technology-based firms in Mexico – policy environment and framework conditions	16
Object of the OECD evaluation	17
<i>Notes</i>	19
<i>References</i>	20
CHAPTER 1. KNOWLEDGE-BASED SMALL AND MEDIUM-SIZED ENTERPRISES IN MEXICO: AN EMERGING ISSUE IN INNOVATION POLICY	21
Support to high-growth innovative SMEs: Policy rationales	22
Mexico’s initial S&T policy initiatives in support of innovative SMEs	22
Recent institutional, regulatory and policy initiatives	27
Structural weaknesses and challenges	30
Concluding remarks	34
<i>Notes</i>	35
<i>References</i>	37
CHAPTER 2. CRITICAL OVERVIEW OF SUPPORT PROGRAMMES	39
Current government programmes and instruments providing direct or indirect support to new technology-based firms	40
Role and performance of intermediary institutions	50
Higher education and research institutions	53
The build-up of regional innovation systems	58
Overall assessment	60
<i>Notes</i>	62
<i>References</i>	66
CHAPTER 3. POLICY RECOMMENDATIONS	67
Introduction: Where does Mexico stand?	68
Guiding principles	69
Specific recommendations	74
Concluding remarks	83
<i>Notes</i>	84
<i>References</i>	86
ANNEX A. LIST OF INTERVIEWS	89
ANNEX B. INTERVIEW GUIDELINES	91

Boxes

Box 1.1. New technology-based firms.....	26
Box 1.2. Promoting private equity investment through corporate governance reforms	29
Box 2.1. The role of intermediary institutions in the promotion of innovative SMEs: The example of FUMEC.....	52
Box 2.2. CINVESTAV's Technology Transfer and Commercialisation Office	55
Box 3.1. Fostering the ecosystem for the development of high-technology start-ups.....	78
Box 3.2. Integrated support of NTBFs' early development stages	79
Box 3.3. France's support to PRIs/HEIs through participation in seed capital funds.....	80
Box 3.4. Spain's support for the development of business angels networks	82

Figures

Figure 1.1. Administrative burden on start-ups, 2008	31
Figure 1.2. Gross domestic expenditures on R&D by sources of funds and as percentage of GDP, 2001-09.....	33

Tables

Table 1.1. Number of PCT patents filings by institutional sector and priority date	30
Table 1.2. Domestic credit to private sector (% of GDP)	32
Table 1.3. Private equity/venture capital as a proportion of GDP	32
Table 1.4. Gross domestic expenditures on R&D and distribution by sector of performance, 2001-09.....	33
Table 1.5. Budget appropriations for CONACYT and innovation support programmes	34
Table 2.1. Fondo PYME: main measures in support of the creation and operation of incubators	42
Table 2.2. The Ministry of Economy's main instruments in support of enterprises in incubators	45
Table 2.3. Programmes and instruments in support of NTBFs, 2012.....	48
Table 2.4. Patent application ranking – main national universities and public research institutions.....	54
Table 3.1. Policy instruments according to start-ups' development stages	71

Acronyms

ADIAT	Asociación Mexicana de Directivos de la Investigación Aplicada y del Desarrollo Tecnológico Mexican Association of Applied Research and Technological Development Executives
AERIs	Alianzas Estratégicas y Redes de Innovación Strategic Alliances and Innovation Networks
ANUIES	Asociación Nacional de Universidades e Instituciones de Educación Superior National Association of Higher Education Institutions
AVANCE	Alto Valor Agregado de Negocios con Conocimiento y Empresarios High Value Added Knowledge-based Businesses and Entrepreneurs
CAF	Comunidad Andina de Fomento Andean Development Community
CIEBT	Centro de Incubación de Empresas con Base Tecnológica Incubation Centre for Technology-based enterprises
CII	Comité Intersectorial de Innovación Intersectorial Innovation Committee
CINVESTAV	Centro de Investigación y Estudios Avanzados del IPN Advanced Research and Studies Centre
CIT2	Centro de Investigación y Transferencia de Tecnología Research and Technological Transfer Centre
CONACYT	Consejo Nacional de Ciencia y Tecnología National Science and Technology Council
DGRI	General Directorate for Research and Innovation (France) Dirección General de Investigación e Innovación (Francia)
ESIDET	Encuesta sobre Investigación y Desarrollo Tecnológico Science and technology Survey
FCCYT	Foro Consultivo Científico y Tecnológico Science and Technology Consultative Forum
FIDETEC	Fondo de Investigación y Desarrollo para la Modernización Tecnológica R&D Fund for Technological Modernisation
FINNOVA	Fondo Sectorial de Innovación Sectoral Innovation Fund
FIT	Fondo de Innovación Tecnológica Technological Innovation Fund

FOCIR	Fondo de Capitalización e Inversión Rural Rural Capitalisation and Investment Fund
FOMIN	Multilateral Investment Fund Fondo Multilateral de Inversión
FONLIN	Fondo Nuevo León para la Innovación Nuevo Leon Innovation Fund
FORCCYTEC	Fondo para el Fortalecimiento de las Capacidades Científicas y Tecnológicas Fund for Strengthening S&T capacities
FUMEC	Fundación Mexico-Estados Unidos para la Ciencia Mexico-United States Science Foundation
HEI	Higher Education Institution Institución de Educación Superior
ICTDF	Instituto de Ciencia y Tecnología del Distrito Federal Institute of Science and Technology of Mexico City
IDB	Interamerican Development Bank Banco Interamericano de Desarrollo
IMPI	Instituto Mexicano de Propiedad Industrial Mexican Industrial Property Institute
INCUPOLS	Red de Incubadoras de Universidades Politecnicas Polytechnic University Incubators Networks
INEGI	Instituto Nacional de Estadística y Geografía National Institute of Statistics and Geography
IPN	Instituto Politécnico Nacional National Polytechnic Institute
IPRs	Intellectual Property Rights Drerechos de Propiedad Intelectual
ITAM	Instituto Tecnológico Autónomo de México Autonomous Technological Institute of Mexico
ITESM	Instituto Tecnológico y de Estudios Superiores de Monterrey Monterrey Institute of Technology and Higher Education
LAVCA	Latin American Venture Capital Association Asociación Latino Americana de Capital Emprendedor
LLC	Limited Liability Company Sociedad de Responsibilidad Limitada
MITC	Ministry of Industry, Tourism and Commerce of Spain Ministerio de Industria, Turismo y Comercio de España
MTYCIC	Monterrey Ciudad Internacional del Conocimiento Monterrey International Knowledge City

NTBF	New Technology-based Firm Nueva Empresa Basada en Tecnología
NAFIN	National Financiera National Development Bank
OECD	Organisation for Economic Development and Co-operation Organización para la Cooperación y el Desarrollo Economicos
OTC	Oficina de Transferencia de Tecnología Technology Transfer Office
PAVETT	Programa Avanzado de Formación de Capital Humano en Vinculación Efectiva y Transferencia de Tecnología Advanced Human Capital Training Programme for Technology Transfer
PECITI	Programa Especial de Ciencia, Tecnología e Innovación Special Programme for Science, Technology and Innovation
PECYT	Programa Especial de Ciencia y Tecnología Special Programme for Science and Technology
PEI	Programa de Estimulos a la Innovación Innovation Incentives Programme
PIEBT	Programa de Incubadoras de Empresas de Base Tecnológica Incubators Programme for Technology-based Enterprises
PIIT	Parque de Investigación e Innovación Tecnológica (Monterrey) Research and Technological Innovation Park (Monterrey)
PNI	Programa Nacional de Innovación National Innovation Programme
PRI	Public Research Institution Institución Pública de Investigación
PROMTEC	Programa de Apoyo a la Modernización Tecnológica de la Industria Support Programme for Industry's Technological Modernisation
PREAEM	Programa de Enlace Academia-Empresa Academy-Enterprise Linkage Programme
RENIECYT	Registro Nacional de Instituciones y Empresas Científicas Tecnológicas National Registry of Scientific and Technological Institutions and Enterprises
R&D	Research and Development Investigación y Desarrollo
SAPI	Sociedad Anónima Promotora de Inversión Limited Liability Stock Corporation
SARE	Sistema de Apertura Rápida de Empresas Enterprise Registration Rapid System
SNI	Sistema Nacional de Investigadores National System of Researchers

STI	Science, Technology and Innovation Ciencia, Tecnología e innovación
TEKES	Finland's Innovation Agency Agencia para la Innovación de Finlandia
TTO	Technology Transfer Offices Oficina de Transferencia de Tecnología
UNAM	Universidad Nacional Autónoma de México National Autonomous University of Mexico
UVTC	Unidad de Vinculación y Transferencia de Conocimiento Knowledge Transfer and Linkage Unit
WIPO	World Intellectual Property Organization Organización Mundial de Propiedad Intelectual

Executive summary

Support to small and medium-sized enterprises' investment in R&D and innovation activities have long been a major axis of science, technology and innovation (STI) policy. More recently, in many OECD countries, increased attention has been focused on new innovative firms that often offer untapped means of transforming knowledge resources into economic opportunities and sources of employment for highly qualified personnel. STI policy mixes have therefore evolved to incorporate policy instruments that address specific market and systemic failures that hinder the creation and expansion of knowledge-based start-ups.

Although there are no reliable statistics on the creation and survival of knowledge-based start-ups in Mexico over the last decade, there is more than anecdotal evidence that in this area Mexico lags behind other countries with a higher or similar level of scientific and technological (S&T) development. This lag reflects the fact that Mexico suffers from a discrepancy between, on the one hand, the relatively significant S&T capacities developed in the country's higher education institutions and public research centres and, on the other, a rather low dynamism in the creation of knowledge-based start-ups. Despite positive initiatives taken in the framework of the 2009 revision of Mexico's S&T law, this state of affairs points to structural weaknesses related to framework conditions, compounded by specific inefficiencies in innovation policy design and implementation.

Main structural weaknesses

- *Weak financial markets.* In Mexico, access to capital by knowledge-based start-ups is negatively affected by the risk aversion of the traditional banking system and the very weak development of the domestic seed and venture capital markets as compared with other countries with similar levels of S&T capacities. These factors are compounded by insufficient capacities to effectively assess the market potential of new ventures based on intangible assets.
- *Administrative barriers to the creation of start-ups.* While administrative barriers to entrepreneurship have decreased with the introduction of the system for quick business start-up in the early 2000s (SARE), at the end of the last decade Mexico still lagged behind other major Latin American countries in this area, especially as concern knowledge-based start-ups whose when main assets are intangible.
- *Low patenting performance of public research institutions.* The relatively high level of excellence of Mexican public research institutions in terms of scientific performance is not matched by their record in their capacity to generate knowledge with commercial potential as measured by international patents. Up to recent governance changes that have not yet produced all their expected benefits, incentives to patent and engage in technology transfers leading to the creation of knowledge-based-start-ups were insufficient.

Policy biases and inefficiencies

- *Excessive fragmentation of the support system.* Over the years a number of support instruments for innovative SMEs have been implemented. This has generated a duplication of support programmes which reflects overlapping responsibilities among government agencies and gives rise to fragmentation of support measures that lack critical mass, involve high administrative management costs and may lead to inefficient use of resources or windfall profits.
- *Policy design, funding and delivery problems.* Most support programmes have been designed to benefit *innovative projects* of existing SMEs rather than the *creation* of knowledge-based start-ups. The differentiation and customisation of incentives according to stages of the start-ups development process has often been overlooked. The choice of the forms of funding of support instruments through either budget or trust funds seems to have been driven more by institutional considerations than beneficiaries' interests.
- *Lack of continuity and poor visibility.* The changing focus of competitive calls and the frequent absence of specific mention of start-ups as a focus of support confuse potential beneficiaries.

Policy recommendations

- *Framework conditions.* The success of policies in support of knowledge-based start-ups is predicated upon the improvement of legal, fiscal and regulatory framework conditions that affect Mexico's business environment in terms of competition, market entry and exit conditions, corporate governance, private equity investment regulations and minority holder rights, IPR regimes and remaining obstacles to the creation of academic spin-offs. Although there have recently been positive initiatives in these areas, Mexico could still improve framework conditions in a direction more favourable to the various development stages of knowledge-based start-ups.
- *Public research base.* Research excellence feeds the pool of potential knowledge-based start-ups. Continued support to public research should be considered as a prerequisite for the dynamism of the knowledge-based start-up sector, provided this support is accompanied by governance reforms that increase the innovation and technology transfer performance of public research institutions.
- *Policy governance and delivery.* Improved coordination among government agencies supporting innovative SMEs should be developed at the level of policy design and implementation to curtail duplications and waste of resources and increase critical mass of efficient programmes. However, a one-stop-shop approach to knowledge-based start-up support as well as sectoral selectivity should be avoided. More emphasis should be given to support to start-ups in overall support schemes to innovative SMEs, and more particularly to initial development stages. Modes of funding support should be adapted to the type and duration of incentives according to the various stages of knowledge-based start-ups' development cycle, from pre-creation to expansion stages.

- *Complementarity between public support and private investment.* Direct public support instruments should not crowd out private investment but leverage it through specific financial schemes (e.g. venture capital funds) or investment incentives (e.g. for business angels).
- *Decentralisation issues.* Innovation ecosystems favourable to knowledge-based start-ups are essentially local. Local institutions are often better placed than federal agencies to implement support programmes according to regional characteristics and to judge projects submitted in competitive calls. In Mexico a more efficient balance has to be struck between federally managed programmes and those that are federally funded but managed at state level. The government should continue to subsidise accredited intermediary institutions that technological and other business services to innovative SMEs and can facilitate the emergence of start-ups.
- *Strengthening technology transfer schemes.* Consolidate current programmes in support of the development of public research institutions' technology transfer offices based on certification (e.g. FINNOVA) and facilitate these institutions access to seed capital for the development of academic spin-offs. Streamline barriers to mobility of academic researchers.
- *Financing the development of knowledge-based start-ups.* The availability of seed capital is probably the weakest link in the start-ups financing supply chain. Programmes like FINNOVA that address this weakness should be sustained to support the “valley of death” transition costs. A good balance should be struck between seed capital provided as grants vs. equity participation; in the latter case the private sector should play a leading role as it already does it in venture capital. The legal status and regulatory framework of business angel institutions or groups should be adapted to safeguard the security of investment by ensuring limited liability. Emulating the experience of a number of OECD countries, fiscal incentives schemes in favour of angel and venture capital companies or of private investors as a means to channel more investment to the creation and expansion of knowledge-based start-ups should be considered.

Introduction

Across the OECD, knowledge-based small and medium-sized enterprises, and more particularly start-up enterprises, are playing a growing role in employment and value creation. Increased attention is being given to the promotion of these enterprises in innovation policies. This introduction sets the framework against which Mexico's innovation policies and support programmes that impinge upon the dynamism of knowledge-based start-ups can be analysed and recommendations to improve their efficiency can be made.

Growing policy interest in the knowledge-based start-up sector across OECD countries

Since the beginning of the present decade a large number of OECD countries, as well as major emerging economies, have implemented policies to support the creation and expansion of new technology-based firms. The reasons behind these policy initiatives, which involve complementary actions by various ministerial departments, are many.

First, at a general level, there has been a realisation that start-ups are increasingly a major source of employment creation. The emphasis on new firms' potential to generate jobs, which is particularly relevant during economic slowdowns, has given rise to a wide array of policy initiatives. These have ranged from the development of entrepreneurship programmes, notably in higher education institutions, to support for the development of incubators, to the removal or alleviation of regulatory obstacles to the creation of enterprises, to the improvement of competition regimes in order to facilitate the entry of new firms, to the reform of capital markets to facilitate new ventures' access to finance and, in many instances, to the opening of new lines of credit, subsidised loans or guarantee schemes for start-ups by development banks (OECD, 2010a).

Second, while policies in support of investment in R&D and innovation by existing SMEs have long been a major axis of science, technology and innovation (STI) policy in most OECD countries, attention has recently focused on new innovative firms that offer often untapped means of transforming knowledge resources into economic opportunities and sources of employment for highly qualified personnel (OECD, 2010b). STI policy mixes have therefore evolved to incorporate policy instruments that address specific market and systemic failures that hinder the creation and expansion of new technology-based firms (NTBFs).¹

In advanced countries where STI policies are efficiently designed and implemented in the framework of a "whole-of-government" approach (OECD, 2010c), these STI policy mixes have been co-ordinated across government agencies or ministerial departments to strengthen the various components of an innovation "ecosystem" that is favourable to the creation and sustainable development of NTBFs. Moreover, attention is given to the complementarity of these components and their synergy effects in order to reduce risks of failures caused by weak links in the ecosystem.

With the benefit of hindsight, it is important to recognise that the build-up of efficient innovative ecosystems that provide a springboard for NTBFs has rarely derived from an integrated *ex ante* design. In most instances public and private initiatives and institutional and regulatory reforms in various policy areas have converged to pave the way for the progressive consolidation of an ecosystem which is supportive of knowledge-based entrepreneurship and recognises the promotion of NTBFs as an important component of STI policy.

The creation of new technology-based firms in Mexico – policy environment and framework conditions

Over the last decade Mexico has implemented a variety of policies to support business innovation. Support instruments have included direct subsidies to firms in the framework of competitive calls and R&D tax credit schemes. Specific policies have aimed at supporting public-private partnerships and technological collaboration between public research institutes and higher education institutions (PRIs and HEIs) and enterprises. In many instances support focused on priority sectors or technology areas, but in recent years more

emphasis has been placed on support to small and medium-sized enterprises (SMEs) and the build-up of technology transfer capacities (CONACYT, 2008; OECD, 2009).

The shift of emphasis promoted by CONACYT and the Ministry of Economy has increased the innovative capacity of the business sector. However, with rare exceptions, all support measures aimed at fostering innovation were directed at innovation projects in established enterprises. This left a *de facto* vacuum with respect to policies aimed at the creation of NTBFs. This situation was particularly damaging in Mexico for a number of reasons. The most important of these were:

- *Weak financial markets.* Risk aversion in the traditional banking system, combined with the very weak development of the seed capital market and a low capacity to assess the potential of new ventures based on scientific and/or technological development, left most would-be new entrepreneurs without the financial means to jump start their enterprises. Moreover, the limited size and scope of the venture capital market in Mexico constrained the medium- and longer-term financial sustainability of new ventures, making the best option the sale of the firm or its affiliation to a larger enterprise.
- *Poor development and valuation of intangible assets.* An intellectual property rights (IPR) culture has only developed slowly in Mexico. The practice of patenting results derived from scientific and technological (S&T) activities, which conditions the build-up of intangible assets and facilitates access to seed capital, is still underdeveloped both in enterprises and in PRIs. However, this situation has begun to improve following initiatives of CONACYT, IMPI and, more recently, the Ministry of Economy.
- *Obstacles to the development of S&T spin-offs.* With few exceptions Mexican PRIs and HEIs have been slow to develop technology transfer and /or licensing offices (TTOs or TLOs). When they have done so they did not receive public support until recently. Moreover, these offices have rarely been able to develop their patent portfolio actively and build upon it to support the creation of spin-offs. Regulatory obstacles related to the mobility of public researchers and the possibility of owning assets in firms created on the basis of their inventions considerably reduced the incentives of individual researchers and their institutions to engage in spin-off development activities. Here again, recent reforms of a legal and regulatory nature as well as new incentives to develop TTOs' capacities are beginning to transform the landscape.

Object of the OECD evaluation

Like most OECD countries, Mexico lacks readily available, reliable statistics for measuring the magnitude of the universe of new S&T-based firms, its evolution or firms' survival rates.² However, there is more than anecdotal evidence that the actual number of such firms is quite limited and that Mexico's performance in fostering their development is weak in comparison with that of other OECD countries.³

Given the increased importance of NTBFs for reaping the benefits of investment in R&D and innovation in terms of economic and social returns and qualified employment opportunities, the question of how to improve performance is a major policy issue. What policy initiatives and institutional and regulatory reforms are needed to increase the pool of potential S&T start-ups and to build an innovation ecosystem more favourable to their development?

It is against this background that CONACYT asked the OECD to undertake an evaluation of the performance of the knowledge-based sector and provide policy recommendations for improving the financing, creation and expansion of innovative knowledge-based start-ups.⁴ Specifically, the OECD evaluation was to cover the following areas:⁵

- An analysis of the current policy framework and instruments to support the creation and expansion of knowledge-based firms in Mexico.
- A review of the specific mechanisms, institutions, resources and governance structures impinging upon the development of innovative knowledge-based start-ups in Mexico.
- Recommendations to strengthen government support mechanisms, including the identification of possible new instruments, and to improve the policy mix to encourage the creation and expansion of innovative knowledge-based start-ups.

This report is organised as follows:

After a brief overview of the main rationales and current policy developments in support of high-growth innovative SMEs in general and knowledge-based start-ups in particular, *Chapter 1* reviews how the issue of innovative SMEs has been addressed in the evolution of Mexico's S&T policy mix over the last decade. It presents some recent public initiatives of a policy, legal or regulatory nature which, along with private ones, have contributed to the gradual build-up of a still fragmentary innovative ecosystem that could help broaden the pool of knowledge-based start-ups and ensure their sustainable development. It highlights some of the framework conditions and innovation performance features that may weaken the dynamism of NTBFs creation in Mexico.

Chapter 2 provides a more detailed analysis of various government departments and agencies' policies and instruments that support or promote innovative SMEs directly or indirectly and can encourage the creation and expansion of knowledge-based start-ups. It reviews the role and performance of public and private financial institutions and other types of intermediary institutions in the development of NTBFs. On the basis of interviews conducted with a limited number of NTBFs created in the last five years and with selected HEIs the chapter provides some insight into factors that impinge upon the performance of the private and the academic sectors in terms of the creation of knowledge-based start-ups. It also sheds light on issues related to policy governance, co-ordination, design, implementation and delivery and on regulatory frameworks that may negatively affect the benefits start-ups can expect from support policies that have been mainly designed to support the development of innovative projects in existing SMEs.

Chapter 3 proposes recommendations for strengthening the innovation ecosystem to favour the creation and expansion of knowledge-based start-ups within the general framework of Mexico's STI policy. Drawing on examples of good practices in more advanced countries it suggests possible policy initiatives to develop this ecosystem through improved governance mechanisms and more dedicated support instruments. A number of recommendations go beyond the competence of STI policy makers to encompass more general framework conditions and regulatory and taxation issues.

Notes

1. A comprehensive list of the main programmes in support of innovative start-ups implemented in European countries (as well as a few other countries) can be found in the EU PRO INNO data base (European Commission, 2009). This database also provides information on the objectives and implementation modalities of these programmes.
2. The lack of statistical information about the demography of NTBFs is not specific to Mexico. With the assistance of CONACYT efforts were made to obtain reliable estimates of the number of recently created NTBFs by trying to match data from CONACYT databases of supported enterprises less than five years old and enterprise data from the ESIDET innovation survey managed by INEGI, the Mexican Statistical Office. Unfortunately these efforts could not be realised in the timeframe of this project.
3. Such evidence was collected during the OECD mission through interviews with seed capital companies and with research and academic institutions regarding their spin-off creation performance and by sampling enterprises that have submitted proposals for early-stage innovation project financing according to age and size criteria.
4. There is no standard definition of a knowledge-based or innovative start-up. This report uses the notion of new technology-based firm (NTBF) generally defined in OECD literature as “Enterprises less than 5 years old, whose creation and development are based on a novel exploitation of an existing or newly developed technology or scientific discovery”. This new technology or scientific discovery may or may not have been developed by the institution or individual at the origin of the firm but represents an intangible asset of the firm (OECD, 2010a, 2010b, 2010c).
5. As indicated in the Terms of Reference of the Agreement signed between the OECD and CONACYT in December 2011. The Terms of Reference include a related and complementary project consisting in a comparative review of good practices across OECD members and selected Latin American countries, regarding policy instruments and financing mechanisms aimed at fostering the development of knowledge-based start-ups.

References

- CONACYT (2008), Términos de Referencia para la Operación de la Modalidad “Paquetes Tecnológicos” Subprograma AVANCE, mimeo, México.
- European Commission (2009), Support programmes for innovative start-ups and gazelles, INNO-Policy Trendchart, Brussels.
<http://proinno.intrasoft.be/index.cfm?fuseaction=wiw.measures&page=list&CAT=55>
- OECD (2009), *OECD Reviews of Innovation Policy: Mexico 2009*, OECD Publishing.
doi: [10.1787/9789264075993-en](https://doi.org/10.1787/9789264075993-en).
- OECD (2010a), *High-Growth Enterprises: What Governments Can Do to Make a Difference*, OECD Studies on SMEs and Entrepreneurship, OECD Publishing.
doi: [10.1787/9789264048782-en](https://doi.org/10.1787/9789264048782-en).
- OECD (2010b), “Innovative SMEs and Entrepreneurship for Job Creation and Growth”, issues paper presented at “Lessons from the Global Crisis and the Way Forward to Job Creation and Growth, ‘Bologna+10’ high-level meeting on SMEs and entrepreneurship, 17-18 November, available at:
www.oecd.org/cfe/bologna10high-levelmeetingonsmesandentrepreneurship.htm.
- OECD (2010c), “Ministerial Report on the OECD Innovation Strategy – Key Findings”, available at: www.oecd.org/innovation/strategy.

Chapter 1

Knowledge-based small and medium-sized enterprises in Mexico: An emerging issue in innovation policy

This chapter reviews how the issue of innovative small and medium-sized enterprises has been addressed in the evolution of Mexico's S&T policy mix over the last decade. It presents some recent public initiatives of a policy, legal or regulatory nature which, along with private ones, have contributed to the gradual build-up of a fragmented innovative ecosystem that could help broaden the pool of knowledge-based start-ups and ensure their sustainable development. It highlights some of the framework conditions and innovation performance features that may weaken the dynamism of new technology-based firm creation in Mexico.

Support to high-growth innovative SMEs: Policy rationales

Beyond the well-known market and systemic failures that underpin policies in support of business investment in R&D and innovation, whatever the size and sector of activity of the potentially benefitting enterprises, some apply specifically to high-growth innovative small and medium-sized enterprises (SMEs) and in particular to new technology-based firms (NTBFs) (OECD, 2010).

Innovative SMEs may suffer more than larger firms from acknowledged market and systemic failures and are also more prone to suffer from the inability of markets to meet their specific needs in terms of risk capital, qualified resources, information and project assessment. The combined effects of sunk and fixed costs, reduced scale, risk factors and asymmetry of information often put SMEs at a disadvantage when embarking on innovation. These disadvantages are often compounded for knowledge-based start-ups in the stage that precedes their actual creation because of a lack of resources to bridge the gaps between research results, pilot development and market entry.

The increased policy attention to high-growth innovative SMEs, owing to their potential contribution to growth and to an acknowledgment of legitimate reasons to provide specific support for the development of their knowledge-based innovative activities, may increase the risks of government failures in the design and/or implementation of support measures and funding instruments (OECD, 2011b; Lilischkis, 2011). Among the reasons behind possible failures the most frequent are:

- *Information constraints* and civil servants' limited competencies for assessing projects eligible for support may limit governments' ability to intervene effectively; they can also give rise to distortions of competition, waste of resources and windfall profits.¹
- *Regulatory causes of market inefficiencies*. When specific constraints affect the development of high-growth innovative SMEs, governments may be more prone to subsidise the costs due to inefficient markets rather than address the causes of these inefficiencies, which are often related to regulatory issues.²
- *Governance issues*. The build-up of ecosystems favourable to the development of knowledge-based SMEs implies efficient co-ordination among government departments whose policies impinge upon the efficient functioning of the ecosystem and the ability of innovative SMEs to take advantage of it. Lack of co-ordination may give rise to waste and inefficiencies even if policy initiatives taken by individual departments are well founded. As emphasised in a comparison of support initiatives for high-growth innovative SMEs in nine advanced countries, an important element of good governance in the area of knowledge-based entrepreneurship is the ability to "cross the traditional boundaries of policy silos" (Autio et al., 2007).

Mexico's initial S&T policy initiatives in support of innovative SMEs

The first shift in Mexico's S&T policy towards greater emphasis on support to business R&D, S&T capacity building in the enterprise sector, and the promotion of science/industry linkages in its policy mix took place in the 1990s.³ No particular emphasis was given to innovative SMEs in this evolving policy mix.

However, as early as 1992, CONACYT developed the Programme of Incubators for Technology-Based Enterprises (PIEBT). The main objectives of these incubators, which in most cases were co-financed by institutions such as NAFIN, state governments, industrial associations and research institutions, was to assist potential NTBFs in undertaking technical and commercial feasibility studies (Pérez Hernández and Márquez Estrada, 2006). Owing to the scarcity of competencies to assist enterprises as well as to administrative rigidities in the management and funding of supported incubators, the programme was discontinued in 1997. Of the 20 or so enterprises that were supported by the PIEBT only a handful remained active, mainly because they had managed to develop a sustainable model which combined the technical and commercial competencies needed to enhance their chances of success in market-based selection processes.⁴ Apart from weak competencies, other factors also strongly lowered the incubators' success in creating viable NTBFs, among them:

- the absence of complementary support programmes to subsidise proof of concept, pilot production or patenting costs;
- the weakness of business angel capital supply and administrative or regulatory obstacles to firm creation.

A more important shift towards support for business innovation took place at the beginning of the last decade in the framework of the Special S&T Programme (PECYT) and the amended 2002 S&T Law. Promoted by CONACYT, this shift gave greater emphasis to direct and indirect measures to support STI investment in industry, accorded greater attention to support of innovative SMEs through dedicated measures⁵ and promoted better articulation of science and industry through support to innovation projects involving technology transfer and co-operation activities. However, as argued in the OECD review of Mexico's innovation policy, this improved policy mix did not substantially improve the performance of the innovation system because of policy fragmentation and policy co-ordination failures in a context of limited resources (OECD, 2009).

Although no support programmes were specifically devoted to the creation and expansion of knowledge-based start-ups, certain programmes contributed directly or indirectly. Among these, some initiated in the first half of the last decade are still ongoing and are reviewed in more detail in Chapter 2. They include:

- *The Technological Innovation Fund (FIT)* created in 2002 is funded by the Ministry of Economy and managed by CONACYT.⁶ The general objective of this sectoral fund was to support and promote innovation in Mexican SMEs.⁷ Its focus has evolved over time and it was only in 2010 that it explicitly included a sub-programme devoted to the support of activities related to the creation and expansion of S&T-based start-ups.
- *The SME Fund (Fondo PYME)* funded and operated by the Ministry of Economy provides support to a wide array of service activities and infrastructure investment aimed at fostering innovative entrepreneurship. This fund supports in particular the TechBa business accelerator programme created in 2005 which has proved quite successful in fostering the development and internationalisation of a number of Mexican SMEs and covers the infrastructure costs of incubators certified by the ministry.

- *The PROSOFT programme* created in 2002 and co-funded by the Ministry of Economy and state governments provides subsidies for the provision of technological and business services to new innovative firms in the ICT area. Praised for its management simplicity, this programme operates at regional level and has facilitated the emergence of an ICT cluster favourable to the creation and development of start-ups.

The High Value Added Knowledge-based Businesses and Entrepreneurs programme (AVANCE), created by CONACYT in 2003, is the only programme developed in the framework of the PECYT that could have had a significant impact on the creation and expansion of start-ups.⁸ Its main purpose was to set up a wide array of support schemes aimed at market or systemic failures that hindered the development of viable commercial ventures based on business investment in knowledge and technology transfers. The ambitious idea behind the programme was to channel support to areas deemed essential for the build-up and strengthening of a rather weak Mexican innovation ecosystem to make it more conducive to the expansion of knowledge-based activities by existing firms and, eventually, to the creation of NTBFs.⁹

Three complementary measures were launched in 2003 and the following years:

- *Ultima Milla* (Last Mile), created in 2003, is a competitive support measure which provides matching grants for the later development stages of innovative projects (technical feasibility, patent registration, business services for commercial prospects and potential investors attraction).
- *The CONACYT/NAFIN Entrepreneurs Fund*, launched in 2006, could provide complementary angel or venture capital (up to 20%) to finance the development of innovative projects once private capital investment had been committed.
- *A Guarantee Fund* operated with NAFIN, also launched in 2006, was intended to back innovative firms' request for loans to finance working capital and equipment.

Overall the results achieved by the AVANCE programme appear rather modest in terms of number of projects supported through its various modalities.¹⁰ However, as highlighted in an evaluation report conducted by the Autonomous Technological Institute of Mexico "there is some evidence that AVANCE [as designed and implemented by CONACYT] has increased investors' interest in technological innovation projects, has fostered the generation of technical capabilities for the identification and evaluation of innovative projects and contributed to the creation of business angel and venture capital funds which were practically non-existent in the country" (González Brambila, 2008).

From its inception AVANCE suffered from various problems. Identifying and analysing these problems can provide useful lessons for the design and implementation of better policies in support of innovative SMEs and knowledge-based start-ups:

- First of all AVANCE was a valuable attempt to change the paradigm governing the design and implementation of Mexico's S&T policy by putting greater emphasis on the economic outcomes of public support to R&D and innovative activities, in particular those undertaken by SMEs. However, the programme was endowed with a limited amount of resources and did not achieve critical mass. Moreover, the new policy orientations it promoted suffered the drawbacks that usually affect the learning curve of policy experimentation. Results are slow to materialise and performance indicators that reflect budgetary cycles may not be appropriate in cases where a programme's success should be measured in terms of

the portfolio of supported firms rather of the outcomes of individual firms supported.¹¹

- Second, with hindsight, AVANCE was fraught with implementation problems linked to its centralised management, project evaluation mechanisms and delivery of support. It is undeniable that the technical committees in charge of project evaluation, largely composed of civil servants, did not always have the competencies needed to assess the technical validity, financial soundness and commercial prospects of project proposals. Experience also suggests that a bottom-up approach involving regional or local institutions in the development of pipelines of sound projects, in project selection and in delivery of public support as well as the provision of other possible sources of finance is usually preferable to centralised systems.
- Third, despite the efforts put into developing incubators, AVANCE clearly shed light on the limited ability of would-be innovative entrepreneurs to develop projects in a way that would attract potential investors.
- Fourth, the incompleteness of the innovative ecosystem in terms of availability of angel and venture capital and regulatory obstacles to the protection of minority capital limited the expansion of the pool of potential NTBFs.
- Fifth, legal or regulatory barriers to the creation of knowledge-based start-ups by personnel of public research institutions and the general underdevelopment of their technology transfer offices limited these institutions' access to the benefits of the programme and their ability to transfer knowledge to industry.

In view of AVANCE's mixed performance, which at the time was mainly attributed to design shortcomings, six new schemes were added by CONACYT in 2008¹² to support critical links in the development of innovative projects of SMEs and NTBFs and to increase the pool of S&T-based new ventures (CONACYT, 2008a):

- *Technological packages*: Support to research teams in PRIs, HEIs and to independent researchers to help them ensure the technical and commercial viability of S&T-based projects. This scheme included subsidisation of proof of concept and pilot development which is widely available in many developed countries but was lacking in Mexico (CONACYT, 2008b). It filled an important gap and was taken advantage of by the most advanced PRIs and by private enterprises.
- *National patents*: Reimbursement of costs associated with national patent applications by PRIs, HEIs, SMEs and independent researchers. This support scheme, which also filled an important gap, proved instrumental in developing an intellectual property rights (IPR) culture and increasing the propensity to patent.¹³
- *Technology transfer offices (TTOs)*: Support for the creation or consolidation of such offices in PRIs, HEIs, and S&T services firms.¹⁴
- *Business schools programme*: Support for the supply of and demand for entrepreneurship training focused on the development of S&T-based ventures.
- *Strategic alliances and innovation networks for competitiveness (AERIs)*: Support for collaboration of industry and PRIs and HEIs on innovative projects.
- *Seed capital fund* with two support modalities: one to advance recoverable capital for the initial phases of innovative projects and one consisting of a temporary capital injection to venture capital funds to induce them to develop their seed

capital investments in innovative ventures. This scheme encountered design and delivery problems as CONACYT was not sufficiently equipped to manage seed capital. Its only successful experience involved a decentralisation process and a capital contribution from the CONACYT Institutional Fund to the regionally managed Nuevo León Innovation Fund (FONLIN) (see Chapter 2).

Box 1.1. New technology-based firms

Diagnosis and policy recommendation in the 2009 OECD review of Mexico's innovation policy

Support of new technology-based firms is a weak point in the Mexican policy mix. Only AVANCE and, to a lesser extent, the business accelerators initiative funded by the Ministry of Economy, support the development of research-based innovation activities in new high-technology firms. These programmes fulfil an important mission but are under-funded and provide few opportunities for researchers from public research institutions to create high-technology firms or spin-offs. In this regard, more attention and support should be given to access to financial markets and the development of financial and prudential products (e.g. seed and venture capital, guarantee schemes) adapted to the creation and expansion of this category of firms (p. 18).

In parallel with the reduction of indirect support provided by fiscal incentives, the volume of direct support to firms through existing (or reformed) competitive support schemes should be increased by providing resources in the form of matching funds, subsidised loans or, in certain cases, grants. A bonus should be given to collaborative projects. Eligibility criteria should be streamlined. Support for developing new technology-based firms should be increased, obstacles to their creation should be reduced and their access to capital markets should be facilitated. Part of this increase should be financed by the savings incurred by the reform of the fiscal incentive system (p. 28).

Support to new technology-based firms does not get the policy attention and support it deserves. As mentioned, support to science-based innovation activities is available through existing schemes such as AVANCE, and possibly now INNOVAPYME. But, in the absence of effective seed and venture capital markets, a specific support scheme should foster the creation and/or development of high-technology firms or spinoffs from public research institutions (p. 198).

Unfortunately, the AVANCE programme has been poorly endowed and the bulk of its resources go to relatively mature projects in the later stages of development. Start-ups are therefore generally excluded from the programme (p. 178).

Other actions to promote science/industry linkages and the creation of academic spin-offs should rely on incentives provided by institutional reforms such as those on the mobility of researchers and the development of technology transfer or licensing offices (TTOs and TLOs) in research institutions receiving public funding. As compared with more advanced countries and major emerging economies (e.g. Brazil and China) the development of such offices is slow in Mexico and the rules that govern the management of IPRs by PRIs and the appropriation or allocation of the proceeds should be clarified (pp. 186-188).

The Economía/CONACYT Technological Innovation Fund (TIF) could develop links with the financial sector through its contribution to the development of venture and seed capital funds and guarantee funds in co-operation with NAFIN. Like innovation agencies in various OECD countries, it could also provide special incentives for the creation of new technology-based firms. Possibly, this fund could become an autonomous innovation agency able to participate financially in firms it supports. In this case, it would have to receive endowments from the public sector and financial institutions (pp. 204-205).

Source: OECD (2009), *OECD Reviews of Innovation Policy: Mexico*, OECD Publishing.
<http://dx.doi.org/10.1787/9789264075993-en>

Overall, the portfolio of support schemes implemented since AVANCE's inception represented a relatively coherent attempt to fill various gaps in the Mexican innovation system that hindered the emergence and consolidation of an ecosystem more favourable to innovative SMEs and NTBFs. In the second phase of AVANCE, in spite of a rather low resource endowment and management problems, CONACYT succeeded in kick-starting some positive changes in SMEs' propensity to invest in technology-based innovation projects. In this sense the programme most certainly had positive behavioural additionality

effects on its beneficiaries.¹⁵ This was notably the case of the schemes devoted to technological packages, patent support, TTOs and, to a lesser extent, AERIs. Despite the encouraging results, the AVANCE programme was discontinued and no longer funded as of 2009. This was probably due to a difference of appreciation of programme outcomes in terms of output additionality¹⁶ between CONACYT and the Ministry of Finance.¹⁷

In its 2009 review of Mexico's innovation policy the OECD underscored the weakness of government policies and instruments in support of NTBFs and the absence of dedicated support for S&T-based start-ups. Acknowledging the positive role of the incubator policy and the AVANCE programme, the review underlined the low endowment of the latter and made a number of recommendations aimed at strengthening the modes of support to NTBFs and start-ups in Mexico's S&T policy mix, including the development of more dedicated policy instruments (Box 1.1).

The response to these policy recommendations was mixed. While no dedicated policy instruments were developed to support NTBFs and start-ups, a number of institutional, regulatory and policy initiatives contributed to a gradual build-up of the constituents of an ecosystem more favourable to the creation and development of these types of enterprises.

Recent institutional, regulatory and policy initiatives

Revision of the S&T Law

The institutional reforms with probably the greatest potential impact on the growth of the pool of S&T-based start-ups are those related to several revisions of the 2002 *S&T Law* passed in 2009 (Government of Mexico, 2011b). Among these revisions, those that may have the most effect are:

- The new *Article 25bis* that allows trust funds financed by sectoral ministries and operated by CONACYT to support, among others:
 - the creation of TTOs¹⁸ in PRIs and HEIs and their linkages with industry
 - the creation of seed and venture capital funds for the development of new S&T-based enterprises.
- *Articles 40 and 40 bis* are specifically devoted to linkages between PRIs and HEIs and industry. They indicate that in granting support to innovation projects priority should be given to those that involve knowledge transfer or collaboration between public research institutions and enterprises, in particular SMEs. More importantly, these articles state that in establishing TTOs, PRIs and HEIs may choose the legal status they deem most appropriate, which means that the option of a private TTO operating under the aegis of a public research institution is legally acknowledged.¹⁹ This initiative has important consequences for the management of IPRs by PRIs and HEIs and reduces regulatory barriers to the development of academic spin-offs and the involvement of public researchers in the development of privately owned start-ups either as consultants or asset owners.²⁰
- As modified in 2009, *Articles 51 and 56* substantially increase the autonomy of PRIs as regards their governance and the management of their intellectual assets. In order to promote the commercialisation of research results, and in line with the practice established in HEIs, PRIs have been granted ownership of their intellectual property and researchers at the origin of IP can receive up to 70% of the royalties generated, which enhances their role in the creation of S&T-based start-ups either by their own research staff or through licensing.

With these institutional changes Mexico finally emulated best practices for the management of TTOs and IPRs which had already been adopted in most of the more advanced OECD countries (OECD, 2003). These initiatives eliminate or alleviate some legal or regulatory barriers that constrained the creation of academic spin-offs and limited technology transfer opportunities that fuel innovative start-up creation.

One should, however, stress that such initiatives have to be considered just as enabling reforms, albeit important ones. They are necessary but far from sufficient to build up an ecosystem more favourable to the development of start-ups. These reforms must be complemented by a wide array of other instruments that facilitate the emergence of projects, ensure efficient selection processes that attract investors, and condition the availability of funding for the various stages of development.

Finally, the revised S&T Law specifically sets the conditions for improved governance of innovation policy through its provisions setting up the Intersectoral Innovation Committee (CII).²¹ This Committee is composed of the Minister of Economy, who chairs it, the CONACYT Director (Vice-chair) and the Minister of Public Education. It is entrusted with the co-ordination of the preparation, implementation and monitoring of the National Innovation Programme (PNI). As highlighted below, this programme explicitly considers the development of support measures in favour of NTBFs.

Government STI programmes

The most recent government S&T and innovation programmes do not explicitly identify the development of S&T-based start-ups as a specific policy orientation. However, they recognise the commercialisation of knowledge as an important policy priority and emphasise the need to tailor innovation support according to the different requirements of the various stages of project development.

The 2008-2012 *Special Programmes for Science Technology and Innovation* (PECITI) issued in 2008 marks clear progress over the preceding programme (PECYT) inasmuch as it fosters greater integration and an improved policy mix for Mexico's S&T and innovation system. Indeed, the PECITI puts greater emphasis on policies that foster co-operation between PRIs and the business sector, the development of human resources for S&T, and direct support to business innovation, in particular SMEs (CONACYT, 2008c). However apart from its reference to the Technological Innovation Fund created in 2007, the PECITI does not mention the creation of NTBFs or S&T-based start-ups as a specific policy orientation deserving of dedicated support instruments.

The *National Innovation Programme* (PNI) prepared in 2011 under the aegis of the Intersectoral Innovation Committee (CII) is more explicit about the importance of developing policy instruments in support of NTBFs and start-ups. This programme recognises that “through the use of various types of support programmes and instruments the government should ensure the availability of sources of financing of innovative projects throughout their development stages” (Government of Mexico, 2011a).

The programme puts particular emphasis on the need to support the development of sources of seed capital and rightly stresses the importance of linking private capital to government initiatives. As will be highlighted in Chapter 2, it is in the framework of this programme that the main funding instruments financed by the Ministry of Economy and operated by CONACYT and NAFIN that are currently in use were developed.²² Additionally, the PNI defines a number of indicators deemed necessary to monitor the creation and expansion of NTBFs and to assess the outcomes of support programmes and instruments.²³

The PNI is undoubtedly a valuable governance and policy initiative. It gives a fair assessment of Mexico's innovation performance, highlights policy gaps, provides a clear vision of innovation policy priorities and defines a number of support programmes and instruments that should foster the creation and expansion of NTBFs, in particular those related to technology transfer mechanisms and the availability of early-stage financing. However, like too many documents of this kind which are mainly devoted to the definition of policy frameworks and priorities, it often falls short of attempting to translate its carefully considered lines of action into concrete policy implementation measures and devotes too little attention to the details of co-ordination, implementation and budget allocation.

Revision of the Securities Market Law

Private equity participation in the form of angel and venture capital are the main sources of finance for the early and expansion stages of knowledge-based start-ups. While access to these sources is an imperative for the entrepreneurs who are at the origin of the start-up project, both the investors and the original owner who engage in a relationship of trust involving a risky project need to have their ownership rights protected, in particular those with minority rights. This is a condition that guarantees the mutual interest of both parties. It follows that start-ups should benefit from a type of corporate governance status that provides this type of guarantee. This was done in Mexico through the creation of SAPIs in 2005 (Box 1.2).

Box 1.2. Promoting private equity investment through corporate governance reforms

The creation of SAPIs

Private equity investments have boomed in the past several decades, particularly in the United States and other developed countries, where most private equity investments are concentrated. Latin America lags far behind. It receives around 1% of global private equity flows, of which Mexico only receives 10%. This is by no means representative of the size of its economy.

At the end of 2005 Mexico amended its Securities Market Law (*Ley del Mercado de Valores*, LMV), with a view to fostering the development of private equity through specific corporate governance provisions that guarantee the rights of minority shareholders in privately owned companies and facilitate their possible transition to publicly owned ones. This was done through the introduction of a new form of corporation: the *Sociedad Anónima Promotora de Inversión*, or SAPI.

In the framework of SAPIs all investors, controlling and non-controlling, acquire rights and obligations which allow them much more control and ensure more transparency than before, while allowing for a better alignment of interests among shareholders. It also creates incentives for founders of start-ups to attract external private equity and in particular seed and venture capital, and for external investors to be able to establish rules to secure their equity.

The new LMV law became effective in June 2006. While it has not substantially boosted the private equity market in Mexico in the last five years it has facilitated the access of new technology-based start-ups to seed capital funds as most of these start-ups were created under the SAPI status and venture capital funds would have been more reluctant to invest in them in the absence of a corporate status.

Source: Author's elaboration based on OECD mission interviews and www.iflr.com/Article/1984607/SAPIs-to-promote-private-equity-in-Mexico.html.

Structural weaknesses and challenges

Mexico continues to suffer from a number of structural weaknesses that affect the dynamism of the S&T-based start-up population as regards both the conditions of their initial creation and those that impinge upon the sustainability of their further stages of development and their survival rates. Some of the most important weaknesses are briefly outlined below.

The public S&T system's relatively low capacity to generate knowledge with commercial potential

Mexico has a number of public research institutions that enjoy a relatively high level of scientific excellence according to international standards and whose performance has improved in terms of the volume and relevance of their scientific publications.²⁴

However this performance is lower in terms of their international (Patent Cooperation Treaty, PCT) patenting, generally the source of the intangible assets that are most likely to give rise to S&T-based start-ups, especially academic spinoffs. As shown in Table 1.1 Mexican PRIs and HEIs lag behind those in other major Latin American countries in this area and their performance did not improve in the second half of the last decade.²⁵

Table 1.1. Number of PCT patents filings by institutional sector and priority date

Selected countries, 2006-09

	BIOTECH				ICT				TOTAL			
	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009
Public research institutions												
Brazil	0	2	2	1	1	1	2	1	4	14	6	7
Chile	0	0	0	0	0	0	0	0	0	1	2	0
Colombia	4	0	0	1	1	0	0	0	4	0	3	6
Mexico	1	1	3	0	2	2	2	0	8	13	12	2
Higher education institutions												
Brazil	15	14	17	14	8	9	6	9	44	53	56	44
Chile	1	4	7	5	0	1	5	1	8	11	20	14
Colombia	1	0	0	1	0	0	1	2	1	1	4	7
Mexico	1	3	3	3	1	3	3	1	14	17	17	5
Total research institutions												
Brazil	15	16	19	15	9	10	8	10	48	67	62	51
Chile	1	4	7	5	0	1	5	1	8	12	22	14
Colombia	5	0	0	2	1	0	1	1	5	1	7	13
Mexico	2	4	6	3	3	5	5	1	22	30	29	7

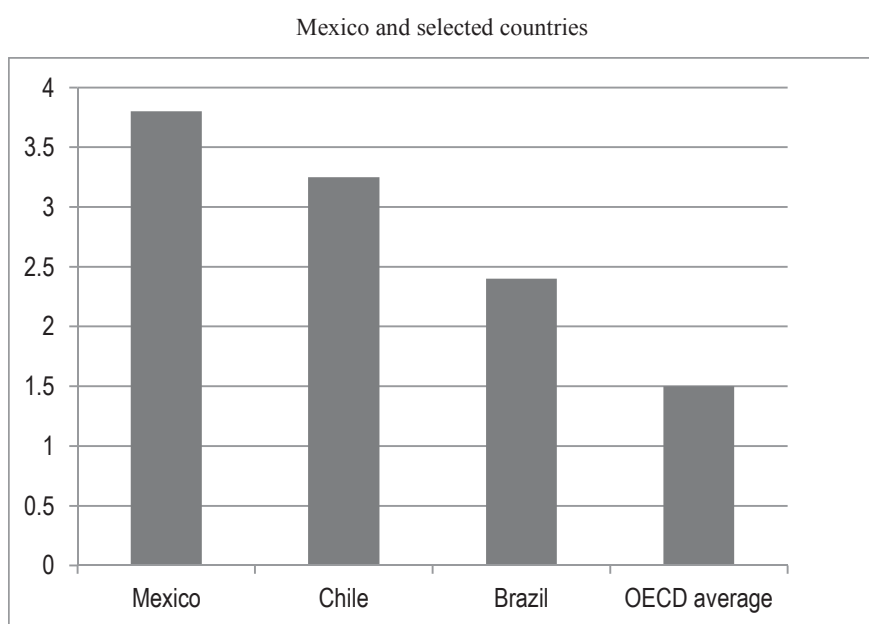
Source: OECD, Patent Database, February 2012.

The scheme recently developed in the framework of the FINNOVA programme to support the development of certified TTOs in PRIs and HEIs (see Chapter 2) will provide additional incentives for their patenting activities, hopefully both at national and international level.

Administrative barriers to the creation of start-ups

While administrative barriers to entrepreneurship have decreased with the introduction of the system for quick start-up business (SARE) in the early 2000s and its subsequent further generalisation there are still non-negligible administrative barriers to the creation of start-ups in Mexico. At the end of the last decade, Mexico lagged behind other OECD major Latin American countries in this area (Figure 1.1).²⁶

Figure 1.1. Administrative burden on start-ups, 2008*



* Index scale of 0-6 from least to most restrictive.

Source: OECD, Indicators of Product Market Regulation Database (OECD, 2011a).

Financial markets and access to capital for risky ventures

Compared to their counterparts in more advanced OECD and major Latin American countries Mexican SMEs in general and start-ups in particular face more difficulties for accessing bank credit in order to develop.

First, the banking system's engagement in the economy is quite limited for Mexico's level of development as shown by the low level of credit to the private sector as a proportion of GDP (Table 1.2).

Table 1.2. Domestic credit to private sector (% of GDP)

Mexico and selected Latin American countries (average 2007-11)

Mexico	Brazil	Chile	Colombia	Advanced OECD countries
24.6%	57.0%	86.3%	43.5%	> 100%

Source: World Bank (2012).

Second, SMEs are penalised by sharp asymmetries between large and small companies. SMEs face greater difficulties for accessing bank financing given their higher risk and lack of access to foreign borrowing. While larger companies in tradable sectors have access to bank credit, SMEs rely mainly on costly suppliers' credit. This is not a possibility for start-ups which are further penalised by the highly conservative and risk-averting behaviour of the banking system.

Access to capital by new technology-based firms remains especially difficult as the effects of the traditional conservatism of the banking system, naturally adverse to financing intangibles, are compounded by the scarce and costly system of guarantees and the paucity of alternative sources of finance. Furthermore, financing instruments such as private equity and venture capital are particularly underdeveloped. Accordingly, the provision of venture capital as a share of GDP is very low by international standards (Table 1.3).²⁷

Table 1.3. Private equity/venture capital as a proportion of GDP

Selected countries, 2008-11

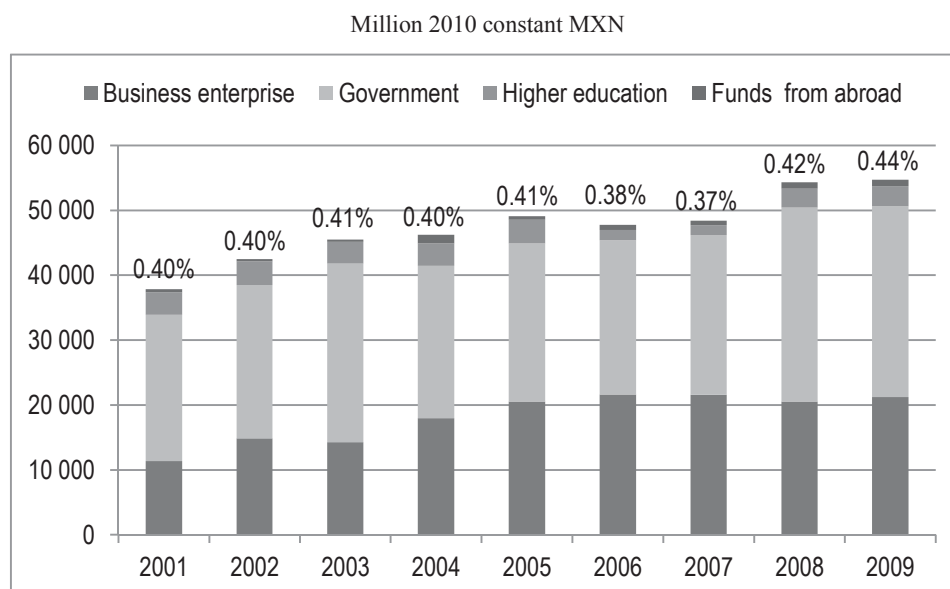
Country	2008	2011
Israel	0.94	0.73
Spain	0.32	0.18
Brazil	0.14	0.27
Chile	0.13	0.18
Colombia	0.04	0.16
Mexico	0.04	0.02

Source: LAVCA annual reports 2008, 2011.

This situation reflects a systemic failure that hampers the creation of new S&T-based firms by “freelance” innovative entrepreneurs. As will be seen in Chapter 2, the situation is slowly beginning to improve with the emergence of angel capital funds and the implementation of public financial instruments in support of seed and venture capital funds.

Low leverage of public R&D investment in private innovation

Over the last decade the volume of R&D expenditures has grown slowly. The ratio of these expenditures to GDP has fluctuated between 0.40% and 0.44%, which places Mexico among the two or three worst OECD performers on this indicator (Figure 1.2).

Figure 1.2. Gross domestic expenditures on R&D by sources of funds and as percentage of GDP, 2001-09

Source: *Indicadores de actividades científicas y tecnológicas, Edición de Bolsillo*, CONACYT (2010).

The structure of these expenditures both by sector of performance and by sources of funds is skewed and marked by the relatively low engagement of the business sector. It is notable in particular that, contrary to what happens in most OECD countries, the share of the business sector in R&D performance and funding has stagnated or fallen in the last half of the 2000s (Figure 1.2 and Table 1.4). In Mexico it seems that, contrary to an important expected outcome of public investment in S&T, the leverage of that investment on business R&D and innovation expenditures remains very weak.

Table 1.4. Gross domestic expenditures on R&D and distribution by sector of performance, 2001-09

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Million MXN ¹	38 143	42 847	45 863	46 592	49 542	47 839	48 472	54 417	54 823
Total Million USD	2 453	2 733	2 866	3 036	3 499	3 600	3 844	4 616	4 616
Business sector	30.3%	34.0%	30.7%	42.7%	46.9%	48.9%	47.5%	37.9%	40.7%
Government	39.1%	25.0%	28.4%	25.9%	23.2%	24.1%	25.1%	29.9%	27.4%
HEI	30.4%	39.7%	39.7%	30.3%	28.7%	25.8%	26.0%	29.4%	29.0%

¹ At 2010 constant prices.

Source: *Indicadores de actividades científicas y tecnológicas, Edición de Bolsillo*, CONACYT (2010).

This raises the important question of the cost effectiveness and additionality effects of programmes in support of business innovation, especially in a period in which the funding of such programmes is experiencing a levelling of budgetary appropriations by CONACYT and in programmes funded by the Ministry of Economy (Table 1.5). The limited effectiveness of existing programmes in a context of a levelling of resources may have important implications for the funding and implementation of programmes designed to support the creation and expansion of S&T-based start-ups.

Table 1.5. Budget appropriations for CONACYT and innovation support programmes

Million current MXN

	CONACYT budget	PEI ¹	FINNOVA ²	FIT ²	Total innovation
2009	15 474.7	2 500.0	-	0.00	2 500.0
2010	15 946.6	2 630.1	139.3	USD 124.9	2 894.9
2011	17 619.0	2 450.2	124.8	USD 104.4	2 679.5
2012	21 872.2	2 000.0	287.0	USD 102.0	2 389.0

¹ CONACYT Innovation incentive programme.

² Programmes funded by the Ministry of Economy.

Source: Budget data 2009-2012, Ministry of Finance.

Concluding remarks

Over the last decade, starting with the launching of the AVANCE programme, Mexico's S&T policy has progressed on various fronts towards the build-up of an innovation ecosystem better adapted to technology transfer and the development of innovative SMEs, including knowledge-based ones. Major achievements have been made through the revision of the S&T Law: greater autonomy has been granted to PRIs and HEIs to develop their technology transfer schemes through more efficiently managed TTOs and the establishment of the Intersectoral Innovation Committee (CII) constituted a positive institutional initiative aimed at improving governance and innovation policy and its co-ordination across government agencies and ministerial departments.

However, the effects of these improvements on actual policy design and implementation as well as on outcomes in terms of SMEs' innovative performance and the creation of NTBFs are still lagging. As will be seen in Chapter 2, despite the valuable policy orientations given in the framework of the PNI, support programmes and instruments in support of SMEs and NTBFs still suffer from insufficient co-ordination, partial duplication, critical mass shortcomings and in some instances, management and delivery problems.

The most important obstacles to the development of NTBFs may still be the chronic weakness in the supply of seed, angel and venture capital and the low leverage effects of public support on access to such capital.

Notes

1. This often happens when governments tend to have innovation policy approaches with a high degree of selectivity based on the nature of the supported enterprises.
2. As in the case of capital markets and institutional mobility of human resources.
3. Notably through support programmes such as PROMTEC, FORCCYTEC, and PRAEM (OECD, 2009).
4. This was the case of the model developed by the IPN (National Polytechnic Institute).
5. Implemented either by CONACYT, or by the Ministry of Economy (e.g. Fondo PYME), or jointly between the two (Technological Innovation Fund - FIT).
6. Initially created as the S&T Sectoral Fund for Economic Development, its name was changed to the Technological Innovation Fund in 2007.
7. Especially the so-called “gazelles” which are high-growth SMEs as defined by the Ministry of Economy.
8. AVANCE is the Spanish acronym for High Value Added for Knowledge Businesses and Entrepreneurship.
9. Firms benefitting from AVANCE support measures had to be registered in the National Registry of Scientific and Technological Institutions and Enterprises (RENIECYT). This meant that individuals who were developing knowledge-based start-ups but had not yet established its form and registered it could not benefit from the programme except if they were developing the start-up within a registered institution. This point was highlighted in the OECD review of Mexico’s innovation policy (OECD, 2009).
10. Between 2003 and 2008 around MXN 400 million were spent in support of 139 projects under the Last Mile programme; between 2006 and 2008 the Entrepreneurs Fund invested a total of about MXN 110 million in 19 firms and the Guarantee Fund backed five loan requests (González Brambila, 2008).
11. To some extent the elements of risk inherent in a support programme like AVANCE can be compared to those affecting angel or venture capital funds where the returns from a small percentage of successful investments more than compensate for a much larger proportion of unsuccessful ones. Funds need to have critical mass to begin with so as to spread risk over a sufficiently broad portfolio. They also need to operate with a time horizon that allows them to balance the risks against the prospective returns.
12. Except for the AERIs programme launched in 2007. Competitive calls were launched for these support schemes in 2008. In the case of AERIs a first call was launched in 2007 and a second in 2008.
13. However, this instrument stopped short of supporting the much higher costs of international patenting.

14. One of the purposes of this support scheme was to induce beneficiary institutions to implement TTOs according to validated models based on successful international or domestic experience. It is in this context that CONACYT commissioned a review of TTOs models on the basis of international experiences (ADIAT, 2010).
15. Behavioural additionality effects reflect changes in patterns of R&D and innovation investment as a result of, or in response to, government policy instruments (OECD, 2006).
16. Output additionality is defined as the share of outputs (e.g. increase of qualified employment, sales of new products, etc.) that would not have been achieved without public support (OECD, 2006).
17. The Ministry of Finance performance criteria for programme funding usually use a much shorter term than those that should be used to assess the behavioural change of firms' innovation investment in response to government support programmes, especially when these programmes have experimental characteristics. Moreover, in funding allocations AVANCE competed with other support programmes such as sectoral and mixed funds whose outcomes were more immediately visible.
18. In Spanish, Unidades de Vinculación y Transferencia de Conocimiento (UVTC).
19. If public resources can be allocated for the development of TTOs they cannot be used to cover the operating costs of these offices.
20. There are however some remaining barriers owing to the discrepancies between the S&T Law and the Public Service Law which is more restrictive as concerns the complementary income which public researchers can receive as public servants and their possible status in a privately owned firm.
21. See S&T Law Articles 41, 41bis and 41ter.
22. Notably the FIT with its new support instruments more geared to NTBFs, the FINNOVA Innovation Sectoral Fund, and the Fund of Funds for Entrepreneurship Capital (*Fondo de Fondos de Capital Emprendedor*).
23. Such as their share in total enterprise creation and the number of HEI and PRI spin-offs and NTBFs in the total of innovative enterprises. The PNI seems to underestimate the difficulty of developing these kinds of indicators.
24. Number of articles published in international journals or number of citations over a five-year period (CONACYT, 2010).
25. The best performing research and higher education institutions in terms of PCT patent filings over 2005-09 have been ITESM, UNAM, IMP, UAM, CINVESTAV and IPN.
26. According to the World Bank's *Doing Business 2012* Mexico's ranking for starting a business dropped 9 places from 66 in 2011 to 75 in 2012 (www.doingbusiness.org/data/exploreeconomies/mexico#starting-a-business).
27. Table 1.3 includes growth equity investing. In a recent review of Mexico venture capital the estimate of the share of seed and other forms of early-stage investing in GDP was 0.0003% in 2007 compared with 0.42% in Israel and 0.22% in the United States (Lerner, 2010).

References

- ADIAT (2010), Oficinas de Transferencia de Tecnología – Fundamentos para su formación y operación en México, ADIAT, México.
- Autio, E., M. Kronlund and A. Kovalainen (2007), High-Growth SME Support Initiatives in Nine Countries: Analysis, Categorization, and Recommendations, Ministry of Trade and Industry, Publications 1/2007, Helsinki, Finland.
- CONACYT (2008a), Lineamientos del Subprograma de Alto Valor Agregado en Negocios con Conocimiento y Empresarios – AVANCE, mimeo, México.
- CONACYT (2008b), Términos de Referencia para la Operación de la Modalidad “Paquetes Tecnológicos” Subprograma AVANCE, mimeo, México.
- CONACYT (2008c), Programa Especial de Ciencia, Tecnología e Innovación, 2008-2012, CONACYT, México.
- CONACYT (2010), Science and Technology Indicators at a Glance, CONACYT, México.
- González Brambila, C. (2008), Informe de Evaluación del Programa AVANCE, ITAM, México.
- Government of Mexico (2011a), Programa Nacional de Innovación, mimeo, Comité Intersectorial para la Innovación, México.
- Government of Mexico (2011b), Ley de Ciencia y Tecnología (Última Reforma), Diario Oficial de la Federación, México.
- LAVCA (2011), Scoreboard 2011 – The Private Equity and Venture Capital Environment in Latin American Countries. <http://lavca.org/2011/05/09/2011lavcascorecard/>.
- Lerner, J. (2010), “Mexico Venture Capital Review”, paper presented at the 2010 Monterrey Venture Capital Conference, www.mvcc.mx/wp-content/uploads/2010/04/Mexico-VC-Report-2010.pdf
- Lilischkis, S. (2011), Policies in support of high-growth innovative SMEs, INNO-Grips Policy Brief No. 2, European Commission, Brussels. www.proinno-europe.eu/innogrips2
- OECD (2003), *Turning Science into Business: Patenting and Licensing at Public Research Organisations*, OECD Publishing.
doi: [10.1787/9789264100244-en](https://doi.org/10.1787/9789264100244-en)
- OECD (2006), *Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality*, OECD Publishing.
doi: [10.1787/9789264025851-en](https://doi.org/10.1787/9789264025851-en)
- OECD (2009), *OECD Reviews of Innovation Policy: Mexico 2009*, OECD Publishing.
doi: [10.1787/9789264075993-en](https://doi.org/10.1787/9789264075993-en)

- OECD (2010), *High-Growth Enterprises: What Governments Can Do to Make a Difference*, OECD Studies on SMEs and Entrepreneurship, OECD Publishing.
doi: [10.1787/9789264048782-en](https://doi.org/10.1787/9789264048782-en)
- OECD (2011a), *OECD Product Market Regulation Statistics* (database),
<http://dx.doi.org/10.1787/pmr-data-en>
- OECD (2011b), *Business Innovation Policies: Selected Country Comparisons*, OECD Publishing.
doi: [10.1787/9789264115668-en](https://doi.org/10.1787/9789264115668-en)
- OECD (2012), *OECD Patent Statistics* (database).
doi: [10.1787/patent-data-en](https://doi.org/10.1787/patent-data-en), OECD, Paris
- Pérez Hernández, P. and A. Márquez Estrada (2006), Análisis del Sistema de Incubación de Empresas de Base Tecnológica de México, Congreso Iberoamericano CTS+I, mimeo, www.oei.es/memoriasctsi/mesa11/m11p03.pdf
- World Bank (2012), *Doing Business in 2012*, World Bank, Washington D.C.

Chapter 2

Critical overview of support programmes

This chapter reviews the main policies and instruments that support the development of innovative small and medium-sized enterprises and can be used to encourage the creation and expansion of knowledge-based start-ups. It analyses the role and performance of public and private financial institutions as well as that of other intermediary institutions in the development of new technology-based firms. On the basis of interviews conducted with a number of knowledge-based start-ups created in the last five years and with selected higher education institutions the chapter provides some insight into factors that impinge upon the performance of the private and the academic sectors in terms of the creation of knowledge-based start-ups.

As noted in Chapter 1, most government S&T and innovation support programmes, except those defined in the National Innovation Programme (PNI), do not explicitly mention the development of new technology-based firms (NTBFs) as a specific policy orientation. Mexico has recently implemented several instruments to support different phases of the innovation process in domestic firms. Although most focus mainly on the development of established firms' innovative activities (product and process development and market expansion, among others), some involve support for the creation of new firms. Most support therefore goes to the established firms that represent lower risks for (public or private) investors. In this respect, Mexican innovation policy differs from that of other OECD countries (or some emerging economies such as Brazil) which place greater emphasis on direct support for the creation and growth of NTBFs.

The first section of this chapter reviews the current portfolio of policies and instruments in support of innovative small and medium-sized enterprises (SMEs) at federal and regional levels that can contribute directly or indirectly to the creation and expansion of knowledge-based start-ups, with particular attention to those considered in the framework of the PNI. It also gives some insights on government support measures from a small panel of recently created NTBFs.

The second section analyses the role and performance of public and private financial institutions in the development of NTBFs as well as those of other types of intermediary institutions that benefit from public funding and are more oriented to supporting NTBFs' competencies, strategic development and capacity building. The third then reviews the role and performance of higher education institutions (HEIs) in the creation of knowledge-based start-ups with a focus on the best-performing institutions. It also sheds light on aspects of the regulatory environment that may impinge upon the academic sector's creation of start-ups. Finally, the fourth section discusses the importance for NTBFs of the build-up of regional innovation systems, which may be facilitated by greater decentralisation of policy implementation.

The chapter concludes with a brief overall assessment of the innovation policy framework in terms of issues concerning governance, funding, implementation and delivery issues that may affect the dynamism of knowledge-based start-ups.

Current government programmes and instruments providing direct or indirect support to new technology-based firms (NTBFs)

This section focuses on the policies and instruments of federal departments and public agencies that directly or indirectly support various stages of the development of NTBFs, mainly CONACYT, the Ministry of Economy, the Ministry of Education and the National Development Bank (NAFIN).

The presentation follows the stages in the creation and expansion of NTBFs: the incubation stage that precedes actual firm creation; the early development stage (e.g. patent registration, proof of concept, prototype development); the managerial and initial investment stages (e.g. coaching, seed and venture capital); and the expansion stage (e.g. venture capital).

It is important to note here the differences between innovation support programmes whose financial grants or incentives are channelled through existing trust funds and those whose support is granted through budget funds. In effect, the type of fund (or financial instrument) best adapted to supporting the various phases of NTBFs' development is an important issue. The difference between the two types of funds, in terms of modes of

funding, management implementation and co-ordination, are significant, as trust funds can be disbursed over several fiscal years and thus have the flexibility to finance projects over development stages that may exceed a fiscal year. In principle they also allow for better fine-tuning of the support programme over various competitive calls and better selection and evaluation procedures. The management of trust funds may imply more complex inter-institutional co-ordination and discontinuities in the focus of support in the sequence of competitive calls. Such discontinuities may be warranted by policy adjustments following programme evaluations, but they may also give rise to policy instability. This does not serve the interests of potential beneficiaries who have to wait for competitive calls to know what the modalities of support will be in terms of focus and eligibility.

On the other hand, while support programmes financed by budget funds are more stable over time, the fact that grants have to be disbursed within a fiscal year makes this type of funding better adapted to innovative projects of existing firms rather than of NTBFs, as these may require a form of support that can be scheduled over a longer period. The fact that budget funds undergo yearly evaluations may also lead to biases, as the expected outcomes may require periods longer than a fiscal year.

The review of the programmes and instruments makes clear that there is incipient government attention to supporting science and technology based start-ups in Mexico but not yet a coherent policy framework. Policy is still fragmented, with an ad hoc combination of existing or recently developed support measures that mostly apply to entrepreneurship and incubation, promotion of innovation in SMEs, strengthening technology transfer between research institutions and HEIs and the business sector, and improving the availability of seed, angel and venture capital. As will be seen, beyond this fragmentation and the variation in the focus of competitive calls of interest for the development of knowledge-based start-ups, partial duplication of support programmes implemented by various department or agencies highlights policy governance and co-ordination issues and possible waste of public resources, especially when programmes lack critical mass.

Incubation and entrepreneurship

Ministry of Economy: National System of Business Incubators (SNIE) and incubator programme

In Mexico the Ministry of Economy has undertaken efforts to promote entrepreneurship through incubators in public and private institutions since the turn of the century. However, the primary objective of the incubator programme was not necessarily to support medium-technology or high-technology entrepreneurship, but rather to address pressing social issues by reducing unemployment through support of entrepreneurship among medium- and relatively low-skilled labour.

Incubators supported by the ministry through a programme of its Fondo PYME¹ are part of the National System of Business Incubators (SNIE) in the following categories: the traditional business incubator,² medium-technology business incubator,³ and high-technology business incubator in sectors such as information and communication technology (ICT), biotechnologies and health, advanced food processing, energy and environmental remediation.

Table 2.1. Fondo PYME: main measures in support of the creation and operation of incubators

Objective	Costs supported	Level of support (MXN)	Periodicity
Creation of incubator according to accredited model	Consulting costs		Once per institution
High technology		50% up to 1 000 000	
Medium technology		50% up to 250 000	
Traditional business		50% up to 200 000	
Operating costs	Office equipment and consulting		Once per year and institution
High technology		60% up to 5 500 000	
Medium technology		60% up to 1 500 000	
Traditional business		60% up to 300 000	
Operating costs	Capital equipment		Once per year and institution
High technology		35% up to 3 000 000	
Medium technology		35% up to 700 000	
Traditional business		35% up to 400 000	
Monitoring and evaluation	Consulting costs	90% up to 150 000	Once per year and institution

Source: Secretaría de Economía, Fondo PYME, www.fondopyme.gob.mx.

Public support for incubators in public or private institutions is provided at the development stage for the adoption of a business model which must be validated by the ministry⁴ and at the consolidation stage for equipment and infrastructure expenditures (Table 2.1). Incubators generally also receive support from other entities, such as state governments or professional associations. According to the SNIE operational rules, the average time of incubation can be up to two years for high-technology incubators.

According to a recent Ministry of Economy report on the SNIE's operation there are about 500 incubators located in 190 cities. Of the total, 217 are traditional, 262 are medium-technology and only 21 are high-technology incubators. From a different perspective, there are eight municipality incubators, five incubators created by firms, 123 created by non-governmental organisations (NGOs), 30 social incubators, and 328 incubators created in universities or technological institutions (204 in public institutions and 124 in private ones). About 5% of total incubators cater for high-technology firms. Among these over 60% are located in the Federal District and the states of Mexico, Jalisco and Nuevo Leon.

Ministry of Education: incubator networking

The Ministry of Education (SEP) has also been strengthening the incubator programme, particularly in the public technological and polytechnic institutes, using models approved by the Ministry of Economy, the responsible public agency in this area. Each institute provides own resources for its incubator's infrastructure, while the Ministry of Economy, through Fondo PYME, covers the other relevant areas (training, knowledge transfer or consulting expenses, among others).

The Ministry of Education plays a crucial role in the creation and strengthening of the incubator programme, as it continuously reviews and applies successful incubation models at the technological universities through detailed monitoring and training (Garcia

Ibarra, 2012). It is also a fundamental link between public regional academic institutions (many of them in extremely poor parts of the country and completely cut off from science and technology) and the Ministry of Economy.

To date, technological institutes have developed 122 incubators, located throughout the country. This networking started operating in 2009 under the CIIE (centres for firm incubation and innovation). The technological universities have created 65 incubators in 27 states and operate since 2007 as part of the RISUT (Network of Incubators of the Technological University Sub-System). The Polytechnic University system of incubators, created in 2010, is the most recent and has nine incubators in eight states. It is known as INCUPOLS (Polytechnic Universities Incubators).

The incubator system represents an enormous effort by the government to promote an entrepreneurial culture and to provide regional public technological institutions with knowledge-based tools, but the programme is just beginning and, according to SEP officials, only 5% of the incubators created are of the high-technology type and no more than 1-2% of projects emerging from these incubators can be considered high technology.

Early development stage

Technological Innovation Fund (FIT)

The FIT,⁵ financed by the Ministry of Economy and CONACYT, is a trust fund oriented towards innovative firms, typically SMEs. As noted, this structure allows for the disbursement of the appropriated resources across several years. No minimum amount is specified, but public funds usually cover 50-70% of the total project cost. Accepted projects usually receive formal replies within 45 days following application.⁶ FIT grants resources according to three “modalities” (or types of proposals):

- i) Development and technological innovation: innovative improvement of products, processes and services. This modality includes provision of support for consulting services, development of pilots, and elaboration of prototypes to validate the financing and commercial strategy associated with launching the innovative project.
- ii) Creation and consolidation of research groups: projects that include specialists and professionals associated with the relevant industry, as well as laboratory equipment.
- iii) Pre-commercial validation of the science and technology (S&T) components of innovative projects deemed necessary to prepare and present viable business plans and attract private investors and other financing sources.

Modalities i) and iii) can concern NTBFs although the main beneficiaries of modality i) are likely to be established firms seeking support for a new innovative project. Modality iii) was only introduced in 2010.⁷ Although it can benefit established firms it can be considered a new initiative to promote NTBFs. Under this modality costs eligible for support include those related to: IP registration at national or international (Patent Cooperation Treaty – PCT) levels; techno-economic feasibility studies; legal and other consulting services to prepare the business plan; environmental and sanitary certification. These costs are similar to those covered by the AVANCE “technological packages” presented in Chapter 1. This is also a good example of a programme that was a budget fund (AVANCE) and became a trust fund (FIT).

Having drawn the lessons from AVANCE, CONACYT's performance in implementing the fund has been quite good. Between 2007 and 2011, FIT supported 517 projects with a total public investment of MXN 1 397 million (in 2010 and 2011 public financing amounted to MXN 930 million), and reported a complementary private investment of MXN 1 525 million for a multiplier effect of 1 to 1.15 of private investment. The total cost of the 517 projects supported over five years was therefore nearly MXN 3 000 million (an average of almost MXN 6 million per project, mainly from the SME sector of the Mexican economy).⁸

Innovation Stimulus Programme (PEI)

In 2009 CONACYT launched the Innovation Stimulus Programme (PEI)⁹ following the suppression of the R&D tax incentive programme that had been in place from 2001 to 2009 (OECD, 2009).¹⁰ This competitive matching fund programme is implemented on an annual fiscal basis with no carryover for beneficiary enterprises. It has two main objectives: to foster enterprises' innovation activities through the provision of subsidies for R&D and innovation-related costs, including those pertaining to the training and incorporation of highly skilled human resources; to encourage collaboration among firms and between firms and public research institutes (PRIs) and HEIs on research and innovation activities.

The PEI has three modalities: INNOVAPYME for SMEs, INNOVATEC for large companies and PROINNOVA for SMEs or large companies that allocate at least 25% of the total cost of the project to a public or private university or to a public research centre. Only INNOVAPYME can be considered an instrument for the creation or expansion of NTBFs. To CONACYT's credit, in the last three years a number of such firms have benefited from the programme to launch or to expand S&T-based innovative activities.¹¹

Firms applying to INNOVAPYME can be supported up to MXN 21 million per project (35% of the total cost if the firm applies alone and 50% if it applies with an academic institution).¹² Between 2009 and 2012, the PEI's total budget was MXN 9.5 billion, although its budget decreased during 2009-2012 from MXN 2.5 billion to MXN 2 billion. During the first three years, the PEI supported 1 723 projects, more than a half of them presented by SMEs, of which INNOVAPYME supported 648.

Fondo PYME: "gacela" firms

Fondo PYME supports SMEs in areas such as advice for boosting their companies, locating new markets and consolidating value chains in different industries.¹³ In general, Fondo PYME (not only the "gacela" firms) has one of the largest budgets among public policy instruments directed to SMEs. In 2010 the appropriated budget was MXN 6 billion.

"Gacela" firms are companies that have rapidly increased their value. For this category, the Ministry of Economy supports innovation and technological development; increase in value; business acceleration; expansion and diffusion of models of successful franchises. The support covers: innovation and technological development projects: MXN 1.75 million (50% of total cost) for a single firm and MXN 3.5 million (60% of total cost) for a group of firms; technology adoption: MXN 0.75 million for a single firm and MXN 2 million for a group of firms; and development and implementation of prototypes: MXN 1.75 million (80% of total cost).

For gacela firms the Fondo PYME can support the expansion stage of established NTBFs. Even if the main objective of this instrument is to grow established firms, communication could be improved between CONACYT and the Ministry of Economy for

reviewing applications for this programme from projects already supported (recently created firms) by other programmes of these public agencies or for directing previously supported successful projects to a further stage of development as *gacela* firms.

Mexico Emprende

This programme supports the creation of enterprises that have gone through the incubation process (Table 2.2). Services offered by this programme include: linkage to public and private programmes, financial services (advice for loan application) and entrepreneurial coaching, among others. In terms of seed capital, one of the main components of this programme, loans are considered for market studies, commercial prototypes, business plans, protection of intellectual property rights (IPR). However, most HEI-based high-technology incubators consider that the Ministry of Economy seed capital programme suffers from bureaucratic management and is too costly in terms of interest payments.

Managerial and innovation investment support

Sectoral Innovation Fund (FINNOVA)

FINNOVA is a trust fund created in 2010 on the initiative of the Intersectoral Innovation Committee (CII). In principle, FINNOVA is composed of two separate instruments (ITAM, 2011):

- The Sectoral Innovation Fund financed by the Ministry of Economy and managed by CONACYT, described in this section;
- A venture capital fund of funds, with public resources from the Ministry of Economy, NAFIN and CONACYT, whose role and operation in the financing of the expansion of start-ups is discussed later in the chapter.

Table 2.2. The Ministry of Economy's main instruments in support of enterprises in incubators

Objective	Costs supported	Level of support (MXN)	Periodicity
Development of business plan	Consulting costs		Once per enterprise
High technology		70% up to 50 000	
Medium technology		70% up to 35 000	
Traditional business		70% up to 25 000	
Seed capital (loan) ¹ for start-up phase	Prototypes Business plan and market prospects Capital equipment		Terms
High technology		Between MXN 200 000 and MXN 1.5 million, up to 85% of project cost	48 months with a 9 month grace period. Firm's capital input: 15% minimum
Medium technology and traditional business		Between MXN 50 000 and MXN 500 000, up to 80% of project cost	42 months with a 6 month grace period. Firm's capital input: 15% minimum

¹ Interest rate of 12% in 2012.

Source: Secretaría de Economía (2012), www.economia.gob.mx/mexico-emprende/empresas/emprendedor.

The main objectives of the Sectoral Innovation Fund are to increase the base of innovative enterprises (including start-ups) and to foster the generation of S&T-related public goods and projects with high positive externalities. Sub-programmes of the Fund have more concrete goals which give rise to periodic competitive calls (CONACYT, 2011). The two sub-programmes currently most relevant to the creation and expansion of NTBFs are the creation and strengthening of technology transfer offices (TTOs); and the strengthening of seed and venture capital markets.¹⁴ At present, the two other focus areas are development of S&T public goods aimed at strengthening the innovation system and the development of a “productive biotechnology” programme.

In recent years, the development and strengthening of TTOs has been increasingly recognised as an important way to foster innovative activities in public research institutions, including through academic spin-offs, and to facilitate knowledge transfers to innovative enterprises.¹⁵ In this sub-programme, FINNOVA supports technology transfer centres located in public or private academic institutions, research centres and private companies with four types of activities: consulting, licensing, spin-offs and angel capital market linkages.¹⁶

In terms of strengthening TTOs, FINNOVA is currently certifying private and public academic institutions and research centres in three areas: regulations for technology transfer, intellectual property management and elaboration of a business plan for the TTO. FINNOVA will provide innovation vouchers for the certified institutions; these will be given to firms to subsidise innovation-related services as long as the services are provided by certified TTOs. These vouchers will set conditions for allowing certified institutions to access public funds to strengthen their competencies in areas such as patenting.

The TTO programme can be important for the development of academic spin-offs because the private and public institutions that are certified by FINNOVA can operate as private innovation centres that allow academics and researchers to participate in new businesses (this is also part of recent changes in the legal framework). The projects can be further supported by acceleration programmes and venture capital funds. International evidence indicates that scientific performance by researchers is compatible with technology transfer activities (Zuniga, 2011).

In developing countries, the deployment of efficient TTOs requires long-term financial support and commitment by both public and academic authorities (Zuniga, 2011). FINNOVA will provide support for certain TTOs (an estimated 25-30% of the total) during a period of between three and eight years to establish them firmly. Under the envisaged programme, public support will be conditional on the availability of matching funds from the TTO’s parent institution.¹⁷ The programme will be project-oriented and support activities such as proof of concept and patenting. It may also provide seed capital for spin-offs.

The strengthening of the FINNOVA fund, with additional resources for sub-programmes that have not yet been launched, should undoubtedly boost the creation of NTBFs by the academic and enterprise sectors and their consolidation at the early development stage. In practice the success of the fund will depend upon its efficient management and its leverage effects on complementary resources from more autonomous TTOs and angel capital associations.

Venture capital

NAFIN

Nacional Financiera (NAFIN) is a public development bank that provides capital and financial services to enterprises that are not or are imperfectly served by the private financial sector. NAFIN has both own resources and provides guarantees that allow firms to apply for private funds that would otherwise be inaccessible. It can have an important leverage effect on allocation of resources by the financial markets notably for S&T-based projects.

Fund of Funds – Venture Capital Programme

This programme, administered by NAFIN, is funded by the newly created Fund of Funds, a federal government effort to generate venture capital resources from several public development agencies, such as NAFIN or the Ministry of Economy, that can leverage and operate jointly with private venture capital funds.¹⁸ Target firms for this programme are mainly SMEs, notably S&T-based firms seeking equity capital investment to finance their expansion stages. This new programme, Mexico Ventures, has four components:

- Mexico Venture One, a fund with a planned budget of USD 100 million, adds public resources and capital investment from international institutions to privately managed capital funds to invest in equity/venture capital operations. The average size of each fund is presently around USD 15-20 million and the public share should not exceed 35%.
- Development of training programmes for fund administrators in collaboration with private institutions.
- Technical assistance and coaching for entrepreneurs on project development requirements to attract potential angel and venture capital funding.
- Support for the development of angel and venture capital networks to strengthen the public and private financial components of innovation systems favourable to the development of NTBFs.

Currently, USD 70 million has been assigned to NAFIN by the Ministry of Economy. Of this amount, USD 20 million is already allocated to firms and funds in Mexico, USD 25 million is committed and to be allocated, and USD 25 million is still available for firms or funds interested in the programme. The support depends on the project and type of firm or fund interested, but there is an interest in sectors with good innovative and commercial prospects on domestic and international markets.

Table 2.3 on the following page summarises the programmes and instruments in support of NTBFs presented above. To keep the table simple, only the programmes' most important aspects are mentioned.

Table 2.3. Programmes and instruments in support of NTBFs, 2012

Programme	General objective/focus on NTBFs	Beneficiaries	Amount/period
<i>Incubators</i>			
Ministry of Economy: National System of Business Incubators	Creation and strengthening of incubators: traditional, medium-technology and high-technology Modalities: business plan development (consulting); seed capital for start-up phase (prototypes, business plan, equipment)	Firm associations, social organisations, public and private universities	High-technology: business plan: MXN 0.05 million Seed capital (loan) for start-up phase: MXN 0.2-1.5 million (for 48 months with a 9 month grace period)
Ministry of Economy: Fondo PYME: Incubator System	Creation and strengthening of incubators: traditional, medium-technology and high-technology Modalities: creation (consulting); operation (consulting/equipment); evaluation (consulting)	Firm associations, social organisations, public and private universities	High-technology: Consulting (evaluation): MXN 0.15 million Office equipment: MXN 5.5 million Capital equipment: MXN 3 million Model transfer: MXN 1 million
Ministry of Education: Incubator Networking	Promotion of incubators within technological universities	Technological universities	Each technological university covers the infrastructure costs
<i>Early development stage</i>			
Technological Innovation Fund (FIT)	Development of STI in SMEs interested in increasing their business Mod. (i): Development and technology innovation Mod. (iii): Integration of technology-based business prospects	SMEs interested in innovation in specific sectors (agro, biotechnology, ICT, health)	Depends on project (50-70% of total cost)
Innovation Stimulus Programme (PEI)	Complements on one-year basis innovation projects by firms located in the country Modalities: innovation processes, new products, prototypes, equipment	Firms registered in RENIECYT that present a one-year innovation project	INNOVAPYME: MXN 21 million/ 12 months (per firm, per fiscal year)
Fondo PYME: "Gacela" firms	Innovation and technology development; rapid growth of companies that increase their value in a short period of time (called Gacela)	SMEs with the characteristics of a Gacela firm (rapid increase in value)	Adoption of an innovation project: MXN 1.75 million/ 12 months Technology adoption: MXN 0.75 million/ 12 months Implementation of prototypes: MXN 1.75 million/ 12 months
Mexico Emprende	Supports the creation of enterprises that have gone through the incubation process Seed capital for market studies, commercial prototypes, business plan, IPR protection	SMEs, entrepreneurs	Depends on project (loans)
<i>Managerial and innovation investment support</i>			
FINNOVA	Increase the amount of innovation-oriented firms. Create incentives for development of public centres of technology transfer Mod: Innovation vouchers For NTBFs: consulting, patenting, licensing, spin-offs and consolidation of angel capital Possible contributions to seed and angel capital investment (not yet implemented)	Certified technology transfer offices (TTOs) in public and private academic institutions, research centres, private companies	Certification MXN 0.5 million/ 12 months TTO to reach maturity: 66% of total cost/ 3-8 years
<i>Venture capital</i>			
Fund of Funds Venture Capital Programme	Support for firms seeking additional capital for their projects; complement to other private capital	Firms that require additional capital and report annual sales of USD 20-150 million	Up to MXN 30 million/ 10-12 years as a minority shareholder

Previously reviewed government programmes and instruments are undoubtedly relevant for supporting S&T-based start-ups, as they allow recently created firms or entrepreneurs to access public resources at different stages of the innovation process. However, as discussed below, these instruments have at least two shortcomings: the resources assigned by the Mexican government in support of NTBFs (and, in general, for the whole innovative process) are limited and there are still gaps in the innovation process owing to a lack of programmes or funds.

For instance, most of the programmes described are designed for growing already operating companies, whereas the NTBFs have to find resources at earlier stages for advice on IPR protection or elaborating a business plan. The portfolio of support programmes and instruments should give more attention to the correspondence between the sequencing of support and the support requirements of NTBFs' development stages. There is another clear gap in the innovation process at the angel venture capital stage. As noted below, some intermediary institutions support innovation projects in domestic or international markets, but their resources are scarce and there is a lack of co-ordination among public agencies for sharing information (between them and with private investors) about previously supported successful projects which can become large companies in the future.

Assessment by a panel of enterprises

As mentioned in the Introduction of this report, Mexico lacks databases or statistics that can give a reliable estimate of the country's NTBFs.¹⁹ It is therefore difficult to determine the size of the universe of NTBFs or of the subset that has benefited from the support programmes discussed above. In the absence of the statistical information that would have been needed to evaluate the impact of support instruments on the demography and performance of NTBFs, a limited qualitative assessment exercise was conducted. It was based on interviews of a small panel of enterprises created in 2010 or later which had benefited (or were benefiting) from CONACYT support programme (mainly INNOVAPYME) at the creation and/or development stage.²⁰ The main issues raised by the assessment are discussed below.

Policy transparency and co-ordination

Most of the firms interviewed acknowledged that in recent years greater emphasis has been placed on support for innovative SMEs, notably through FIT and FINNOVA. However, there was a general agreement that the information available about new instruments or policy initiatives is insufficient and that the respective roles of the various agencies or ministerial departments in supporting the various stages of NTBFs' development is not clear enough. Concern was also expressed about a lack of co-ordination among agencies. Support is considered fragmented without insufficient attention paid to the need for matching the support instruments available with the various types of support that are useful at different stages of development. Firms also advocated more homogeneity in terms of the information required by the application forms issued by various agencies or ministerial departments.

Policy management and delivery

Interviewed firms questioned some aspects of the selection process, highlighting the value of a better balance between academic and business representatives on project evaluation committees. They claimed that this would facilitate access to sources of capital.²¹ They also expressed concern about the lengthy delays between project approval and the

actual granting of resources. While similar concerns are voiced in almost every country, it has particular relevance in Mexico for the support granted through budget funds with concurrent resources which have to be spent in the fiscal year. The schedule of support to NTBFs is probably longer than that of support to an existing firm innovative project.

Policy gaps

The main policy gaps identified are the following:

- At present support for incubation is restricted to incubators certified by the Ministry of Economy. Angel capital institutions can also offer incubating and coaching services in the context of their appraisal process. Support for incubating services could be extended to a broader scope of institutions providing such services, subject to a different type of certification process.
- Some firms suggested that seed capital, support for proof of concept activities and international patenting should be more readily available and better funded.
- All firms insisted that the sequence of successful applications to government support programmes should ease access to angel and venture capital sources (public or private).

Role and performance of intermediary institutions

Alongside public support, various intermediary institutions play a fundamental role in promoting NTBFs. Particularly relevant in the context of this report are the private financial institutions that can invest capital in early and expansion stages of NTBFs' development, and those dedicated to the provision of managerial and technological services throughout these stages.²² As in the case of public funds, most of these institutions focus their activities on already established firms, rather than on the processes of creation and expansion of new knowledge-based firms. Public support to NTBFs can also be geared to strengthening the role of intermediary institutions in activities which they can undertake more efficiently than government bureaucracies.

Financial institutions

Angel capital institutions

As mentioned in Chapter 1, the Mexican angel capital market has long been under-developed, and, contrary to a number of OECD countries, angel capital does not benefit from any kind of public support, such as tax incentives for investors or financial support for the creation of specialised networks. However, following a few initiatives in recent years, the situation of the angel capital market is slowly beginning to improve as the following examples illustrate.

Angel Ventures Mexico is one of the largest angel investment “clubs” currently existing in the country.²³ The aim of this fund is to identify potentially successful start-ups and to facilitate their access to capital in their early development stage. Following current international best practices, start-up proposals are submitted to a strict selection process involving professional investment committees. Those that pass the selection process are presented to a group of potential investors interested in participating in new knowledge-based ventures.

The amount of support, the group's participation in the supported firms (usually as minority shareholders), the structure of the new firm and other business aspects considered depend entirely on the type of project presented to the group of potential investors. The financial support is therefore tailored to the specific project. In addition to capital, Angel Ventures offers several services to supported firms, such as business advice, training or promotion of innovation.

Angel Ventures Mexico has now operated for four years. It has 32 business advisers (from different sectors and industries), and MXN 103 million has already been invested in nine new businesses; 1 850 projects and 390 business plans have been reviewed. In 2011, Angel Ventures opened private investment offices in the states of Puebla and Yucatán, and there are 60 potential investors in the Mexico City office.

However, the angel capital groups still face several regulatory difficulties. At least two issues are worth mentioning: first, there is a lack of an incentive scheme (fiscal incentives for investors or support for networking) for angel capital investors in any public agency; and second, there are regulatory issues yet to be resolved, since in Mexico angel capital groups cannot organise themselves as limited liability entities. To do so, they have to register abroad (mainly in Canada or the United States) in order to ensure protection of their minority shareholders.²⁴

Another disadvantage for these private investing clubs (such as the one in Monterrey, to be discussed below) is that they do not receive projects from the National System of Incubators. For new firms this points to a clear gap between public resources and potential private investors. Such a situation could imply that projects developed within an incubator have a higher risk of failing, or that the projects reviewed by the Angel Venture investing committee have good ideas rather than well-developed, market-oriented projects.

The Start Up Factory in Mexico City provides seed funding for radical innovation start-ups. It offers assistance with know-how (in terms of market orientation or product design) and resources for new businesses in exchange for capital participation in newly created firms. The programme has three main features: raising scale (12-18 months), following the business (6-12 months) and start-up boot camp (12 weeks).²⁵ The capital provided for potentially successful start-ups comes from private agents and participation in the newly created firms is usually between 15% and 30% of total capital.

Multilateral Investment Fund (MIF)

The Multilateral Investment Fund (MIF), created in 1993 and managed by the Inter-American Development Bank (IDB), is the largest international provider of technical assistance for private sector development in Latin America. In Mexico as in other Latin American countries it is probably also the most important international financing instrument for the promotion of innovative SMEs. Major activities of the MIF focus on: *i*) capacity building to improve the competitiveness of high-growth and innovative SMEs and facilitate their access to financing sources; and *ii*) direct equity investment in seed and venture capital funds to finance the creation and expansion of NTBFs.²⁶

Concrete examples of the MIF's involvement in Mexico's innovation funds include: participation in NAFIN's Fund of Funds, participation in Nuevo León's FONLIN (reviewed below) and participation in Angel Ventures Mexico. In December 2011, the IDB approved a large investment of private capital in Mexico (USD 4 million), to be operated by Angel Ventures Mexico. It is intended mainly for knowledge-intensive and technology-based firms located in Mexico with capital requirements of MXN 0.2-2 million.

**Box 2.1. The role of intermediary institutions in the promotion of innovative SMEs:
The example of FUMEC**

The United States-Mexico Foundation for Science (FUMEC) was initially established in 1993 as an NGO whose main objective was the promotion of co-operation in science and technology between Mexico and the United States. Over the years FUMEC's objectives have broadened: with the support of the Ministry of Economy and governments of federal states it has become a major actor in the promotion and internationalisation of Mexican technology-based SMEs, particularly in the areas of clean technologies, ICT, life sciences and aerospace and automotive industries. The main assistance programmes in the areas of knowledge management, technological services and business acceleration are the following:

- **The Technology Business Accelerator Programme (TechBA)** identifies highly innovative Mexican small businesses with strong growth potential (gazelle businesses) and assists them in enhancing their technological capacities and developing international partnerships with a view to successful participation in global markets. TechBA was created in 2004, funded by the Ministry of Economy, as part of the Gazelle Enterprises Programme of Fondo PYME. It currently has eight centres¹ outside of Mexico which provide management, technological and networking assistance to businesses that have developed technologies with promising potential on international markets. Over 2010-11 TechBA assisted over 230 SMEs and helped create more than 3 500 new high-value jobs.
- **The Technological and Business Assistance System (SATE)** was created in 2001 as a FUMEC programme funded by the Ministry of Economy's Fondo PYME to provide managerial and technological assistance for the technological upgrading of SMEs through a network of certified advisors. Initially focused on the automotive and machinery industry, it extended its activities in 2004 to cover all technology-based SMEs, to include services related to certification and to intellectual property, and to facilitate the integration of these SMEs in regional or national value-added production networks. SATE also has an important role in facilitating technology-based SMEs' access to sources of knowledge in research institutions and to federal and state sources of support for innovative investment. SATE builds its competencies through the adoption of best practices for the provision of technology assistance and transfer services developed in North American institutions.² In 2010-11 SATE supported 250 SMEs and contributed to a 16% increase in their sales. It also supported some 140 businesses' access to TechBa pre-acceleration and acceleration services and facilitated SMEs' access to public and private sources of funding for innovative projects.

The target groups of these two programmes are existing firms that show good potential for technology-based growth rather than technology based start-ups. However, the competencies developed in the framework of these programmes could be built upon to entrust FUMEC with a role in channelling public funding to the creation and expansion of S&T-based start-ups. In fact FUMEC already has some experience in this area through its participation as a partner in the Microsoft-led BizSpark programme. Since 2008 these two organisations have joined forces to provide support and tools to strengthen Mexican SMEs in the area of information technology. In 2011 the partnership evolved into a jointly managed BizSpark programme. Microsoft provides entrepreneurs the means to access development tools, technical training, free software licensing and technology roadmaps; FUMEC provides technological, managerial and training services. Firms retain intellectual property generated through their participation in the programme. Through competitive calls start-ups are connected to potential investors.

¹ Five in the United States (Silicon Valley, Austin, Detroit, Phoenix and Seattle); two in Canada (Montreal and Vancouver) and one in Spain (Madrid). In each case, TechBa centres operate in close connection with local institutions with successful acceleration performance.

² Such as the US Network of Small Business Technology Development Centres (SBTDC), the Pennsylvania Technological Assistance Programme (PENNTAP) and Canada's Industrial Assistance Programme (IRAP).

Sources: Author, based on OECD interviews; <http://fumec.org.mx>; www.microsoft.com/bizspark.

Business accelerators, managerial and coaching services

Some NGOs and professional associations that are subsidised or supported by government agencies have provided managerial and coaching services to firms with S&T-based development strategies on national or international markets. They have helped strengthen domestic firms that might otherwise have lost market opportunities. Two examples are FUMEC and ADIAT.

FUMEC

The International Business Acceleration Programme, co-ordinated by ECONOMIA and the United States-Mexico Foundation for Science (FUMEC), known as TechBA, was created to promote Mexican firms in domestic or foreign (mainly US) markets. The domestic resources for the programme are provided by the Ministry of Economy. Box 2.1 describes the programme.

ADIAT

The Mexican Association of CEOs of Applied Investment and Technological Development (ADIAT) is an NGO created in 1989. It supports Mexico's public and private R&D centres in boosting applied research, strengthening technological development and spreading best practices in technology management. Over time ADIAT has diversified its activities in several directions.

First, ADIAT has become the major advocacy institution for the promotion of innovation as a strategic policy priority by the Mexican government and the diffusion of best practice policies to improve the performance of the Mexican innovation system. ADIAT also has an important advisory role, notably but not only in the framework of the Consultative Forum on Science and Technology (FCCyT). ADIAT fulfils these advocacy and advisory functions by drawing on significant analytical and evaluation capacities. A clear example is the recent ADIAT international review of TTO models that served as background reference for the FINNOVA TTO support scheme (ADIAT, 2010).

Second, ADIAT broadened the scope of its service activities aimed at enhancing firms and research institutions' innovation capacities. Initially, these activities involved technology management assistance and advice for applications to competitive calls for support programmes; they now encompass coaching services for enterprises and a programme of training for technology transfer specialists from the public and the private sector with a view to greater collaboration between them. Named PAVETT, this programme is partially funded by CONACYT.²⁷

Higher education and research institutions

In most OECD countries, reforms of governance structures, new forms of IPR management and evolving research financing modalities for PRIs and HEIs have led institutions and researchers to put greater emphasis on the commercial exploitation of scientific research results through patenting, licensing activities and the creation of academic spin-offs (OECD, 2001; OECD, 2003a; OECD, 2003b). A recent WIPO document notes that this trend is being emulated in developing countries such as Mexico, where public research institutions have developed relatively significant scientific capacities (Zuniga, 2011). The document stresses in particular the importance, for the development of commercialisation activities and the creation of spinoffs, of policy frameworks and incentive systems for academic patenting and licensing activities.²⁸

Mexico has already undertaken regulatory reforms or policy initiatives that go in the right direction. This is notably the case for the rules that govern IPR ownership and allocation of royalties in HEIs and the extension of the HEI regime to PRIs (in the 2009 revision of the 2002 S&T Law) and the flexibility allowed HEIs and PRIs as regards the legal status of their TTOs.²⁹

Leading Mexico academic institutions have advanced towards fulfilling their so-called “third mission” (i.e. commercialisation of knowledge through technology transfers and academic spin-offs). Through their technological incubators and TTOs and their ability to benefit from government programmes that support collaboration with the business sector, these institutions have upgraded their commercialisation activities, initiated the development of academic spin-offs and promoted the creation of private NTBFs by incubated firms or through knowledge transfers. However, compared to other Latin American countries with similar levels of research performance, the record of Mexican HEIs and PRIs in terms of creation of spin-offs seems to be on the low side.³⁰

This relatively weak performance is no doubt related to factors that are not intrinsically related to public research institutions but rather to the overall system in support of NTBFs, such as project assessment capacities and early financing conditions. These institutions’ patenting performance is also concentrated in a few institutions (Table 2.4) and is relatively weak both at national level and in international comparisons with other Latin American countries with similar or lower levels of development (see Table 1.1 above).

Table 2.4. Patent application ranking – main national universities and public research institutions

Institution	Patents granted	Patents filed	
	1991-2009	2009	2011
ITESM (Monterrey)	3	37	42
CINVESTAV	47	14	39
UNAM	121	21	31
CONACYT Centres	9	37	22
Mexican Petroleum Institute (IMP)	446	12	14
Electrical Research Institute (IIE)	53	6	n.a.
National Polytechnic Institute (IPN)	31	5	13
Autonomous University of Mexico (UAM)	52	5	8
University of Guanajuato	5	10	7
Autonomous University of Nuevo León	8	5	3
Benemerita Autonomous University of Puebla	0	1	13

Source: IMPI.

Several issues relating to Mexico's HEIs and PRIs still need to be addressed. Changes in internal governance and governance policies would help to create NTBFs and foster their performance: through their incubator function (with support for entrepreneurs in IPR protection, market research and business plan elaboration); through TTOs established as a means of support in the FINNOVA programme; and through their increased ability to create academic spin-offs owing to the recent changes in the S&T Law.

This section reviews below, in some detail, the performance of three public institutions (CINVESTAV, UNAM and IPN) and one private university (ITESM) which have established TTOs and incubators. It describes their different experiences with the governance of their innovation and technology transfer activities and the creation of knowledge-based start-ups.

Research Centre for Advanced Studies (CINVESTAV)

CINVESTAV is among Mexico's leading highly qualified basic research centres and probably the one with the highest level of excellence. In recent years it has developed a strategy that combines the pursuit of research excellence with successful initiatives to emphasise applications of its research results not only to achieve socioeconomic development objectives but also to transfer and commercialise its technology. CINVESTAV has promoted the build-up of an internal culture favourable to the development of S&T-based start-ups and technology licensing activities and the integration of all actors involved to bring applied technologies to the market. This has strengthened academic involvement in industrial processes and allowed public agencies to match industry technological and innovative demands with the academic and research capabilities of CINVESTAV staff (Box 2.2).

Box 2.2. CINVESTAV's Technology Transfer and Commercialisation Office

The creation of the Technology Transfer and Commercialisation unit (TTC) is currently under way. In this initial stage CINVESTAV has benefited from support from CONACYT and, later, from the Ministry of Economy.

The stage leading to the establishment of a Knowledge Transfer Office, as envisaged in the 2002 S&T Law as amended in 2009, will be supported by the CONACYT/Economy FINNOVA Fund in the certification process. CINVESTAV-TTC is among the 32 institutions to which support has been granted in the framework of this process.¹ After certification, development costs may benefit from further support from FINNOVA and other sources but operating costs will be borne by the institution, in part through royalty proceeds. The preferred option for the legal status of the Knowledge Transfer Office will probably be that of an independent private institution, with CINVESTAV assuming chairmanship of the Board. The office may also be entitled to participate in the capital of spin-offs.

In the process leading to the development of a successful TTC unit several challenges had to be addressed. The first to be overcome was communication among the research community. It was predicted that this would be difficult, as the community was composed of about 630 researchers distributed among 10 units throughout Mexico and the timeframe was very short. However, almost 10% of the research staff responded and is currently active in the process.

The second challenge involves convincing researchers to consider how their technologies can be commercialised. Incentives and institutional structures will also be needed to ensure that their research results contribute both to address social issues and to foster innovation either through well-managed technology transfer via licensing or the creation of CINVESTAV spin-offs. The question of incentives for the scientific community also raises specific challenges. Today, most incentives encourage papers and research publications, rather than patents and commercialisation of the technologies, even though researchers share patent royalties with the institution and the laboratory to which they belong. CINVESTAV-TTC is creating and evaluating, with insight from the research community, a more complete and integrative policy in this area. It will be launched by the end of 2012.

.../...

Box 2.2. CINVESTAV's Technology Transfer and Commercialisation Office (*continued*)

Another challenge is still under study. It concerns the inventor's or researcher's legal permission to be part of the new start-up. Under the Mexican law for public officials it is not clear whether it is possible for them to obtain profits from a privately owned company.

The CINVESTAV-TTC has so far been a success. The first steps towards its stated objectives have been accomplished despite the initial obstacles. Today, with the help of a private technology management consulting firm which has accompanied CINVESTAV since the beginning, the first 39 projects were evaluated and seven technologies in disciplines such as pharmaceuticals, medical devices, plant biotechnology, food technology, analysis equipment and materials were selected for focused commercialisation efforts and spin-off creation.

In 2012 CINVESTAV-TTC is expected to strengthen its project portfolio and start work to position its technological commercialisation projects with potential investors and enterprises in the coming years. It is expected that the number of technologies ready to be commercialised or give rise to spin-offs will keep growing as successful initiatives increase, creating greater incentives for researchers to integrate potential commercial opportunities concerns in the development of their scientific and technological activities. In a new departure for technology commercialisation, CINVESTAV is developing a customised venue that will allow enterprises, investors, entrepreneurs and government to gather with the objective of generating business opportunities for the technologies offered.

¹ By March 2012, at the time of the OECD mission.

Source: Author's summary of the OECD CINVESTAV interview.

National Autonomous University of Mexico (UNAM)

UNAM, the largest and most important public university in Latin America, was one of the first academic institutions involved in incubation activities, spin-off creation and technology transfer. UNAM formally launched technology transfer activities providing services to all its research institutes as early as 1984³¹ and created its first incubator in 1994. The CID (Co-ordination for Innovation and Development), encompassing UNAM's TTO and incubator functions, was created in 2008.

The CID's operational costs are mostly covered by resources from the rector's office (about 90%), with a complement in the form of a CONACYT subsidy and marginal additional resources from the Ministry of Economy (mainly for incubation activities)³² and the Mexico City's S&T Council (ICTDF). The CID has applied to the FINNOVA TTO certification process, which will open the possibility of other sources of funding, such as technology vouchers for enterprises that contract services from TTOs and matching funds from FINNOVA for CID expenditures for NTBF pre-creation or early development stages (e.g. proof of concept and patenting expenditures). Although the CID provides patent registration services to UNAM researchers, it does not presently receive a share of the royalties derived from the exploitation of UNAM patents.³³ This situation is expected to change with the new TTO model proposed for certification, and it is very likely that the CID would enjoy greater operational flexibility with private legal status.³⁴ Following the adoption of the revised S&T Law UNAM developed guidelines that define the framework within which academic researchers can participate in the creation and operation of private knowledge-based start-ups.

The CID incubator currently caters for around 80 enterprises, mainly originated by UNAM staff and alumni. It has begun to provide some coaching activities involving the provision of advice for business plans, market research development and linkages with potential sources of angel financing, such as Alta Ventures, Monterrey and Angel Ventures. However, the number of academic spin-offs and successful knowledge-based start-ups emerging from the incubation process has so far been very limited, and neither UNAM nor the CID has developed an information base that would allow monitoring of performance on this matter.

Technological Institute of Monterrey (ITESM)

ITESM is Mexico's leading private university in S&T- and business-related curricula and research activities.³⁵ Its emphasis on technology management and entrepreneurship in student training has allowed a significant share of graduates to find executive positions in Mexico's largest domestic and foreign companies. Its S&T activities emphasise applied research and it has the best patenting record among Mexican research institutions (Table 2.4). Presently ITESM has a portfolio of 200 patents.³⁶ Research and academic staff face no obstacles to participation in private firms' activities and in particular NTBFs, so long as they maintain their teaching and research commitments. Its activities that contribute to the creation of knowledge-based start-ups are organised around two units: the Centre for Innovation and Technology Transfer (CIT2) and a technology transfer office (TTO).

The CIT2's main mission is to provide services in support of NTBFs' creation and early development stage³⁷ through the following activities:

- *Incubation.* CIT2 manages a small set of high-technology incubators³⁸ that provide technological and coaching services (e.g. testing facilities, IP protection, business plan preparation, legal services, market prospects and linkages with sources of financing) as well as a platform for sharing knowledge between recently created firms and incubation services.
- *Brokerage.* CIT2 manages the selection of technological and business partners best suited for the take-off stages of NTBFs. It also assists firms in accessing seed capital offered by federal and regional government support programmes and facilitates linkages with angel capital and venture funds (e.g. FONLIN, Alta Ventures). ITESM can provide seed capital but cannot participate directly in the capital of NTBFs. However, it can engage in partnerships with private intermediary entities that can.

The ITESM TTO was created in 2005 and is currently in the process of certification through the FINNOVA procedure.³⁹ Its main missions are:

- to provide IP-related services (e.g. patent search and registration) to ITESM researchers and outside companies
- to manage the ITESM patent portfolio, notably as regard licensing to private enterprises and providing support for the creation of academic spin-offs.

Between 2009 and 2011, IP licensing revenues were around USD 130 000. This may seem low by international standards for a university of excellence, but they represent a significant amount for Mexican HEIs. The TTO supports 25 NTBFs presently in the process of incubation. Between 2007 and 2011 it supported the creation of six academic spin-offs.

National Polytechnic Institute (IPN)

The IPN, Mexico's most important technology-oriented academic institution, has developed its technology commercialisation activities around three units:

- A large high-technology incubator, the Incubation Centre for Technology-based Enterprises (CIEBT) with a strong selection process. Incubating firms have access to the institute's S&T facilities. CIEBT also offers coaching entrepreneurship and management courses for students and alumni.
- The Polytechnic Unit for Development and Competitiveness fundamentally plays the role of TTO and manages the institute's patenting and licensing activities. As in other public HEIs, the IPN retains patent ownership and the royalties are shared between the IPN and the researcher at the origin of the patent. The TTO's operating costs are covered in part by a transfer of part of the patent royalties. This unit is currently in the process of certification through FINNOVA, whose support is oriented towards IP management, business plan development, techno-commercial assessment of technology-based projects and coaching activities.
- The Technopolis Centre provides S&T support to new projects developed *in situ* by high-technology enterprises in a collaborative framework with the IPN.

With the new margins of manoeuvre created by the revised 2002 S&T Law, the IPN is moving ahead in addressing internal institutional and regulatory issues regarding the creation of academic spin-offs. The IPN can participate in the capital of a newly created firm through a newly created foundation with a private legal status (Fundación Politécnico) or an IPN trust fund whose resources come from the proceeds of technology transfer and licensing activities.

The build-up of regional innovation systems

In Mexico, with its large regional disparities, there is a necessary complementarity between support measures designed and implemented at the federal level and those promoted at regional or local levels. Such complementarity is important in both developed and developing countries. Regional and local authorities can take better account of local characteristics, notably as regards S&T potential and infrastructure, industrial structure and specialisation, institutional capacities and local financial conditions. In some cases, for better management of scarce resources, it may be more efficient for federal authorities to transfer funds to regional institutions.⁴⁰ Nuevo León and Mexico City are described below as examples of leading states in terms of S&T development.

Nuevo León's innovation system

Over the past decade Nuevo León, under the leadership of local authorities, has developed a "city of knowledge". This knowledge-based regional system has many components, such as the academic cluster, with two leading universities, one private, the Technological Institute of Monterrey (ITESM; see Box 2.3), and the other public, Nuevo León Autonomous University (UANL).

Box 2.3. ITESM in the Monterrey innovation system

As part of the Nuevo León innovation infrastructure, ITESM has developed in recent years a centre for innovation and technology transfer, incubation cells (professor-student particular projects), and an incubator. Projects developed in the ITESM incubator are usually supported by public or private resources and many become successful commercial products or services. This is in part because industry collaboration is at the heart of the institute's research activities. Also, ITESM graduates often take leading positions in industry, as they are generally familiar with the management of innovative processes before graduating.

ITESM implemented specific measures to foster the development of entrepreneurship skills and the creation of academic high-technology firms. The Incubation Cells Programme aims at providing entrepreneurship skills to PhD students. Students are included into *Catedras de Investigación* (Research Chairs), where, with the help of supervisors, they define an incubation project that can lead to the creation of a new technology-based firm. Currently, there are 25 technology-based incubation cells at the Monterrey Campus.

During 2003-10, 158 domestic patent applications were made, 13 patents were granted, 26 spin-offs were created, 15 trademarks were registered and 13 patent licensing agreements were signed.

ITESM research and innovation activities are supported by federal and state (public and private) funds which can largely cover the whole innovation process of a project originated in the incubator system. Two state funds are worth mentioning: the public Nuevo Leon Fund for Innovation (FONLIN) and the (smaller and more recent) private Monterrey Global Ventures.

FONLIN resources come from CONACYT, the Interamerican Development Bank (IDB), the Mexican Foundation for Innovation and Technological Transfer to SMEs (FUNTEC) and the Nuevo Leon government. The Fund currently supports 36 high-technology projects for MXN 58 million. Monterrey Global Ventures is a fund that covers projects that are reaching the commercialisation stage, with an average support of USD 500 000 per project. This fund aims at high-technology and high-risk projects. It has supported 42 projects (most of them supported by FONLIN during the previous stages) in mechatronics, software, nanotechnology and health industries.

Sources: Author's summary of OECD interviews; www.mty.itesm.mx; www.mtycic.com.mx/fonlin; <http://mglobalventures.com/>.

Both of these academic institutions have established an incubator and both are active participants in a larger public-private state programme geared to the promotion of innovative activities and NTBFs. Within the Nuevo León system, the Technological Research and Innovation Park (PIIT) has been strengthened during previous and current local administrations, in particular to give more support in terms of infrastructure and softer types of assistance to technology-based firms in the process of creation.

In recent years, angel investment initiatives (such as Monterrey Global Ventures) and a public fund for seed capital (the Nuevo Leon Fund for Innovation, FONLIN) have been strengthened. Monterrey Global Ventures mostly supports projects that were previously supported by FONLIN. Mexico City's innovation system

In recent years, Mexico City's authorities have considered supporting entrepreneurship and innovation as a priority. As a result, Mexico City has one of the largest state budgets for STI. Local authorities have been working closely with public higher education institutions and research centres located in the state (such as UNAM, IPN or CINVESTAV). This collaboration has led to the support of many university incubator spin-offs in areas such as IPR protection.

Perhaps one of Mexico City's most conceptually advanced and innovation-oriented regional programmes is the firm innovation and NTBF programme conducted by the Institute of Science and Technology of Mexico City (ICTDF). This programme is one of the few public instruments that consider support for NTBFs, and it is innovation-oriented as it supports the patenting process, which is particularly difficult for Mexican firms, especially for SMEs.

The programme is part of a larger initiative for the capital called "A City with a Competitive Industry" which contemplates strategies involving the public, private and academic sectors in order to generate new processes and products that could have a significant impact on Mexico City's development. In this sense, the programme's goal is to strengthen innovation by SMEs and encourage the creation of knowledge-based start-ups. Some of the support concepts are alliances for NTBFs incubation and patenting orientation.

Overall assessment

This chapter casts a contrasted light on Mexico's current portfolio of programmes and instruments in support of the creation and expansion of knowledge-based start-ups. The contrast is due to the fact that the new policy initiatives in favour of NTBFs have mostly been developed in a pre-existing policy framework that is better adapted to existing firms and suffers from chronic governance, co-ordination, implementation and policy delivery problems.⁴¹

On the positive side:

- Greater attention to the "valley of death" development costs faced by new entrepreneurs in the stages that precede or immediately follow the creation of their knowledge-based start-up. This underpins the argument for supporting patenting, proof of concept, prototypes and the provision of seed capital, notably through FINNOVA and FIT sub-programmes managed by CONACYT.
- A well-conceived support scheme for the development of venture capital which involves a leveraging of public resources and privately led management of investment decisions. It is too early to say if Mexican venture capital will be able to develop a more risk-taking strategy to increase its investment in new technology-based start-ups.
- A more flexible legal and regulatory framework for HEIs and PRIs, coupled with a coherent effort towards short- and longer-term support for the development of efficient TTO models in public research institutions. This opens the way to a more active role for these institutions in the creation of academic spin-offs and business-led NTBFs.
- The spur to innovative activities and other efforts, such as efficiency indicators, given by the PNI and the recent changes to the S&T Law, and the crucial role that CONACYT can play in the appropriate application of these regulatory improvements, particularly for the creation and expansion of NTBFs.
- The strengthening of a few regional innovation systems built up around positive synergies between a strong S&T infrastructure, performing incubating facilities and local initiatives to develop robust project assessment capacities and angel capital investment capacities.

On the negative side:

- Duplication of programmes which reflects overlapping responsibilities among government agencies and gives rise to fragmentation of support measures that lack critical mass, involve high administrative management costs and may lead to inefficient use of resources or windfall profits.⁴²
- Policy design, funding and delivery problems. Most support programmes are focused on existing firms' innovation projects. They would have probably been designed differently had their focus also encompassed new innovative firms, owing to the importance of sequencing support instruments for this latter category. Trust funds and budget funds both have pros and cons but the choice among the two types of support often seems to be driven more by institutional considerations than beneficiaries' interests. These may not be the same for projects and for new firms.⁴³
- Lack of continuity and poor visibility. The changing focus of competitive calls and the frequent absence of specific mention of start-ups as a focus of support confuse potential beneficiaries.
- Limited public and private capabilities for effective technological, commercial and financing assessment of the viability of NTBF projects. In a number of countries the granting of public support to start-ups is a positive signal that facilitates access to private financing; this is hardly the case in Mexico⁴⁴ and points to another weakness that concerns coaching capacities of incubators, and more generally the availability of appropriate consulting services,⁴⁵ which could be partly subsidised.
- Weakness of an angel capital market that caters for the crucial financing of NTBFs' take-off and constitutes the link between seed and venture capital. Whereas there are public programmes or instruments that can provide seed and venture capital or increase their availability or lower their costs, there is hardly any public support aimed at strengthening Mexico's venture capital market,⁴⁶ either in the form of support for the development of networks or fiscal incentives to individual investors as is the case in a number of OECD countries (OECD, 2011).

In conclusion, Mexico is currently at a crossroads in this area. A number of policy and regulatory initiatives should foster the development of NTBFs and may be considered elements that could contribute to the emergence of a system more favourable to knowledge-based start-ups. However the system is fragmented and does not promote efficient complementarity between the public and the private sectors in terms of provision of services and investment. As Chapter 3 will show, its efficient build-up calls both for better governance of the support system predicated upon programme rationalisation, interdepartmental co-ordination, visibility, elimination of duplication, improved programme delivery and a degree of decentralisation, and better leverage of public resources devoted to the promotion of NTBFs through private involvement in the development of those firms.

Notes

1. The Fondo PYME is the main programme funded and implemented by the Ministry of Economy to support the creation and/or development of micro, small and medium-sized enterprises. (www.fondopyme.gob.mx).
2. It supports the creation of firms in traditional industries and provides resources for physical and technological infrastructure. The average incubation time is three months. Examples are: restaurants or supermarkets.
3. It supports the creation of physical and technological infrastructure for firms with partially specialised products and some innovation features. The average incubation time is 12 months. Examples are web applications or partially specialised software.
4. The Fondo PYME only validates and supports models developed in academic institutions such as the National Polytechnic Institute (IPN) or the Monterrey Technological Institute (ITESM). These models are known as models “recognised” by the Ministry of Economy.
5. Formerly a CONACYT-Ministry of Economy sectoral programme.
6. Some of the priority areas are: agro-industry, biotechnology, nanotechnology, health technologies or advanced manufacturing. However, projects from firms in other industries are not necessarily rejected.
7. Before 2010 FIT modality (iii) was intended to support technological innovations conducted by associations but had no concrete results.
8. Several studies have reviewed FIT results. In 2008, the Technological Autonomous Mexican Institute (ITAM, 2008) revealed no geographical or sectoral bias, but identified unsatisfied demand in this innovation segment and recommended broader diffusion and prioritisation of industries with market potential. A study conducted in 2011 by the Autonomous Mexican University (UAM) recommended tracking the supported firms after confirmation of the results and an annual call for projects with specific application dates.
9. See CONACYT (2012) for the PEI’s terms of reference.
10. While in its last year the tax incentive programme had a budgetary cost of MXN 4.5 billion, the PEI budget was only MXN 2.5 billion in 2009.
11. The NTBFs less than three years old interviewed during the OECD mission were all INNOVAPYME beneficiaries.
12. For INNOVATEC, the maximum amount per project is MXN 36 million (22% of total cost if the firm applies alone and 30% if it applies in association with an academic institution). For PROINNOVA the maximum amount provided by CONACYT is MXN 27 million and covers 75% of the academic institution’s costs. In all cases, the amount provided by CONACYT must be spent during the fiscal year.

13. The Fondo PYME has five main categories. This section is focused on the fourth, and the first is described in the section on incubators: *i)* entrepreneurs and incubators; *ii)* micro-companies; *iii)* small and medium-sized companies; *iv)* “gacela” firms (companies that have experienced an important increase in value in the previous years); and *v)* tractor firms (large companies with SME production value chains in their industries). In all cases, support is on a year-to-year basis and based on the annual budget.
14. To be launched in the second semester of 2012 or in 2013. There is still no information on how this sub-programme will be implemented and what the eligibility criteria will be.
15. Initiatives to develop and strengthen TTOs advocated by the OECD (OECD, 2009) drew on reviews of international best practices such as the one carried out by ADIAT with a particular focus on Spanish and Israeli experiences (ADIAT, 2010).
16. The rationale for supporting business sector TTOs is questionable as the development of technology transfer activities by enterprises is a profit-oriented activity which does not suffer from market or systemic failures. The only question here is the certification of enterprises’ TTOs so that they can benefit from the technological voucher scheme.
17. For selected projects the contribution of the TTO parent institution should amount to at least half of the amount of the FINNOVA grant.
18. The capital structure is: NAFIN (USD 40 million), Ministry of Economy (USD 30 million), IDB Multilateral Investment Fund, FOMIN, (USD 10 million), Mexican Rural Investment Fund, FOCIR, (USD 8 million) and the Andean Development Community, CAF, (USD 5 million).
www.capitalprivado.com.mx/2010/11/02/fondo-de-fondos-de-capital-emprendedor.
19. This lack of statistics is not specific to Mexico. In other countries NTBFs are often monitored by the agencies that implement support programmes dedicated to these newly created firms. This is not yet the case in Mexico.
20. Firms were mainly asked to present their experience regarding problems encountered at the various development stages, to give a candid assessment of the support schemes and, more generally, to give their views on the main obstacles faced by Mexican entrepreneurs for creating and growing an NTBF. Interview guidelines for the enterprise sector are provided in Annex B.
21. Indeed, in a number of OECD countries the fact that NTBFs have passed through a severe selection process involving business representatives is considered as positive signal by angel and venture capital markets.
22. In the framework of this report only a few of the most relevant intermediary institutions are reviewed.
23. Angel Ventures does not discriminate among projects according to sectors or technological intensity. However, their main orientation is support for technology-based start-ups.
24. The concepts of “limited liability company” or “limited liability partnership” do not exist in Mexican law. As a result minority shareholders are unsure of their legal standing. Moreover, in Mexico trust management and execution of guarantees are ensured by the courts, whereas in countries such as Canada, where many private

- Mexican funds are established, trust decisions are applied directly and there are no legal obstacles. An example is a limited partner's decision to leave the firm.
25. For the start-up boot camp, the agents review the product's potential, design the business model and draw together the business components with a view to ensuring the firm's success.
 26. See <http://www5.iadb.org/mif/About/OurMission/tabid/339/language/en-US/Default.aspx>.
 27. See www.adiat.org/es/columna.aspx?id=414.
 28. According to the study, policy frameworks should establish IP ownership rights and incentives for researchers according to each university's regulations, standardise IP management practices and incentives for technology transfer, foster a culture of entrepreneurship, and review employment rules for civil servants that may restrict the involvement of public universities' researchers in private companies.
 29. One element that may be lacking is better accounting of researchers' patenting and/or commercialisation performance in the SNI evaluation system. This could provide researchers with incentives to patent and perhaps to participate in the creation of spin-offs.
 30. There are no publicly available reliable statistics on spin-offs originated in Mexican HEIs and PRIs. The poor performance argument is based on interviews conducted during the OECD mission. It appears that the best performing HEI is ITESM with 26 spin-offs created and still in existence. According to informal estimates the total number of Mexican academic spin-offs is not over 70-100. In comparison, the best-performing Brazilian university, the University of Campinas (UNICAMP), had fostered by 2008 the creation of more than 150 spin-offs (Lemos, 2008).
 31. These activities were co-ordinated within a new UNAM General Directorate in charge of technological development (Dirección General de Desarrollo Tecnológico). Subsequently, a network of small TTOs operating at faculty level was developed with some support from CONACYT. The network still exists.
 32. It seems that CID management costs to apply for and administer theses resources often exceed the subsidy received from the Ministry of Economy.
 33. UNAM keeps the patent ownership and royalties are distributed among the university, the research department and the researcher at the origin of the patent (25%, 25% and 50%, respectively).
 34. The model is adapted from that of the Hebrew University of Jerusalem.
 35. ITESM, which began with a campus in the city of Monterrey, has grown to become a system of campuses located in various regions of the country.
 36. ITESM retains the patent ownership and royalties are distributed as follows: 30% for the institution, 30% for the research department, 30% for the researcher and 10% for the ITESM TTO.
 37. Another mission is to offer business services to foreign enterprises in high-technology sectors that wish to establish subsidiaries in Mexico or develop joint ventures with Mexican firms.
 38. ITESM developed 26 of the 500 SNIE incubators.

39. CIT2 and the TTO may eventually merge as part of the certification process.
40. One example of this transfer scheme is the CONACYT Fondos Mixtos programme, through which federal authorities transfer resources to local S&T councils, which contribute an equivalent amount to support local-based innovation projects.
41. Identified in Chapter 3 on the role of government of the recent OECD review of Mexico's innovation policy (OECD, 2009).
42. In particular Fondo PYME, México Emprende, FINNOVA, FIT and PEI.
43. A counter example may be the substitution of the AVANCE “paquetes tecnológicos” sub-programme (budget fund) by a FIT modality (trust fund) with exactly the same terms of reference.
44. However, at regional or sectoral levels private angel capital associations are beginning to develop such capacities.
45. In areas such as the preparation of business plans for project financing applications in line with seed and angel capital investment requirements; services related to national and international patenting applications and protection.
46. With the possible exception of the CONACYT contribution to the capital of FONLIN.

References

- ADIAT (2010), Oficinas de Transferencia de Tecnología – Fundamentos para su formación y operación en México, ADIAT, México.
- CONACYT (2011), Reglas de Operación del Fideicomiso “Fondo Sectorial de Innovación Secretaría de Economía – CONACYT”, mimeo, México.
www.CONACYT.gob.mx/fondos/FondosSectoriales/FINNOVA/Documents/Reglas_de_Operacion_FINNOVA.pdf.
- CONACYT (2012), Programa de Estímulos a la Innovación, Términos de referencia de la convocatoria 2012, mimeo, Mexico.
- García Ibarra, C. (2012), La Incubación de Empresas en el Sistema Nacional de Educación Superior Tecnológica, Innovación y Competitividad No 45, ADIAT, México.
- ITAM (2008), Evaluación de impacto de los programas orientados a la innovación de las empresas, mimeo, CONACYT, México.
- ITAM (2011), Evaluación de diseño 2011 del Fondo Sectorial de Innovación (FINNOVA), mimeo, Secretaría de Economía, México.
- Lemos, L.M. (2008), Desenvolvimento de Spin-offs Academicos : Estudo a partir do caso da UNICAMP, Unpublished Master Dissertation, Campinas University, Brazil.
- OECD (2001), *STI Review, Volume 2000 Issue 1: Special Issue on Fostering High-tech Spin-offs: A Public Strategy for Innovation*, OECD Publishing.
doi: [10.1787/sti_rev-v2000-1-en](https://doi.org/10.1787/sti_rev-v2000-1-en)
- OECD (2003a), *Turning Science into Business: Patenting and Licensing at Public Research Organisations*, OECD Publishing.
doi: [10.1787/9789264100244-en](https://doi.org/10.1787/9789264100244-en)
- OECD (2003b), *Governance of Public Research: Toward Better Practices*, OECD Publishing.
doi: [10.1787/9789264103764-en](https://doi.org/10.1787/9789264103764-en)
- OECD (2009), *OECD Reviews of Innovation Policy: Mexico 2009*, OECD Publishing.
doi: [10.1787/9789264075993-en](https://doi.org/10.1787/9789264075993-en)
- OECD (2011), *Financing High-Growth Firms: The Role of Angel Investors*, OECD Publishing.
doi: [10.1787/9789264118782-en](https://doi.org/10.1787/9789264118782-en)
- Secretaría de Economía (2012), Programa de Financiamiento a Emprendedores 2012 con la Banca Comercial, mimeo, www.economia.gob.mx/mexico-emprende/empresas/emprendedor.
- Zuniga, P. (2011), The State of Patenting at Research Institutions in Developing Countries: Policy Approaches and Practices, WIPO, Working Paper No 4, Geneva.

Chapter 3

Policy recommendations

This chapter proposes recommendations for strengthening the innovation ecosystem to favour the creation and expansion of knowledge-based start-ups within the general framework of Mexico's science, technology and innovation (STI) policy. Drawing on examples of good practices in more advanced countries it suggests possible policy initiatives to develop this ecosystem through improved governance mechanisms and more dedicated support instruments. A number of recommendations go beyond the competence of STI policy makers to encompass more general framework conditions and regulatory and taxation issues.

Introduction: Where does Mexico stand?

Although there are no reliable statistics on the creation and survival of knowledge-based start-ups in Mexico over the last decade there is more than anecdotal evidence that in this area Mexico lags behind other countries with a higher or similar level of S&T development. This lag reflects the fact that Mexico suffers from a discrepancy between, on the one hand, the relatively significant S&T capacities developed in the country's higher education institutions (HEIs), public research institutions (PRIs) and technological institutes and, on the other, rather low dynamism in the creation of knowledge-based start-ups. This state of affairs points to the combination of a number of syndromes that have been touched upon in previous chapters:

- Weaknesses in the build-up of a pipeline of promising knowledge-based start-up projects that can attract private investors and meet their selection criteria. These weaknesses are in particular related to: *i*) deficiencies in knowledge diffusion and transfer mechanisms; *ii*) the low level of business and marketing culture of would-be innovative entrepreneurs; and *iii*) the low propensity of HEIs and PRIs to commercialise their research results through the creation of spin-offs, owing in particular to weaknesses in technology transfer offices (TTOs), regulatory obstacles and lack of incentives for researchers.
- Inadequacies between the system of support for innovation in the business sector as a whole and the particular support requirements of knowledge-based start-ups from the stages that precede their actual creation to those that involve their take-off and access to the capital required for expansion.
- Limited capacities in both the government and the financial sector to assess the technical feasibility and market prospects of risky knowledge-based new ventures and the weakness of capital markets for providing sources of development finance for such ventures.

While a number of policy initiatives taken in recent years to promote business innovation have somewhat alleviated them, these syndromes have far from disappeared.

As highlighted in previous chapters, various support programmes in the last decade have focused on the development of innovative entrepreneurship and innovation in small and medium-sized enterprises (SMEs). They have been implemented mainly by the Ministry of Economy, CONACYT and NAFIN. While most of these programmes have not explicitly targeted the creation and expansion of new technology-based firms (NTBFs), they have contributed, together with regulatory reforms and the 2009 revision of the S&T Law, to a gradual assembly of building blocks of an ecosystem more favourable to the NTBFs across the various stages of their development.

However, as a whole, this ecosystem remains incomplete and fragile, with poorly articulated support programmes and a lack of policy co-ordination among the main federal bodies responsible for the design, funding and implementation of the set of policies that should support NTBFs' development. The current support system is better geared to the promotion of innovative activities in existing enterprises than to the promotion of NTBFs.¹ This is notably the case of the CONACYT Innovation Incentives Programme (PEI) initiated in 2009, and to a lesser extent of the FINNOVA and FIT Trust Funds funded in recent years by the Ministry of Economy and managed jointly with CONACYT. Lack of policy co-ordination can be a source of duplication and complexity for potential beneficiaries who are often confronted with a maze of potential support

instruments that may not correspond to the specific needs of NTBFs in terms of focus, eligible costs or operative rules. Policy articulation seems to be better organised at the local level in the federal states that have fostered an innovation ecosystem which promotes synergies between knowledge creation, knowledge transfer and the financing of knowledge-based start-ups.

Guiding principles

There is no “best policy toolkit” for the creation and expansion of knowledge-based start-ups, as policy development must take into account framework conditions, institutional idiosyncrasies and innovation system specificities that affect the dynamism of “techno-entrepreneurship”. In Mexico, as in a number of other middle-income countries that have developed a relatively sophisticated S&T infrastructure and innovation support programmes catering mainly for existing enterprises, the next stage of policy development to kick-start the endogenous dynamism of NTBFs has often proved problematic (Teubal and Kuznetsov, 2012).

Best practices that have proved successful in more advanced countries can certainly inspire Mexico’s new policy initiatives but their adaptation may require reforms of framework conditions, changes in the way the present system of support is organised, and better articulation of the public support and private financing components that contribute to the dynamism of NTBFs. In this adaptation process Mexico should take into consideration a number of guiding principles that can be considered prerequisites for good policy performance, independently of national specificities.

Political commitment

Mexico still suffers from rather low political commitment to S&T and innovation policy as a major driver of economic growth and social welfare. Public resources devoted to the support and funding of R&D and innovation activities remain small in proportion to GDP. In spite of the policy reorientation in favour of support to innovation that took place in the last decade, public resources have not significantly leveraged private investment in R&D and innovation to increase its share in total R&D expenditures.

The National Innovation Programme developed under the aegis of the CII is certainly a positive policy development, but the fact that this document, issued in 2011, has not been the object of a formal publication² gives a wrong signal about political commitment at the highest level to the importance of innovation and the role of government in its promotion.

Political commitment should not be limited to strategic documents and programmatic statements, whatever their quality and relevance, but be based on realistic performance prospects reflected in the policy agenda and underpinned in the budgetary allocation process. In this regard, if policy documents such as the PNI and the PECITI rightly emphasise the importance of business innovation, they still underestimate the specific role that NTBFs can play in reaping the benefits of public investment in R&D and in contributing to growth and to the development of qualified employment and high-value exports. Moreover, strong political commitment usually has a positive effect on policy design and co-ordination.

Framework conditions

The success of support policies for NTBFs is to a large extent predicated upon the soundness of legal, fiscal and regulatory framework conditions that affect the business environment in terms of competition, market entry and exit conditions, corporate governance, private equity investment regulations and minority holder rights, IPR regimes and possible obstacles to the creation of academic spin-offs.

Although there have been positive recent initiatives in these areas, Mexico could still improve framework conditions in a direction more favourable to NTBFs' various development stages.

Public research base

In OECD countries there is no example of successful innovation policies in support of the creation and expansion of knowledge-based start-ups that have been implemented at the expense of support to research in PRIs and HEIs. Research excellence feeds the pool of potential knowledge-based start-ups, although governance and funding conditions can facilitate or hinder the development of the science/industry linkages that are favourable to the creation of these start-ups (OECD, 2003; OECD, 2010). In this area Mexico has certainly made some progress as a result of the recent revisions of the S&T Law. More is to be expected from the impulse given to the development of TTOs and the opening of various options for their legal and institutional status. In the framework of hopefully increased budgetary resources devoted to R&D, the balance between support of public research and support to business innovation should not fundamentally change, but the leverage of the former on business R&D expenditures and the creation of innovative start-ups should increase considerably.

Policy governance: design, co-ordination and implementation

In Mexico as in most OECD countries the portfolio of instruments and programmes that directly or indirectly support the creation and expansion of NTBFs are funded and managed by a diversified set of government departments or agencies that are responsible, among other things, for entrepreneurship, SME development, the promotion of innovation projects through grants and other financial resources (e.g. subsidised loans, seed and venture capital, guarantees). In most cases, these instruments and programmes have not been developed in the framework of policies which had the promotion of NTBFs as a specific objective but can be adapted to benefit such enterprises provided their operative rules allow it. In some cases new instruments specifically dedicated to the promotion of NTBFs have been developed either within the framework of existing support programmes or as standalone instruments.

This state of affairs has usually given rise to a “piling up” of support instruments that have been established over time and implemented by distinct departments or agencies according to different objectives, eligibility conditions, management rules and delivery procedures. This is understandable when instruments provide support for very distinct stages of NTBFs' development. But, more often than not, it reflects institutional overlaps and duplication of programmes that waste resources and give rise to complex co-ordination issues with high transaction costs. In many countries that have pursued an NTBF policy for some time, this overlap/duplication issue has been addressed through more efficient user-driven co-ordination mechanisms among institutions and reduction of red tape, as well as through programme streamlining based on policy evaluation.

Table 3.1. Policy instruments according to start-ups' development stages

FOCUS	Incubators	Proof of concept/patent registration	Prototypes and pilots	Technical and coaching services	R&D support	Seed/angel capital	Guarantee	Venture capital
Pre-start-up	SE/SEP	AVANCE (<i>Paquetes Tecnológicos</i>)		AVANCE (<i>Escuela de negocios</i>)		AVANCE (<i>Capital semilla</i>) FINNOVA FONLIN		
Start-up creation	SE/SEP	AVANCE (<i>Patentes</i>) FIT modalities a & c	FIT modality a	FIT modality c FINNOVA (Vouchers)				AVANCE Fondo Emprendedores
Start-up expansion		AVANCE (<i>Patentes</i>) INNOVAPYME	INNOVAPYME FIT modality a TECHBA	FIT modality c FINNOVA (Vouchers) FONDO PYME FUMEC/SATE	AVANCE (<i>Nuevos negocios</i>) INNOVAPYME FIT	FINNOVA FONDO PYME (gacela) MEXICO EMPRENDE Capital semilla FONLIN	AVANCE/ NAFIN Guarantee Fund	AVANCE Fondo Emprendedores NAFIN FoF Mexico Ventures
Innovation projects in existing firms		AVANCE (<i>nuevos negocios</i>) INNOVAPYME FIT modalities a & c	AVANCE (<i>nuevos negocios</i>) INNOVAPYME FIT modality a	FIT modality c FINNOVA (Vouchers)	AVANCE (<i>Nuevos negocios</i>) INNOVAPYME FIT modality a		AVANCE/ NAFIN Guarantee Fund	NAFIN FoF Mexico Ventures
PRI/HEI spinoffs	SE (Fondo Pyme) SEP	AVANCE (<i>Paquetes Tecnológicos y TTOs</i>) FINNOVA (TTOs)		FINNOVA TTOs (Vouchers)	INNOVAPYME FIT	FINNOVA FONLIN		NAFIN FoF Mexico Ventures

Note: AVANCE programmes marked in italics were discontinued in 2009.

This issue remains a chronic one in Mexico. As noted in Chapter 2, and well illustrated in Table 3.1, there has been over the last ten years a multiplication of innovation support programmes and instruments that can directly or indirectly benefit the creation and expansion of NTBFs. The duplication and co-ordination issues mentioned above are compounded by other problems related to idiosyncrasies in the support system's programme design and delivery modes. On the one hand, whereas programmes financed by Trust Funds can finance projects over periods that exceed the fiscal year, those that are funded on departments' or agencies' annual budgetary resources must exhaust their grants over the fiscal year. This places a strong limitation on NTBFs.³ On the other hand, the terms of reference of programmes funded by Trust Funds can be very general and the focus of support can change from one competitive call to the next, which raises continuity issues. For potential beneficiaries the fragmented support system has the overall appearance of a maze in which the paths change over time.

The fragmentation, complexity and, to some extent, opaqueness of the Mexican support system raises the question of the usefulness of a "one-stop shop" for the portfolio of programmes and instruments in support of start-up creation and expansion. Given the diversity of support programmes, and the entrenched interests that often defend current institutional arrangements, no OECD countries have adopted such a one-stop shop in the form of a single institution responsible for the management of support programmes. In countries with a more integrated approach to NTBF support, support is organised under the aegis of a dedicated intersectoral body whose role is to ensure complementarity among programmes and the reduction of duplication. In Mexico the Intersectoral Innovation Committee (CII) has the authority to play a rationalising role in this respect. In most countries efforts have also been made to ensure good visibility of the portfolio of available support programmes. In Mexico it would certainly be illusory to attempt to launch a new Trust Fund dedicated to support of the various phases of NTBFs' development, as it would probably quickly become an unmanageable "white elephant", but the establishment of a co-ordinating or advisory body would be useful.

Policy rationalisation also raises the question of the most appropriate level of government to implement and deliver support programmes. This question is particularly relevant for policies in favour of knowledge-based start-ups, as the emergence and development of these firms strongly depends on the dynamism of local ecosystems that nurture the links between S&T infrastructure, entrepreneurship capabilities and capital markets, notably in the case of technological clusters.⁴ In competitive calls for support to early development stages that lead to a selective process for access to angel and venture capital investment, regional or local public and private stakeholders are in a better position than national ones to make efficient decisions. This may imply a partial decentralisation of public funds to regional institutions, often subject to matching funds criteria.

Balance between government-led support and private capital investment

In all OECD countries, the resources required for the creation and expansion of NTBFs come from a combination of public and private sources. Incubators usually benefit from public and institutional sources of financing. Public funding is more important at the initial stages where risks are deemed too high to attract private capital (proof of concept and prototype development).⁵ For R&D-intensive firms, public resources also play an important role in the expansion stages through R&D support schemes. Private investment is attracted when angel and venture capital fund managers see potential returns at some stage of new firms' development. In a number of countries public resources also contribute to venture capital funds via a fund of funds or co-

investment funds as well as to the provision of seed capital. They contribute to a lesser extent to angel capital investment groups whose activities are generally supported through other means. Public support or involvement is therefore greater at initial stages while private investment takes the lead at later stages with an intermediary grey zone in which public and private involvement can be complementary, competitive or collaborative.

The rationale for government support across the various stages of NTBFs' development evolves as some of the market and systemic failures that can hinder the creation and expansion of such firms are progressively overcome by the positive results of the combination of government incentives and improved framework conditions.⁶

This is typically the case of the evolving role that governments have played in the development of angel and venture capital markets in some more advanced OECD countries where an initial, relatively important participation of public resources in venture capital funds, essentially through a “fund of funds”, has catalysed a leverage effect with rapid development of domestic private capital funds and attraction of foreign funds and a progressive contraction of the share of public resources.⁷ The examples of Israel's Yozma Fund, Finland's Finnvera and New Zealand's NZVIF are particularly telling in this regard (Lerner, 2009; OECD, 2011c).

In Mexico the modes of public involvement in the financing of knowledge-based start-ups activities should differ with the development stages of these firms. They should take into account both the nature of the financing requirements (and the related rationale for public support) and the specific weaknesses of capital markets.

As illustrated in Table 3.1, government support schemes for the earlier development stages (coaching, proof of concept, prototypes and seed capital) are scattered over various programmes managed by different departments. They are not always adequately funded, which raises problems of critical mass, and they lack continuity as their terms of reference may change over time. There is certainly a need to strengthen and rationalise support schemes for the earlier development stages, preferably in the form of grants.

At the other end of the financing spectrum, in the expansion stages, Mexico's initiatives to strengthen public support for developing venture capital seem so far to have been implemented with an appropriate balance of roles between the public and the private sectors as regards both capital inputs and funds management. However, the capitalisation of the Mexico Ventures I fund of funds is still limited and so is the present share of its investment in new and high-risk NTBFs. It is to be hoped that in the future other tranches of Mexico Ventures will focus more on technology-based start-ups.

In contrast with the state of support programmes and instruments focusing on the pre-creation, initial creation and the expansionary stages of start-up development, Mexico seems to have a specific weakness at the crucial take-off stage. For the most part, this stage is basically left to Mexico's incipient private angel capital institutions which do not benefit from public support.⁸ This weakness has two complementary aspects: on the one hand a poorly developed coaching and assessment system which should act as a screening process and provide a label for would-be angel investors; on the other hand, some regulatory obstacles and the absence of incentives that may limit the development of a dynamic angel capital market. The development of the angel capital market certainly deserves more attention on the part of the Mexican authorities either through participation in regional funds such as FONLIN, or through specific incentives to private investors and support to development of angel association network.

Targeted vs. non targeted support

In Mexico as in most other countries innovation support programmes may have sectoral priorities among their eligibility criteria. The question arises as to whether or not this should also be the case for programmes that support the creation and extension of NTBFs, notably those concerning early development stages and the provision of venture capital. The general answer is that it should not, with some caveats.

While it may be legitimate for governments to have sectoral priorities for public investment in R&D and support for private innovation in order to build up or strengthen competitive advantages, it is inappropriate when the selection process concerns the creation or expansion of NTBFs, as public agencies are less capable than private venture capital funds to assess their growth prospects. Indeed, international evidence shows that the performance of venture capital funds in which public resources participate appears to be lower when this participation emphasises selection criteria based on technological or sectoral priorities (Brander et al., 2010).

Specialisation of angel capital groups is warranted in the case of NTBFs that emerge in the framework of technological clusters and when funds' assessment committees have specific competencies in the related technological fields. Another case in which sectoral or technological specialisation is warranted is support programmes for seed capital provided by sectoral ministries or government agencies to NTBFs. This does not apply in Mexico but exists in countries such as the United States.⁹

Monitoring and evaluation

Monitoring and evaluation of support programmes should be the norm. Programmes in favour of NTBFs are no exception, but call for specific implementation modalities since the efficiency of public support has to be assessed in a way that includes its effects on the build-up of an ecosystem favourable to the creation and expansion of NTBFs and takes account of the leverage of public resources on private investment in the various stages of NTBFs' development. This is particularly important because, beyond its legitimate role in addressing market and systemic failures, public support should be designed and implemented so as to limit the risks of windfall profits by supported firms and to catalyse increased private involvement in the selection and financing of potentially successful firms and thus result eventually in reduced public intervention.

Specific recommendations

Specific recommendations to strengthen Mexico's policies to support the creation and expansion of knowledge-based start-ups can be made on the basis of the above guiding principles and the overview of support programmes and instruments presented in Chapter 2. These recommendations are presented below under generic headings; some are underpinned by examples of good practices implemented in other OECD countries which Mexico could emulate.

Framework conditions and the regulatory environment

Support policies cannot be as effective as they should be if they are implemented in an adverse regulatory environment and under unsound framework conditions. Policies that are devised to compensate for such impediments can even make the situation worse. As indicated in Chapter 1 good initiatives have been taken in this area, but more needs to be achieved.

Three types of recommendations can be advanced under this heading:

- *SMEs' market entry and exit.* Administrative burdens and regulations that weigh on the costs of market entry and exit for SMEs should be alleviated.
- *Corporate governance and liability conditions.* Angel capital associations and venture capital funds should be able to adopt the status of limited liability companies (LLC) or limited liability partnerships (LLP). Otherwise, they will have to register abroad, which would hamper their development in Mexico.
- *Mobility of academic researchers.* The revised S&T Law allows public HEI and PRI researchers to participate in privately owned start-ups. Further measures should be adopted to allow for temporary leave of academic researchers who take executive responsibilities in spin-offs created on the basis of the results of their research and may wish to reintegrate their institution in case of failure.

Policy governance: support programmes design, co-ordination, implementation and delivery

General recommendations related to the governance of innovation policy were made in the recent OECD review (OECD, 2009). A number of these recommendations are still valid, notably those related to interdepartmental co-ordination, policy fragmentation and the balance between top-down and bottom-up approaches. This section focuses on recommendations related to policies and support programmes to promote NTBFs which include, but go beyond, the strict area of innovation policy. The Intersectoral Innovation Committee should be the institution to implement these recommendations which cut across the various agencies or ministerial departments implementing support policies.

- *Policy rationalisation.* Over the years a number of ministerial departments or public agencies have developed programmes that offer direct or, more often, indirect support for the creation and expansion of NTBFs. The complementarity or duplicative nature of such programmes should be reviewed to streamline the support system, curtail the waste of resources and increase support to the remaining programmes.
- *Policy co-ordination.* Policy rationalisation enhances the need for better co-ordination of agencies, especially given the importance of the sequencing of support measures to be proposed in line with the various stages of development of NTBFs. Another point related to interdepartmental co-ordination is of a more practical nature and relates to the information that firms have to provide when they apply for support. It seems that this information varies significantly among the institutions that manage support programmes. This can create an additional and often unnecessary administrative burden for applying firms. A standardisation effort should be undertaken to address this question.
- *Policy continuity.* Feedback from regular evaluations can lead to policy changes, but a good balance must be struck between the need for periodic policy adjustments and a stable support programme portfolio which is important for enterprises' decision-making process. In Mexico some programmes were discontinued (e.g. AVANCE) owing to the lack of appropriate evaluation criteria and left a temporary vacuum of support in areas important for the development of NTBFs.

- *Policy visibility.* At present it is very difficult for entrepreneurs involved in the creation or expansion of NTBFs and wishing to benefit from government support to find their ways through the maze of existing programmes and identify the most appropriate for their development. Portals of ministerial departments or public agencies offering support programmes are not up to date and often do not provide appropriate information on terms of reference and eligibility conditions.¹⁰ A dedicated website with regularly updated information on support programmes for NTBFs or young innovative enterprises should be rapidly developed.¹¹
- *The one-stop shop issue.* The diversity of programmes with direct or indirect support for the development of NTBFs means that it is probably counterproductive to make them available through a one-stop shop. However, as in OECD countries such as the United Kingdom and Finland (Maula et al., 2007) co-ordination and rationalisation imperatives may require the creation of an *ad hoc* consultative body composed of representatives of public departments and agencies responsible for support programmes (Ministries of Economy, Finance and Public Education and CONACYT) as well as other stakeholders from the private sector (angel capital and associations of NTBFs), TTOs and high-technology incubators. Such a body could be assembled under the aegis of the Consultative Forum on Science and Technology (FCCyT, 2011).
- *Programme implementation and delivery.* As argued above on several occasions, because their disbursement is not constrained by fiscal years, trust funds are more appropriate than budget funds for programmes that support NTBFs' costs incurred in the early development stages ("valley of death" costs). The choice of financing mode should be driven by the type of support, not by the nature of budgetary appropriations in the managing institution. Terms of reference of support programmes are often too broad and encompass modalities that are only very loosely related (e.g. in FIT). Moreover the focus of support may vary in the sequence of competitive calls. Support programmes should identify more clearly – even in their titles – the type of costs they help to finance (e.g. proof of concept, coaching), the target population (e.g. young innovative firms, academic spin-offs) or the generic issues they address (e.g. provision of seed capital). Efficient programme implementation also requires a professional assessment capacity to examine NTBFs' applications to competitive support programmes which public management bureaucracies may not possess to the same degree as when selection is made among projects presented by existing firms. To the extent possible, private institutions with experience in NTBF evaluation (e.g. angel and venture capital groups) should be associated with selection processes in public support programmes. This is not presently the case in Mexico.
- *Policy decentralisation.* The dynamic development of NTBFs is often a regional or local phenomenon associated with synergies in efficient regional innovation ecosystems. Local institutions are often better placed than federal agencies to implement support programmes according to regional characteristics and to judge projects submitted in competitive calls. Yet local governments may be more prone to influence by local vested interests and a possible bias in project selection procedures. An efficient balance has to be struck between federally managed programmes and those that are federally funded but managed at state level. Transfer of resources from the federal level to regional institutions should be considered when at least two conditions are met: *i*) existence of matching funds at

the regional level; and *ii*) acknowledgment of superior project assessment capacities at regional level. A good example is the CONACYT contribution to FONLIN.

- *Policy monitoring and assessment.* The development of indicators on the demography of NTBFs (e.g. creation and survival rates; academic spin-offs; technological areas) is a prerequisite for efficient policy monitoring and evaluation. This requires the build-up of new statistical databases or the matching of the existing ones of public agencies, TTOs and private angel and venture capital associations. Such indicators and statistical databases are conspicuously missing in Mexico.¹² A working group composed of relevant user and producer institutions (including INEGI, the Ministries of Economy and of Public Education and CONACYT) should be organised to decide upon the statistical work to be undertaken to develop a system of indicators appropriate for monitoring and policy evaluation purposes.

Support to pre-creation and early development stages

The pre-creation and early development stages of NTBFs involve R&D-related activities (e.g. proof of concept and prototype development) and the use of a variety of services aimed at optimising access to capital and efficiently advancing the commercialisation process (e.g. patenting, coaching, management services). In Mexico support to early development stages, which can be granted directly to firms or indirectly through intermediary institutions, is presently fragmented among various funding institutions and of insufficient scope as some activities are poorly covered. Support should be reorganised to reduce these shortcomings, with particular attention to the following:

- *Support for proof of concept, patenting, technology and commercialisation services.* Establishing proof of concept is an essential step in the transition from a research result to a potential commercial application. Beyond the advantages of protection, patenting provides an intangible asset that eases access to angel and venture capital. Coaching and management services increase opportunities to access sources of financing and reduce risks related to commercial take-off. In Mexico support for these activities is scattered among various institutions and programmes. Support for proof of concept and patenting,¹³ as currently provided by FIT, is mainly aimed at existing firms registered in RENIECYT. Coaching support goes mainly to firms in SNIE-certified incubators¹⁴ with limitations on funding and the scope of assistance. Coaching activities rarely include selection processes that establish a bridge to seed and angel capital funds. In various OECD countries these procedures provide a signal that almost guarantees access to such funds (Box 3.1). It is recommended to integrate all of the elements of support to these early development stages in a new dedicated Trust Fund that emulates “Commercialisation Australia” (Box 3.2). The “mature” component related to proof of concept and patenting for FINNOVA support to TTOs could be a separate modality of this new fund or integrated in it under the same funding and eligibility conditions.¹⁵
- *Seed capital.* Financing of seed capital can presently be obtained or subsidised through various support programmes that are scattered across government departments and publicly supported funds.¹⁶ FINNOVA contemplates launching, in the near future, a seed capital sub-programme which is a welcome initiative. Main recommendations in this area are the following:

Box 3.1. Fostering the ecosystem for the development of high-technology start-ups

German and Swiss experience with public-private co-operation

Germany and Switzerland have high-performing research systems and are among the most innovative OECD countries. They have developed effective public federal and sub-federal policies in support of R&D activities and knowledge transfer between public research institutions and industry. Although both countries have a dynamic innovative SME sector, they have devoted attention over the last decade to overcoming market and systemic failures that may adversely affect the creation and expansion of high-technology start-ups. With public support and the active participation of the private sector, they have employed policy initiatives to foster the build-up of ecosystems that reduce obstacles encountered by start-ups in the critical early stages of their development. Two important initiatives are described here.

The German High-Tech Gründerfonds

The High-Tech Gründerfonds was created in 2005 at the initiative of the German Ministry for Economics and Technology as a public-private fund for financing start-ups as a response to the weakness of the seed capital market. The Gründerfonds quickly broadened its initial financing objectives to encompass the provision of a wide array of services aimed at enhancing the chances of success and the sustainability of start-up proposals notably as regards coaching, proof of concept funding, linkages with research institutions, access to public R&D support programmes and networks of potential VC investors in funding rounds subsequent to seed financing.

The volume of the High-Tech Gründerfonds currently amounts to around EUR 280 million. In addition to the participation of the Ministry of Economics and Technology, capital contributions come from a private banking group (KfW) and six research-intensive industrial groups (BASF, Deutsche Telekom, Siemens, Robert Bosch, Daimler and Carl Zeiss).

The Fund invests in innovative companies that are at the most one year old. It contributes up to 80% of the total investment with a ceiling of EUR 0.5 million and a possibility of further financing up to EUR 2 million. Selected companies are eligible for coaching programmes and proof of concept funding. During its first five years the Fund financed over 250 companies in the high-technology sector with a survival rate of over 80%, and successfully set them on an expansion path by facilitating their access to VC capital.

The Swiss CTI start-up promotion programme

The CTI start-up promotion programme was created in 1996 by the Swiss Innovation Promotion Agency as a comprehensive platform for coaching potentially successful high-technology start-ups, providing business training programmes, supporting their proof of concept and prototype development activities and facilitating access to seed capital financing. The programme supports both innovative entrepreneurs and market-oriented scientists irrespective of technological or scientific field or economic sector of application.

Projects proposals are submitted to a very selective business and technical appraisal process that opens the way to various stages of coaching throughout the various phases of project development and to support for R&D activities via innovation vouchers. The coaching process culminates with the award of a CTI start-up label that proves determinant in accessing seed capital from the CTI public/private partnership for early-stage commercial development and subsequent access to VC capital.

More than 180 start-ups have been awarded the CTI Start-up Label in the last ten years. Today over 85% are successfully operating commercially and quite a few are regarded as “stars” of the Swiss entrepreneur scene.

Sources: Author, based on Brandkamp (2011) and the Swiss CTI (2011).

- Given the generally weak collateral offered by NTBFs, seed capital should preferably be provided in the form of grants and equity participation rather than loans. In this respect it may be useful to conduct an assessment of the performance of Mexico Emprende seed capital financing scheme as regards its impact and merits for NTBFs.
- Seed capital provided in the form of equity should preferably be channelled through funds with a private legal status, whose management maintains an arm’s-length relationship with the public source of funds. Investment returns accruing to FINNOVA as equity owner should cover management costs and preferably be reinvested to expand the seed fund’s capitalisation.
- Seed funding should be awarded according to the intrinsic merits of NTBF projects and should not discriminate among NTBFs according to sectors¹⁷ and regions or whether they were incubated in SNIE-certified institutions.
- Seed capital funding for spin-offs from PRIs and HEIs may call for specific modalities involving TTOs that could contribute to equity funding of their spin-offs through their participation in seed funds; Mexico could emulate a number of schemes implemented in OECD countries such as the French “capital d’amorçage” scheme (Box 3.3) or the Australia Pre-seed Fund which is operated on similar lines.¹⁸

Box 3.2. Integrated support of NTBFs’ early development stages

The example of Commercialisation Australia

Commercialisation Australia is a government initiative started in early 2010. It assists researchers, entrepreneurs and innovative firms in turning their intellectual property into successful commercial ventures. The support provided by the scheme aims to help successful applicants through the commercialisation process. Assistance is tailored to the needs of each successful applicant and is structured around the key stages in the commercialisation pathway. It is a merit-based, competitive assistance programme which offers:

- Skills and knowledge grants of up to AUD 50 000 (USD 39 000) to pay for specialist advice and services.
- Experienced executive grants of up to AUD 200 000 (USD 156 000) over two years to assist with the recruitment of experienced executives to help build the skills, knowledge and connections required to commercialise new ideas.
- Proof of concept grants of AUD 50 000 (USD 39 000) to AUD 250 000 (USD 195 000) to test the commercial viability of a new product, process or service.
- Early-stage repayable commercialisation grants of AUD 250 000 (USD 195 000) to AUD 2 million (USD 1.6 million) to develop a new product, process or service to the stage where it can be taken to market.

Successful applicants are assigned case managers to guide them through the commercialisation process and facilitate access to experienced volunteer business mentors.

Source: OECD (2011b); www.commercialisationaustralia.gov.au/.

Box 3.3. France's support to PRIs/HEIs through participation in seed capital funds

This support programme was created in 2007 to encourage the development of seed capital to finance start-ups. It contributes equity to funds that invest in innovating companies originated in, or connected with, public research institutions. The seed capital funds are private companies, whose creation is supported by the Treasury and a subsidiary of the French development bank, Caisse des Dépôts et Consignations (CDC). Support takes the form of an advance of capital to public research institutions' TTOs whose share in the funds should not exceed 40%. Capital advances are reimbursable in a time span of 12 years.

Supported seed capital funds have to invest more than 75% in firms linked with public research in the early stage of their development (creation phase). Private investors should have the majority of the capital and be in charge of its management. TTOs cannot have more than 40% of the fund capital. Seed capital funds should neither control the companies in which they invest nor search to increase their share of capital in these companies. Their vocation is to withdraw at a later stage when other venture capital investors come in.'

Since 2000, 11 seed capital funds have been created with public support of EUR 22 million in capital advances to TTOs from the budget and more than EUR 30 million capital investment from CDC. By 2006 these funds had invested in more than 130 start-ups.

Source: French Ministry of Research, www.enseignementsup-recherche.gouv.fr/cid5734/les-fonds-capital-amorcentage.html.

Intermediary institutions

- *High value-added technological services.* The acquisition of such services is to be supported through technological vouchers in the framework of the FINNOVA TTO programme whose terms of reference, in terms of eligibility and the nature of costs covered, are not yet clearly defined. Such schemes have already been developed in many OECD countries.¹⁹ One of the great advantages of such schemes is their low management and administrative costs. It is to be hoped that Mexico will be able to adapt other countries' best practices and extend the benefits of vouchers to firms engaged in the incubating process. In general in OECD countries vouchers can be used only for services provided by public research institutions. However, in Mexico, as private enterprises' TTOs can also benefit from the FINNOVA certification process it will be possible to use these vouchers to contract services from private enterprises.²⁰ HEIs with a strong S&T infrastructure generally ensure that knowledge-based start-ups that they incubate can benefit from such an infrastructure. Vouchers could also be used for that purpose.
- *Coaching services.* Coaching services play a crucial role in the successful transition from applied research results to successful commercialisation by knowledge-based start-ups. In particular, they make a difference in survival rates. On the one hand they facilitate a more efficient build-up of a pipeline of NFBFs with high survival rates through their assistance in preparing comprehensive business plans that integrate technological and commercial prospects and can attract the interest of seed and angel capital funds.²¹ On the other hand, they raise the competence levels of the managers of such funds so that they are able to assess NTBFs' prospects. Mexico suffers from weaknesses in these two types of coaching services. For *coaching services to firms*, beyond what is already offered in the framework of the support to SNIE-incubated firms, a greater role could be given to ADIAT and FUMEC/TechBa in strengthening the supply of coaching services to NTBFs through a subsidised network of service providers.²² For *coaching services to fund managers* (actual or potential), their development is supported in some OECD countries either by foundations²³ or through public subsidies. In Mexico they could be included in the framework of public support for the development of angel capital networks in the form of subsidies conditioned by matching resource commitments (see below).

- *Angel capital.* As highlighted above, despite incipient but encouraging initiatives, the provision of angel capital for the initial commercial take-off of NTBFs is one of the weakest features of Mexico's system of public and private system of support to and promotion of knowledge-based start-ups. The main recommendations for developing the angel capital market and improving the efficiency of angel capital groups in the selection and financing of potentially successful NTBFs are:
 - *Legal status.* As mentioned in the section on the regulatory framework, angel capital groups or associations should be able to form a limited liability company or a limited liability partnership. This offers a much more secure legal status for attracting potential investors and developing their operations. At present, the only way to register as a LLP or LLC is to do so abroad.
 - *Fiscal incentives.* A number of OECD countries have established fiscal incentive schemes in favour of angel and venture capital companies or of private investors as a means to channel more investment to the creation and expansion of knowledge-based start-ups.²⁴ Mexico does not offer such incentives and should consider the possibility of implementing them in one form or another. It is important to take into account the balance between the positive effects of such incentives (investment multiplier, additionality) and possible adverse effects, such as tax distortions that bias risk assessments or tax deduction opportunity costs (Mason, 2009).
 - *Guarantees.* In some OECD countries public agencies can provide guarantees for angel investment in start-up companies.²⁵ Evaluations of the effectiveness of such programmes, which require strong assessment competencies on the part of these agencies, have not proven conclusive in terms of additionality. Such guarantee schemes are not recommended for Mexico.
 - *Scope of investors.* The possibility of broadening the scope of investors beyond individuals to include institutional investment sources such as state pension schemes and capital development certificates should be considered.²⁶ The involvement of public funds (for instance from NAFIN) in angel capital funds should be considered with caution, as their participation is more warranted for initial (seed) financing and expansion (venture) capital.
 - *Support to angel associations and networks.* As emphasised in a recent OECD publication, “National angel associations, or federations of networks, play a very important role in developing the angel market by raising awareness about angel investment, collecting data, providing training and liaising with policy makers” (OECD, 2011a). Indeed, over the past decade, a number of governments have supported the development of the angel investment market through the provision of financing for angel networks or groups and even of coaching for fund managers (Box 3.4). Such forms of support are conspicuously absent in Mexico. The only initiatives in this matter have been taken by private groups such as Angel Ventures. It is recommended to support the establishment of business angel networks with a share of operative costs related to information exchange, sharing of coaching practices and assessment experiences through competitive calls.

Box 3.4. Spain's support for the development of business angels networks

Spain's Ministry of Industry, Tourism and Commerce subsidises the creation and development of business angel networks to facilitate intermediation between groups of private seed capital companies and firms looking for financing in order to engage in the development of innovative projects or new S&T based start-ups. This intermediation is done through the provision and diffusion of information services and advisory services to suppliers of capital and firms looking for funding.

Subsidies are granted through competitive calls for networking proposals presented by associations of business angel companies. Subsidised costs mainly cover wages and operative costs of the technical personnel that run the network and provide the services offered.

In 2011 the budget for this subsidy amounted to a little over EUR 740 000. The first tranche of the subsidy is granted to the winners of the competitive calls.

Source: MITC (2011).

Higher education and public research institutions

Although there are no reliable statistics on the subject, the number of spin-offs that originated in Mexican HEIs and PRIs and are still in existence is rather low. This performance does not match the scientific and technological capacities of the Mexican higher education and public research system. As discussed in previous chapters, a number of factors are beginning to improve this situation. There are signs that a cultural shift is beginning to take place in research institutions of excellence in that the importance of third mission activities is increasingly recognised at the level both of individual researchers and institutions' governing boards.

Given that past initiatives to develop TTOs are now formally supported by FINNOVA in the framework of a certification process, and that the S&T Law gives more flexibility to HEIs and PRIs in the choice of their TTOs' legal status and more possibilities for researchers to participate private enterprises' activities, the likely increased availability of seed capital should bode well for more dynamic academic spin-off creation. To this end, the main recommendations are:

- *Governance and funding.* Other OECD countries' experience should be emulated by including third mission performance among the criteria used for determining budgetary resources allocated to public HEIs (OECD, 2010d).²⁷ Criteria should include patenting and licensing performance as well as the number of spin-offs created.²⁸
- *Career motivation.* SNI criteria for researchers' promotion and the granting of compensation bonuses should include the third mission.
- *Mobility of researchers.* Progress has been made through the S&T Law but should be complemented by a provision in the Public Service Law allowing researchers involved in the creation of a spin-off two years of absence with the possibility to re-integrate the public service without prejudice in case of failure.
- *Seed capital.* The possibility of a specific modality of the FINNOVA seed capital sub-programme for academic spin-offs should be considered by adapting models developed in OECD countries such as France and Australia (Boxes 3.2 and 3.3). Incentives should be used to attract the participation of foreign angel capital funds.

- *Performance monitoring.* Unlike their counterparts in many OECD countries, Mexican HEIs and PRIs have not developed standardised information bases on their patenting, licensing and spin-off activities.²⁹ Commitment to provide this information should be a condition of the FINNOVA-supported TTO certification process. It could be supported by the National Association of Higher Education Institutions (ANUIES).

Concluding remarks

In spite of the relatively satisfactory performance of its academic and public research institutions in terms of scientific production and training of highly qualified personnel, Mexico lags behind countries at similar levels of development in terms of its ability to draw on its scientific, technological and human capital assets to foster the development of new technology-based enterprises.

At various levels of government as well as in academic institutions and the business sector, there is an increasing consciousness of the growing importance of NTBFs for reaping the benefits of public investment in science, technology and innovation in order to create value and contribute to economic growth, high-skilled employment and exports of goods and services. This has led to a reorientation of S&T policies and to legal and regulatory reforms that place greater emphasis on technology transfer capacities, support to SMEs' investment in innovation and measures which support the creation and expansion of NTBFs. Combined with the dynamism of an incipient angel capital market, this set of measures has begun to lay the building blocks of an ecosystem more favourable to the development of NTBFs. The successful emergence of such an ecosystem at regional level shows that such a policy orientation can bear fruit.

However, at national level, the success of an innovation policy that integrates the development of NTBFs as one of its efficiency and performance criteria is predicated upon a number of achievements. A first is the commitment of resources to that policy. Others concern the improvement of conditions related to policy governance and implementation, framework and regulatory conditions, and the evolving balance between public and private support of NTBFs that conditions the leverage of public support on private investment.

This chapter presents the main recommendations for reaching these goals. It acknowledges valuable policy initiatives and regulatory reforms, spells out conditions that should improve policy outcomes and reiterates some recommendations already made in the context of the 2009 OECD review of Mexico's innovation policy, notably concerning the excessive fragmentation of the country's portfolio of support programmes and instruments and issues related to programme implementation and delivery. Too little has been achieved in this area and more efforts are in order, especially for programmes in support of NTBFs.

The implementation of the National Innovation Programme should provide a useful opportunity to implement the recommendations proposed in this report.

Notes

1. The beneficiaries of almost all support programmes have to be already registered in the National Registry of S&T enterprises and institutions (RENIECYT).
2. This programme should have been published following a formal presentation by the President of the Republic which never took place.
3. This difficulty has particularly affected CONACYT. Its performance in terms of outcomes is constrained by rules requiring disbursement of the grants during the fiscal year corresponding to the project approval.
4. See for instance the Swedish Teknopol approach to innovation support for technology-based firms (Heydebreck et al., 2000).
5. However, in some of the most advanced countries proof of concept and even sometimes prototype activities may be funded by private sources such as foundations or even technological firms through endowments to HEIs (Gulbranson and Audretsch, 2008).
6. In the framework of a virtuous circle that has been referred to as “venture capital/start-up co-evolution [which reflects] an endogenous process of emergence of new private venture capital market embedded in new entrepreneurial high-tech sector” (Teubal and Kuznetsov, 2012).
7. There is strong international evidence that moderate government involvement in venture capital funds is associated with good performance while extensive government activity in VC funds is associated with weaker performance (OECD, 2004; Brander et al., 2010).
8. The rationale for such support includes information asymmetries and spillover effects as analysed in Mason (2009).
9. The SBIR seed capital programme is funded by contributions of a percentage of the R&D budget of federal departments or agencies, the so-called “set aside” contributions.
10. Such shortcomings are more important for NTBFs than for established enterprises more familiar with the portfolio of programmes.
11. See, for instance the example of Finland’s Tekes (2011) and the website www.tekes.fi/about/niy.
12. It is conspicuous that in the PNI annex devoted to the System of Innovation of Indicators the source referred to for the development of indicators related to NTBFs is labelled “to be defined”.
13. Including international patenting registration.
14. No support is given to firms incubated in the framework of angel capital companies or associations.

15. At present FINNOVA envisages a matching financing requirement by the TTO parent institution amounting to half of the amount of public support.
16. Such as FONLIN in Nuevo León.
17. Unless the private fund in which it participates has a high-technology sectoral orientation.
18. See www.ausindustry.gov.au/programs/venture-capital/psf/Pages/default.aspx.
19. For an overview of these voucher schemes in Europe see Table 3.1 in OECD (2011b).
20. This raises the question of why private enterprises can benefit from FINNOVA support for their certification process. In principle private enterprises' TTOs are for-profit units whose creation need not be supported by public funds. What is important is the certification process.
21. As stated in a recent European Commission study on policies in support of high-growth innovative SMEs (Lilischkis, 2011): "Coaching by experienced certified coaches has been demonstrated to improve significantly the number of firms which make the leap from a fledgling high-tech start-up with a technology optic to a dynamic high-growth firm with a market orientation."
22. As illustrated in a recent NESTA report, accelerators can play an important role in the promotion of knowledge-based start-ups (Miller and Bound, 2011). TechBa's role as an accelerator of technology-based SME development in international markets could in fact be extended to bridge the gap between early-stage technology firms and international venture funding in the same way as the Finnish VIGO programme (OECD, 2011c and www.profi.fi).
23. Such as the Angel Capital Education Foundation (ACEF) developed under the aegis of the Kauffman Foundation (www.angelcapitaleducation.org/education/).
24. Such incentives exist for instance in France, Ireland, Israel, Italy, Japan, Portugal and the United Kingdom, and, at local level in Canada and the United States (OECD, 2011c).
25. This is notably the case of Austria's AWSi2 Business Angel Matching Service and Denmark Vaeksfonden investment fund (OECD, 2011c).
26. In Spanish AFORES/CKDs. The public fund of funds Mexico Ventures II created in June 2012 benefits from this possibility.
27. In principle, this is already done for PRIs through their performance contracts.
28. To avoid distortions a more valid criterion would take survival rates into account.
29. Examples of good practice in the development of comparable indicators are those of the American Association of University Managers (AUTM) and Spain's RedOTRI.

References

- Brander, J., Q. Du and T. Hellmann (2010), Governments as Venture Capitalists: Striking the Right Balance, Working Papers Volume 3: The Global Economic Impact of Private Equity Report 2010, World Economic Forum.
- Brandkamp, M. (2011), Seed capital for good ideas: The experience of the German High Tech Gründersfund, mimeo, Bonn. www.en.high-tech-gruenderfonds.de/.
- Gulbranson, Ch. and D. Audretsch (2008), Proof of Concept Centers: Accelerating the Commercialization of University Innovation, Kauffmann Institute.
- Heydebreck, P., M. Klofsten and J. Maier (2000), Innovation support for technology-based firms: the Swedish Teknopol approach, R&D management 30, 1, Blackwell publishers, Oxford.
- Lerner, J. (2009), The Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital have failed-and what to do about it, Princeton University Press, Princeton.
- Lilischkis, S. (2011), Policies in support of high-growth innovative SMEs, INNO-Grips Policy Brief No. 2, European Commission, Brussels. www.proinno-europe.eu/innogrips2.
- Mason, C. (2009), Public Support for the Informal Venture Capital Market in Europe: A Critical Review, International Small Business Journal, Vol.27.
- Maula M., G. Murray and M. Jääskeläinen (2007), Public Financing of Young Innovative Companies in Finland, Finnish Ministry of Trade and Industry, Helsinki.
- Miller, P and K. Bound (2011), The Start-up Factories: The rise of accelerator programmes to support new technology ventures, NESTA discussion paper, London.
- MITC (2011), Subvenciones 2011 para el impulso a las redes de “business angels”, Boletín Oficial del Estado, Madrid. www.ipyme.org/es-ES/SubvencionesAyudas/RedesBusinessAngels/Documents/BusinessAngels-Convocatoria2011.pdf.
- OECD (2003), *Governance of Public Research: Toward Better Practices*, OECD Publishing.
doi: [10.1787/9789264103764-en](https://doi.org/10.1787/9789264103764-en)
- OECD (2004), “Venture Capital: Trends and Policy Recommendations”, OECD Papers, Volume 4, Issue 10, OECD.
doi: [10.1787/oecd_papers-v4-10-en](https://doi.org/10.1787/oecd_papers-v4-10-en)
- OECD (2009), *OECD Reviews of Innovation Policy: Mexico*, OECD Publishing.
doi: [10.1787/9789264075993-en](https://doi.org/10.1787/9789264075993-en)
- OECD (2010), *Performance-based Funding for Public Research in Tertiary Education Institutions: Workshop Proceedings*, OECD Publishing.
doi: [10.1787/9789264094611-en](https://doi.org/10.1787/9789264094611-en)
- OECD (2011a), *OECD Product Market Regulation Statistics* (database).
doi: [10.1787/pmr-data-en](https://doi.org/10.1787/pmr-data-en)

- OECD (2011b), *Business Innovation Policies: Selected Country Comparisons*, OECD Publishing.
doi: [10.1787/9789264115668-en](https://doi.org/10.1787/9789264115668-en)
- OECD (2011c), *Financing High-Growth Firms: The Role of Angel Investors*, OECD Publishing.
doi: [10.1787/9789264118782-en](https://doi.org/10.1787/9789264118782-en)
- Swiss Commission for Technology and Innovation (2011), CTI Start-up promotion, www.ctistartup.ch/htm/home.htm.
- TEKES (2011), “Tekes increased its funding for young, innovative growth companies”, TEKES, Helsinki.
www.tekes.fi/en/community/News/482/News/1344?name=Tekes%20increased%20its%20funding%20for%20young,%20innovative%20growth%20companies
www.tekes.fi/en/community/Young_innovative_growth_enterprises/1155/Young_innovative_growth_enterprises/2528.
- Teubal, M. and Y. Kuznetsov (2012), “Sequencing public interventions to support techno-entrepreneurship”, in *Promoting Inclusive Growth – Challenges and Policies*, OECD/The World Bank, doi: [10.1787/9789264168305-en](https://doi.org/10.1787/9789264168305-en)

Annex A

List of interviews¹

CONACYT

Leonardo Rios Guerrero	Deputy Director General, Technological Development and Business Innovation
Luis Mier y Terán	Deputy Director General, Planning, Evaluation and International Cooperation
Miguel O. Chávez Lomelí	Director, Business Innovation
Gustavo Villar	Director for Technology Commercialization
Alejandro Carlos Farias	Deputy Director for Technological Business
Hugo G. Mirón González	Deputy Director, Business Innovation

Ministry of Economy

Meney De la Peza Gándara	Deputy Director General
Ramón Scott	Director, Process and Information Control
Cecilia Raya Soto	Deputy Director, Technological Incubators

Ministry of Education

Eduardo Calderón	Advisor to the Deputy Minister for Higher Education
------------------	---

FCCyT

Juan Pedro Laclette	General Coordinator
José Fernández Zayas	CONACYT SNI Director and Former FCCyT General Coordinator

NAFIN

Juan Ángel Hernández	Administrator, Fondo Emprededores
----------------------	-----------------------------------

ADIAT

Gerardo Fernando Bravo	President
Leopoldo Rodríguez Sánchez	Former President

FUMEC

Guillermo Fernández De la Garza	Executive Director
Carlos Morán Moguel	Advisor to the Executive Director
Iván Zavala	Coordinator for the ICT Industry

Angel Ventures Mexico

Hernán Fernández Lamadrid	Founding Member
Christian Meade	Founding Member

¹ For confidentiality reasons the names of NTBFs interviewed during the OECD mission are not disclosed.

Nuevo Leon Institute for Innovation and Technology Transfer (I2T2)

Jaime Parada Ávila	General Director
Oscar Vázquez Montiel	Director, Innovation and New Business
Karym Giacomán Zapata	Coordinator, Entrepreneurship
Reynold González	Director, Scientific infrastructure (PIIT)

FONLIN

Francisco Aguilar Martínez	Director
José Antonio Manrique García	Coordinator

Monterrey Global Ventures

Arturo Guerra Rodríguez	General manager
-------------------------	-----------------

Center for Global Innovation and Entrepreneurship (Monterrey)

Carlos Ross	Director general
-------------	------------------

ITESM

David Garza	Rector
Francisco J. Cantú Ortiz	Director for Research and Entrepreneurship
Mario A. Martínez Hernández	Director, Entrepreneurship
Silvia P. Mora Castro	Director, Technology Transfer

Nuevo León University

Ricardo Gómez Flores	Director, Incubation Centre and Technology Transfer
----------------------	---

UNAM

José Luis Solleiro Rebolledo	Researcher, former Director General UNAM Centre for Innovation and Development (CID)
Alejandra Herrera	Director of de Incubators and Technological Parks, CID
Carlos Maynor Salinas Santano	Coordinator of the Innova/UNAM Incubator System

IPN

Lourdes Duque	Director, Incubation Centre for Technology-based enterprises (CIEBT)
José Clemente Reza García	Director, Polytechnic Unit for Enterprise Development and Competitiveness
Ricardo Castañeda	Deputy Director, Enterprises Incubation
Juan Alberto González Piñón	Deputy Director, Post-incubation

CINVESTAV

René Asomoza	Director General
Luis Carreño	Deputy Director, Technology Transfer
Marco Antonio Meraz Ríos	Planning Secretary
Pablo Rogelio Hernández	Academic Secretary

Annex B

Interview guidelines²

A. Enterprise sector

i) Presentation of the project

CONACYT has asked the OECD to analyse the performance of the Mexican knowledge-based start-up sector, to assess the policies and instruments that have been implemented to support this sector and to make recommendations aiming at improving the current support system and the regulatory environment in order to foster the dynamics of creation and expansion of new technology-based firms (NTBFs).

ii) Presentation of the enterprises' experience

- Date of creation and main characteristics of the enterprise (e.g. sector and/or technological area; nature of the market; growth of employment and turnover; R&D intensity; patents; composition of capital; linkages with public research institutions).
- Types of support received for the creation of the enterprise and the development of its innovative activities (e.g. subsidies; access to seed and venture capital; guarantees; patent registration) from government departments or agencies (e.g. Conacyt, Ministry of Economy, Nafin).
- Main benefits and outcomes from support received in terms of: investment, production, employment, R&D, markets expansion, other.
- Views on efficiency of public support instruments: design, application and selection process, implementation, other.

iii) Enterprises' views on main obstacles to the creation and expansion of NTBFs in Mexico

- *Financing*. Access to sources of seed and venture capital; weakness of business angel networks; lack of guarantees; transaction costs for bank credits.
- *Government policies*. Need for specific emphasis of policies and instruments focusing on NTBFs; complementarity between support instruments provided by different departments or agencies.
- *Regulatory and/or administrative obstacles*. Barriers to entry; corporate governance; red tape.
- *Markets*. Small internal markets and support to international development.
- *Human resources*. Availability of qualified human resources with research and management competencies.
- *Patents*. Costs of application, registration and protection.
- Linkages with public research institutions. Technology transfers and licensing issues.

iv) Possible recommendations

² These guidelines were circulated to the institutions interviewed prior to the interviews.

B. Higher education and public research institutions**i) Context**

- The creation and expansion of NTBFs are an important outcome of public and private investment in S&T. These firms whose activities are based on knowledge contribute to economic growth, the creation of qualified jobs opportunities. They often contribute to address social needs in areas such as health, energy, environment and water remediation.
- Most OECD countries as well as several emerging economies with significant S&T capacity have implemented various types of policies and instruments in support of the creation and expansion of NTBFs (e.g. high-tech incubators, incentives to R&D and innovation investment, tax incentives, access to seed and venture capital, support to patent application and intellectual property protection). Among these countries many have given a particular emphasis to measures that foster the role of higher education and public research institutions (HEIs and PRIs) in the creation of NTBFs in general and academic spin-offs in particular (e.g. development of TTOs and incentives to technology transfer, new governance structure and financing modes that give a premium to third mission performance).

ii) Presentation of the project

CONACYT has asked the OECD to analyse the performance of the Mexican knowledge-based start-up sector, to assess the policies and instruments that have been implemented to support this sector and to make recommendations aiming at improving the current support system and the regulatory environment in order to foster the dynamics of creation and expansion of new technology-based firms (NTBFs) including academic spin-offs.

iii) Presentation of HEIs experience in the promotion of NTBFs and the development of academic spin-offs

- *Incubator and technology transfer activities.* Organisation and track record over the last two decades.
- *Innovation performance.* Number of IMPI and PCT patents (applications and granted); How many patents have been licensed? How many spin-offs have been created over the last two decades? In which areas?
- *Technology Transfer Offices.* Is the HEI benefitting from FINNOVA OTC support for the creation or the strengthening of its TTO? What status will the TTO have (integrated in HEI or autonomous status); How will TTOs activities be financed?

iv) HEI's view on main obstacles to the development of incubated NTBFs and academic spin-offs

- *Incentives.* Researchers' incentives to get involved in third mission activities and to patent research results.
- *Regulatory issues.* Can research staff participate in the capital of spin-offs? Can the benefit from temporary leave to participate in the creation of spin-offs?
- *TTO management.* Possible lack of management capacities, including those related IPR; financing of TTO operations.
- *Dedicated policies.* Weakness of specific support policies and instruments focusing on technology transfer and academic spin-offs.
- *Ecosystem linkages.* Weak linkages with industry and financial markets.

v) Possible recommendations

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where governments work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Union takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

Knowledge-based Start-ups in Mexico

Contents

Introduction

Chapter 1. Knowledge-based small and medium-sized enterprises in Mexico:
An emerging issue in innovation policy

Chapter 2. Critical overview of support programmes

Chapter 3. Policy recommendations

Related reading

OECD Reviews of Innovation Policy: Mexico (2009)

Consult this publication on line at <http://dx.doi.org/10.1787/9789264193796-en>.

This work is published on the OECD iLibrary, which gathers all OECD books, periodicals and statistical databases.
Visit www.oecd-ilibrary.org for more information.