Chapter 1

Economic Performance and Framework Conditions for Innovation

Mexico's economic performance in terms of growth of GDP per capita has been respectable but still insufficient to close the gap vis-à-vis *the most advanced OECD countries in terms of the population's living standards, and overcoming widespread poverty.*[1] *To shift the economy to a path of higher, sustainable growth, Mexico's economic policy needs to boost productivity growth. In the past, it has been sluggish. Given the salient role of innovation in driving longer-term productivity growth, the challenge is to encourage innovation throughout the Mexican economy. Achieving this goal will require significant, broad-based reform and dedicated efforts.*

1.1. Economic performance

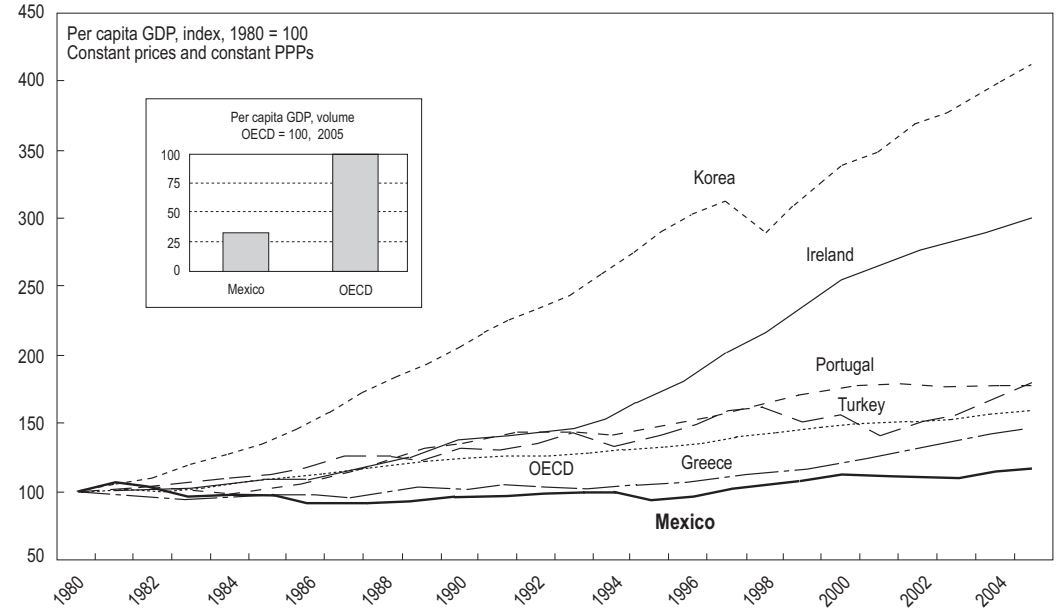
1.1.1. Macroeconomic performance

Since the 1994-95 peso crisis, Mexico's macroeconomic performance has improved significantly. It has benefited from structural reforms and the opening of the economy and achieved broad macroeconomic stability. From 2001 to 2007, GDP per capita has grown at a rate slightly above the OECD average. Underpinned by buoyant exports, strong investment and sustained domestic demand, GDP growth reached a robust 5.1% in 2006, slowing in 2007 to 3.3% following a drop in manufacturing exports. Given its specific international linkages, including its export specialisation patterns, Mexico has been severely hit by the current economic crisis, and both exports and domestic demand have fallen sharply. As the recession deepened in the United States – by far Mexico's main export destination – industrial production fell sharply and growth turned markedly negative in the first quarter of 2009. Continued difficulties, notably in the automotive industry, have reinforced the downturn. It is expected that the impact of a weak US economy, particularly on the manufacturing sector, and declining oil extraction will keep export growth negative during 2009 (OECD, 2009b).

In a longer term perspective, some economic analysts have called Mexico's post-NAFTA per capita GDP growth "reasonable but unremarkable" (Tornell *et al*., 2004, p. 34).[2] While economic performance in terms of growth of GDP per capita improved in the decade preceding the current crisis, Mexico's economic dynamism has not matched that of the better-performing emerging markets, nor has it been sufficient to sustain a process of convergence with the more advanced OECD economies:

- *Mexico's economic performance has not been outstanding in the longer term*. Mexico has not achieved the growth performance in terms of GDP per capita of the world's two most populous countries, China and India, over 1987-2007. Ireland, Portugal and Turkey have also performed better on this measure, as has Korea, with an exceptionally successful catching-up process despite the setback it suffered in the Asian crisis of the late 1990s (Figure 1.1). In Latin America, Chile provides an example of economic success and higher growth performance. However, Mexico has performed better than major emerging markets such as Brazil, the Russian Federation (which went through a transition crisis in the 1990s) and South Africa in terms of per capita GDP growth.

Figure 1.1. Per capita GDP in selected countries

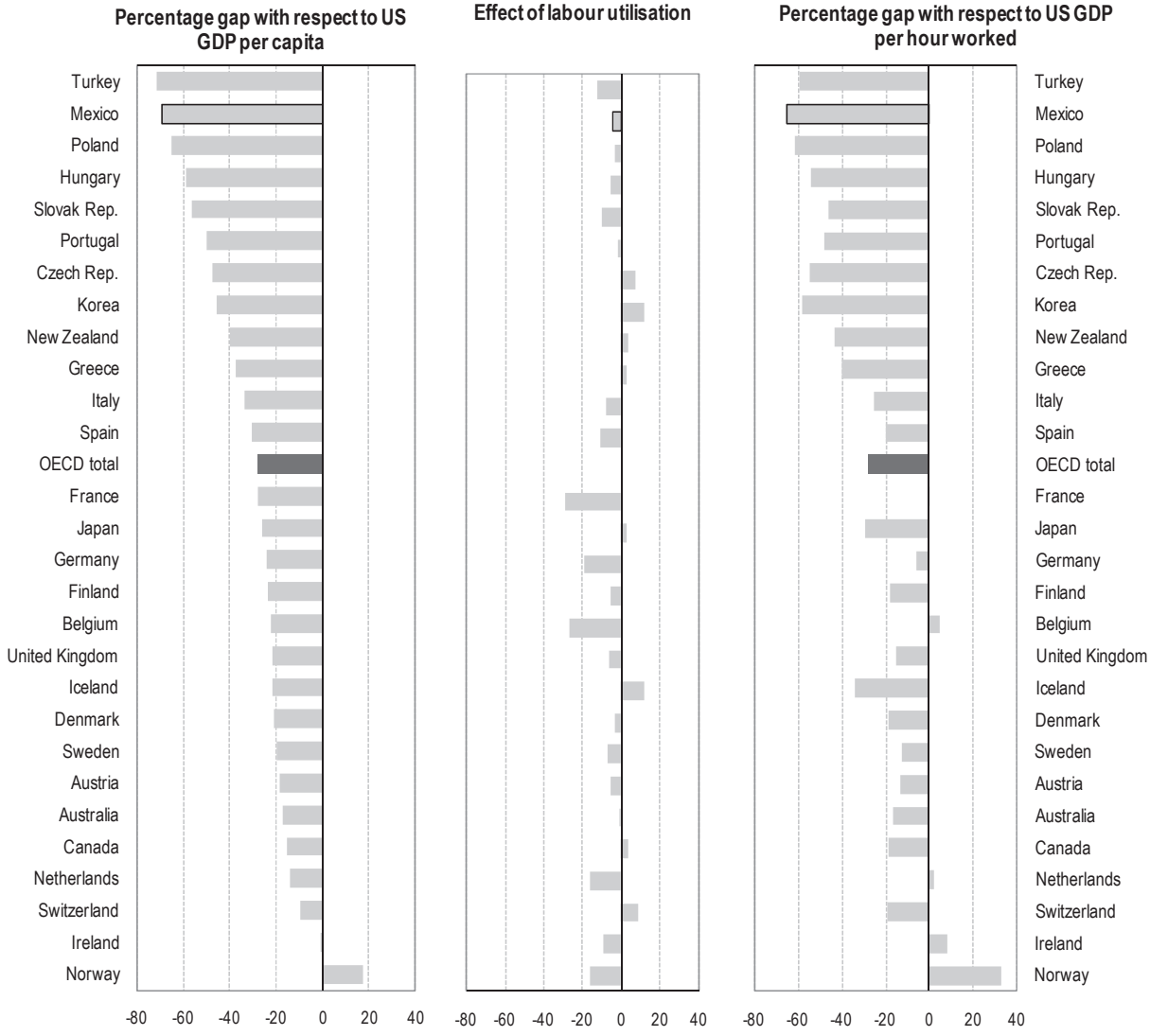


Source: OECD (2007), *Economic Survey: Mexico*, OECD, Paris.

- *However, growth performance improved in the decade preceding the current crisis*. Mexico's growth of GDP per capita was around 2% a year over 1997-2007, which implies a significant boost in performance as compared to the preceding decade (1987-97).
- Yet, Mexico's growth performance has not achieved convergence to the OECD average and particularly to the stronger performers among high-income countries. Mexico's level of GDP per capita remains the second lowest among OECD countries. In 2007 the gap *vis-à-vis* the United States amounted to 69 percentage points, and was almost completely (65 percentage points) accounted for by lagging labour productivity (as measured by GDP per hour worked). Lower labour utilisation accounted for only a very small part of this gap (Figure 1.2). In fact the level of labour productivity is the lowest in the OECD. As will be seen, the Mexican productivity gap has not been narrowing over time.

Figure 1.2. Income and productivity levels, 2007

Percentage point differences with the United States



Source: OECD (2009), *OECD Factbook 2009*, OECD, Paris.

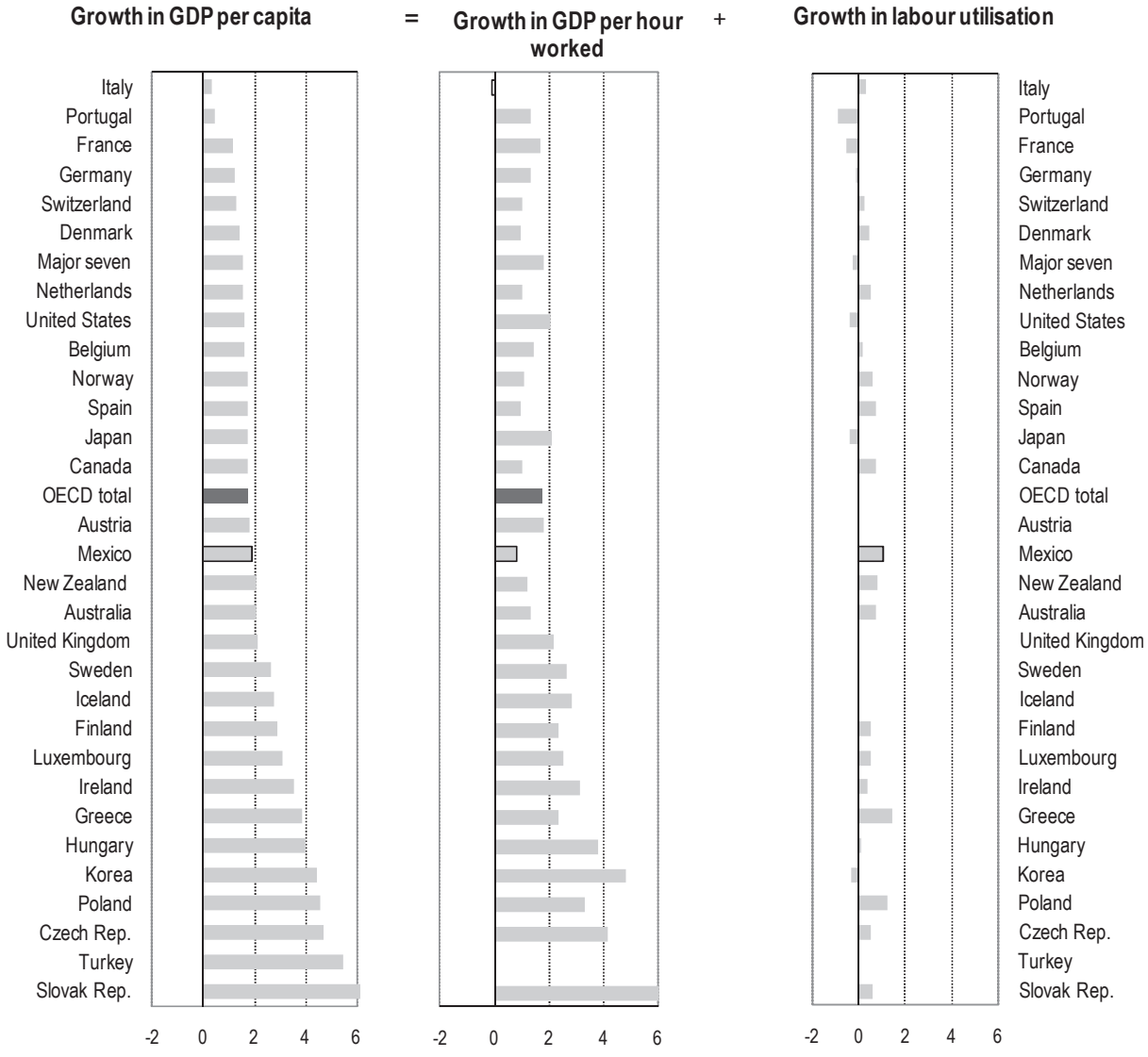
1.1.2. Productivity growth

Mexico's sluggish productivity growth stands in the way both of convergence of its per capita GDP and living standards with those of the advanced OECD countries and of keeping pace with high-performing emerging economies. Mexico's labour productivity growth (measured in terms of GDP per hour worked) has been among the lowest among OECD countries since 2000 (Figures 1.3 and 1.4). Mexico is the only OECD country in Figure 1.3 in which increased labour utilisation contributes more to growth of GDP per capita than labour productivity over 2001-07. It has been observed that Mexico's economic growth has been primarily based on augmentation of inputs of production factors rather than on higher productivity growth. From 1987 to 2007, Mexico's growth pattern has been "extensive", that is, based on increased labour utilisation (measured as

the ratio of those employed to persons of working age, *i.e.* 15 to 64 years) and on changes in the demographic structure (an increase in the ratio of the population of working age to the total population). Over the same period better-performing countries such as Chile, China, India and Turkey have tended to pursue an "intensive" growth path, relying more on labour productivity growth (OECD, 2009a).

Figure 1.3. Contribution of labour productivity and labour utilisation to GDP per capita, 2001-07

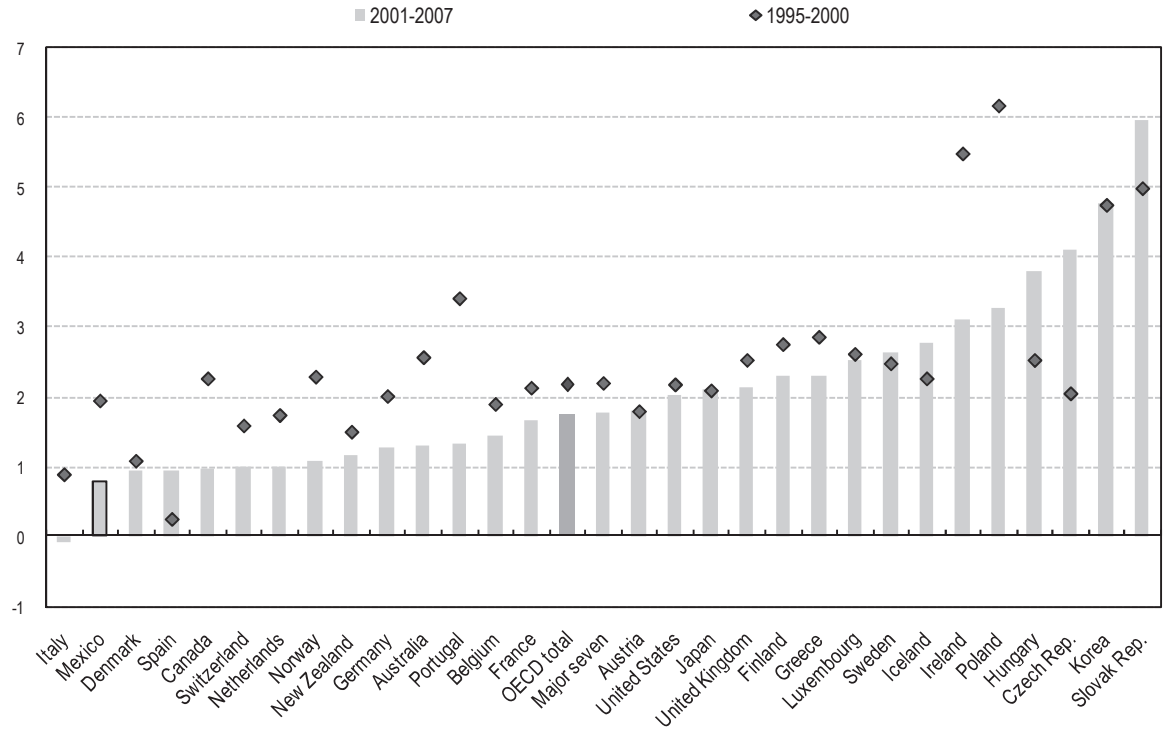
Percentage change at annual rate



Source: OECD (2009), *OECD Factbook 2009*, OECD, Paris.

Figure 1.4. Growth in GDP per hour worked, 1995-2000 and 2001-07

Percentage change at annual rate



Source: OECD (2009), *OECD Factbook 2009*, OECD, Paris.

There is evidence of some shift in the patterns of productivity growth. In recent years, productivity growth has been mostly driven by within-sector rather than between-sector growth (OECD, 2009a). The latter captures re-allocation of labour resources between sectors, while the former is associated with capital accumulation and technical change. Between-sector productivity growth tends to be characteristic of countries in earlier stages of economic development as they shift from low-productivity agriculture to other sectors, such as manufacturing. Thus, the observed shift in the pattern of productivity growth implies that it has become more similar to that of more advanced countries.

The overall weakness of productivity growth is partly related to a lack of innovation capacity. At the sectoral and firm level, the preference for imported technology over the development of indigenous innovation capacity has led to less technology diffusion and transfer than would have been expected from increased international (including intra-sectoral) trade and flows of foreign direct investment (FDI). The problem has been compounded by framework conditions that are in some respects not conducive to the adoption of innovative strategies – which entail funding and managing the inherent risks. This is reflected in the very low level of patenting by Mexican industry. Moreover, industries classified as high-technology do not invest significantly more in R&D and innovation as a share of value added than lower-technology ones. As a result, they do not play a driving role in the dissemination of knowledge and technology throughout the business sector or in the formation of technology-based value chains. At an economy-wide level, this points to an under-performing innovation system.

Productivity growth can be fostered by improving educational outcomes, upgrading the infrastructure, further boosting international trade and FDI, increasing competition, lowering the cost of doing business, and facilitating access to finance for business enterprises, notably innovative start-ups. The *OECD Economic Survey of Mexico 2007* investigated a broader set of these issues in depth (OECD, 2007a). There is significant potential in the Mexican economy for the adoption of such policies. Yet, these broad policies need to be complemented by targeted measures aimed at improving Mexico's innovation performance.

1.2. International trade and foreign direct investment

In the global economy, international trade and foreign direct investment are important pillars of growth.[3] Openness to international trade and FDI affects a country's innovation performance in various ways.

Mexico began to liberalise international trade and to ease restrictions on foreign investment in the 1980s. In 1986, Mexico became a member of the GATT (General Agreement on Tariffs and Trade, later the World Trade Organization – WTO). Mexico has also made significant progress in opening the economy to international trade by lowering tariffs through bilateral and multilateral regional free trade agreements (RTAs). Mexico's RTAs now encompass its main trading partners and main players in global trade, notably the United States and Canada (through the North American Free Trade Agreement, NAFTA, in force since 1994), the European Union (2000) and Japan (2005). In practice, NAFTA is by far Mexico's most significant RTA. The integration of the Mexican and the US economy is particularly important; the United States is the source of much FDI and the destination of 85% of Mexican exports. Mexico's import sources are more diversified (Table 1.1).

As a result of two decades of reform, Mexico is much better integrated in the global economy today than it was at the beginning of the liberalisation process in the 1980s. Yet, as will be discussed below, there remain important barriers to further economic integration. According to the KOF Index of Globalisation 2009,[4] which provides a synthetic measure of economic, social and political globalisation, Mexico ranks 65th on all three dimensions taken together, and 79th on the economic dimension of globalisation, a low rank for an OECD country. Economic globalisation is captured by a synthetic indicator which encompasses actual flows (trade, FDI stocks and flows, portfolio investment and income payments to foreign nationals) and restrictions (hidden import barriers, mean tariff rate, taxes on international trade, current account restrictions).[5] Mexico's low rank in terms of economic globalisation is mainly due to remaining restrictions. These are dealt with in some detail later in the chapter.

Table 1.1. Trade in goods between Mexico and the United States, 1992-2008

	1992	1995	2000	2005	2008
Share of Mexico's exports destined to the United States	69.8	91.1	87.1	88.9	84.9
Share of Mexican imports originated in the United States	67.9	70.0	74.5	62.0	51.1
Share of US exports destined to Mexico	7.3	9.0	11.6	13.5	12.9
Share of US imports originated in Mexico	6.0	6.8	10.2	10.7	10.4

Note: ISIC Rev. 3 divisions 01-37.

Source: OECD STAN Bilateral Trade Database.

The opening of Mexico's economy has resulted not just in increased trans-border trade and capital flows and significant structural change, it has also helped to improve the functioning of product markets, creating a more favourable general business environment.

1.2.1. International trade

The expansion of international trade, underpinned by economic reform, has been a major driver of economic growth. NAFTA very significantly increased the size of the markets that are freely accessible to Mexican exporters. With the opening of the economy, Mexico's trade in goods and services (defined as the average of the share of exports and imports) increased from 17.5% of GDP in 1994 to a peak of 29.2% in 2007. A jump in Mexico's trade in goods and services (by 9 percentage points) occurred between 1994 and 1995 (26.5%), with the coming into force of NAFTA, but the increase was insignificant in subsequent years. Following a relative decline during the early years of this decade it reached this level again in 2007. Mexico's combined share of exports and imports has increased from 39% of GDP in 1990 to 58% in 1995 (the year after NAFTA came into force) and 67% in 2007.

Both exports and imports of goods have grown rapidly (nearly fivefold between 1994 and 2007 to approximately USD 270-280 billion), *i.e.* faster than the OECD average. Mexico has developed an export specialisation in manufactured goods, which now account for over 85% of all goods exports; the automotive sector and electrical and television equipment furnish the main export items (see below). The share of Mexico's exports of manufactured goods in world manufactured imports (in value terms) increased from 1.5% in 1994 to 3% in 2000 and 2001, before declining to around 2.3%, where it remained between 2004 and 2006 (Haugh *et al*., 2008). Yet, the dynamism of Mexico's exports has not matched that of goods exports from emerging economies such as Brazil, China, India, Indonesia, Russia or Turkey. The level of exports and imports of services is much lower and has grown much less rapidly than exports and imports of goods (not even doubling in the period concerned). Indeed, during the last decade, growth in Mexico's service exports was one of the lowest among OECD countries. Import penetration, measured as a share of domestic demand, has also increased, but at around 30% it is still among the lowest in the OECD area. As mentioned, Mexico's international trade has been severely affected by the current economic crisis.

Trade liberalisation, especially through NAFTA, created new opportunities and very significantly expanded the size of markets available to Mexican exporters. It also increased the exposure of Mexican firms to import competition in the domestic market and intensified competition in export markets, especially in the United States. Openness thus creates opportunities but also poses formidable challenges for Mexican firms and for the government to provide broad framework conditions that are conducive to business activities.

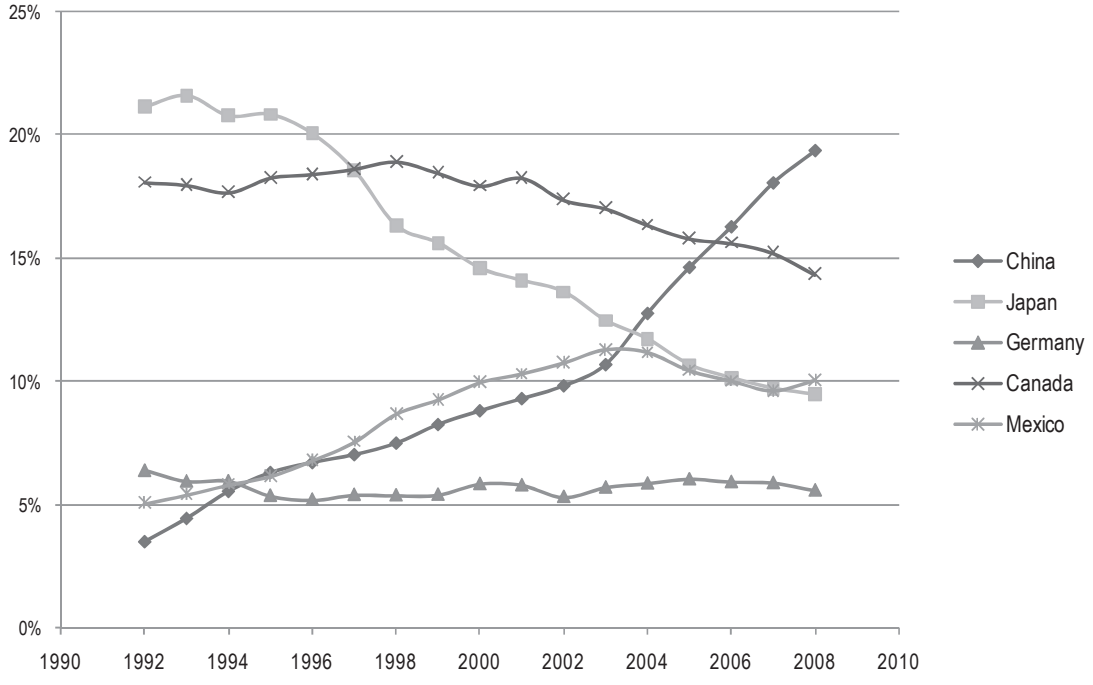
This challenge is illustrated by OECD work on Mexico's export performance (Haugh *et al*., 2008). Mexico's export performance was very strong in 1994-2000, and its share of the world market for manufactures rose by 92%. Using constant market share analysis, Haugh *et al.* (2008) show that two-thirds of this increase was due to the "market share effect", as Mexican products gained market share in their individual markets. Following the coming into force of NAFTA, Mexico also benefited from its strong export specialisation in the US market at a time when US import growth exceeded the world average.[6] As a result, "geographic specialisation" contributed 14 percentage points of the total change. Mexico's export "product mix" contributed 6 percentage points to the total

change in world market share. In 2001 export performance weakened significantly, and market share started to decline in 2002. In all, Mexico's world market share dropped by 18.4% over 2001-06. This can be largely attributed to Mexico's geographic specialisation, which accounted for 14.4 percentage points of the decline, owing to slower growth of US imports relative to world imports. Mexico's product specialisation had no part in the decline in market share. However, the market share effect – which drove strong export performance in 1995-2000 – was clearly negative (contributing -5.6 percentage points), particularly in the United States.

This result is consistent with the observation that the entry of firms from emerging economies, notably China, into the US market led to more vigorous competition for Mexican firms exporting to the United States, especially after the accession of China to the WTO in 2000, and a loss in competitiveness aggravated by a gradual real exchange rate appreciation. The current decade saw the spectacular rise of China as the "workshop of the world". Chinese exports to the United States expanded very rapidly. By 2005 its share of US imports of manufactures had risen to 15%. As a result, all major exporters to the United States – including Mexico – lost market shares over the period, with Japan suffering the largest losses. As of 2004, China had overtaken Mexico and Japan to become the second largest exporter of manufactured goods to the United States after Canada. It later rose to first position (Figure 1.5).

Figure 1.5. Shares of major exporters to the United States, 1992-2008

Manufacturing imports as a percentage of total US imports



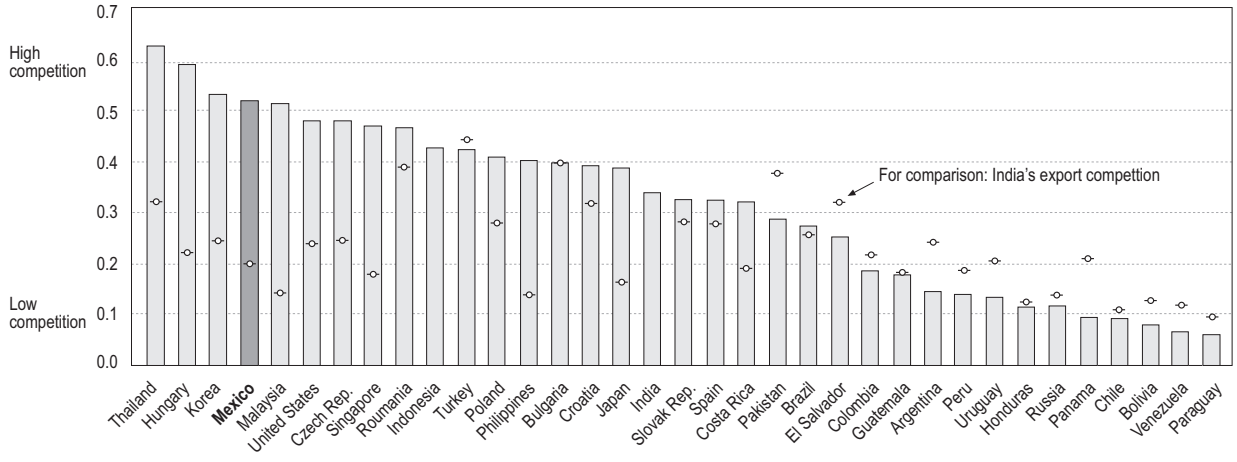
Source: OECD STAN Bilateral Trade Database.

Gallagher *et al*. (2008) find that more than half of Mexico's non-oil exports were under direct or partial threat from Chinese competition. Mexico was able to retain its position in exports based on low-skill assembly operations with higher transport costs and on NAFTA's rules of origin, which serve as local content rules and mandate that production must stay in North America (Gallagher *et al*., 2008, p. 1376).

In light of the increased competition from Chinese exporters, Mesquita Moreira (2006) revisits the long-standing debate about the role of manufacturing in Latin America's future development.[7] The issue is particularly important for Mexico because of its comparatively large manufacturing sector. In addition, the specialisation of Mexican exports is quite similar to China's. Figure 1.6 shows the similarity of export structures between China and selected Latin American and emerging economies. A high measure indicates similarity in export structures, as determined by the specialisation and conformity coefficients.[8] Based on this measure, Mexico appears potentially to be the most exposed of Latin American countries to Chinese competition. Along with Mexico, exports from Hungary, Malaysia and Thailand (all of which have an export-oriented manufacturing sector) also closely resemble those from China. By contrast, the similarity of Mexico's export structure to that of India and thus to potential competition is much weaker.

Figure 1.6. Export competition with China, selected countries, 2000-05

Average coefficients of specialisation and coefficients of conformity



Source: OECD (2007), *Latin American Outlook 2008*, based on WITS and Comtrade data (2007).

Given this background, a number of factors may have contributed to the fact that the shares of Mexico's main non-oil exports to the US market have either declined or grew at a slower pace than China's. They include the rising real exchange rate of the peso relative to the US dollar (notably in conjunction with the dollar/yuan exchange rate), weaknesses in Mexico's infrastructure, limited access to bank credit and a lack of innovation (Gallagher *et al*., 2008). Low innovative performance of the business sector as a whole (as indicated by innovation outputs or the creation of technology-based firms) and low productivity growth have contributed to the decline in international competitiveness of Mexican firms. The rise of unit labour costs during the second half of the 1990s in an environment of increased competitive pressure from emerging economies also had a part in eroding Mexican competitiveness.

Although the evidence suggests that Mexico's export performance was on the way to recovery before the onset of the current economic crisis (Sargent and Matthews, 2008), competition from exporters in emerging markets will almost certainly remain strong. Moreover, it can reasonably be expected that "China is bound to have a spectrum of comparative advantages" (Mesquita Moreira, 2006). China, and to a lesser extent Brazil, have outpaced Mexico in innovation-related investment as a share of GDP or manufacturing value added. There is strong evidence that China's effort will be sustained, with investments in education, science, technology and innovation (OECD, 2008a). While China may face initial disadvantages in research productivity relative to the scientifically and technologically more advanced OECD countries, it is exceptional in many respects, including its size, which may be an advantage for spreading the cost of R&D, and its proven ability to sustain a coherent effort to reach long-term goals. As a result, China can be expected to retain its existing comparative advantages and to develop new ones in a broad range of products both in the low-skill and in knowledge- and technology-intensive segments of production.

1.2.2. Foreign direct investment (FDI)

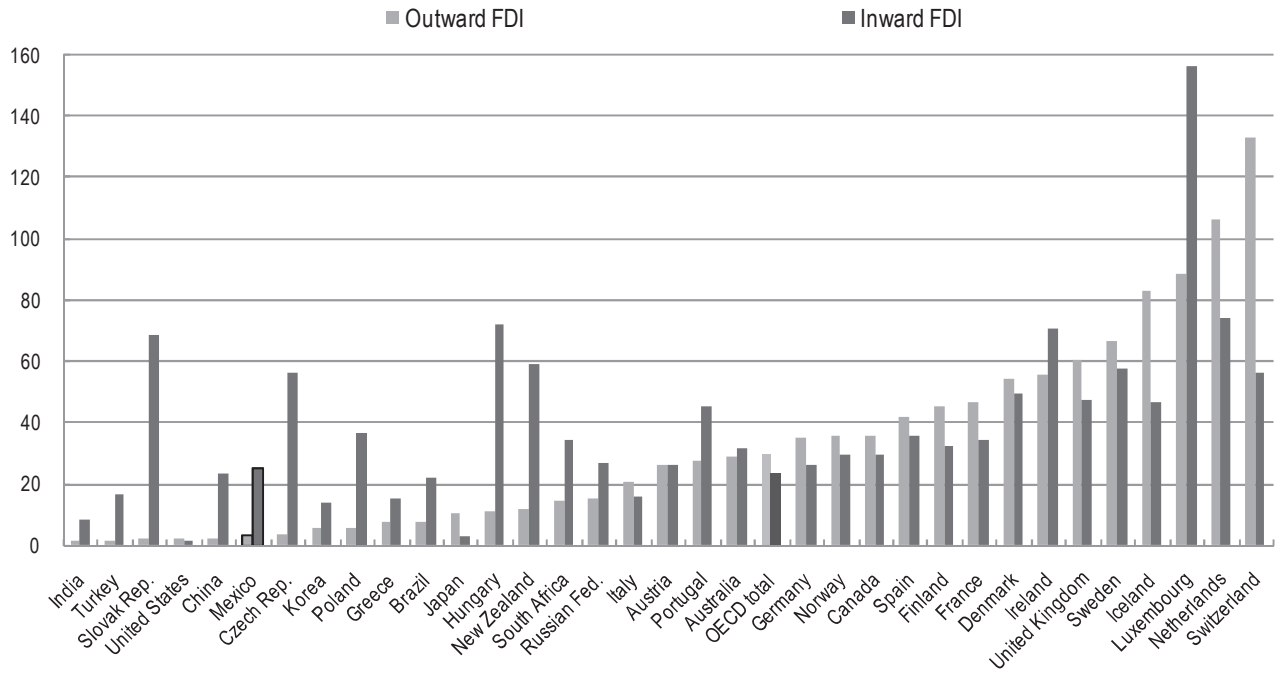
At 25% of GDP, Mexico's inward FDI stocks are slightly above the OECD average (2006), and relatively larger than those of major emerging markets such as Brazil, China, India and Turkey (Figure 1.7). Between 1990 and 2006 Mexico's inward direct investment stocks increased more than tenfold (in USD). Yet, Mexico does not seem to have made full use of its potential. UNCTAD (2008) lists Mexico among the countries with high inward FDI potential but low performance.[9] Outward FDI stocks (3.3% of GDP) are small, as they are for many other emerging economies (with the exception of the Russian Federation and South Africa). However, some Mexican companies have developed a strong presence through subsidiaries abroad. For example, Cemex is among the global leaders in the cement industry.

In recent years, gross FDI inflows relative to GDP were close to the OECD average. Yet, during 2000-06 a number of catching-up economies, including some OECD members, have been able to attract significantly higher inflows of direct investment. From 1994 to 2005, manufacturing accounted for approximately half of the gross FDI inflows to Mexico. However, except for financial services there have not been complementary large inflows of direct investment in the services and infrastructure sectors. This imbalance may have a negative impact on the development of the manufacturing sector in the longer term as there are already some bottlenecks as regards services and infrastructure provision.

In principle, FDI can serve many purposes in the overall context of a country's economic development. It is closely related to goods trade and, especially in service industries, commercial presence is one of the main modes of cross-border service supply. Higher inward FDI increases competitive pressures in the economy. It is also an important vehicle for technology spillovers and stimulates innovative activity (Nicoletti *et al*., 2003). There is empirical evidence that openness to international trade and FDI is an important channel for the international R&D spillovers which are an important source of total factor productivity growth (Coe *et al*., 2008).

Figure 1.7. FDI stocks, 2006[1]

As a percentage of GDP



1. Or latest available year.

Source: OECD (2009), *OECD Factbook 2009*, OECD, Paris.

FDI has contributed to Mexico's economic growth in various ways. Foreign-owned manufacturing firms play a major role in export-oriented industries. In principle, multinational enterprises can be a source of learning about advanced methods in production, finance and marketing, and thus can help foster innovation. In this way they can contribute indirectly to improving economic performance. However, these positive spillover effects do not accrue automatically. The empirical evidence suggests that the degree and quality of spillovers depend on the absorptive capacities of the host country (human capital, capabilities of firms in a variety of dimensions).[10] In Mexico, spillovers from inward FDI appear to be limited. Improving the ability to attract more FDI and increase the benefits of spillovers of FDI to domestic firms is strongly related to business firms' capabilities, which largely reside in their human capital stock (see below).

Through competition, trade, and technology transfers, FDI is an important driver of growth. There is also empirical evidence that it boosts labour productivity, both directly by augmenting the capital stock, and indirectly, by inducing greater domestic capital investment (Ramirez, 2006). However, as the section on framework conditions for innovation will show, the barriers to FDI in Mexico are still among the highest in the OECD area.

1.3. Economic structure and structural change

There has been a significant change in Mexico's structure of production and trade. The export-oriented manufacturing sector has received significant flows of FDI, primarily from the United States, and has been an important engine of growth, especially after NAFTA came into force. Mexico's international trade has also undergone structural changes, and its composition differs markedly from that of the vast majority of Latin American countries.

1.3.1. Industry and trade

Between 1970 and 2006, the share of agriculture in GDP has declined in real terms, a process which has accelerated in the last decade. Mining, including oil extraction, also lost weight albeit marginally. As in other countries, the contribution of the services sector to GDP has increased, most strongly in financial and transport and telecommunication services. Unlike many developing countries and some natural-resource-based emerging economies, Mexican manufacturing largely maintained its share in GDP, driven by the stunning performance of its export-oriented, globalised segment; the expansion recorded up to 2000 was followed by a (possibly temporary) loss of share towards the mid-2000s. Growth in the globalised segment offset the decline in parts of manufacturing which are not strongly linked to global value chains. Chemical substances and oil derivatives lost shares, and the contribution of textiles, leather and footwear products declined as well in relative terms. The part of the manufacturing sector that significantly increased its contribution to GDP was metal products, machinery and equipment; this is mainly due to the dynamism of the automotive and electronics (radio, TV sets, computers) industries, all of them strongly export-oriented.

The export-oriented sector of the economy is the source of more than 90% of high-technology manufacturing exports. Upper-medium or high-technology industries (electronics and auto parts) dominate the *maquila* sector, which also produces low-technology goods (textile products). The PITEX programme was centred on medium-high-technology products such as automobiles. Mexican manufacturing has specialised in segments of the manufacturing process that require little domestic R&D. Under standard classifications, some of the products are nevertheless in the high-technology category (since production of the same product categories is R&D-intensive in more advanced countries). R&D expenditure (as a percentage of value added) is only slightly higher in the segments of the Mexican economy that produce goods commonly classified as high-technology. In addition, many of those activities are not or only weakly linked to local production – a significant share of inputs are imported – or with the larger national innovation system.[11] Industries oriented towards the (less dynamic) domestic markets are characterised by high technological heterogeneity and typically low-technology activity. Leading firms recorded significant productivity growth but productivity gaps between industries and sectors are increasing. Best practices relating to technology and productivity performance fail to diffuse smoothly across industries.

Along with other important – albeit often incomplete – structural reforms, trade liberalisation had a profound impact on the direction and speed of structural change in Mexico's economy. Not only has the volume of trade expanded, the structure of trade flows has also changed radically during the past two decades. Mexico's export specialisation today is primarily in manufactured goods, reflecting an increasing specialisation in

economic activities that are integrated in global value chains. The main export items are manufactured goods related to the automotive industry and electrical and television equipment (Table 1.2).

Table 1.2. Main categories of manufactured exports by value, 2001-06

Average share in percentage

Sector	% of manufactured exports
Transport equipment (primarily autos and auto parts)	20
Radio and TV equipment	14
Wires, cables, circuits and components	11
Computers and office machines	8
Electric motors and appliances	6
Clothing and footwear	6
Base metals	6
Chemicals, rubber and plastics	5

Source: Haugh *et al*. (2008), "Maximising Mexico's Gains from Integration in the World Economy", Economics Department Working Paper No. 657, OECD, Paris, based on OECD International Trade by Commodities Statistics.

Mexico's export structure differs markedly from that of other Latin American countries:

- The share of inter-industry trade is high. It has been argued that inter-industry trade in manufactures provides relatively larger opportunities for (technological) learning, especially compared to commodity exports. However, this potential depends on the precise nature of economic activities and the capabilities of domestic actors.
- Mexico has comparative advantages in a relatively broad range of goods.[12]

In the wake of trade liberalisation, Mexico significantly increased the variety of its exports in the 1990s (Feenstra and Kee, 2007). China did so as well and in some industries to a greater degree than Mexico. A high degree of product variety can be important. For example, there is some evidence that the greater variety of imports helped to raise welfare in the United States (Broda and Weinstein, 2006). Greater variety in exports seems to have a positive impact on the exporting country's aggregate productivity, although it does not explain much of between-country differences (Feenstra and Kee, 2008).

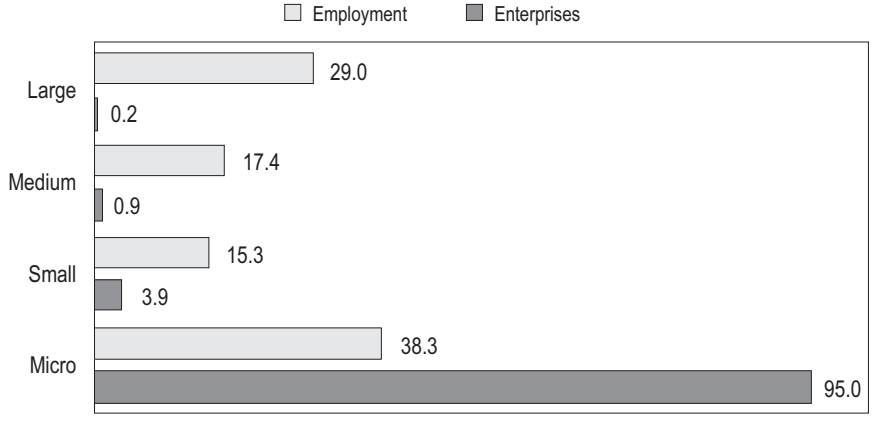
In principle, the differentiated comparative advantage linked to fast-growing intra-industry trade may be seen as an advantage.[13] However, the expansion of Mexico's international trade, underpinned notably by NAFTA and the *maquila*/PITEX programmes that allowed rapid expansion of manufactured exports, resulted from low labour costs rather than high and rising productivity and innovative capacity. In view of the changing international environment and strong competition from emerging economies, this may become an even greater constraint in the future.

1.3.2. Firm size

The size distribution of the total population of firms is important since firms' size is related to their capabilities, not least in the area of R&D and innovation, the role they play in the national innovation system and specific requirements for facilitating their operations. The Mexican industrial ecology[14] is dominated by micro-enterprises, with more than 4 million in the formal economy, whereas the number of large and medium-sized firms is extremely small at just 6 700 in 2003 (Figure 1.8). As Table 1.3, which refers only to manufacturing, shows, the predominance of micro-enterprises is greater than in most other OECD countries. Small enterprises account for just about 10% of employment in the manufacturing sector, much less than in other OECD countries (Table 1.4). However, large firms (more than 250 employees) and micro-enterprises account for a larger share in total employment in the manufacturing sector than in many other OECD countries. The informal sector is believed to include as many micro-enterprises as the formal sector. Mexico has high levels of self-employment compared to most other OECD countries (Figure 1.9).

The evidence points to a fragmented production structure and a highly polarised profile of employment and productivity levels (OECD, 2007b). The typical firm is small and mostly owned and run by a family. Around 90% are located in retail, services and agriculture and their output is oriented towards local markets. Only a small share of micro-enterprises are in manufacturing (just over 300 000). In contrast, a few internationally competitive firms, mainly situated in the metropolitan areas of Mexico City and Monterrey, have modern equipment and a strong innovation culture (Mittelstädt and Cerri, 2008). In addition there are the *maquiladoras*, defined as factories or assembly plants operated in Mexico under preferential tariff programmes. In 2004, there were almost 3 000 *maquilas* employing more than 1 million workers. Many are operated by multinational enterprises and their suppliers. A main weakness of Mexico's smaller firms is their outmoded product design and the low product quality, outdated equipment, and inadequate marketing. This is related to limited access to finance, low levels of human capital and inadequate use of technology, as illustrated by Mexico's gap in the diffusion of information and communication technologies (ICTs). There is no own R&D effort in large parts of the sector of small and medium-sized enterprises (SMEs).

Figure 1.8. Distribution of employment and enterprises by firm size, 2003



Source: OECD (2007), *SMEs in Mexico: Issues and Policies*, OECD, Paris.

Table 1.3. Share of enterprises by size class in the manufacturing sector, 2003

	1-9	10-49	50-249	250+
Mexico	**90.9**	**6.0**	**2.2**	**0.9**
Czech Republic	90.2	7.1	2.1	0.6
Hungary	86.2	10.2	2.8	0.8
France	82.8	13.2	3.2	0.8
Italy	82.6	15.1	2.0	0.3
Portugal	79.8	16.3	3.5	0.4
Spain	78.0	18.7	2.8	0.5
Netherlands	74.5	19.1	5.3	1.1
Austria	72.6	20.6	5.3	1.5
Denmark	71.7	20.9	6.0	1.4
United Kingdom	71.3	21.4	5.9	1.4
Germany	60.2	29.7	8.0	2.1
United States	58.2	33.7	5.1	3.0

Note: For the United Kingdom and the United States data are for 2002. Size class discrepancies: United States: 20-99, 100-499, +500; Mexico: 0-10, 11-50. Size classes for all countries but Mexico have been merged for 10-19 and 20-49.

Source: OECD Database Business by Size Class. Data for Mexico are from INEGI.

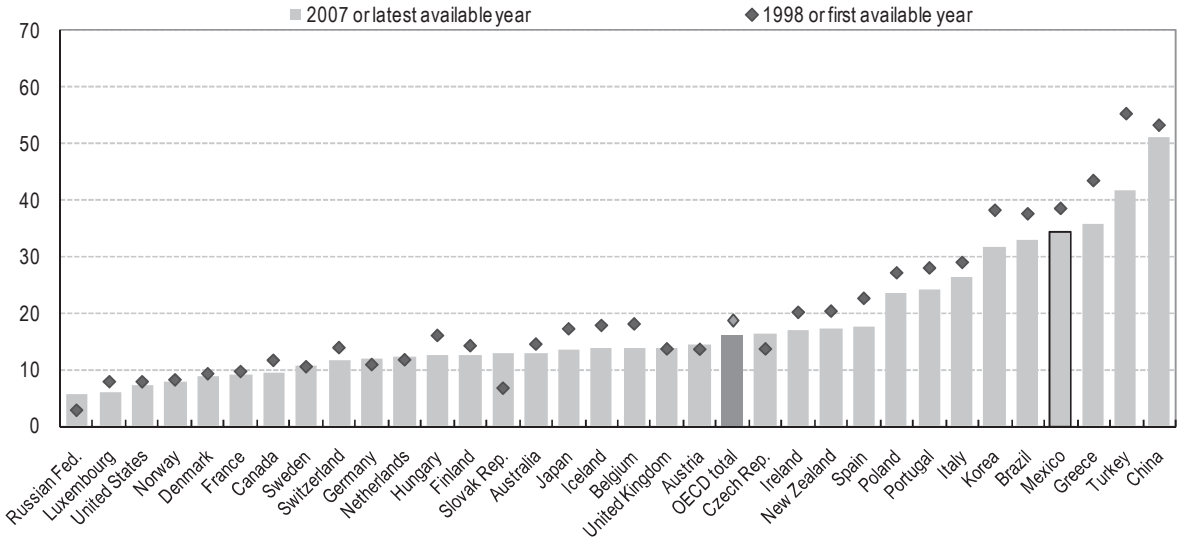
Table 1.4. Percentage of employees by size class in the manufacturing sector, 2003

	1-9	10-49	50-249	250+
Portugal	18.7	29.4	30.3	21.6
Mexico	**18.1**	**10.3**	**19.3**	**52.3**
Spain	14.8	33.2	24.5	27.5
Italy	14.6	34.0	24.8	26.6
Japan	12.6	28.3	30.0	29.1
Korea	11.3	34.8	25.0	28.9
Hungary	10.4	18.0	25.3	46.3
France	10.2	19.3	22.5	48.0
Netherlands	10.1	22.7	29.7	37.5
United Kingdom	8.8	19.2	26.7	45.3
Austria	7.8	19.0	27.9	45.3
Denmark	6.0	19.2	26.9	47.9
Czech Republic	5.5	17.5	28.5	48.5
Germany	5.2	15.6	23.8	55.4
United States	4.3	20.7	17.1	57.9

Note: For the United Kingdom and the United States data comes from 2002. Size class discrepancies: United States: 20-99, 100-499, +500; Mexico: 0-10, 11-50; Korea: 50-199, 200+. Size classes for all countries but Mexico have been merged for 10-19 and 20-49.

Source: OECD Database Business by Size Class. Data for Mexico are from INEGI.

Figure 1.9. Total self-employment rates, 1998 and 2007



Source: OECD (2009c), *OECD Factbook 2009*, OECD, Paris.

1.4. Framework conditions for innovation

Innovation cannot flourish in a business environment that restricts competition, imposes undue regulatory, administrative or financing burdens on the creation of new enterprises, discourages intangible investment, overprices infrastructure costs or raises undue barriers to the mobility of the labour force. Reforms introduced in recent years to improve the business environment of Mexican firms have certainly borne fruit, but they remain incomplete, insufficiently implemented and enforced. This situation is partly due to administrative inefficiencies or lack of resources, but it also reflects resistance by entrenched interests.

Achieving good innovation performance requires framework conditions that are conducive to innovation. Seriously flawed framework conditions can frustrate the work of innovation policy. Framework conditions encompass macroeconomic stability, international openness, vigorous competition and intellectual property rights, innovation-friendly regulation and taxation, a well-functioning system of financing innovative firms and projects, a well-functioning infrastructure, good corporate governance, efficient information systems, etc.

Innovation policy needs to be carefully designed in order not to crowd out private-sector efforts and initiatives. Successful innovation policy will enable the market to play its proper role in spurring innovation. Appropriate framework conditions should aim at ensuring that private innovation activity can improve entrepreneurs' economic position. Specific innovation policy measures are required to correct for specific instances of market or systemic failure in knowledge transactions which may arise in the interplay of different market and non-market actors of the innovation system.

There are several reasons why favourable framework conditions and a healthy business environment are essential for boosting innovation:

- Innovation activity requires a medium- or long-term planning horizon and thus a sufficiently stable environment in which to perform it. This is particularly important for R&D and other more complex types of innovation activity.
- A competitive environment provides powerful incentives for business enterprises to innovate.
- The regulatory framework is of crucial importance for the speed of diffusion, and in some cases also for the generation of specific new technologies. This was demonstrated on a global scale in recent decades by developments in the telecommunications sector.
- Framework conditions also have an impact on the effectiveness of innovation policy itself. Unfavourable framework conditions may reduce the effectiveness of specific policy measures designed to foster innovation: No amount of dedicated innovation policy measures can compensate for the absence or the serious malfunctioning of markets or other fundamental economic institutions.

The following is a discussion of some important elements of the overall framework conditions for fostering innovation: the macroeconomic framework, competition and intellectual property rights.

1.4.1. Macroeconomic framework

As mentioned above, the macroeconomic management of the Mexican economy has improved substantially since the financial crisis of the mid-1990s. This is apparent in the drop in inflation, small current account and fiscal deficits, and low public and foreign debt. OECD experience shows that a stable macroeconomic environment – in particular strong and robust rates of output growth – provides better conditions for business firms to pursue the medium- to long-term goals that are a salient feature of R&D investment and of the more demanding types of product, process and organisational innovation. A sound macroeconomic framework may also help investment in R&D and innovation through low and stable inflation rates by reducing the level and volatility of real interest rates (Jaumotte and Pain, 2005b; OECD, 2006b). Apart from these direct effects of macroeconomic conditions on the level of business R&D, indirect effects may be operating through the policy-making process. Under tight budgetary conditions public expenditure directed towards long-term objectives may be crowded out by other expenditure which is perceived as more urgent. As a result, long-term issues tend to move down on policy makers' lists of priorities.

Mexico's commitment to macroeconomic stability has already become an important factor in improved economic performance; it is also a necessary – albeit not a sufficient – condition for better innovation performance.

1.4.2. International openness

Despite major progress in opening its economy, Mexico's trade policy remains more restrictive (on a combined measure of tariff and non-tariff barriers) than the OECD average and than in other emerging economies (Haugh *et al*., 2008).[15] A combination of high protection of low-productivity industries and bilateral trade agreements can have harmful effects on innovation and productivity growth (see the example of trade diversion discussed in Box 1.1).

Box 1.1. Trade diversion, productivity and employment

The combination of relatively high protection of low-productivity sectors and bilateral trade agreements can lead to the expansion of low-productivity sectors and trade diversion. Trade diversion occurs when two economies have lower tariffs between them than with the rest of the world, so that trade between them increases at the expense of more efficient trade with other economies outside the trading bloc. For the importing economy this results in higher import costs and for the exporting economy it can result in the expansion of low-productivity sectors that drag down overall productivity performance and growth.

Evidence suggests that trade diversion has almost certainly occurred to some degree in NAFTA, especially in the clothing industry. The creation of NAFTA, together with high US and Mexican external import barriers for clothing, created a strong bias towards US imports from the Mexican clothing sector, which is labour-intensive and has lower labour productivity than other parts of the economy. This led to a large expansion of the sector in Mexico, with employment growing and Mexico posting large market share gains in the United States in the 1990s, while the Asian market share was falling. The adjustment of Mexico's sector was only postponed. During the early 2000s, as the United States began to reduce its barriers to imports of clothing from rest of the world markets and imports from other countries into the United States grew, Mexico's market share fell.

Although the expansion of the clothing sector helped absorb part of the rapidly growing workforce in the non-farm sector, it is also one of the reasons why Mexico's productivity growth performance has failed to match that of other middle-income countries. It is important to create enough employment to absorb the very rapid increases in the labour force, but increased employment in low-skilled protected sectors, such as the clothing industry, is only a short-term, second-best, solution. As the experience of the clothing industry illustrates, continued protection will maintain or increase jobs in low-skilled industries only temporarily, postponing the adjustment. Sooner or later, developments beyond Mexico's control, such as trade policy in other countries, technology changes and structural measures in other countries that improve the cost competitiveness of foreign firms, will eventually put pressure on the industry and lead to job losses.

Hence, Mexico should move ahead to gradually reduce protection in favoured industries, while at the same time ensuring that adequate retraining programmes are available for displaced workers with temporary income support if appropriate. Raising human capital is the only way to ensure sustainable higher productivity employment growth in the long run.

Source: Haugh *et al.* (2008), "Maximising Mexico's Gains from Integration in the World Economy", Economics Department Working Paper No. 657, OECD, Paris.

Mexico also maintains certain barriers to FDI[16] which are high compared with those in place in most other OECD countries, and also higher than in Latin American countries such as Argentina, Brazil and Chile. Comparatively tight ownership restrictions account for the larger part of these. Screening and notification procedures are also relatively complex, while management (*e.g.* reservation of a certain proportion of positions for nationals) and operating restrictions (*e.g.* local content requirements) are broadly in line with those in many other OECD countries. The four main types of ownership barriers and the sectors of particular importance for trade and productivity performance are summarised in Table 1.5.

Table 1.5. Summary of FDI ownership restrictions[1]

Restriction	Sector/activity
Activities reserved to the state	Petroleum and hydrocarbons, electricity
Activities reserved to Mexican nationals	Domestic land transport, gasoline retail sales and distribution of liquefied petroleum gas (propane)
Ownership limits	Up to 25% in airlines. Up to 49% in telecommunications, insurance companies, retirement funds management and coastal shipping
Ownership above 49% with government approval	Cellular telecommunications, airports, railways, ports, legal services, insurance agents, construction of pipelines for distribution of petroleum products, drilling of petroleum and gas wells

1. The complete list of sectors covered by these barriers is listed in Annex A4 of Haugh *et al.* (2008), "Maximising Mexico's Gains from Integration in the World Economy", Economics Department Working Paper No. 657, OECD, Paris.

Source: Haugh *et al*. (2008), "Maximising Mexico's Gains from Integration in the World Economy", Economics Department Working Paper No. 657, OECD, Paris.

Barriers to FDI are higher than the OECD average across all the main sectors of the economy (Table 1.6). The electricity sector is closed and restrictions are relatively tight in the financial sector, the transport sector (especially air and maritime transport) and the telecommunications sector (especially the fixed-line segment). Overall regulatory restrictiveness is well above the OECD average and that of some emerging economies. Restrictions in the construction, distribution, hotels and restaurants, and manufacturing sectors are lower but still above the OECD average and tighter than in many of the emerging economies included in this comparison. Mexico has below-average restrictions in the business services sector (legal, accounting, architecture and engineering services).

Table 1.6. OECD FDI regulatory restrictiveness index for Mexico by sector[1]

	Mexico	OECD average	Rank out of 29 countries (best to worst)
Business services	0.206	0.152	21
Telecoms	0.356	0.184	24
Construction	0.125	0.074	24
Distribution	0.125	0.072	24
Finance	0.502	0.152	24
Hotels and restaurants	0.125	0.072	24
Transport	0.428	0.299	26
Electricity	1	0.326	29
Manufacturing	0.125	0.076	24
Total	**0.278**	**0.187**	**28**

1. Index scale of 0-1 from least to most restrictive. This indicator-based international comparison covers nine sectors (and 11 subsectors) in 29 OECD countries and 13 non-OECD economies.

Source: Koyama and Golub (2006), "OECD's FDI Regulatory Restrictiveness Index: Revision and Extension to More Economies", Economics Department Working Paper No. 525, OECD, Paris.

The sectors mentioned as subject to tight restrictions and highlighted in Table 1.6 provide inputs for downstream industries. They are therefore important for Mexico's overall economic performance, its external trade performance and the country's attractiveness to foreign investors. They also play an important role in overall innovation performance. For example, the supply of high-quality telecommunications services at low cost is important for the rapid diffusion of ICTs and for innovation and productivity performance in the business sector as well as in the public sector.

FDI is closely related to goods trade and, especially in service industries, local presence is one of the main modes of cross-border service supply. Higher inward FDI increases competitive pressures in the economy andI is also a stimulus to innovative activity and an important vehicle for technology spillovers (Nicoletti *et al*., 2003). Through this set of channels (competition, trade, technology transfer), FDI is an important driver of economic growth. There is also empirical evidence that FDI boosts labour productivity both directly, by augmenting the capital stock, and indirectly, by inducing greater domestic capital investment (Ramirez, 2006).

Despite progress over the past two decades, further easing restrictions and regulations on trade and FDI would facilitate innovation and growth.[17] It would help maintain competitiveness, for example by giving easier access to higher-quality production inputs at lower prices. It can also help by increasing competition, encouraging greater returns to scale, further promoting supply chain links and technology spillovers between foreign and domestic firms. Reducing restrictions could increase the stock of FDI in Mexico substantially (Nicoletti *et al*., 2003). There have been significant inflows of FDI in the past in sectors where barriers are lower (such as manufacturing) or have been reduced (such as financial services). Encouraging flows of foreign capital to the services and infrastructure sectors would help raise the quality and cost competitiveness of the inputs used by the manufacturing sector, thereby assisting trade performance. In some of these sectors (insurance and transport), it would also open up possibilities for increasing Mexican services exports. The impact of reform would be maximised under a consistent policy framework. For example, boosting export growth or Mexico's attractiveness to foreign investors would be substantially facilitated by improving the transport infrastructure (see below).

1.4.3. Competition and regulatory regimes

Competition is the most powerful driver of innovation, which lies at the heart of superior innovative performance of market economies (Box 1.2).

Box 1.2. Competition and innovation

Product market competition is a driver of productivity growth either directly or indirectly through a positive impact on innovation (Baumol, 2002), at least until a certain intensity of competition is reached. Aghion *et al*. (2005) established an inverted-U relation between competition and innovation. It appears that the type of product-market competition is also important for favouring particular types of innovation activity (Aghion and Howitt, 2006). Although the relation between competition and innovation is complex, empirical evidence, as summarised by Ahn (2001, 2002) shows that:

- While there is no clear-cut relationship between market concentration or firm size on the one hand and innovation activity on the other, there is a robust relation between product market competition and productivity growth (which can be expected to be closely related to innovation activity in the long term). An increase in the intensity of competition (*e.g.* through regulatory reform, opening of markets to foreign suppliers) results in an increase in productivity growth and higher consumer welfare.
- Competition has long-lasting, dynamic effects on firms' behaviour.
- Competition between existing firms is important, but competition from innovative new firms may be even more important in securing productivity gains at the cutting edge of technology; hence the importance of free entry.

The interactions between competition in product, labour, and financial markets have important influences on innovation and growth. In particular, narrow illiquid capital markets and inflexible labour markets hold back most types of innovation activity.

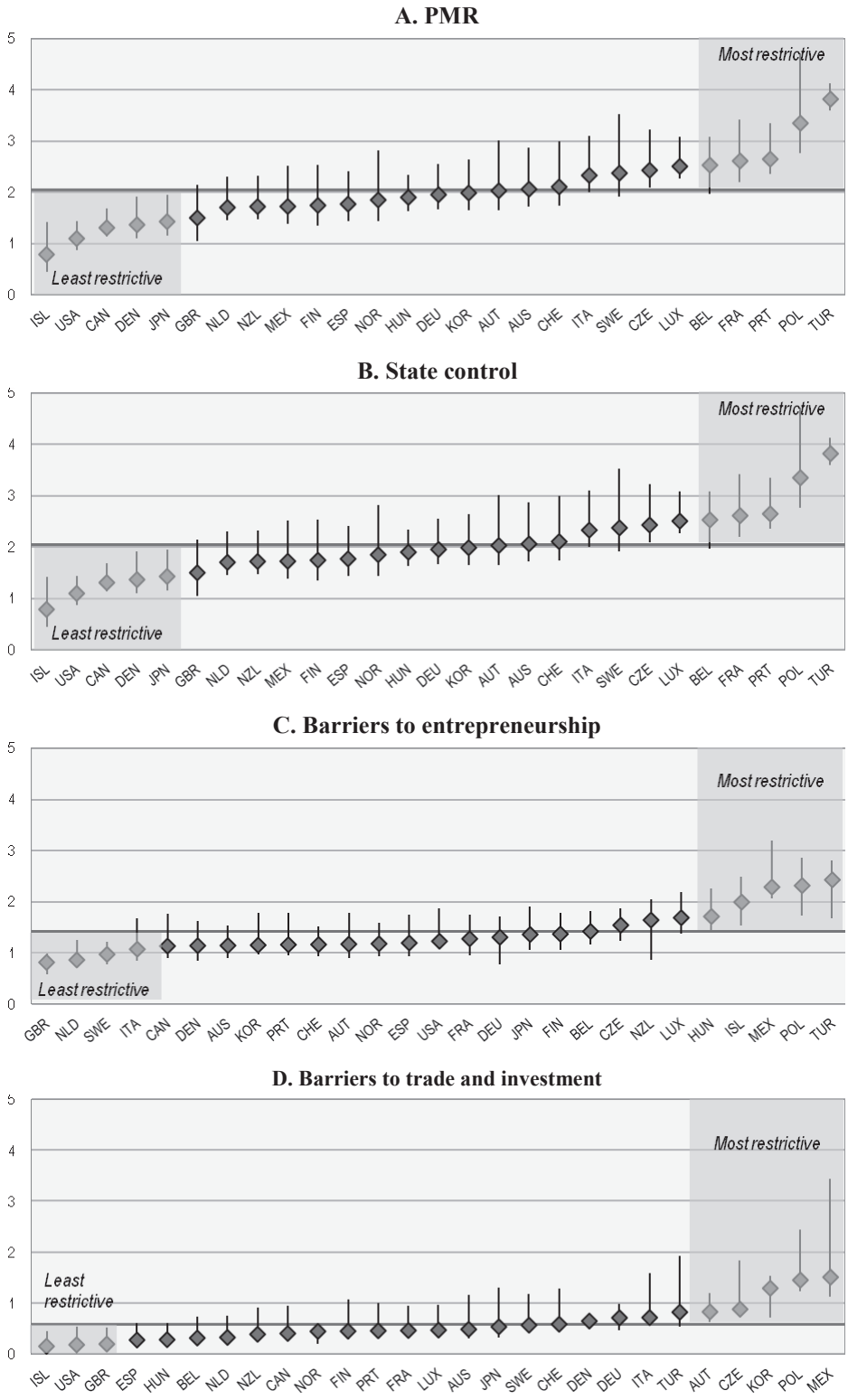
Source: OECD (2008), *OECD Reviews of Innovation Policy: Norway*, OECD, Paris.

Increased competition and better product market regulations could boost productivity and economic growth. Despite improvement of competition regimes in goods and services markets – linked to reforms of legal and regulatory frameworks by the Federal Competition Commission (CFC) and other sectoral regulatory agencies – there is relatively little competition in key sectors such as financial and telecommunication services, energy production and distribution, and transport infrastructure. In these sectors, *de jure* or *de facto* public or private monopolies and/or high market concentration, as well as the perverse effects of abuse of *amparo* procedures,[18] result in high input prices (for downstream firms) and induce barriers to entry that compound other obstacles to the creation of innovative enterprises. The current regulatory framework, for example, does not provide adequate, non-discriminatory third-party access to networks in areas such as telecommunications and railways (OECD, 2007a). The result is high levels of concentration and less than vigorous competition in a number of sectors.

Regulation of network industries such as telecommunications and energy requires particular attention since it may affect innovation, *e.g.* the uptake of new technologies and applications, and adversely affect downstream producers. A lack of competition can slow the uptake of new technologies. This appears to have been the case for the diffusion of some ICT applications. While progress has been made, prices for various telecommunication services are still relatively high by international standards.

Figure 1.10. Countries' relative positions in product market regulation, 2008

Index scale of 0-6 from least to most restrictive



1. Countries are ranked according to the indicator score on aggregate or domain. Diamonds represent the indicator scores, lines represent confidence intervals. *Source*: OECD Product Market Regulation Database.

Insufficient competition, together with restrictive foreign trade and FDI policies, weakens incentives to innovate. However, innovation is a key driver of high and sustainable productivity growth, and OECD work suggests that there are a number of links between product market policies and growth performance (Nicoletti and Scarpetta, 2005). Lower barriers to trade and competition in less tightly regulated countries seem to have increased the level and rate of growth of productivity by stimulating business investment and promoting innovation and technological catch-up.[19] Apart from directly creating barriers to effective competition, the regulatory framework does not facilitate the entry of new firms. Yet this is an important aspect of the dynamic competition which is crucial for rejuvenating the economy.

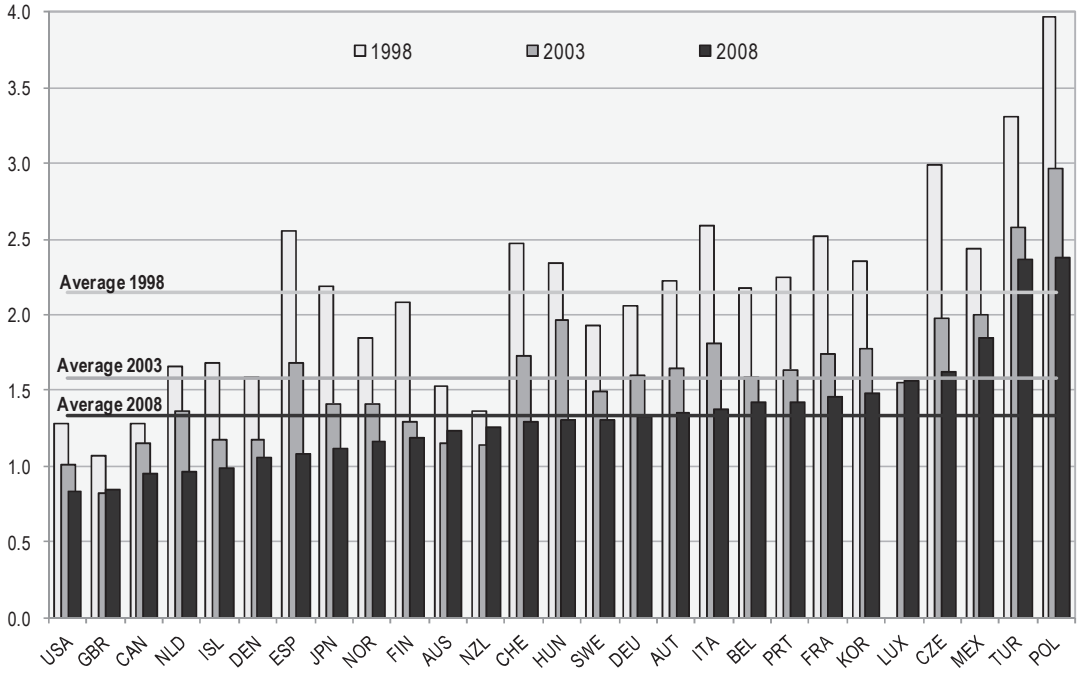
Figure 1.10 provides an overview of OECD member countries' regulatory policy stance in 2008 (see OECD, 2009d, Chapter 7; and Wölfl *et al*., 2009). The stringency of regulatory policy is represented on a scale from 0 to 6 (from least restrictive to most restrictive to competition). At the aggregate level, Mexico – together with the Czech Republic, Luxembourg, Poland and Turkey – is one of the countries with significantly higher restrictions than the OECD average (Figure 1.10, panel A). In line with the general trend among OECD countries, Mexico has adopted a more pro-competitive stance over time. However, it has made less progress than other countries. As in the majority of OECD countries, deregulation slowed during 2003-08 as compared to 1998-2003 (Figure 1.11).

Panels B to D of Figure 1.10 present the three domains of product market regulation.[20] Mexico is the most restrictive country with respect to barriers to trade and investment (panel D) which covers barriers to foreign ownership of firms, tariffs and other non-tariff barriers. Mexico – after Poland and Turkey – is also among the most restrictive countries for barriers to entrepreneurship (panel C), including obstacles to easy access to information on existing regulation, general or sector-specific administrative burdens for business start-ups, and other general or sector-specific regulations that hinder market entry of firms. Mexico is less anti-competitive than the OECD average in the regulatory domain state control (panel B), which reflects the extent to which governments influence firm decisions through public ownership, price controls or other forms of coercive – instead of incentive-based – regulation.

There is still significant potential for boosting productivity by strengthening competition through better regulation and rigorous enforcement of competition policy. Reforms to facilitate access to network industries can help gain competitive advantage. Mexico's decision to conduct a competition assessment review of its current regulatory policies is a major step in this direction.[21]

Figure 1.11. Development of aggregate product market regulation since 1998

Index scale of 0-6 from least to most restrictive



Source: OECD Product Market Regulation Database.

1.4.4. Intellectual property rights

In some areas of the business environment more directly related to technological infrastructure and which affect the capacity or propensity of firms to innovate, advances in institutional development in Mexico have not always met expectations. This is notably the case for intellectual property rights (IPR) regimes and standards and quality certification. Both IMPI (the Mexican Institute of Industrial Property) and CENAM (the National Metrology Centre) are sound, well-qualified institutions but they still fall short of being able to deliver and diffuse their technological services efficiently throughout the productive structure and particularly to SMEs. More importantly, they have been unable to stimulate demand for such services, which remains too low.

Most public research institutions (research centres of the National Council on Science and Technology – CONACYT) play a positive role in metrology services and technology transfer but, unlike most OECD countries, Mexico also suffers from a lack of private intermediary institutions such as "technology brokers" active in knowledge transfer and provision of technology upgrading services.

In general, protection of intellectual property rights, through patents or in other forms (copyright, trademarks) stimulates research by enabling successful innovators to reap rewards and avoid free riding. Their publication requirements also contribute to the dissemination of scientific and technological knowledge and help preventing costly duplication of research efforts. These benefits have to be weighed against the social cost arising from the delayed diffusion and thus reduced use of the invention over the lifetime of the patent, administrative costs, etc. While the relation between IPRs and innovation is a complex one (Jaumotte and Pain, 2005a), modern IPR legislation is an essential part of the overall framework conditions for innovation.

1.4.5. Entrepreneurship, and administrative burden and financing innovation

While administrative barriers to entrepreneurship have decreased with the introduction of the SARE fast-track system for start-ups, the system does not yet seem to have complete national coverage. In a number of respects, regulations related to starting an entrepreneurial activity could still be eased (Table 1.7), not least with a view to facilitating shifting entrepreneurial activities from the informal sector to the formal sector. Dualism and informality remain impediments to higher economic growth.

Table 1.7. Steps for starting an entrepreneurial activity, 2009

Activity	Mexico	Latin America	OECD
Starting a business			
Number of procedures	9	9.7	5.8
Duration (days)	28	64.5	13.4
Cost (% of per capita income)	12.5	39.1	4.9
Minimum capital (% of per capita income)	11.0	3.4	19.7
Dealing with construction permits			
Number of procedures	12	16	14
Duration (days)	222	206	147
Cost (% of per capita income)	159.0	381.2	75.1
Registering property			
Number of procedures	5	6.8	4.7
Duration (days)	74	71.4	30.3
Cost (% of property value)	4.8	6.0	4.7

Source: World Bank (2008), *Doing Business in 2009*, International Bank for Reconstruction and Development and the World Bank, Washington, DC.

Despite some progress, Mexico lags in the financial sector not only compared to more advanced OECD countries but also to some emerging economies.

> *"Domestic credit to the private sector at about 20% of GDP is low compared to countries with similar income levels. For example, Chile and China were close to 80%. Adding credit directly from abroad increases the ratio only to 25% of GDP. Stock market capitalisation has grown from 32% of GDP in 1996 to 42% in 2006, it still remains well below the OECD average of 121% and levels in other fast-growing emerging markets including Chile, China, India and Korea."* (OECD, 2009a, p. 117)

Historically, Mexico's bank overhead costs and net interest margins have been among the highest in the OECD area, an indication of a lack of efficiency in the banking system. The lack of financing at low cost is a major impediment to enterpreneurial activities in Mexico.

Moreover, financing is marked by sharp asymmetries between large and small companies. As Table 1.8 shows, 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 (Bonturi, 2002). This has adverse effects on investment and innovation activities. In 2005, suppliers' credit accounted for two-thirds of finance for small enterprises (see Table 1.8). In comparison, in nearly 80% of cases banks are the main source of financing for EU-based SMEs (OECD, 2007e).

Table 1.8. Sources of enterprise finance in Mexico, 2005

Percentages

Source of finance	Companies			
	Small	Medium	Large	AAA
Suppliers' credit	66.7	57.2	52.3	44.8
Commercial banks	13.7	19.8	21.1	34.5
Foreign banks	0.9	2.9	3.1	6.9
Development banks	1.7	1.2	3.1	0.0
Other sources [1]	17.0	18.9	20.4	13.8
Total	100	100	100	100

Note: Includes head office and other companies of corporate groups.

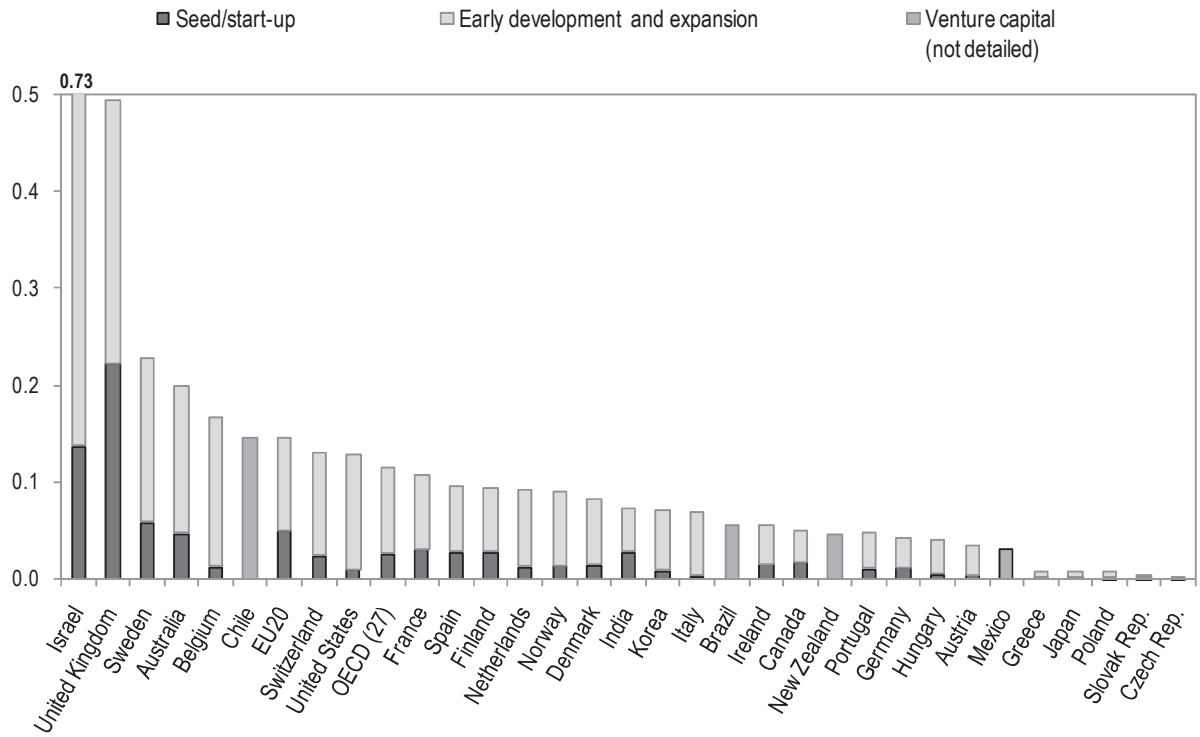
Source: OECD (2007), *SMEs in Mexico: Issues and Policies*, OECD, Paris; data from CANACINTRA and Banxico, 2005.

The supply of bank credit to the business sector has been further limited by the longstanding lack of adequate rules for recovering guarantees and by uncertainties surrounding the application of the new legal framework following the 2003 reform (OECD, 2004a). Shortcomings in the application of the bankruptcy and credit guarantee law and in credit assessment affect smaller firms more acutely than larger ones, thus creating important asymmetries.

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 systems of guarantees and the paucity of alternative sources of finance. Furthermore, financing instruments such as private investment and venture capital remain particularly underdeveloped. Accordingly, provision of venture capital is very low by international standards (Figure 1.12). This situation reflects a systemic failure that hampers the creation of new firms by "freelance" innovative entrepreneurs. At the same time, it seems to indicate a revealed preference for acquisition of technology over original R&D investment in the development of innovative activities.

Mexico introduced reforms earlier in the decade to improve the regulation of the financial sector, and credit growth accelerated before the crisis. Given the large gap between the depth of the financial sector in Mexico and faster-growing countries, Mexico should reinforce reforms in this area, including those related to the rule of law. A well-developed financial system is also a prerequisite for better innovation performance.

Figure 1.12. Venture capital investment as a percentage of GDP, 2006



Source: OECD (2007), *Science, Technology and Industry Scoreboard 2007*, OECD, Paris.

1.4.6. Infrastructure

Recent OECD work shows that improving the infrastructure can have positive effects on economic growth (OECD, 2009d, Chapter 6). As pointed out in subsequent *OECD Economic Surveys of Mexico* (most recently OECD, 2007a and 2009a), Mexico faces a number of challenges in this area. Infrastructure provision in Mexico is low by OECD standards. Inadequate and inefficient infrastructure limits overall efficiency and prevents Mexico from taking full advantage of its natural geographical advantage in trade, most importantly with the United States. Low transport costs could give Mexico-based firms an advantage over international competitors operating from distant locations such as China. Mexico's geographic situation also provides Mexican enterprises with an opportunity to participate in trans-border commercial operations that require short delivery times, such as just-in-time logistics in the automotive sector. However, Mexico does not fully realise this potential advantage as shortcomings in the transport infrastructure and border facilities increase transport costs.

Network industries such as telecommunications are of great importance for innovation and productivity both in the industry itself and in other industries. Prices are relatively high compared with other OECD countries for electricity as well as telecommunication services (OECD, 2007a). Expensive telecommunication services and scarcity of credit are powerful disincentives to innovation. Indeed, in telecommunications Mexico performs less well than other emerging economies on a number of indicators (mainline telephones, fixed, mobile and broadband subscriptions per capita, and international Internet bandwidth). Promoting competition could help to fully realise the potential benefits of lower prices, more innovation and higher productivity in tele-

communications and many other industries. A high-quality infrastructure can help maintain and further develop a strong manufacturing sector that has the potential to become a major pillar of innovation activity in Mexico.

1.5. The role of innovation in Mexico's economic development

Mexico's reforms, especially those that have resulted in increased macroeconomic stability and integration in the global economy, notably through international trade and FDI, have paid off. They have underpinned strong growth of exports and reduced macroeconomic imbalances following the 1995 financial crisis. The economy is now far better integrated in the world economy than it was two decades ago, increasing the pressure on firms to innovate, especially in the more exposed manufacturing sector.

Mexico has made progress in boosting growth of GDP per capita but not enough to sustain a process of catching up with the higher-income OECD countries or to remain in line with the strongly performing emerging economies. Mexico's relatively weaker economic growth performance is largely due to sluggish labour productivity growth, and convergence of productivity levels does not occur automatically.

There are different ways of spurring productivity; a broad set of structural reforms (including strengthening the rule of law) can play a major role. However, innovation plays a key role in driving long-term, sustainable economic growth.[22] Raising innovation capabilities, including for R&D-based innovation, throughout the economy is a major challenge for securing long-term productivity growth and rising living standards for the Mexican population.

International diffusion of technological knowledge is clearly very important for small countries and especially for countries lagging behind the technological frontier such as Mexico.[23] However, even for large, technologically advanced economies such as the United States or the European Union, cross-border knowledge diffusion is of key importance for economic performance in the longer term.[24] Consequently the diffusion of technology and international best practices in organisation and management will continue to play an important role in productivity growth, especially in countries for which the catching-up process is far from complete. Insufficient capabilities of domestic firms limit the benefit from international R&D spillovers.

At the same time countries can benefit from strengthening their own base for R&D and innovation, notably for the following reasons:

- Successful innovators need "absorptive capacities" (Cohen and Levinthal, 1989 and 1990) in order to be able to adopt and make efficient use of existing technological knowledge. The appropriation of technology requires a solid knowledge base. Lederman and Maloney (2006) regard national learning capacity as the missing complement in a situation like that of Mexico. Own domestic R&D activity may help to build and maintain this capacity. There is some evidence that more productive firms benefit more from spillover opportunities created by foreign multinational investments.

- Innovation based on domestic R&D can be expected to become relatively more important as the income and productivity gap *vis-à-vis* the leading countries gradually narrows and a country moves closer to the world technological frontier. To maintain growth under these changing circumstances requires research and technological development activities to feed a constant flow of innovation within the economy.

Given its geographical location, Mexico's potential gains from further trade and investment liberalisation are high.[25] While integration in the global economy offers high potential for technology transfer, it is not sufficient. For Mexico to benefit from the long-term trend towards expansion of the global market "implies a deep restructuring and adjustment in the composition of exports" (OECD, 2007a, p. 32).[26]

Some emerging economies, including China, are set to compete based not just on their traditional comparative advantage – primarily the abundance of unskilled labour – but increasingly also on the basis of economic activity with higher knowledge content (OECD, 2008a). A major challenge for Mexico is to ensure that business enterprises – beyond fully exploiting their current comparative advantages – move up the technology ladder and diversify their export-oriented activities. To maximise the benefit of globalisation under changing conditions entails diversification of the economy and developing new comparative advantages, including in segments of advanced manufacturing.

The globalisation of R&D (OECD, 2008d) provides new opportunities but also increases competition from a larger number of actors. Some emerging countries are also becoming significant destinations of FDI for R&D. Mexico will need to take measures to strengthen its R&D capabilities and related infrastructure in order to be competitive as a location of such activities.

In the face of new competition, Mexico needs to make a very substantial effort to build a well-functioning and high-performing innovation system in order for its business firms to compete in the longer term. Conducive framework conditions for innovation such as macroeconomic stability, vigorous competition, intellectual property rights, an innovation-friendly regulatory framework, financial system and infrastructure are indispensable to such an innovation system. However, necessary as they are, they are not sufficient. They need to be complemented by more targeted efforts to foster innovation performance.

1.6. Performance in science, technology and innovation in an international comparison

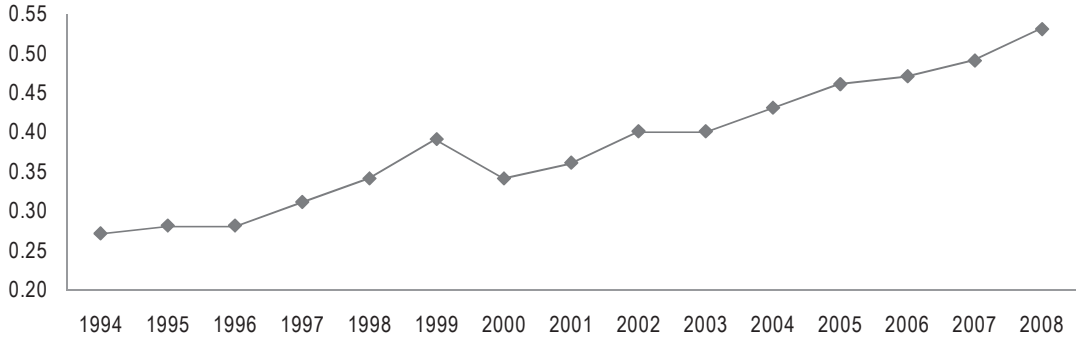
This section provides an overview of the performance of the Mexican innovation system, outlining major trends and developments, based on available quantitative indicators. This is done comparatively, by benchmarking Mexican innovation performance against that of other OECD (and occasionally Latin American) countries. The section begins by reviewing innovation inputs – including R&D spending, human resources and ICT investments – followed by an assessment of innovation outputs, namely scientific publications and patents. It then highlights the concentration of innovation activity in a small number of regions. A final section examines international linkages.

1.6.1. R&D performance and expenditure

Mexico has one of the lowest levels of R&D spending in the OECD area as a percentage of GDP. Gross domestic expenditure on R&D (GERD) in 2005 amounted to approximately USD 6 billion (2005 PPP), while R&D intensity (GERD as a percentage of GDP) was just 0.46%. As Figure 1.13 shows, the level of spending has been increasing steadily over the last decade or so and is expected to reach 0.53% in 2008. Although this amounts to one of the highest rises in R&D intensity in the OECD area (Figure 1.14), the very low levels of spending still leave Mexico well short of achieving an R&D intensity of 1.0% – a target set in the 2002 S&T Law to be reached by 2006. Moreover, as Figure 1.15 shows, R&D intensity remains well below that of a number of non-OECD countries, such as China (1.4%), Brazil (1.0%), South Africa (0.9%) and Chile (0.7%).

Figure 1.13. R&D intensity of the Mexican economy, 1994-2008

GERD as a percentage of GDP



Source: OECD Main Science and Technology Indicators.

Figure 1.14. International comparison of R&D expenditures

GERD as a percentage of GDP, 2005; annual growth rate of GERD, 1995-2005

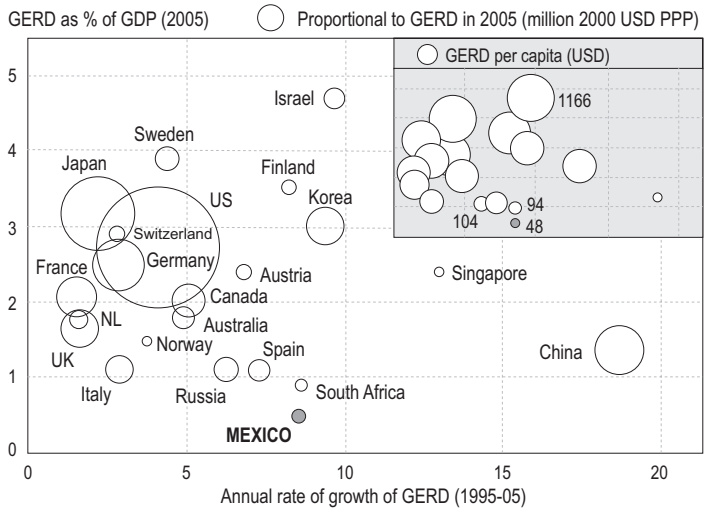
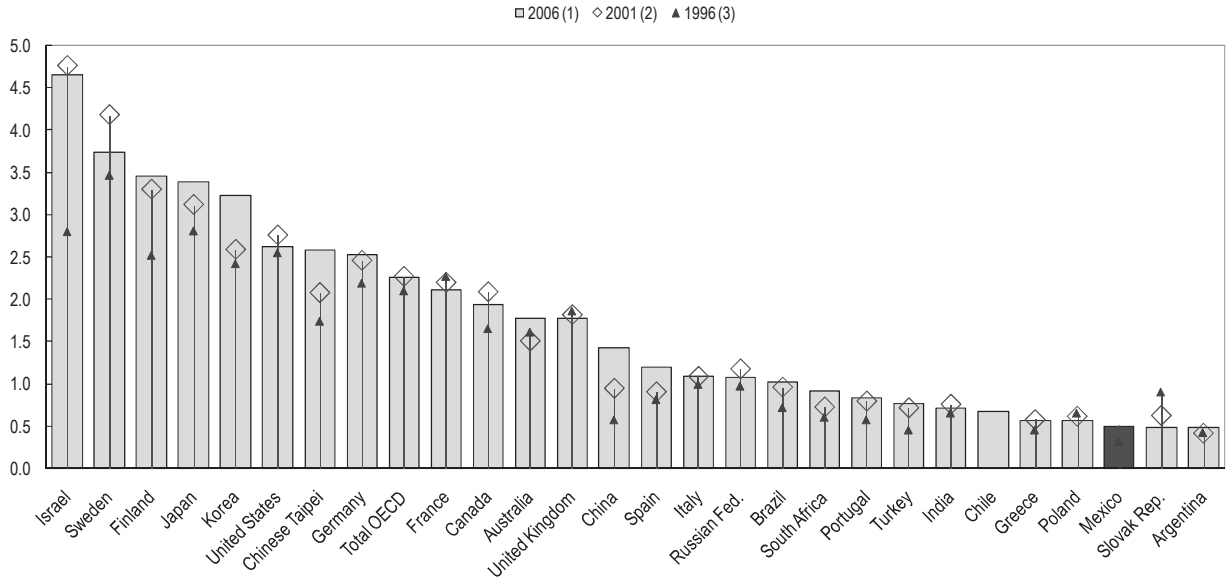


Figure 1.15. R&D intensity in OECD and selected non-OECD economies, 1996, 2001 and 2006

GERD as a percentage of GDP



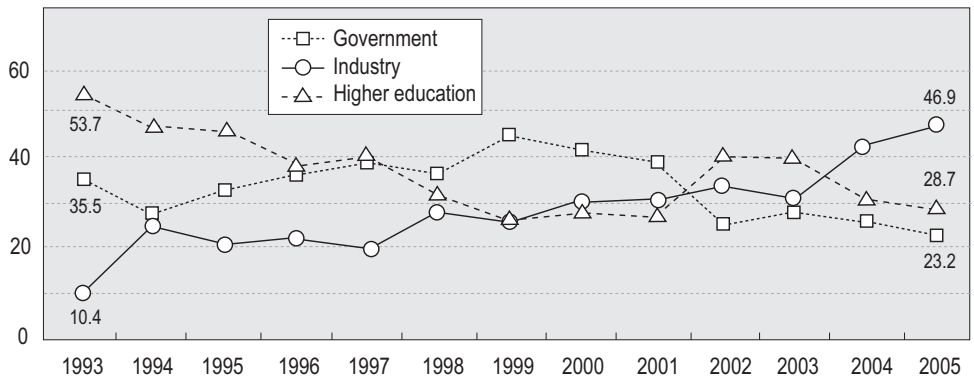
1. 2004 instead of 2006 for Australia, Chile, India; 2005 for Italy, Mexico and South Africa.
2. 2000 instead of 2001 for Australia.
3. 1997 instead of 1996 for Sweden and South Africa.

Source: OECD Main Science and Technology Indicators.

The business sector performs more R&D (in terms of expenditure) than the government or higher education sectors, accounting for 47% of GERD in 2005. As Figure 1.16 shows, the prominent role played by business is very recent and is due to direct and, perhaps more importantly, indirect government support for business R&D, with the latter largely mediated through fiscal incentives. Nevertheless, Mexico still has one of the lowest levels of business R&D intensity in the OECD area, and a level lower than Brazil and Chile (Figure 1.17). This can to some extent be "explained" by the structure of Mexican industry, which is dominated by small enterprises. Such firms are usually unable to take advantage of economies of scale and lack the capacity to make high-volume investments in R&D and equipment embodying new technology.

Figure 1.16. R&D by sector of performance in Mexico, 1993-2005

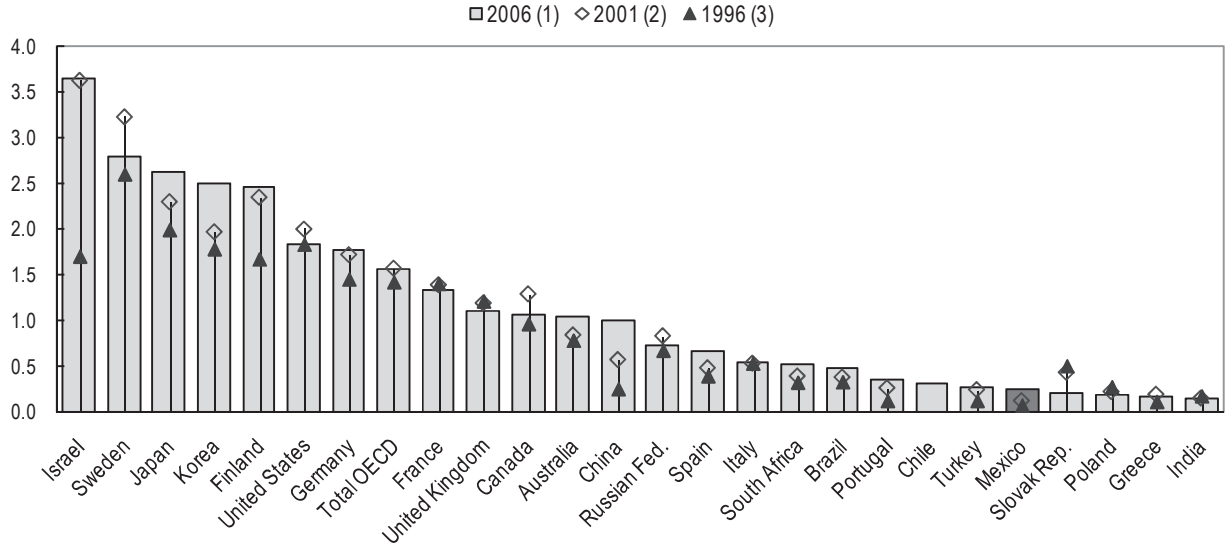
As a percentage of total R&D



Source: CONACYT.

Figure 1.17. Business R&D intensity in OECD and selected non-OECD countries, 1996, 2001 and 2006

As a percentage of GDP

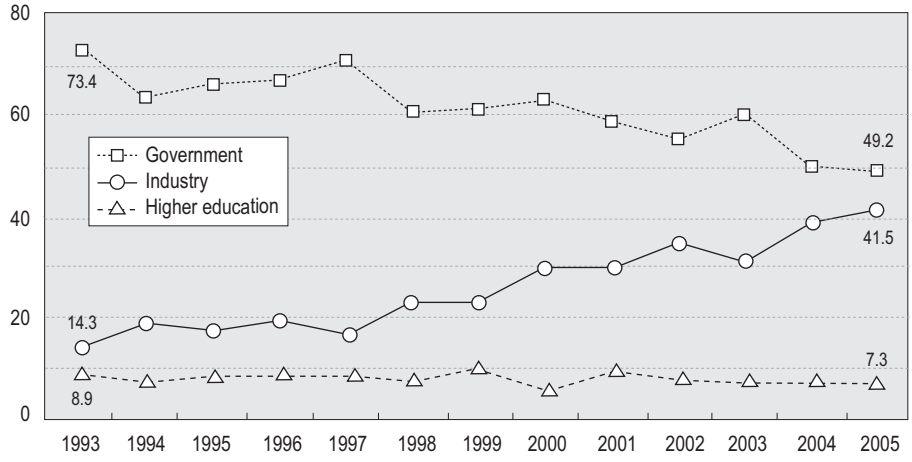


1. 2000 instead of 2001 for Australia.
2. 2005 for Australia, Mexico, and South Africa; 2004 for Chile and India.
3. 1997 for South Africa.

Source: OECD Main Science and Technology Indicators.

Figure 1.18. R&D by financing sector in Mexico, 1993-2005

As a percentage of total R&D



Source: CONACYT.

An increased emphasis on public policy programmes in support of business innovation, and the growing awareness of regional authorities and parts of industry of the benefits to be gained from sustained innovation capacity building have led not only to a significant increase in the volume of business R&D performed, but also in the share of total R&D financed by the business sector (Figure 1.18). This upward trend, which highlights significant growth in the number of firms engaged in S&T-related activities over the last seven years, has been boosted by an increase in direct and indirect public

support. Between 2002 and 2005 the share of direct government financing of total business R&D investment increased from 1.5% to 5.7%. At the same time, the fiscal incentive put in place by CONACYT in 2002 represented more than 75% of total public support in 2006.[27] Since 2001, the number of firms and institutions accredited by the National Registry of S&T Institutions and Firms (RENIECYT), which entitles them to R&D and innovation-related support, has increased more than 15-fold.

As Table 1.6 shows, the increase in business R&D financing as a percentage of total R&D spending mirrors a pattern seen in many other countries. The increase in Mexico is, however, the most startling, albeit from a very low starting base, as figures for the proportion of business R&D financing converge towards levels in other OECD countries. While this would seem to be a positive development, it is partly explained by a slight decline over the last decade in the federal budget for S&T activities as a share of GDP (Figure 1.19). International comparisons show that in better-performing countries, an increasing share of the business sector in total R&D expenditures is not achieved in a sustainable manner when absolute public R&D expenditures decline. In most OECD countries, public expenditures continue to grow (Figure 1.20), albeit at a slower rate than private expenditures, but their leverage on business spending increases because of more efficient incentives and better synergies within the science, technology and innovation (STI) system. This wedge between the evolution of private and public expenditures is certainly an impediment to the strengthening of Mexico's innovation system. Increasing articulation and collaboration between the private and public sectors requires the development of interactions between two dynamic partners. It cannot be achieved if the resources allocated to one of them stagnate or decrease.

Table 1.6. R&D by funding source, 1995 and 2005

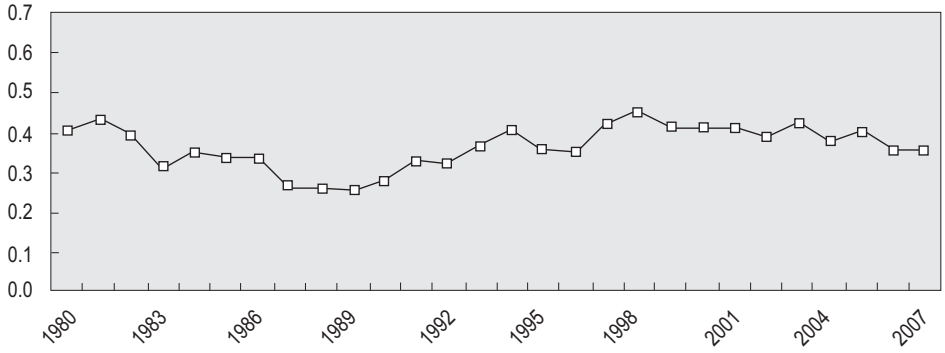
As percentage of total R&D

	Government		Industry		Others	
	1995	2005	1995	2005	1995	2005
Japan	22.8	16.8	67.1	76.1	9.9	6.8
Korea	19.0	23.0	76.3	75.0	4.7	1.3
China	-	24.7	-	69.1	-	-
Germany	37.9	28.4	60.0	67.6	0.3	0.3
United States	35.4	30.4	60.2	64.0	4.4	5.7
Canada	35.9	32.9	45.7	47.9	6.9	10.5
Spain	43.6	43.3	44.5	46.3	5.2	5.0
Chile	58.4	44.5	26.5	45.7	9.0	2.1
Mexico	**66.2**	**49.2**	**17.6**	**41.5**	**16.2**	**9.3**
Brazil	59.1	58.3	38.2	39.4	2.3	2.2
Argentina	46.6	64.3	27.7	31.4	22.4	3.2

Source: OECD Main Science and Technology Indicators.

Figure 1.19. Federal expenditure on S&T activities in Mexico, 1980-2007

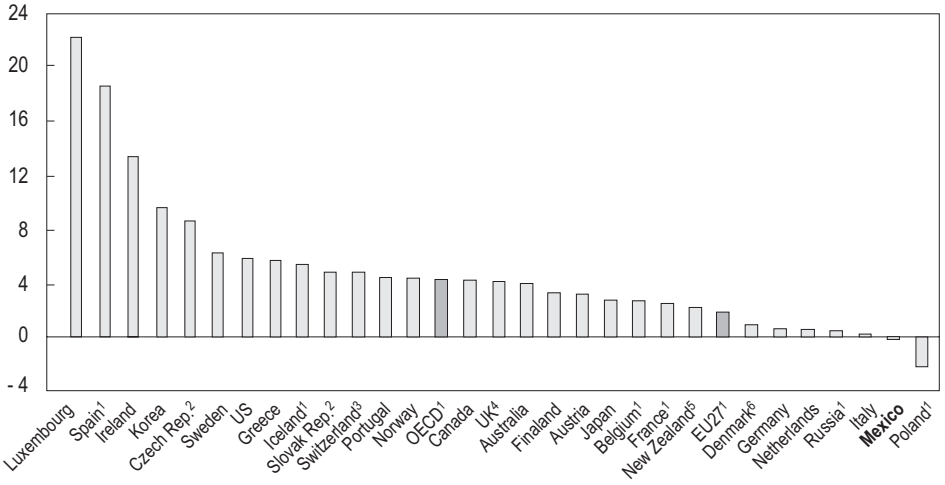
As a percentage of GDP



Source: CONACYT.

Figure 1.20. Change in government R&D budget, 2000-06

Average annual growth rate of GBAORD



GBAORD: Government budget appropriations or outlays for R&D.
1. 2000-05.
2. 2002-06.
3. 2000-04.
4. 2001-05.
5. 2001-03.
6. 2001-06.

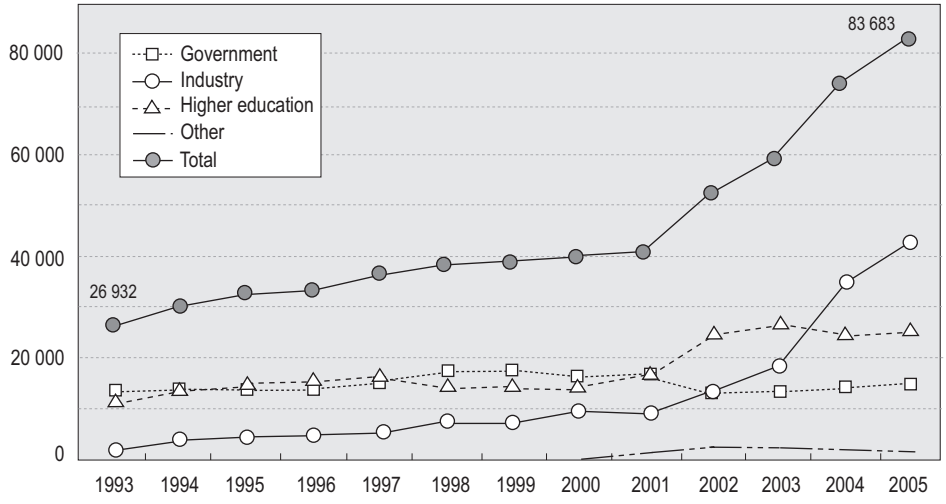
Source: OECD Main Science and Technology Indicators.

Whatever the soundness of framework conditions, the merits of institutional reforms, or the efficiency of support programmes in fostering scientific and innovative activities, no countries have advanced decisively up the ladder of innovative economic performance without sustained investment in tangible and intangible S&T assets. In countries like Mexico that suffer from a fragmented innovation system that limits the production, diffusion and productive use of knowledge for economic growth and social welfare, increasing the volume of resources devoted to R&D and developing the absorptive capacities to put them efficiently to use are a prerequisite for engaging in a virtuous dynamic in which increased public and private investment in innovation complement each other to ensure rising social returns to investment in knowledge.

1.6.2. Human resources in R&D

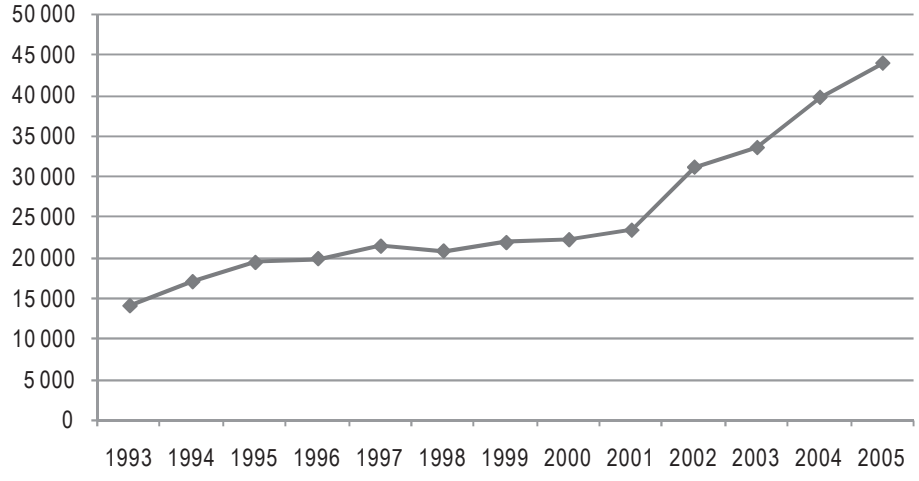
The number of R&D personnel (full-time equivalents) in Mexico stood at almost 84 000 in 2005 (Figure 1.21), of which 44 000 are researchers (Figure 1.22). Mexico has the highest growth rate in human resources for R&D in the OECD in recent years (Figure 1.23). From 1996 to 2005 the average annual growth rate was 10.4% for researchers and 11.4% for total R&D personnel. Accordingly, R&D personnel grew from around 27 000 to 84 000 between 1993 and 2005, while the number of researchers more than tripled from 14 000 to 44 000. Mirroring shifting spending patterns, these increases can be mainly attributed to business enterprises and, to a lesser extent, higher education, whereas employment levels in the government sector have fallen slightly (Figure 1.21). The largest increases in numbers of R&D personnel and researchers have occurred since 2000, again reflecting increased spending levels on R&D. Despite these positive developments, these figures remain very low by international standards when compared to levels of total employment (Figure 1.24).

Figure 1.21. Total R&D personnel by sector of employment in Mexico, 1995-2006



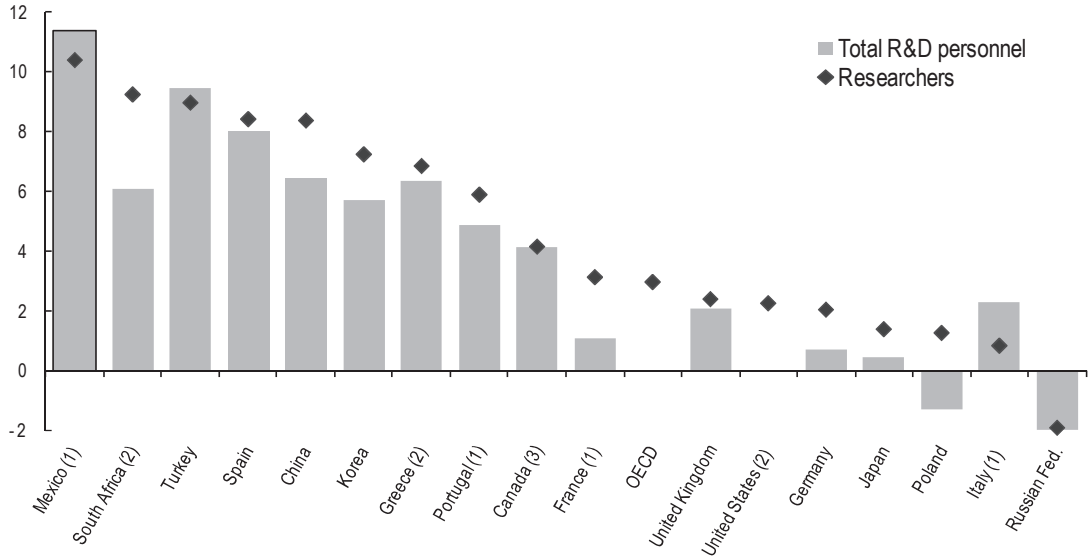
Source: CONACYT.

Figure 1.22. Number of researchers in Mexico, 1993-2005



Source: CONACYT.

Figure 1.23. Percentage average annual growth rate of R&D personnel, 1996-2006

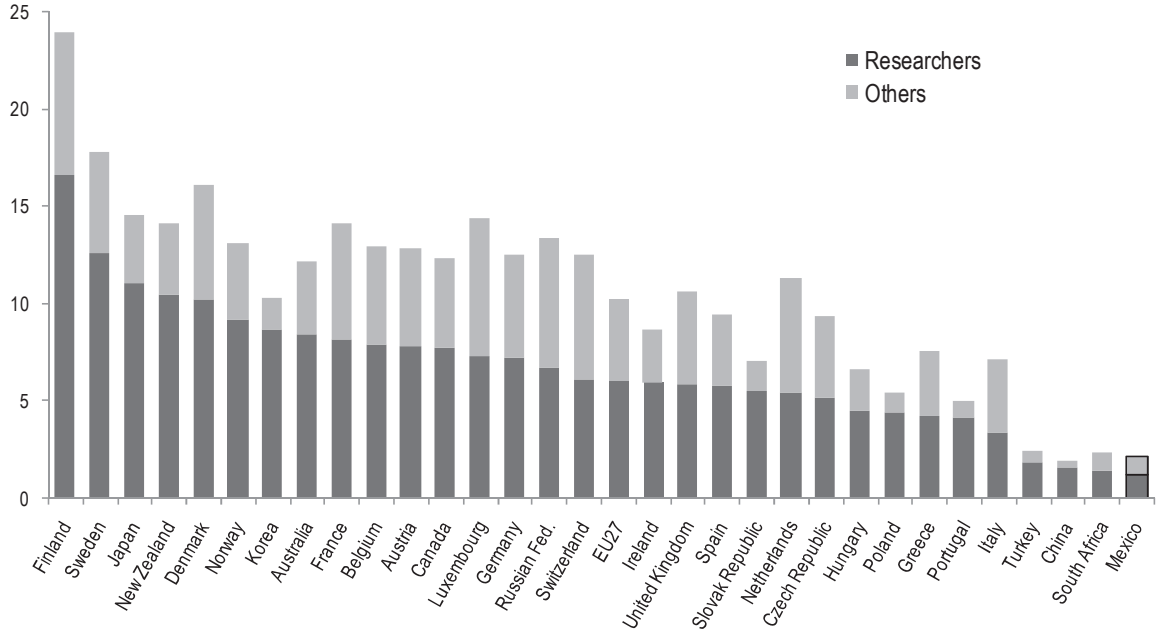


1. 1996-2005 for Italy, Portugal and Mexico.
2. 1997-2005 for South Africa, Greece and the United States.
3. 1996-2004 for Canada.

Source: OECD Main Science and Technology Indicators.

Figure 1.24. R&D personnel, 2006

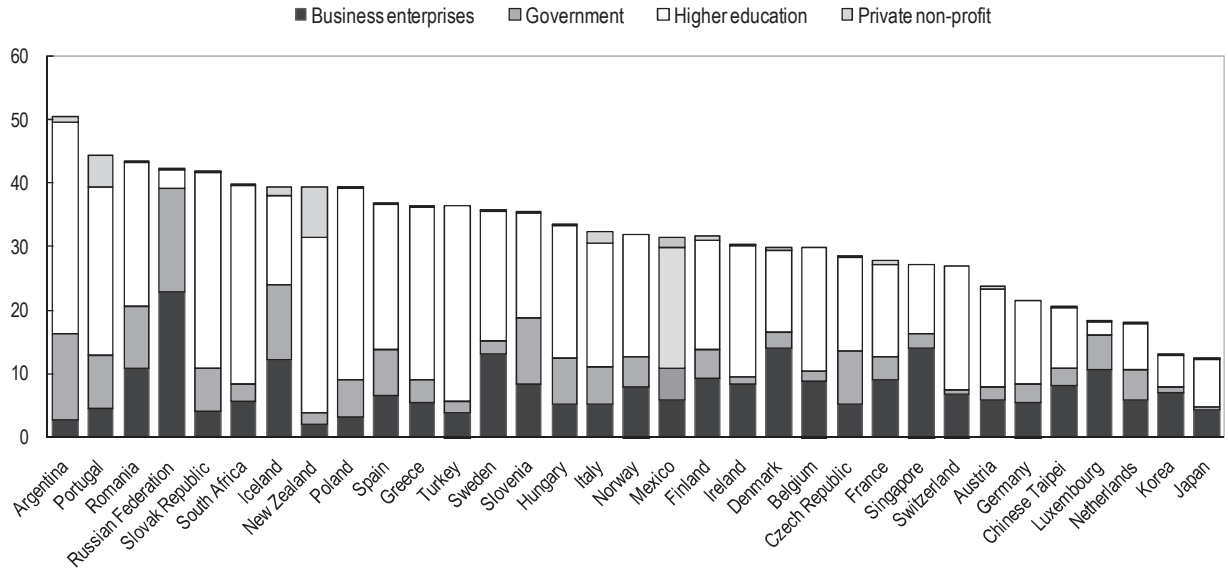
Per thousand total employment



Source: OECD Main Science and Technology Indicators.

Figure 1.25. Women researchers by sector of employment, 2006

As a percentage of total researchers



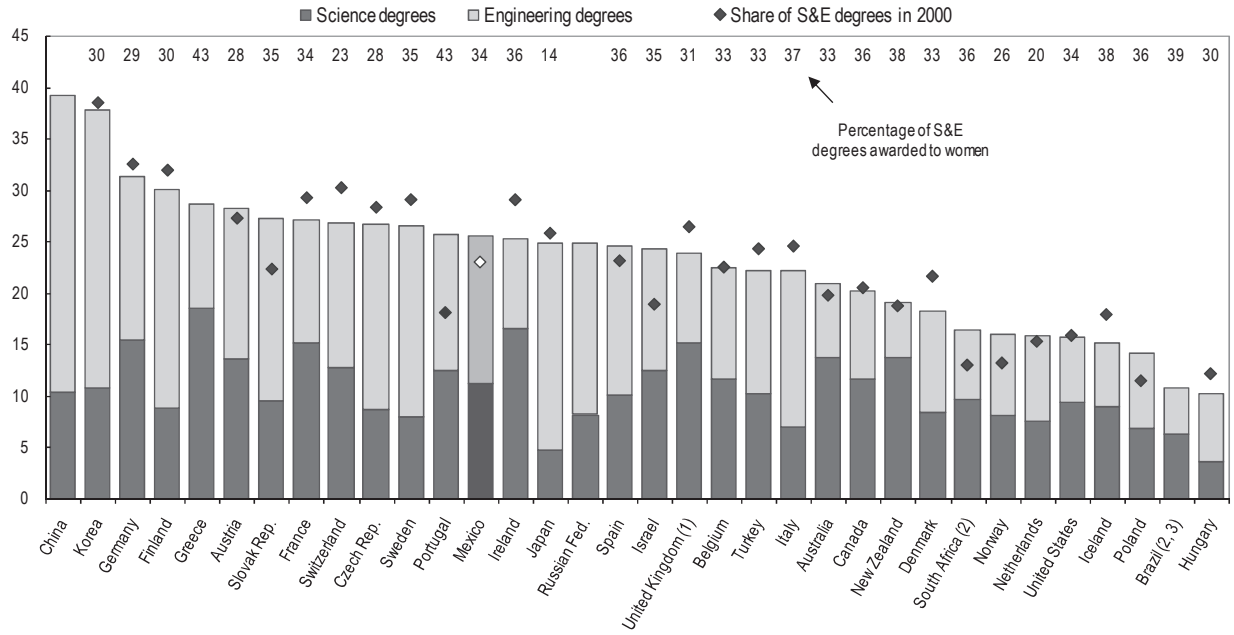
Source: OECD Main Science and Technology Indicators.

The new distribution of researchers represents one of the most important structural transformations in the Mexican innovation system. Previously, with the majority of researchers working in the government and HEI sectors, research was mostly basic in orientation. With a greater number of researchers working in industry, basic research now accounts for a much smaller proportion of research spending in Mexico. In terms of the gender composition of researchers, around one-third are female, a situation comparable to many other OECD countries (Figure 1.25). As in most other OECD countries the HEI sector accounts for the most female employment, while the business sector, despite being the largest employer of researchers, accounts for just a small proportion.

As for the supply of researchers and other human resources for science and technology (HRST), just over one-quarter of university graduates gained science and engineering (S&E) degrees in 2005, a small increase in the proportion of S&E graduates since 2000. This is a relatively large proportion by international standards (Figure 1.26). About one-third of PhD degrees are awarded in S&E disciplines, a proportion comparable to levels in most other OECD countries. However, the number of PhD graduates as a proportion of the total population is extremely low compared to other OECD countries, though growing rapidly from a low base (Figure 1.27). As for student gender, in 1969-70, women represented around 30% of the university population, and 30 years later, in 2000-01, the proportion had almost doubled so that there are now more women studying in universities than men. Nevertheless, women account for only one-third of the S&E degrees awarded in Mexican universities, a figure broadly comparable to most OECD countries (Figure 1.26).

Figure 1.26. Science and engineering degrees, 2005

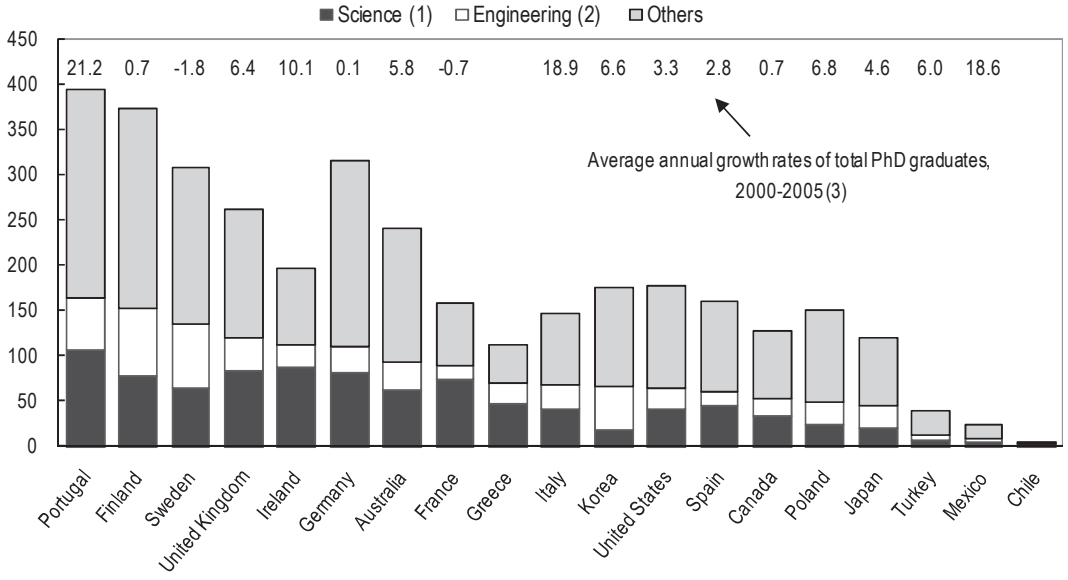
As a percentage of total new degrees



1. UK data are for the year 2003.
2. ISCED 5B programmes are included with ISCED 5A/6; for South Africa, the share of S&E degrees awarded to women is for the year 2003.
3. For Brazil, the share of S&E degrees awarded to women is for the year 2003.

Figure 1.27. PhD graduates in science and engineering and other fields, 2005

Per million population

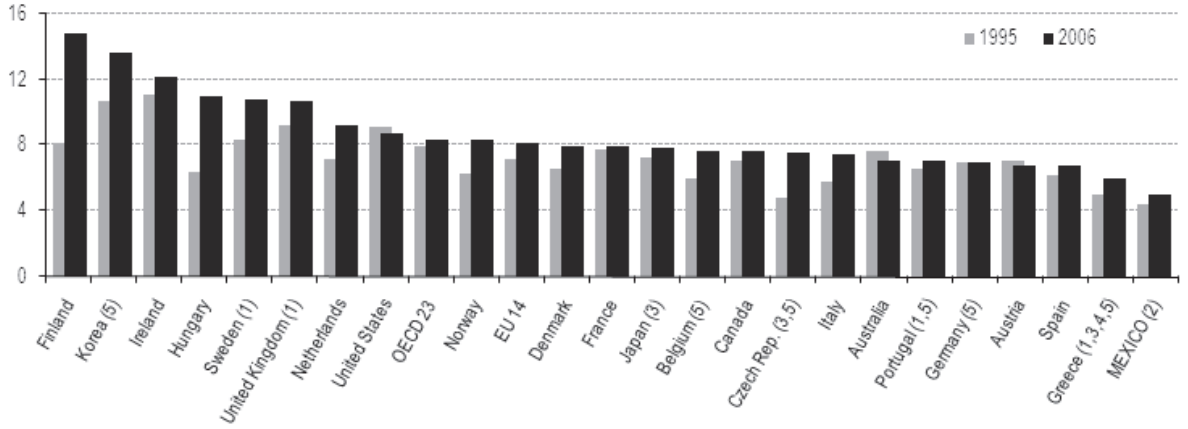


1. Includes life sciences, physical sciences, mathematics and statistics and computing.
2. Includes engineering and engineering trades, manufacturing and processing and architecture and building.
3. Or nearest available years.

1.6.3. ICT investments

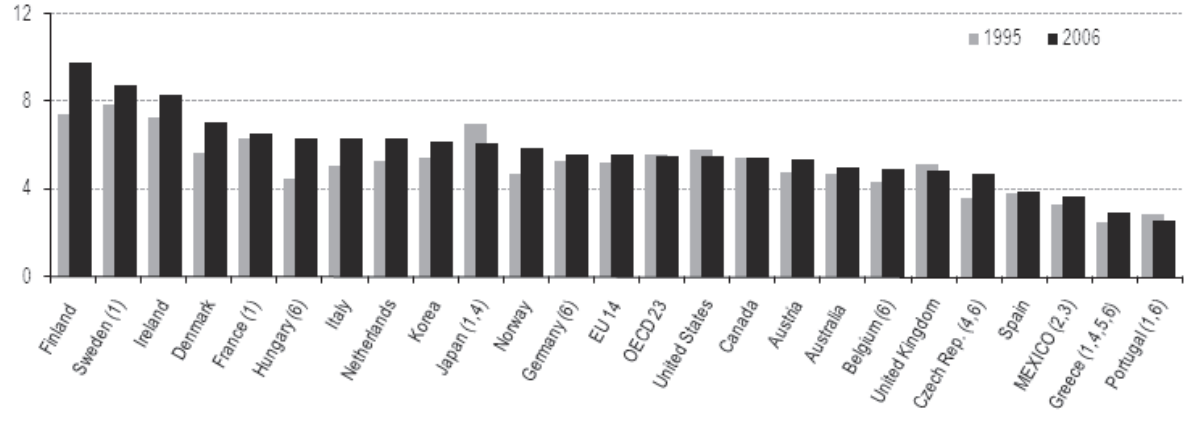
Information and communication technologies have been a major driver of growth in most OECD countries in the past decades – as a growing sector of production or as a main driver of productivity growth. Countries that have specialised in the production of ICTs or have reaped the benefits of rapid ICT diffusion into different areas (eBusiness, eGovernment, eHealth, etc.) have tended to have a better growth record. Mexico has been unable so far to gain very much from this growth potential. For example, the share of ICTs in business sector value added is the lowest among OECD countries (Figure 1.28). Furthermore, the share of ICT in business sector employment remains one of the lowest in the OECD area (Figure 1.29).

Figure 1.28. Share of ICT in business sector value added, 1995 and 2006



1. 2005 instead of 2006. 2. 2004 instead of 2006. 3. ICT wholesale (5150) is not available. 4. Telecommunication services (642) included Postal services. 5. Rental of ICT goods (7123) is not available.

Figure 1.29. Share of ICT in business sector employment, 1995 and 2006



1. 2005 instead of 2006. 2. 2004 instead of 2006. 3. Based on employees figures. 4. ICT wholesale (5150) is not available. 5. Telecommunication services (642) included Postal services. 6. Rental of ICT goods (7123) is not available.

Several indicators also point to weaknesses in the diffusion and use of ICTs. In rankings by the ITU and UNCTAD (2007), which combine several synthetic "information society" indicators, Mexico does not perform favourably on important dimensions such as availability of skills for the information society and networking, ranking below several other Latin American countries (Table 1.7).

Table 1.7. Information society indicators for selected countries, 2007

Rank	Country	Network index	Skills index	Diffusion index
1	Sweden	605.1	153.8	464.5
11	Canada	398.5	136.0	422.1
13	United States	346.7	143.3	443.6
22	Korea	254.1	144.9	392.3
29	Spain	331.9	142.3	255.2
36	Portugal	253.4	134.8	184.3
46	Poland	190.7	137.5	211.6
48	Greece	252.2	139.2	140.2
50	Chile	176.0	122.4	157.0
60	Argentina	149.4	137.1	135.3
63	Russia	161.9	139.2	144.7
64	Brazil	124.2	121.0	168.6
66	Costa Rica	121.2	105.0	197.2
67	Turkey	158.6	116.0	109.6
70	**Mexico**	**113.7**	**108.8**	**150.9**
76	Venezuela	102.0	114.6	120.0
79	China	113.3	106.1	81.6
80	Colombia	131.4	110.9	87.3

Source: ITU and UNCTAD.

1.6.4. Research publications

Research publications are one quantitative indicator available for evaluating and assessing scientific output. Publication counts have traditionally been used as an indicator of the scientific productivity of universities, public research centres, companies, individuals or nations. Figure 1.30 shows that Mexico's share of scientific output accounted for 0.75% of the world's total in 2006, up from 0.52% in 1997. However, the "impact factor" of this output, *i.e.* the extent to which scientific articles are cited in other scientific articles, is one of the lowest in the OECD area and also lags other Latin American countries such as Argentina, Brazil and Chile. Furthermore, the productivity of Mexico's leading researchers, as measured by publication levels in ISI journals by researchers registered in the National System of Researchers (SNI), has declined as the number of researchers covered by the SNI has increased. There are at least two possible explanations for this decline: first, it could indicate that the quality of researchers registered in the SNI has been gradually eroded as the SNI becomes a "standard" source of academic remuneration. Second, it could reflect the relative decline in government funding of public sector research.

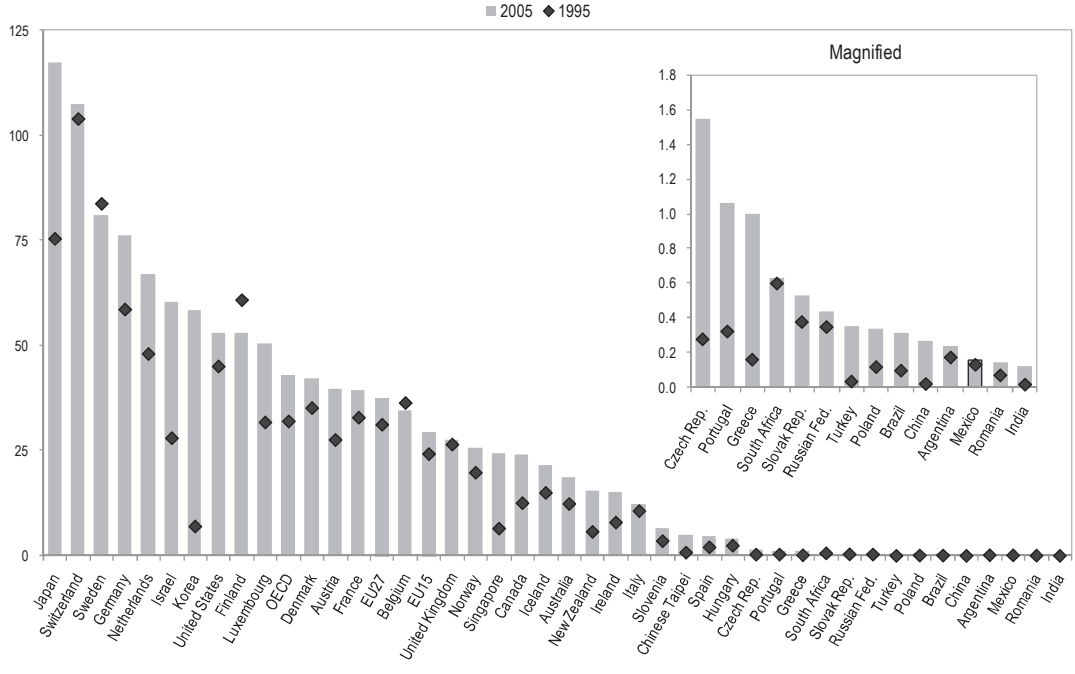
Figure 1.30. Scientific production in Mexico, 2005

Source: OECD, based on data from CONACYT.

1.6.5. Patenting

Patenting and other activities related to intellectual property rights, both of business firms and public research organisations, are weak by international standards. In particular, Mexican firms are far less active in filing applications for patents, industrial design and trademarks than counterparts in more advanced OECD economies. In fact, as Figure 1.31 shows, Mexico has one of the lowest levels of patents filed per capita at the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO) which protect the same invention (triadic patent families). Moreover, this situation has barely improved over the ten-year period between 1995 and 2005, contrary to the situation in many other industrialising countries, where the number of triadic patent applications has often surged.

Figure 1.31. Triadic patent families per million population, 1995 and 2005



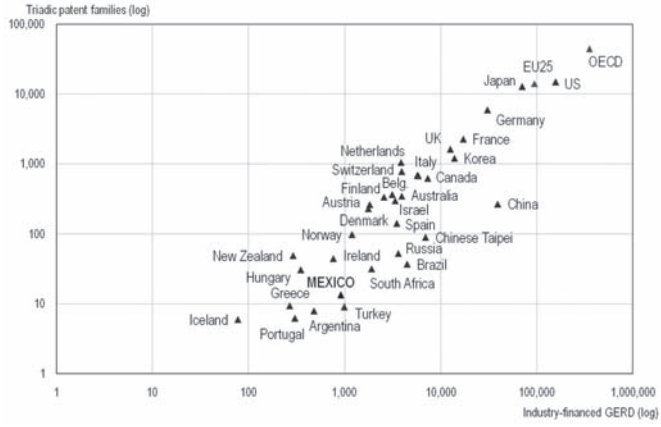
The data for patent applications in Mexico show only a marginally better picture, with applications from Mexican nationals increasing by a little under 50% during the period 1998-2005, *i.e.* from 386 applications in 1998 to 574 in 2005 (Figure 1.32). More than half of the applications made in 2005 came from independent inventors, while just a quarter came from business enterprises. At the same time, the number of applications from foreigners more than doubled between 1998 and 2005, from 6 365 to 14 928. In other words, foreigners accounted for more than 96% of patent applications in Mexico in 2005.

Taken together, these data indicate an apparent paradox in that increased levels of business spending on R&D and the increased number of researchers working in enterprises over the last seven or eight years appear not to have translated into a marked increase in patenting activity. There are several possible explanations for this.

First, Figure 1.32 suggests a strong link between levels of BERD and the number of triadic patent families applications filed. Although the level of BERD has increased in recent years, it is still very low compared to other OECD countries (Figure 1.17) and might explain low levels of patenting. Even so, Mexico might be expected to file more triadic patent applications than it does given its level of BERD. For example, New Zealand, Hungary and Ireland all file many more applications than Mexico on lower absolute levels of BERD.

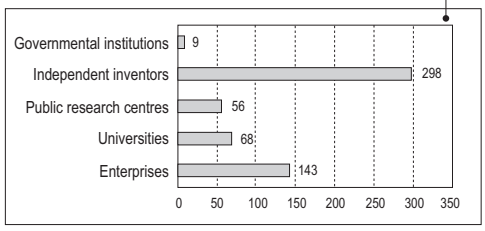
Figure 1.32. Patenting intensity and number and source of patent applications in Mexico

Patent intensity: Triadic patent families[1] and industry-financed R&D
1995-2005 average



Patent applications in Mexico
1996-2006

Number	1996	1998	2000	2002	2004	2006
Total	*6 751*	*10 893*	*13 061*	*13 062*	*13 194*	*15 500*
By foreigners	6 365	10 440	12 630	12 536	12 629	14 926
By nationals	386	453	431	526	565	574



1. Patents filed at the European Patent Office (EPO), the US Patent and Trademark Office (USPTO) and the Japan Patent Office (JPO) which protect the same invention.

Source: OECD and IMPI.

Second, the number of researchers working in enterprises only started to really take off in 2001 (Figure 1.21), while significant increases in BERD did not occur until 2003 (Figure 1.18). Some lag in translating these inputs into outputs in the form of patents should surely be expected and may go a considerable way towards explaining low levels of patenting in 2005 (the latest date for which data are available).

Finally, it is quite possible, and perhaps even reasonable to expect, that much R&D performed in Mexican firms is directed towards adapting existing technologies and incremental innovation, given the history of technological innovation in Mexico. As technology adaptation and incremental innovation tend to require little recourse to patent protection, continuing low levels of patenting might be expected, at least in the short to medium term.

Figure 1.33. Mexico's regional S&T and innovation landscape, 2006

	% of national GDP	Number of NSR[1] researchers	Number of HEIs[2] with doctoral programmes	Number of S&T institutions and enterprises in RENIECYT[3]	% of R&D tax incentives	% of Mixed Funds
Distrito Federal (DF)	21.84	5 846	30	864	43.6	--
México	9.48	797	13	221	7.7	0.9
Nuevo León	7.43	449	5	260	22.1	14.0
Jalisco	6.31	688	9	245	4.2	1.7
Chihuahua	4.33	152	5	112	3.6	1.6
Veracruz	4.17	311	9	70	2.0	2.7
Guanajuato	3.60	415	12	251	3.0	12.1
Puebla	3.55	534	11	75	5.1	0.6
Baja California	3.50	412	8	67	2.4	3.3
Coahuila	3.37	189	9	120	0.9	2.8
Tamaulipas	3.34	110	6	42	1.3	5.2
Sonora	2.68	245	4	97	0.0	3.9
Michoacán	2.21	390	4	47	0.2	3.9
Sinaloa	1.99	151	6	41	0.2	1.4
San Luis Potosí	1.81	253	3	50	0.2	2.6
Querétaro	1.72	281	6	83	2.6	1.4
Chiapas	1.70	116	4	27	0.1	6.4
Guerrero	1.68	39	1	5	0	0.7
Quintana Roo	1.64	53	0	23	0.0	1.9
Oaxaca	1.52	119	6	26	0.0	0
Yucatán	1.41	276	5	37	0.0	2.5
Morelos	1.38	753	9	46	0.1	2.1
Durango	1.33	60	5	33	0.1	1.2
Hidalgo	1.30	173	1	65	0.2	4.8
Tabasco	1.25	78	1	27	0.0	6.7
Campeche	1.24	59	2	11	0	1.6
Aguascalientes	1.23	69	1	51	0.1	2.6
Zacatecas	0.76	95	1	12	0.0	6.0
Baja California Sur	0.60	183	3	7	0.0	0.4
Tlaxcala	0.57	68	2	16	0.1	1.5
Nayarit	0.54	17	1	4	0.0	1.3
Colima	0.53	104	1	23	0.2	0.7

1. NSR = National System of Researchers (SNI). 2.Higher education institutions. 3. National Register of S&T Institutions and Firms.
Source: OECD, based on data from CONACYT.

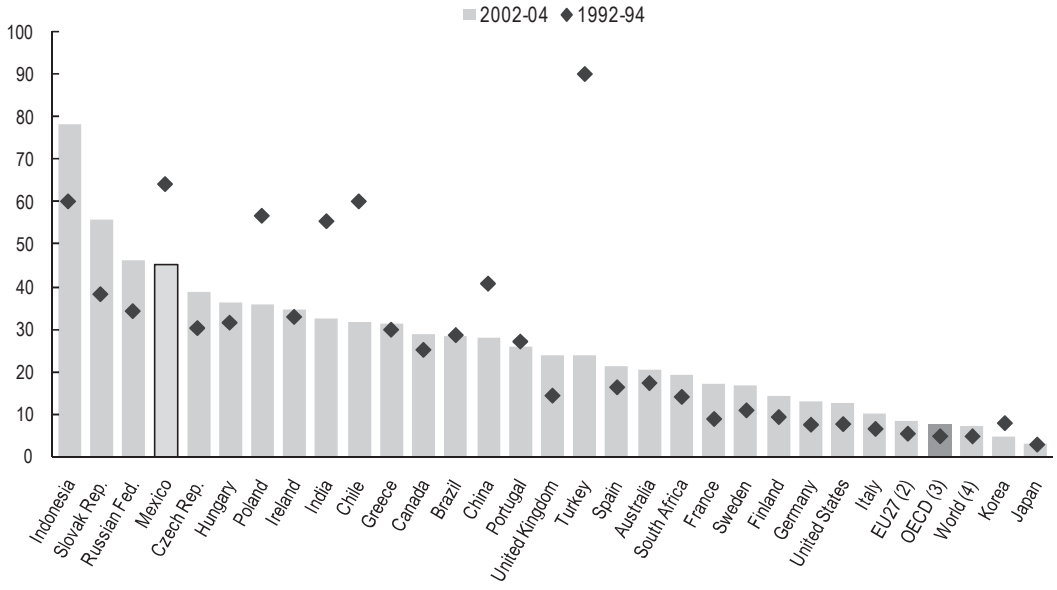
1.6.6. Regional disparities in innovation capacity

As Figure 1.33 shows, there are very considerable disparities in regional science and innovation activity. By far the dominant region is the Distrito Federal, the capital region, which accounts for 43% of SNI researchers in Mexico and 44% of the R&D tax incentives taken up by enterprises. Three other regions have more than 5% each of the total number of SNI researchers: Estado de Mexico, Morelos and Jalisco. Three regions besides Distrito Federal also account for more than 5% of the R&D tax incentives taken up by enterprises: Nuevo Leon, Estado de Mexico and Puebla. On the whole, proportions of SNI researchers and uptake of tax incentives are broadly aligned. The main exceptions are Nuevo Leon, where regional enterprises account for 22% of R&D tax incentives while only around 3% of SNI researchers are based in the region and Morelos, where almost 6% of SNI researchers are based while the percentage of R&D tax incentives take-up is negligible (0.1%).

1.6.7. International linkages

Low levels of patenting by Mexican individuals and entities have already been highlighted, as has the dominance of foreigners in domestic patenting. But it is also apparent that a considerable level of patenting by Mexicans is done in co-operation with foreign co-inventors (Figure 1.34). However, this has decreased somewhat over the last decade, suggesting a growing independence in invention activities, although the numbers are still extremely small. The level of funds from abroad as a proportion of BERD is low by international standards, suggesting that multinational firms tend not to conduct much of their research in Mexico (Figure 1.35). Furthermore, this proportion has fallen sharply in the last decade (Figure 1.36), no doubt owing in part to marked increases in R&D spending by domestic firms.

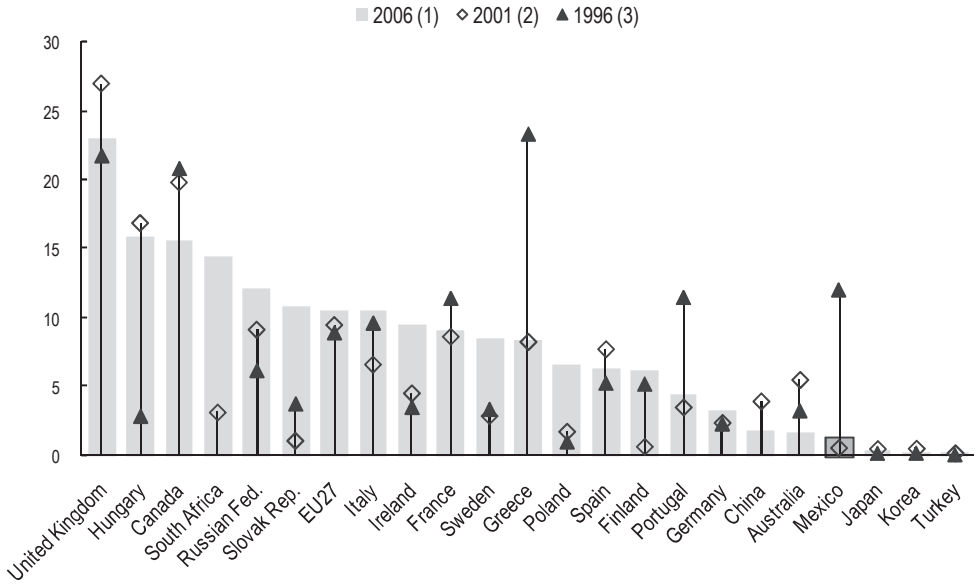
Figure 1.34. Patents with foreign co-inventors,[1] 1992-94 and 2002-04



1. Share of patent applications to the European Patent Office (EPO) with at least one foreign co-inventor in total patents invented domestically. This graph only covers countries/economies with more than 200 EPO applications over 2002-2004. 2. The EU is treated as one country; intra-EU co-operation is excluded. 3. Patents of OECD residents that involve international co-operation. 4. All EPO patents that involve international co-operation. *Note:* Patent counts are based on the priority date, the inventor's country of residence, using simple counts. *Source:* OECD Patent database.

Figure 1.35. R&D funds from abroad, 1996, 2001 and 2005

As a percentage of business R&D (BERD)

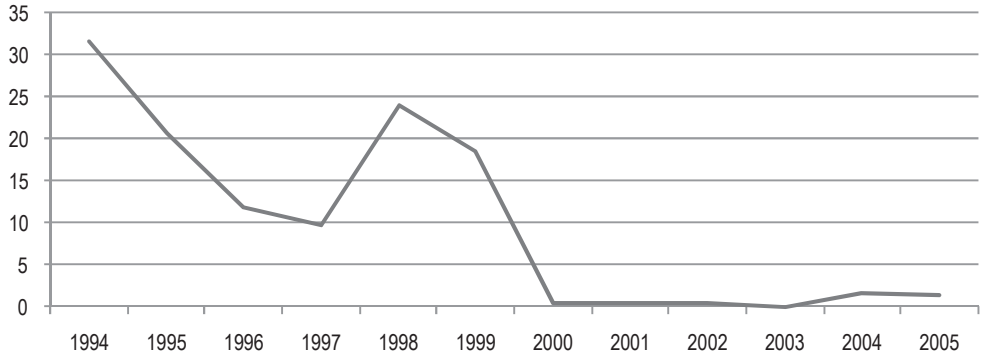


1. 2005 for Australia, France, Greece, Mexico, Portugal, South Africa, Sweden, EU-27.
2. 2000 for China.
3. 1997 instead of 1996 for Finland and Sweden.

Source: OECD Main Science and Technology Indicators.

Figure 1.36. R&D funds from abroad in Mexico, 1994-2005

As a percentage of business R&D (BERD)



Source: OECD Main Science and Technology Indicators.

Notes

1. A recent study (OECD, 2008b) shows that in the mid-2000s, Mexico tops the league in income inequality (measured by the Gini coefficient) among 30 OECD countries, with income inequality twice that of the country with the lowest measure of inequality (Denmark). Independent of the particular threshold used – the share of individuals with equivalised disposable income of less than 40%, 50% or 60% of the median for the entire population – relative poverty rates are always highest in Mexico, Turkey and the United States. However, Mexico (together with Greece, Italy and the United Kingdom) is among the countries in which poverty rates declined by around 1 point or more over the past decade.

2. "Given Mexico's far-reaching reforms, the signing of NAFTA, and the large capital inflows into Mexico, many observers expected stellar growth performance" (Tornell *et al*., 2004, p. 34). The authors present evidence that less than stellar performance may be due to a credit crunch, underlying deterioration in contract enforceability and an increase in non-performing loans.

3. On the link between trade and growth, see, for example, Winters (2004) on exports and productivity at the firm level, and Wagner (2007).

4. The data are available on the KOF (Swiss Economic Institute) Index of Globalization website: *http://globalization.kof.ethz.ch*. For a more detailed description see Dreher *et al.* (2008).

5. The two sets of variables – actual flows and restrictions – are given an equal weight of 50% each.

6. The collapse of the domestic market at a time when the US economy was growing, as well as the large gains in cost competitiveness following the depreciation of the peso also contributed to Mexico's strong export performance at the time (Haugh *et al*., 2008).

7. This debate can be traced back more than half a century (Prebisch, 1950).

8. See OECD (2007c, Statistical Annex, Methodological Note).

9. The inward potential index tries to capture several factors that seem relevant for a country's attractiveness for FDI (beyond market size).

10. For a survey of the literature on FDI spillovers see Görg and Greenaway (2004) and Crespo and Fontoura (2007).

11. "Mexico has already developed many pockets of excellence and high productivity associated with multinationals operating in high-tech and higher middle-tech industries, and with national conglomerates operating in mature industries. These are no longer maquila operations because they employ many professionals and have in-house design and engineering. Yet these pockets of excellence are often enclaves with few linkages to the rest of the economy." (Kuznetsov and Dahlman, 2007, p. 7)

12. As a result, concentration of revealed comparative advantages (RCAs) as measured by a Herfindahl index, is relatively low, especially compared to commodity exporters such as Chile (OECD, 2003a, p. 148; Oliveira-Martins and Price, 2004; OECD, 2007c).

13. The creation of new or higher quality products is a key feature of R&D-based endogenous growth models, such as those of Romer (1990) or Grossman and Helpman (1991). In these models, the creation of new or higher quality products is linked to R&D activities; their availability as intermediate goods translates into higher productivity.

14. The following definitions are used here to categorise Mexican SMEs: *Micro enterprise* – between 0 and 10 employees in manufacturing, retail and services; *Small enterprise* – between 11 and 50 employees in manufacturing and services, and up to 30 employees in retail; *Medium-sized*

enterprise – between 51 and 250 employees in manufacturing, 51 and 100 employees in services, and 31 and 100 employees in retail.

15. Further reductions in tariffs were announced at the end of 2008.

16. According to the Foreign Investment Law (1993) and amendments as well as a number of sectoral laws.

17. Emphasising the importance of capabilities in a model in which firms differ in quality and productivity, Sutton (2007, p. 492) concludes that "in a world in which quality matters and intermediate goods are freely traded, a middle group country may be a loser in the first stage of the process. Yet, it is the middle-group countries … who are best placed to be the most dramatic beneficiaries of the present globalisation, not – or not primarily – because of trade liberalisation per se, but because of the virtuous dynamic that follows as part of the general package of liberalisation of foreign direct investment and capability transfer."

18. An *amparo* remedy or action is an instrument for protecting an individual's constitutional rights.

19. There are several caveats, however, concerning the regulation-growth linkage. Nicoletti and Scarpetta (2005, p. 17) point out that the analysis contains "only indirect evidence of the effects of product market reforms on innovation. More specific analysis of the link between regulation (including intellectual property rights) and aggregate innovative activity is needed."

20. For a description of the structure of the integrated product market regulation (PMR) indicator, see Wölfl *et al*. (2009).

21. This process involves identifying and modifying regulations and policies that unnecessarily restrict competition using the *OECD Competition Assessment Toolkit* (OECD, 2007d).

22. The outstanding role of innovation is acknowledged by modern theories of economic growth (see Grossman and Helpman, 1991; Helpman, 2007; Aghion and Howitt, 2009).

23. See the works of Gerschenkron (1962) and Abramovitz (1986), and the survey by Fagerberg (1994).

24. The importance of international knowledge diffusion was illustrated by Eaton and Kortum (1996). On this issue also see Eaton and Kortum (1999), and the surveys by Gong and Keller (2003) and Keller (2004).

25. See the evidence from a panel of OECD countries (OECD, 2003).

26. There is also another dimension in which increased diversification can be beneficial in the Mexican context. A more diversified range of trading partners would help reduce Mexico's exposure, notably to shocks in the United States and in this way contribute to enhancing macroeconomic stability.

27. If the cost of fiscal incentives is added to the amount of direct support, the percentage of business R&D financed by government reaches about 25% in 2005 and probably more in subsequent years.