Chapter 1

Chihuahua's Economic Model and Challenges

This chapter examines the economic growth and productivity trends in Chihuahua and Mexico. It starts by showing the reader Mexico's slowdown in economic growth and lagging productivity levels. The reader will be able to see Chihuahua's contribution to national performance; thus, Chihuahua's challenges are relevant not only for regional progress, but for Mexico's overall performance. The chapter shows that Chihuahua has gone from being a region that was fast approaching OECD average levels of per capita GDP to be part of the groups of regions that can be considered as lagging and underperforming. Growth decomposition and growth-accounting techniques are used to pinpoint the main factors holding Chihuahua back from fully exploiting its growth potential. Despite being one of North America's leading manufacturing hubs and the lead exporter in Mexico, Chihuahua's outward development model has rendered the region vulnerable to external shocks. The chapter then analyses each of the three long-run economic growth determinants in Chihuahua and pinpoints the main challenges to improve investment, human capital and innovation levels in the state. The chapter ends with a discussion on foreign direct investment trends in the world and Chihuahua and relates multinational enterprise development with specialisation and cluster development in the region and sheds some light on the lack of integration of local firms to global-value chains.

Overview

Chihuahua has benefited from Mexico's trade policy change and its geographical position by creating a successful economic development model that nevertheless raises challenges. Chihuahua, and in particular border municipalities such as Juárez started benefiting from the introduction of the *maquiladora* programme in the late 1960s as a response to northern Mexico's de-integration from the centre, and the cancellation of the *Bracero* programme.[1] Offshoring operations started to locate in Chihuahua attracted by tax incentives, cheaper labour force and minimal transport costs to goods shipped to the US. In the mid-eighties, after a long period of industrialisation based on an import substitution model, the country experienced a trade policy shift by accessing the General Agreement on Tariffs and Trade (GATT) which brought barriers to trade down in a relatively short period of time. The North American Free Trade Agreement (NAFTA) also confirmed investment and international market opportunities for the state. Chihuahua became the main destination in the country for Foreign Direct Investment (FDI) from manufacturing firms and enjoyed the highest share of employment in Mexico's *maquiladora* industry. Chihuahua's outward development model is a common strategy that other OECD regions are following, so the challenges of how to attract FDI, how to maximise its benefits and link local firms to global value chains are also common.

Free trade and increasing flows of FDI has led the region to build useful assets in terms of human capital and innovation that remain somewhat unexploited. Chihuahua is the only state in Mexico with ten technological institutes which provide the manufacturing industry with at least 1 000 engineers every summer. Student enrolment in engineering fields target mostly industrial, electronics and electro-mechanic programmes, but new fields such as aero-space have recently developed. Many of these professionals work directly in manufacturing plants, but some others work on design and engineering centres and some others in laboratories on telecom, environment, advanced materials and renewable energy. Such strong human capital flowing into industry is also supported by high quality education in the state. According to the 2009 PISA results, Chihuahua has the third highest reading score just after Distrito Federal and Nuevo León. Chihuahua is also third in the country in sciences and math. Chihuahua has also the largest share of strong performers in the reading PISA test (12% of the sample just behind DF with 14%) and it is also second in reasoning skills. Despite the presence of institutions for innovation and high-quality human capital development in the state, innovation has not developed in the same way. Chihuahua comes 8th among Mexican states in terms of patent applications and manufacturing firms invest well below national average on R&D. Manufacturing activities could benefit from a greater interaction between research centres and firms. In addition, local firms can seize innovative capacities in the state to engage in global value chains and thereby raise state value added.

The two waves of liberalisation of trade spurred growth, but the outward model followed by Chihuahua and two crises in less than ten years have rendered the region vulnerable to external shocks. After contracting at an average annual growth rate of almost 3% between 1980 and 1985 when Mexico's economy was still under a closed-economy model, the country's accession to GATT resulted in an average growth rate of more than 23% between 1985 and 1993 for Chihuahua. NAFTA brought about growth to levels of almost 9% per year between 1993 and 1998. As the positive impact of the external shock created by Mexico's trade policy change waned, rates slowed down to an annual average of 3.7%. Between 2004 and 2008 annual growth rates averaged just 0.25%.

Relatively lower growth rates since 1998 were partly the result of international competition, multi-national enterprises' (MNEs) organisational changes and technological change prior to the 2001 recession in the US. China's emergence as a global FDI and manufacturing hub provided competition for labour-intensive processes that did not require proximity to the US. At the same time, mergers and acquisitions in the automotive sector render some industrial plants redundant partly affecting Chihuahua which was already struggling to compete on costs with other emerging markets. Nevertheless, the manufacturing sector continues to dominate the state's economy with around one-quarter of state's GDP (Table 1.1). Real estate, which is intimately linked to FDI attraction and manufacturing development, has grown in importance to become the third largest sector in the state with a share of over 12% of GDP. Mergers and acquisitions in the automotive sector also had short-term implications for Mexican plants. Finally, technological change in some of Chihuahua's exports such as electronics were affected by technological change such as the emergence of flat screens and plasma that render old plants based on TV sets redundant. Despite Chihuahua has been able to capture some of the new electronic markets such as flat screens and video-games consoles, job losses have been inevitable as the region moves into relatively more capital-intensive activities.

Table 1.1. **Chihuahua's economic structure, 2003 and 2009**

Sectoral share of the state's GDP (current prices) and employment

	2003	2009	Employment 2009
Agriculture, cattle raising, forestry and fisheries	5.6%	6.4%	0.1%
Mining	0.4%	1.6%	1%
Electricity, water and gas	1.3%	1.5%	1.1%
Construction	9.9%	7.4%	3%
Manufacturing	25.6%	23.9%	44%
Wholesale & retail	15.1%	15.0%	22.6%
Transport	4.8%	4.4%	3.2%
Media	2.3%	2.9%	2.4%
Financial services	1.4%	1.7%	0.4%
Real estate	11.9%	12.1%	1%
Professional services	4.9%	5.4%	1.7%
Business management	0.01%	0.01%	0.1%
Business services	1.5%	1.3%	4.5%
Education	4.5%	5.2%	1.8%
Health and social services	3.2%	3.2%	2.7%
Cultural, sport and recreational services	0.2%	0.2%	0.6%
Accommodation and catering	2.9%	2.7%	5.5%
Other services	2.1%	2.1%	4.5%
Government	3.4%	3.7%	n/a

Source: INEGI (2011), *Banco de Información Económica*, accessed online at *http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe* on August 24th 2011, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

Local firms can hold the key to further benefits from free trade and FDI. The recent economic crises have shown the vulnerability of the region to external changes. In addition and despite past economic success, few local firms have been able to engage in global value chains and thus value added and local content have remained meagre in the region. Although the state is slowly moving into a "third generation *maquiladora*" basing their processes more on design and engineering than on assembly, and in spite of world-class technological centres such as CIMAV, Chihuahua could gain a lot by further supporting human capital development, entrepreneurship and the missing links between

local and global firms. Although Chihuahua is already successful in many primary activities, the sector's shares of total assets are very low and could also improve its contribution in state's GDP currently at just over 6% (Table 1.1). Easing investment, providing financing and helping local firms move up the value chain in the sector represent some of the actions that can help seize missing opportunities. Greater financing and value added in agriculture, cattle raising, forestry and fisheries are not only a sensible strategy for capital deepening and growth, but also to help reduce urban-rural inequalities in the state. However, success in farming largely depends among other things, on water management due to high scarcity levels that have very recently created a crisis for many in rural areas after a sustained drought.

The region's relative economic success and the outward development model have raised new challenges in terms of urban sprawl and missed opportunities in rural areas. The state's population is estimated at 3.2 million and around two-thirds of those live in only two urban areas: Ciudad Juárez and Chihuahua, and since 93% of population growth takes place in these two municipalities, the future seems increasingly urban. Juárez is ranked 8th most populous city in the country and Chihuahua City, 16th. Chihuahua is the only state in Mexico having two cities ranked in the top 20 most populated. El Paso and Ciudad Juárez comprise one of the largest bi-national metropolitan areas in the world with a combined population of 2.4 million people. However a number of urban challenges are present in Chihuahua such as urban sprawl, inadequate public transportation systems and insecurity. Fast population growth in Ciudad Juárez can be explained partly to economic success in the city attracting firms and workers. Population figures in that city almost tripled between 1980 and 2009; in less than 20 years, Juárez went from just over half a million people to almost 1.4. Such population growth has meant urban sprawl as the surface of the city multiplied almost seven times – one of the largest sprawling phenomenon in Mexico according to Mexico's Ministry of Social Development (SEDESOL). As a result, urban centres in Chihuahua have very low density levels. Juárez with almost 1.4 million people has a density of 3.7 inhabitants per square kilometre which is low when compared to OECD cities of a similar size such as Oslo with 206, San Antonio with 98 or Kansas City with 95. The current urbanisation pattern renders population disconnected from main economic areas, excluded from the provision of public services and leads to increased environmental costs. Crime is also an increasing concern.

Recent insecurity issues pose a real social and economic challenge. Insecurity can be linked to social inequality and the region's geographical position. At 144 murders per 100 000 inhabitants, Juárez is arguably one of the most dangerous places in the world. This homicide rate is beyond the average for the countries with the world's highest rates such as Jamaica (59), El Salvador (53), Venezuela (52), Honduras (43) or South Africa (38), and well above the national average at 11. Large inequality levels among municipalities (rural-urban divide), within urban areas and other ethnic and gender expressions of inequality have led Chihuahua to experience inactivity rates among the young that become the target population for organised crime to recruit new members. In addition, Chihuahua's geographical position as an ideal location to ship goods to East and West coast regions in the US, also works for drug trafficking. President Calderon's strategy has been strong on crime leading to several captures. However, the sustained high insecurity levels could represent a constraint for competitiveness and represent a pending social development aspect in the state.

The review is structured to let the reader see the complementarities between efficiency-seeking economic policies and equity-seeking social ones, but arguing that these complementarities are better done at the local level. By fostering each urban and rural areas' economic potential and linking employment opportunities to educational ones, economic strategies can bring about greater equity. Local economic development can be achieved by introducing infrastructure that brings people to jobs, but also strategies for employment and education that bring jobs to people where they are. Regional policy principles can be useful in making the most of local assets to upgrade skills, link people and firms to markets, foster local investments and attract foreign ones, and establish the missing value-chain links, as well as those between researchers and entrepreneurs.

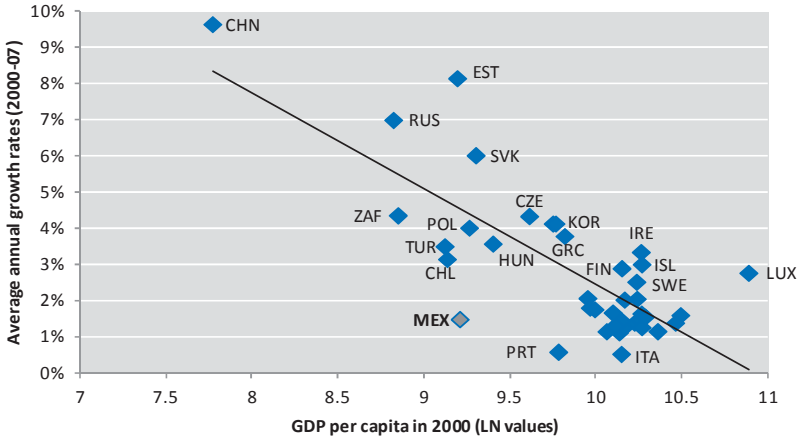
1.1. Economic growth and productivity

Chihuahua's economic growth trends

Mexico's economic growth has been lagging behind the OECD average and outpaced by other emerging economies due to sluggish productivity growth. At an annual average rate of 1.5% between 2000 and 2007, Mexico's economic growth falls behind the average for OECD countries at 1.7% (Figure 1.1).[2] The rate is considerably lower for the same period, than that of some Eastern European economies: Czech Republic (4.3%), Estonia (8.2%), Hungary (3.6), Poland (4%), Russia (7%) and Slovak Republic (6%). Other emerging economies outperforming Mexico are China (9.7%) and Chile (3.2%). Mexico's distance from OECD income levels, the largest income gap in the Organisation (Figure 1.2), are essentially due to lagging labour productivity (OECD, 2011b). Mexico's labour productivity growth is one of the lowest in the OECD. Growing at an annual average of 1.3% between 2000 and 2007, Mexico's productivity growth was even lower than during the 1995-2000 period and in both cases lower than the OECD average (Figure 1.3). On average OECD countries are becoming more efficient than Mexico at twice the speed.

Figure 1.1. **Economic growth, 2000-07**

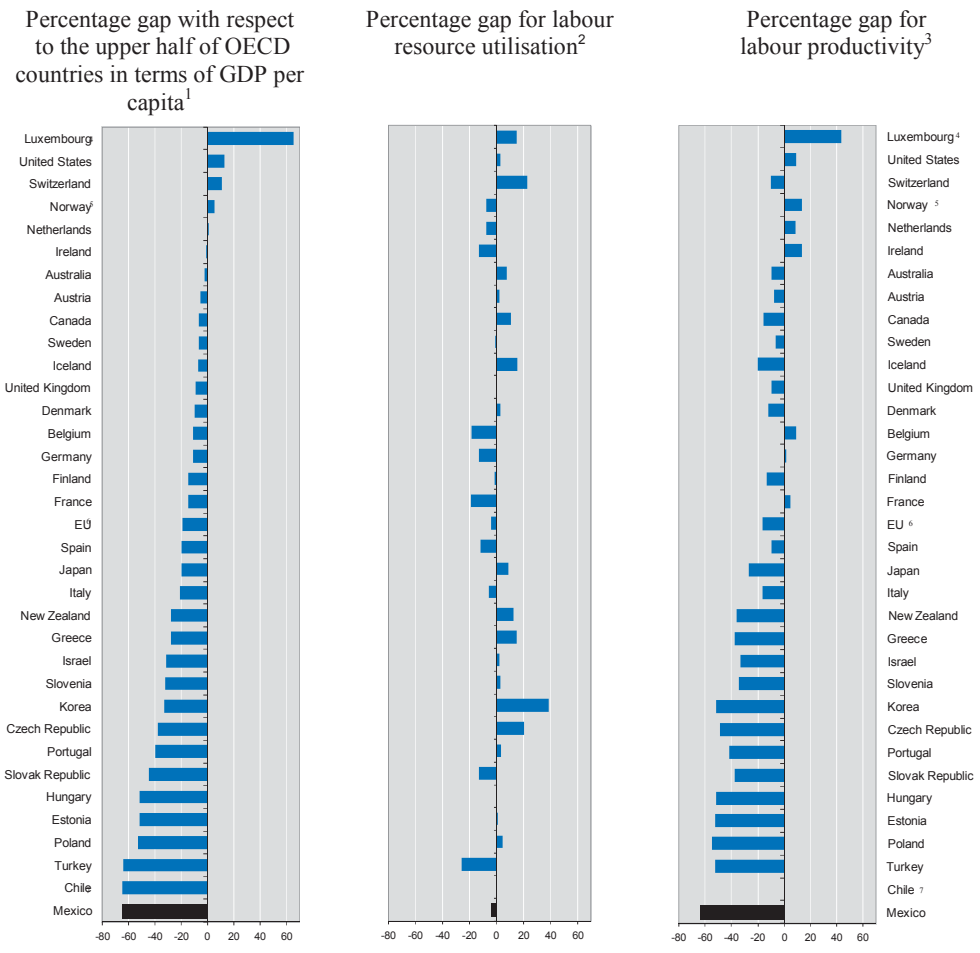
Average annual growth rates for GDP per capita



Note: Due to lack of data initial GDP per capita values for South Africa refers to 2003. Average annual growth rates have been adjusted accordingly.

Source: OECD (2011) *National Accounts*, accessed online at OECD.Stat on June 15th 2011.

Figure 1.2. **Sources of real income gaps in the OECD in 2009**



1. Relative to the simple average of the highest 17 OECD countries in terms of GDP per capita, based on 2009 purchasing power parities (PPPs). The sum of the percentage gap in labour resource utilisation and labour productivity do not add up exactly to the GDP per capita gap since the decomposition is multiplicative.

2. Labour resource utilisation is measured as total number of hours worked per capita.

3. Labour productivity is measured as GDP per hour worked.

4. In the case of Luxembourg, the population is augmented by the number of cross-border workers in order to take into account their contribution to GDP.

5. Data refer to GDP for mainland Norway which excludes petroleum production and shipping. While total GDP overestimates the sustainable income potential, mainland GDP slightly underestimates it since returns on the financial assets held by the petroleum fund abroad are not included.

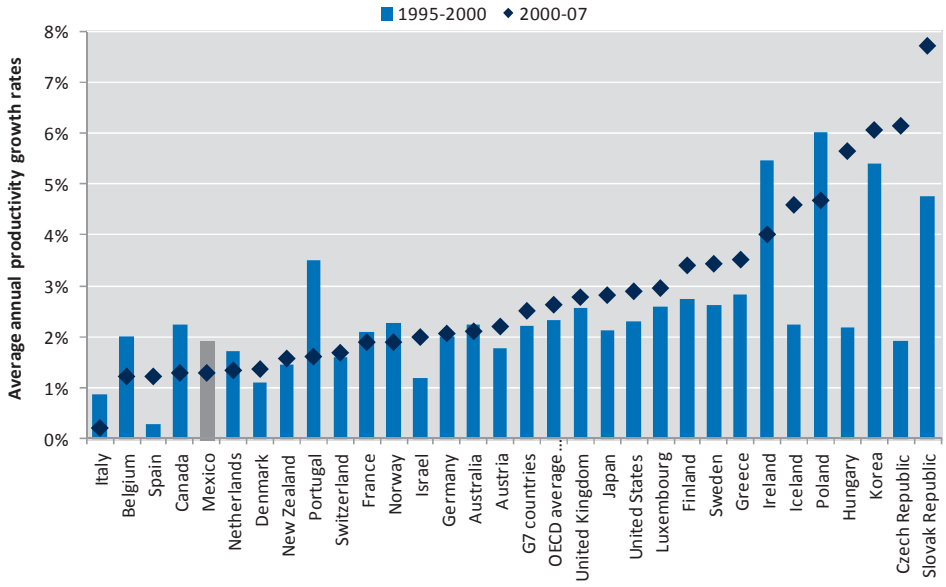
6. EU brings together countries that are members of both the European Union and the OECD. These are the EU15 countries plus Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Slovenia.

7. Data on hours worked are not available for Chile.

Source: OECD (2011) *Going for Growth*, OECD Publishing, Paris.

Figure 1.3. **Productivity growth in the OECD**

Average annual productivity growth rates (1995-2007)



1. Productivity is defined as GDP per hour worked.

2. OECD average (30) refers to the average annual productivity growth rates in 30 OECD countries excluding Chile, Estonia, Israel and Slovenia.

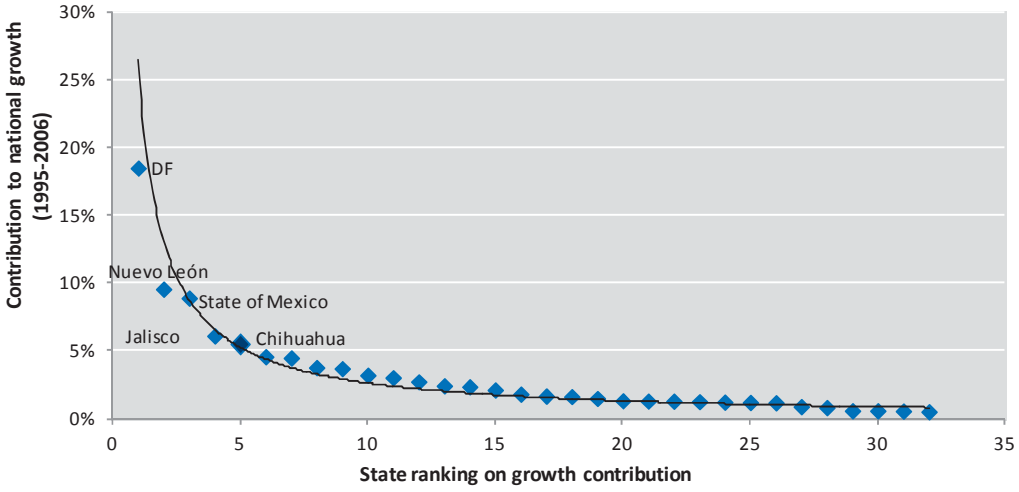
Source: OECD (2011) *Productivity Database*, accessed online at OECD.Stat on June 15th 2011.

Mexico's economic growth is highly geographically concentrated and Chihuahua is one of the main contributors. Almost half of all economic growth experienced between 1995 and 2006 in the country took place in only 5 of the 32 states: Distrito Federal, Nuevo León, Edo. de México, Jalisco and Chihuahua. Chihuahua was the 5th largest contributor to national economic expansion with 5.5% of all national growth (Figure 1.4). The three largest metropolitan areas in the country are clearly driving national growth. Distrito Federal and Edo. de México each contained about half of the population of Mexico City. More than 85% of Nuevo León's population in 2010 was located in one of the 10 municipalities onto which the Monterrey metro-region sprawls. Almost 60% of Jalisco's population was located in the Guadalajara metro-region. Chihuahua comes after these three metro-regions, but growth in the state has been concentrated in two municipalities that already hold two-thirds of population: Chihuahua City and Juárez. These two urban centres concentrated 93% of the state's population growth between 1990 and 2005.

Despite its sizable contribution, Chihuahua's growth has dramatically fallen in the last decade. After being one of the OECD's most dynamic regions between 1995 and 2000 (Figure 1.5), the state's GDP per capita growth moved into the group of lagging regions in terms of income and underperforming in terms of growth between 2000 and 2006 (Figure 1.6). The outstanding average annual growth rate of 7.1% that Chihuahua achieved during the late nineties (1995-2000), was slashed to an annual average rate of just 1.5% between 2000 and 2006. Largely, the reason for slower growth rates lie in vulnerability to external shocks that the model brings about and the two crises that the region had to face in less than ten years.

Figure 1.4. **State contribution to national growth**

Ordinal ranking of state's share of national increase in GDP (2006 with respect to 1995)

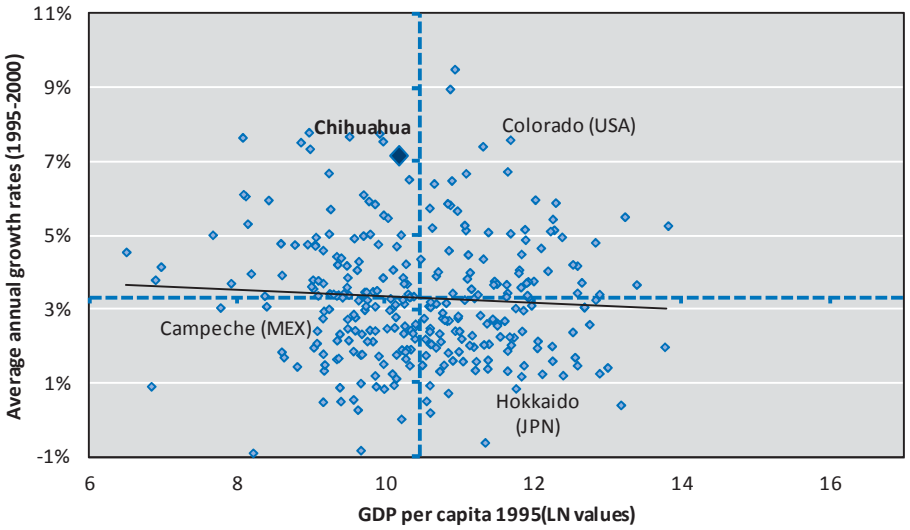


Note: States' are ranked on the horizontal axis according to their growth contribution.

Source: OECD calculations based on OECD (2011) *Regional Database* accessed online at OECD.Stat on June 22nd 2011.

Figure 1.5. **Regional economic growth, 1995-2000**

Average annual growth rates for OECD TL2 regions (1995-2000)



1. Excluded countries due to lack of data at regional level: Iceland, New Zealand and Switzerland.

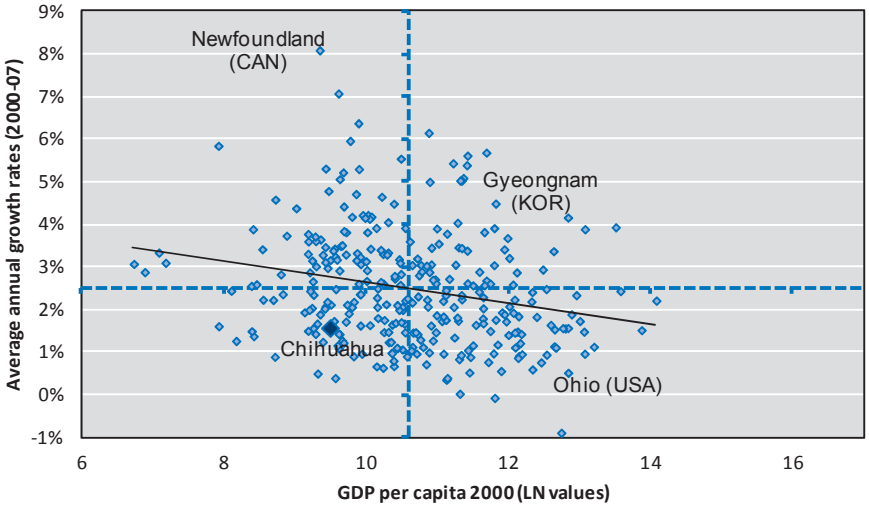
2. Different period for Norway (1997-2000).

3. Turkey was excluded from the sample as it experienced large negative growth rates during the period.

Source: OECD calculations based on OECD (2011) *Regional Database* accessed online at OECD.Stat on June 22nd 2011.

Figure 1.6. **Regional economic growth, 2000-07**

Average annual growth rates for OECD TL2 regions



1. Excluded countries due to lack of data at regional level: Iceland and Switzerland.

2. Different periods for: Japan (2000-06), Mexico (2000-06), New Zealand (2000-03).

3. Turkey was excluded from the sample as it experienced large negative growth rates during the period.

Source: OECD calculations based on OECD (2011) *Regional Database* accessed online on 22 June 2011.

Chihuahua's strong economic performance after Mexico joined NAFTA is related to FDI attraction and export levels. Since the late 1960s, firms have been attracted to northern Mexico as the country implemented the Border Industrialisation Programme and encouraged FDI through the *maquiladoras* (Box 1.1). FDI flows and employment related to *maquiladoras* grew steadily in Mexico and in particular in Chihuahua, but accelerated with Mexico's accession to GATT in the mid 1980s and again with economic integration through NAFTA in the mid 1990s and thanks to its proximity to the US market. openness and proximity were key factors that shifted the relevant market in Mexico from the old industrial belt in and around Mexico City to the border (Krugman and Livas Elizondo, 1996). As a result, Mexico's regional disparities amplified particularly after NAFTA (Sanchez-Reaza and Rodríguez-Pose, 2002). The impact was so vast that Mexico's industrial structure changed completely. In 1990, the gross value of production (GVP) in the *maquiladora* industry represented one-quarter of all manufacturing and the remainder by domestic firms.[3] Ten years later the shares were inverted: three-quarters of the GVP was produced by *maquiladora* plants and the remaining one-quarter by domestic firms (Sánchez-Reaza, 2009). In Chihuahua, FDI flows led to an explosion in the volume of exports and made the state the leading region in Mexico in terms of trade. In 2000, exports represented more than 60% of the state's GDP (Figure 1.7). However, the industry has been accused of a number of shortcomings such as low value added that leads to low paid jobs and lack of linkages with domestic firms despite enjoying a preferential regime.

Box 1.1. **The development of the *Maquiladora* industry in Mexico**

The *maquiladora* industry is what some authors have called export oriented zones, which were introduced in Mexico in 1965 under the Border Industrialisation Programme. The relatively isolated development experienced in border-states attracted immigrants who demanded services, generating social problems (SPP, 1985). Even in 1961, the relative dynamism of border-states and their lack of integration with the rest of the country motivated the government to set up the *Programa Nacional Fronterizo*. In addition, the programme was also an attempt to win over the border area's growing market for domestic firms (SPP, 1985). Further to what the government perceived as the region's de-integration, the situation was aggravated by the decision taken by the US Government in 1964 to suspend the Bracero Programme (García y Griego and Verea Campos, 1988). US participation in the Second World War reduced the labour supply, increasing demand for Mexican migrant workers. Thus, in 1942 the US Bracero Programme allowed temporary non-immigration stay of Mexican workers. The Programme carried on until 1964 (García y Griego and Verea Campos, 1988).

The Mexican Government foresaw a massive return of workers demanding employment and services. Therefore, the Border Industrialisation Programme's scheme allowed foreign-owned firms to operate along its border with the US on a duty-free basis (Sklair, 1990). A large number of firms took advantage of US tariff rules on the re-import of assembled semi-finished goods that incorporated US components. Although Mexico allowed almost unrestricted inflows of US investment in the North, it continued to protect the rest of the country in line with ISI principles. However, the industry eventually became an important source of foreign currency and employment and attained considerable shares of manufacturing production under trade liberalisation. Despite the 1972 regulation, which allowed *maquiladoras* to locate anywhere in Mexico, the industry has remained heavily concentrated along the border with the US.

Source: Sanchez-Reaza (2009), *Trade, Proximity and Growth: The Impact of Economic Integration on Mexico's Regional Disparities*, VDM, Berlin.

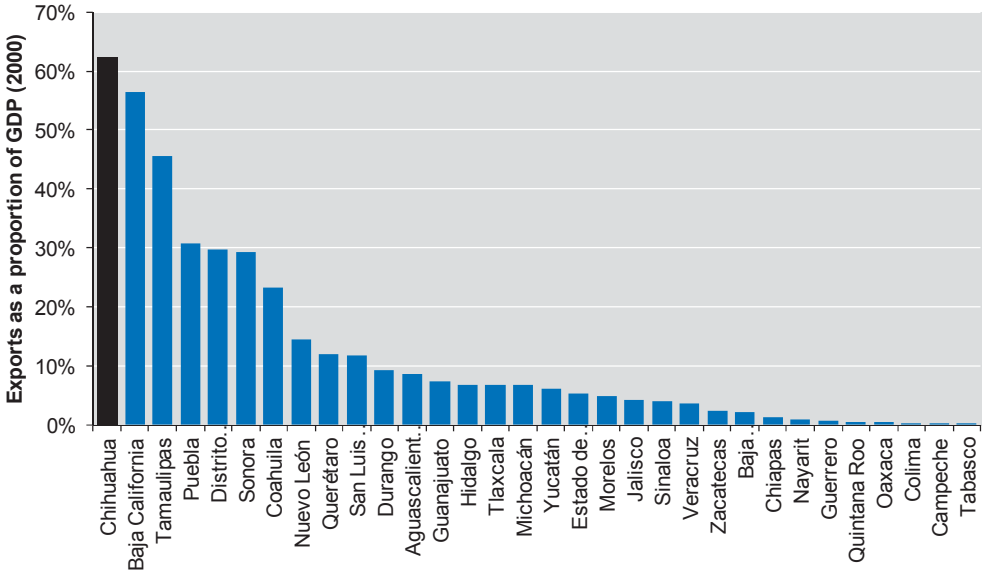
Productivity emerges as the key untapped potential for the state, as it alone can dramatically change performance in the short and medium terms. Per capita GDP levels in leading states in Mexico can be largely explained by productivity, as in the cases of Campeche in the South where most of the oil production in Mexico is located, DF that holds the core of Mexico City's metro-region or Quintana Roo that is heavily based on tourism in Cancún and other attractions. In the case of Chihuahua, productivity is lagging with respect to the national average, and as a result, contributes negatively to explaining GDP per capita differences between the state and the nation (Figure 1.8). Another factor contributing to a lower-than-expected performance is employment rates. Chihuahua, due to the recession in 2001-03 and the recent financial crisis, has not been able to create as much jobs as it requires boosting GDP per capita levels.

Chihuahua is among the many other Mexican states that are not making the most of their assets. Chihuahua, like most leading states, has a demographic bonus. The size of the potential labour market (the proportion of population in their working age) and the participation rates are the sole factors positively influencing Chihuahua's GDP per capita (Figure 1.8). The actual pooled labour market expressed in the size of active workers (participation rates) at 65.6% is larger than the national average (64.5%) in 2007. Such larger participation rate means a smaller inactivity rate (inactive population as a proportion of working-age population) than the national average. Inactive population are in the working-age population group (15 to 64 years), but not employed and because they

are not seeking employment they are neither unemployed. Chihuahua had in 2004, the seventh largest inactivity rate and the second among border-states. At 36.9% of working age population, Chihuahua's inactivity rate was larger than the national average by 3.6 percentage points in 2004. Although inactivity rates have decreased to 34.3% by 2007, they are still high by OECD standards.4 Inactive population includes students, but also other young population and stay-at-home parents. Recently, Mexico has experienced a rise in inactive young population that are neither studying nor working ("ni estudian, ni trabajan") that Mexicans have called the NiNis (Spanish acronym for "neither studying nor working"), and those employed (employment rates). In 2010, 18.4% of those aged between 15 and 19 and one-quarter of those 20 to 24 were NiNis. Among OECD countries, only Turkey and Israel experienced larger inactivity for their young population (OECD, 2011e). Arceo-Gómez and Campos-Vázquez (2011) estimated that some 8.6 million people, which represent almost 29% of population aged between 15 and 29, were NiNis. Moreover, Arce-Gómez and Campos-Vázquez also found that Chihuahua was among the only four states that experienced an increase in NiNis between 1990 and 2010. Although a part of those NiNis are stay-at-home parents, such high inactivity rates could signal fewer opportunities for younger population.

Figure 1.7. **Exports by state in Mexico, 2000**

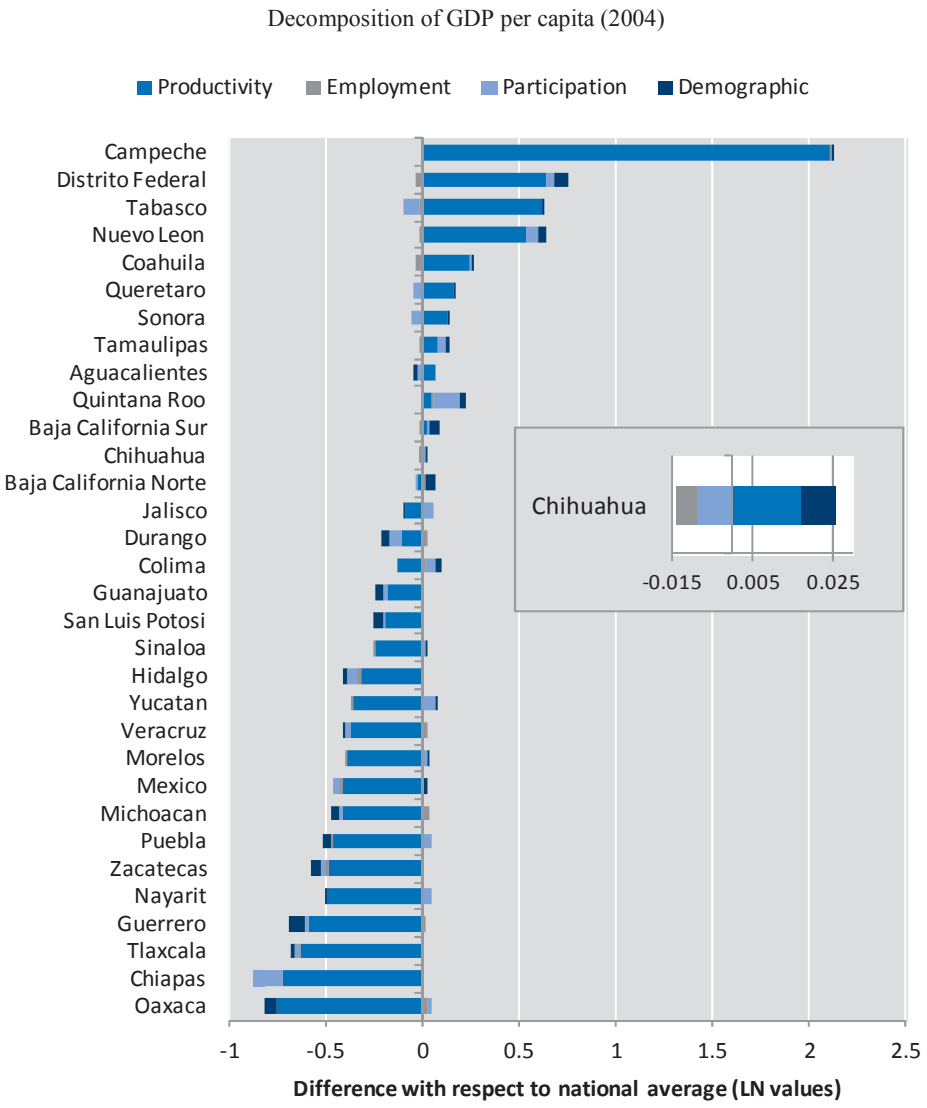
Exports as a proportion of GDP



1. Figures for exports of non-oil activities refer to the latest available year (2000). 2. As data for exports excludes oil, the two main oil-producing states (Campeche and Tabasco) display poor performance. 3. Data for exports stems from Bancomext (2002) *Estadísticas de Comercio Exterior, Mexico*, Banco Nacional de Comercio Exterior, Mexico. Data for GDP in 2000 was taken from INEGI (2007) *Banco de Información Económica*, accessed online in March 2007 at *http://dgcnesyp.inegi.gob.mx*, Instituto Nacional de Estadística, Geografia e Informática, Aguascalientes.

Source: OECD (2007) *Territorial Reviews: Yucatán, Mexico*, OECD Publishing, Paris.

Figure 1.8. **Factors influencing income differences across Mexican states**



Note: GDP per capita can be disaggregated into four components: productivity, employment, participation and demographic. The demographic component represents the size of the pooled labour market of each region compared to the national average. Labour market pool is calculated as the proportion of the working-age population over the total population.

Source: Author's calculations based on OECD (2011) *Regional Database*, accessed online at OECD.Stat on 22 June 2011.

Chihuahua's economic development model

Chihuahua has been following an outward development model that has encouraged foreign investment and created jobs. The state's outward development model is based on FDI attraction. There is an explicit government policy to attract foreign businesses to create jobs and some revenue for the state through the payroll tax. Local entrepreneurs have also become very successful in attracting businesses to land they own in and on the outskirts of cities. With nearly 500 plants that employ almost one quarter of a million

people, Chihuahua is the state with the most *maquiladora* employment and the second in number of plants (CIES, 2010). However, total value added for the industry has remained low, ranking Chihuahua eighth in the country. With average annual flows approaching USD 1.4 billion, Chihuahua is also third in the country in attracting FDI behind only Mexico City (DF) and Nuevo León.

However, an outward development model poses a number of challenges. A high influx of FDI to the state has dominated employment creation. FDI has also influenced policy objectives and strategies, as well as entrepreneurs' activities. As a result, the government has made FDI attraction a core development objective and a number of local entrepreneurs have geared their activities towards FDI attraction. However, the effects on the local economy are mixed. It is unquestionable that FDI has delivered the promise of generating jobs and has also raised wages in the north of Mexico as a result and the regional wage premium has persisted (Hanson, 2003). It is also true, as will be explored below, that there are clear benefits in terms of human capital development as FDI increases demand for skilled labour (Feenstra and Hanson, 1997). However, there are still challenges in connecting these plants to local firms, to upgrade overall stock of human capital and technological spillovers although are arguably made possible by MNEs, this is still not confirmed.

Such an outward development model for Chihuahua has lead to a number of challenges:

- labour demand becomes so important that workers from other states and from Chihuahua's rural areas are attracted to urban areas where *maquiladoras* are located;
- migration increases land and housing demand,[5]
- urban sprawl created by migration, by land and housing demand, as well as by firm location, leads to environmental concerns and increased costs of providing services;
- younger population in rural areas migrate and often their plots of land are abandoned hindering the development of agricultural activities;
- the government runs the risk of overlooking local firms' development; and
- the number of entrepreneurs that could create and innovate new products and services is reduced as market incentives encourage them into attracting FDI instead.

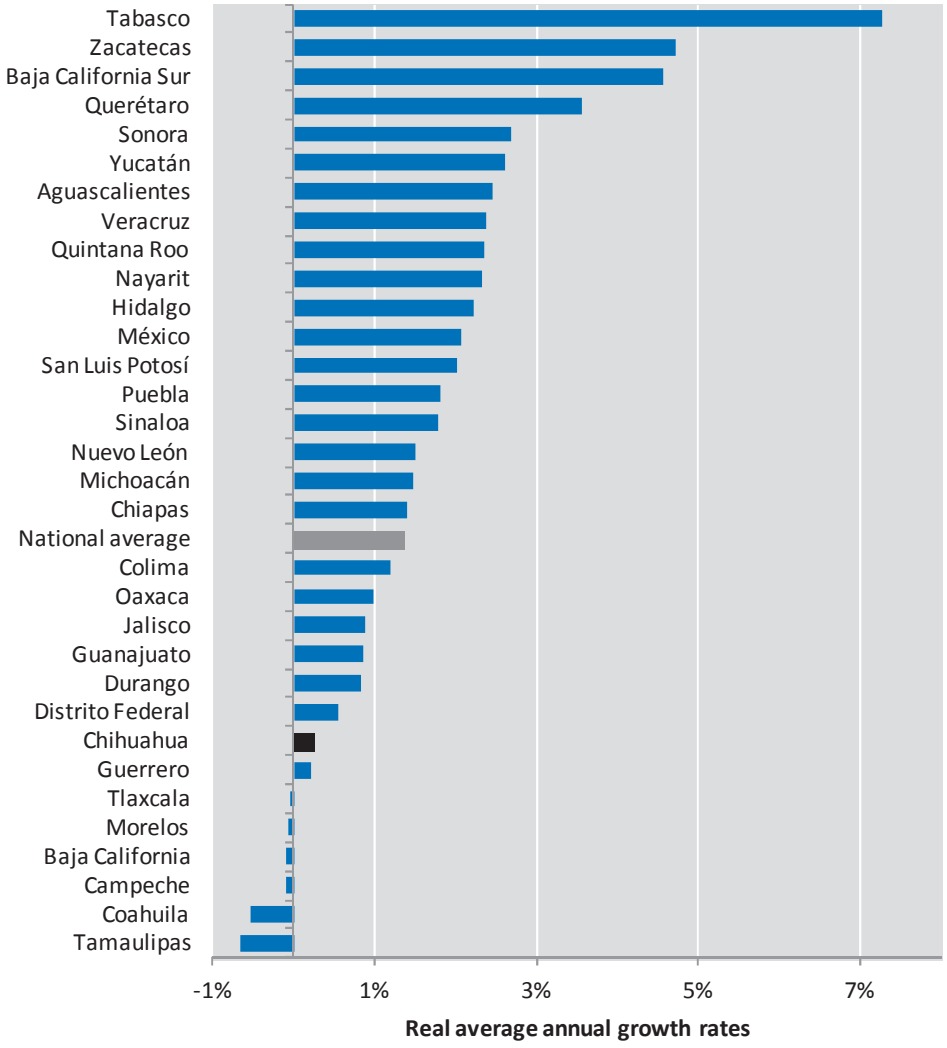
External shocks play a major role in explaining slower economic growth in Chihuahua. The state is among the Mexican states with lower economic growth performance (Figure 1.9). Chihuahua's real GDP (at 2000 prices) was MXN 200 billion in 2004, and five years later output increased in real terms by only MXN 2.5 billion. The economy grew by 1.24% over the 2004-09 period, or at an average annual rate of 0.25%. Mexico's growth over the same period stood at an average annual growth rate of 1.34%, which is more than five times the speed of growth in Chihuahua. The state economy had the seventh lowest performance among Mexican states (Figure 1.9).

Chihuahua's success in attracting FDI has been largely reflected in its long-term economic growth, but has also shown to be a source of potential vulnerability from external shocks. The first of these shocks took place between 2001 and 2002, which led to deep annual contractions –particularly in 2001 that led to a -3.7% growth rate—but overall the period (1999-2004) brought about some growth for the first part of the decade (Figure 1.10). For Chihuahua, the 2001-02 recession was partly due to lower demand from the US through the *maquiladora.* In addition, job losses were due to technological

progress in electronics and mergers and acquisitions in the automobile sectors[6] that resulted in streamlining process, closure of plants and massive layoffs (Sanchez-Reaza, 2009). Chihuahua lost 107 000 manufacturing jobs between October 2000 and June 2002 and although GDP contracts in 2001 and 2003, overall in the period it was still able to grow.

Figure 1.9. **Economic growth among Mexican states, 2004-09**

Real average annual growth rates using GDP (2000 prices)



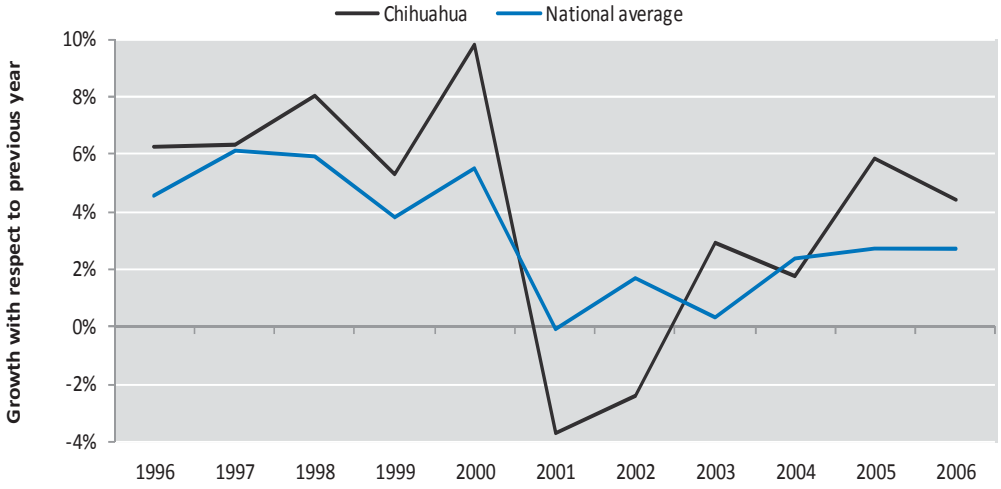
Source: Author's calculations based on *Banco de Información Económica*, accessed online at *http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe* on August 24th 2011, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

The financial crisis of 2008, became the second external shock to reveal Chihuahua's vulnerability. As Chihuahua's economy is intimately linked to US demand, the largest crisis since the Great Depression was bound to hit the region. After solid annual growth rates of around 4% between 2004 and 2006, Chihuahua slowed down in 2007

(Figure 1.11). The growth rate in 2007 with respect to the previous year was halved. By 2008 growth stagnated and 2009 growth rates plunged by almost 10%. Since the recovery from the first external shock in 2001-02, Chihuahua underperformed with respect to the national average. Chihuahua's vulnerability becomes a critical issue in the current world context of crises and sluggish growth (Box 1.2). As most of the world's economic expansion will come from emerging economies like the BRICS (Brazil, Russia, India, China and South Africa) in the coming years, Chihuahua could consider diversifying its economy on markets and on sectors. On the one hand, the new government should partner with the local entrepreneurs to open new markets in emerging economies and on the other, it should look at ways in which to support as well other sectors with potential for growth such as primary activities (see Chapters 2 and 4).

Figure 1.10. **Real annual economic growth in Chihuahua, 1995-2006**

Real GDP growth rates with respect to previous year (2000 prices)

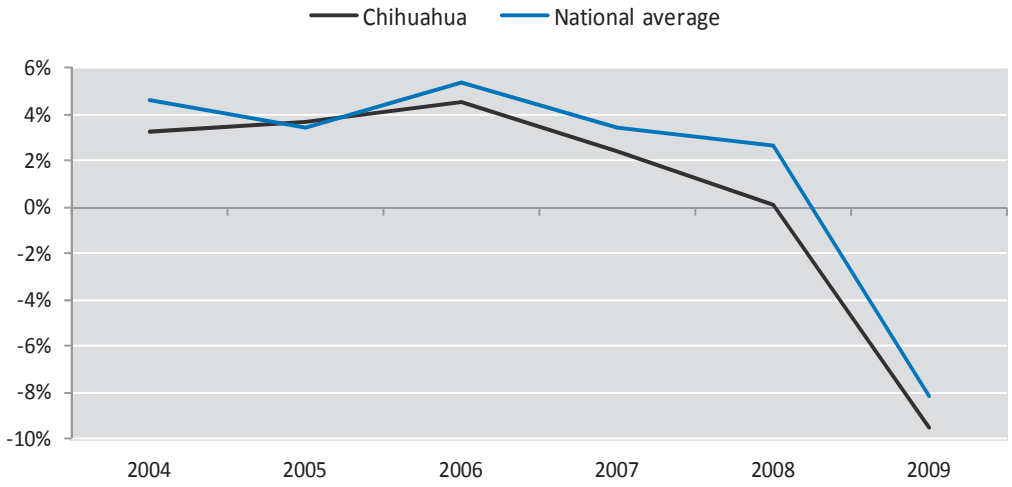


Source: Author's calculations based on OECD (2011) *Regional Database*, accessed online at OECD.Stat on June 22nd 2011.

Chihuahua's economic growth was due to capital deepening chiefly as a result of FDI flows. In order to carry out a growth accounting exercise (see Annex A for the methodology), growth was divided according to dates when the economic census were carried out (1999, 2004 and 2009) since the data for investment is only available in those census and not as annual series. The 1999-2004 period observed an overall growth rate of 8.4%, which is annually an average rate of almost 1.7%. The main driver of such growth was the labour input due to employment growth. Capital deepening not only played a positive role, arguably thanks to FDI, during the 1999-2004 period, but also in the 2004-09 period (Figure 1.12). Technological progress played a negative role during the 1999-2004 period, perhaps due to the initially adverse effects of plant closures in the electronics industry (see above).

Figure 1.11. **Real annual economic growth in Chihuahua, 2003-09**

Real GDP growth rates with respect to previous year (2000 prices)



Note: Data from Mexico's INEGI (2011) was taken in current prices and converted to constant prices of 2000 using OECD reference series for Mexico. Growth was then calculated on the logarithmic quotient of the current and the previous years.

Source: Author's calculations based on INEGI (2011), *Banco de Información Económica*, Instituto Nacional de Estadística, Geografía e Informática, *http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe,* accessed 24 August 2011.

Box 1.2. **OECD's Economic Outlook**

The recovery is projected to strengthen in the near term, but there are concerns about the longer-term legacy of the financial crisis, particularly because of the emergence of unsustainable fiscal imbalances as well as the possible damage to long-term growth prospects. Nearly all OECD economies are expected to improve their fiscal balances over the course of 2011 and 2012. However, for many this will still leave fiscal balances too weak to stabilise government debt and for others, where debt is stable, it will be at levels which remain too high. The crisis could have a long-lasting adverse effect on the growth rate of output, particularly as a consequence of large fiscal imbalances or continuing financial fragilities, and so lead to a prolonged period of stagnation. An alternative risk of "stagflation" – stagnation combined with inflation – might arise as a consequence of continuing upward pressure on oil and other commodity prices. These risks are examined in the context of previous historical episodes of stagnation and the implications for policy are considered.

Fiscal consolidation requirements for many countries are substantial. In Japan and the United States, stabilising the debt-to-GDP ratio would require an overall improvement in the underlying primary balance of 10 to 11 percentage points of GDP from the 2010 position, implying a protracted period of fiscal tightening. Other countries for which consolidation requirements are large include Greece, Ireland, Poland, Portugal, the Slovak Republic and the United Kingdom, which all require consolidation of about 6 to 8½ percentage points of GDP from the 2010 position. In addition, for a typical OECD country, additional offsets of 3% of GDP will have to be found over the coming 15 years to meet spending pressures due to increasing pension and health care costs. Consolidation requirements would be much more demanding if the aim were to return debt-to-GDP ratios to their pre-crisis levels. For the OECD area as a whole the improvement in the underlying primary balance from the 2010 position that

Box 1.2. **OECD's Economic Outlook** *(cont.)*

would be required to reduce the debt ratio to pre-crisis levels by 2026 would be more than 13 percentage points of GDP, compared to seven percentage points to simply stabilise debt.

Many countries will be undertaking fiscal consolidation over a prolonged period and there is a risk that the sustained adverse effect on demand could delay the recovery and even risk stagnation. In this respect, countries face a difficult choice between front-loaded fast consolidation and more gradual consolidation. Fast consolidation has the advantage that it may reduce the overall scale of required consolidation and reassure financial markets, but it also increases the risk of adversely affecting the recovery particularly if monetary policy is constrained. To improve the terms of this trade-off, countries should put greater weight on measures which will improve long-term fiscal sustainability – for example raising retirement ages or containing future increases in health costs – but which have relatively limited immediate negative effects on demand. To reassure financial markets, it is also important to have a clear medium-term fiscal plan specifying objectives and the instruments that will be used. Consolidation should also avoid measures, such as reducing public investment or support for R&D, which weaken the supply side and instead target measures which strengthen it.

From 2013 onwards, the growth rate of OECD-wide potential output recovers to average about 2% per annum, below the average potential growth rate of 2.25% per annum achieved over the seven years preceding the crisis. Most of the difference is due to slower growth both in participation rates and in the working-age population, mainly reflecting demographic trends rather than additional effects from the crisis.

Given the assumption that negative output gaps close by 2015 in most countries, and despite slower potential growth, area-wide GDP growth averages almost 3% per annum over the period 2010-15, compared to 2.5% per annum over the period 2000-07. Unemployment is falling in all countries, with the area-wide unemployment rate down from 8.25% in 2010 to a rate of just over 6.25% by 2015 and just under 6% in 2026, reflecting both the recovery and, perhaps also optimistically, the reversal of post-crisis hysteresis effects. However, growth prospects rely heavily on non-OECD countries continued strong growth – particularly China, India, Russia and Brazil. Strong growth in these regions continues to be a major source of export demand in some OECD economies such as Germany and Japan.

The Mexican economy has embarked on a strong recovery from the recession of 2008-09. Initially driven by exports, activity is expected to be increasingly supported by domestic demand. After a strong rise in 2010 to 5.5%, GDP growth will ease in 2011 (4.5%) and 2012 (3.8%), as the expansion of exports will normalise. The government started fiscal consolidation in 2010 with tax increases and a partial withdrawal of stimulus measures. The projection assumes that the government will implement its plans to return to a balanced budget, based on the national definition of the deficit, by 2012. Oil production has stabilised for now, but the government should reduce its dependence on this volatile source of revenues by implementing further tax reform and withdrawing energy subsidies more quickly. Meanwhile, the central bank can wait to raise interest rates, as slack in production capacity remains large, core inflation has fallen throughout 2010 and inflation expectations remain well anchored. Thus recent food price increases are not expected to lead to important second round effects.

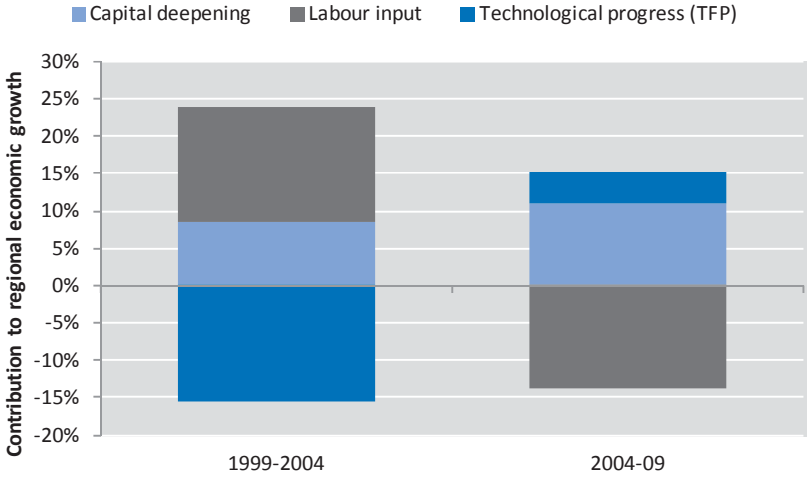
Source : OECD (2011) *Economic Outlook Volume 2011/1*, OECD Publishing, Paris.

The 2004-09 period is affected by another external shock and under those circumstances, capital deepening and to a lesser extent technological progress are leading to, even if meagre, some growth. Capital deepening and the positive effects in terms of total factor productivity of a technological change, led to some growth. FDI accompanied by more capital-intensive processes and even design and engineering centres might be

playing a role in that more recent period. However, the financial crisis led to a severe contraction that made employment contract by almost 14%. In fact, the labour input was a negative factor of growth during the 2004-09 period across all Mexican states (Figure 1.13). Mexican states are in many cases benefiting from technological progress, but its effect in Chihuahua was meagre. It is also possible that insecurity might have deterred capital formation in Chihuahua.[7] As technological progress was the result of an external shock, unless such shocks are sustained –and there is no certainty in that— attention should be geared towards improving labour productivity, attracting FDI and fostering entrepreneurship to increase capital deepening and spark innovation.

Figure 1.12. **Chihuahua's growth factors**

Growth accounting for Chihuahua in different periods



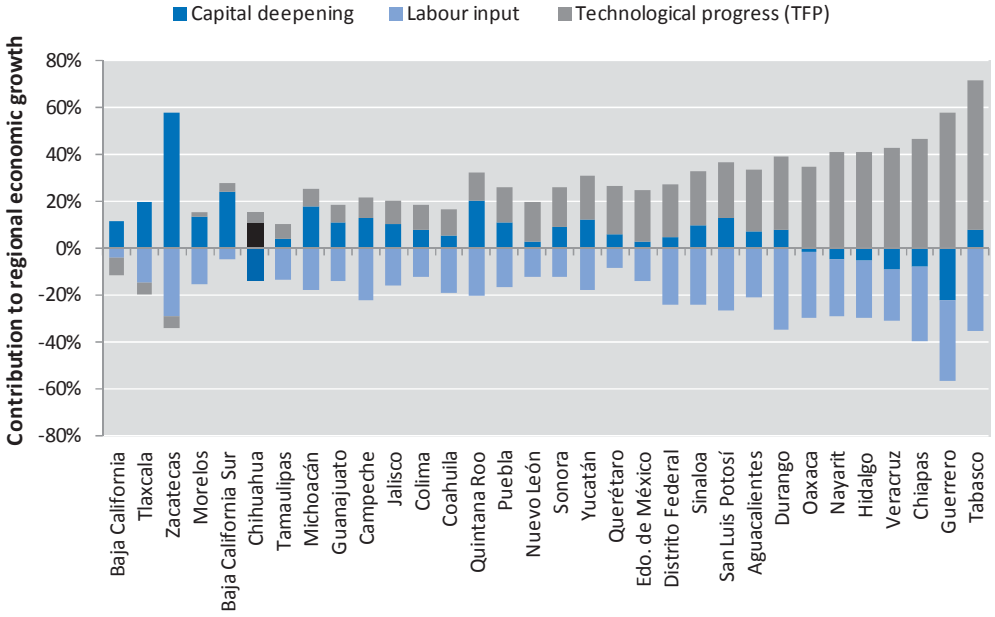
1. Growth accounting followed the methodology in OECD (2008) *Productivity Compendium*, OECD Publishing, Paris. See Annex A for a full description.

2. The 1999-2004 and 2004-09 periods are not necessarily comparable as GDP data for both stems from different sources. The former uses data from the OECD Regional Database, whereas the latter uses INEGI data.

Source: Author's calculations based on different sources. GDP data for the 1999-2004 period: OECD (2011) *Regional Database*, accessed online at OECD.Stat on 22nd June 2011. GDP data for the 2004-09 period: INEGI (2011), *Banco de Información Económica,* Instituto Nacional de Estadística, Geografía e Informática, *http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe*, accessed 24 August 2011. Data for capital stocks and employment levels from: INEGI (1999) *Censos Económicos 1999*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; INEGI (2004) *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; INEGI (2010) *Censos Económicos 2009*; Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

Figure 1.13. **Growth factors in Mexican states**

Percentage contribution to real GDP growth (2004-09)



Note: Growth accounting followed the methodology in OECD (2008) *Productivity Compendium*, OECD Publishing, Paris. See Annex A for a full description.

Source: Author's calculations based on different sources. GDP data from INEGI (2011), *Banco de Información Económica*, Instituto Nacional de Estadística, Geografía e Informática *http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe*, accessed 24 August 2011. Data for capital stocks and employment levels from: INEGI (2004) *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; INEGI (2010) *Censos Económicos 2009*; Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

1.2. Determinants of growth

Long-run growth is driven chiefly by the expansion of capital, skills and innovation. Comparative evidence of economic growth paths across countries shows that often takes very little to get growth started (Rodrik, 2007). Such periods of economic growth spurts albeit short-lived, are not something that should be overlooked. In fact, countries do not need a full range of economic reforms to get growth started (Rodrik, 2007). But once started, the policy challenge is to sustain it in the long-run. OECD research shows that capital, including infrastructure, is a necessary but not sufficient condition for long-run economic growth. Infrastructure provision is an important part of policymaking and often government officials opt to provide it as it is needed to connect communities and people, to enable activities or simply to save lives; it is also thought as an element that triggers long-run growth. While it is possible that short to medium-term growth spurts are possible with a strategy based on building infrastructure, the truth is that to get a long-term positive effect out of infrastructure, the economy requires other key elements in place. And if such spurt does take place, the effect of infrastructure on growth wanes over time (OECD, 2009b). It is also possible that by providing transport infrastructure to connect places, capital would find it easier and more efficient to concentrate in one or few places and ship production through the new transport system that reduces costs. This

'leaking by linking' effect should not discourage governments from providing better transport infrastructure and connecting communities. The idea is that governments should not only focus on that. For a regional economy to grow, human capital development is also crucial. By providing people with skills new jobs are possible and businesses can be attracted or developed locally. However, if governments only pursue skills development, sooner or later skills would migrate, leading to a brain drain. For these two factors to work positively in the regional economy, an adequate business environment and in particular, innovation is paramount (OECD, 2009c).

Investment

One of the most important applications of public investment is infrastructure provision. Infrastructure building can have short-term impacts through hiring of construction workers and demand for raw materials which has been proven to have strong multiplier effects in the economy. Medium to long-term economic growth can be also positively influenced by the efficiencies that new infrastructure can provide e.g. a road that reduces times or transport costs, or the new markets they can open. Despite long-run growth requires infrastructure to be in place, it is always a necessary but not sufficient condition for growth.

Chihuahua's public investment is lagging behind other states in Mexico. Although Chihuahua's public investment has been growing fast since 2005, it is lagging behind those being made elsewhere in Mexico. Chihuahua invested more than MXN 7.5 billion in 2009, the 10th largest investment effort made by a Mexican state that year (INEGI, 2011a). On average allocations to investment projects and assets in the state have been growing at 12.6% every year since 2005 (Figure 1.14). Yet that is not enough to keep to growth in gross fixed capital accumulation at almost 15% that on average Mexican states make. Nor is it enough to match other northern states such as Coahuila (23.8%) or Tamaulipas (26.6%). Having said that, Chihuahua is investing much more than the leading northern state of Nuevo León (3.8%).

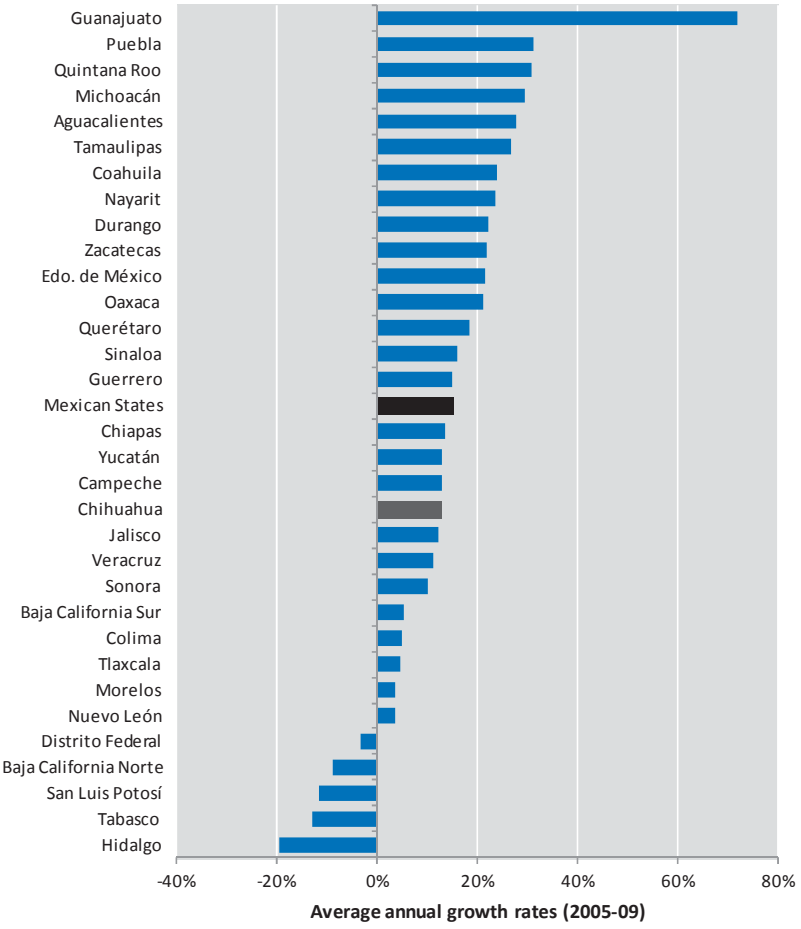
The state and municipal governments have certain capacity to determine infrastructure expenditures that has not been fully exploited to make the most of them to foster growth. According to the sixth and last *Informe de Gobierno* (the regional State of the Union Address) of former Governor Reyes Baeza, MXN 9.8 billion were programmed to be invested during 2010. Almost half of those resources were own, 4.4% coming from federal sources and over one-third being municipal. That is, five out of every six Mexican pesos in public investment were regional or local funds. Although, as will be explored in Chapter 3, a sizable share of those regional and local funds are earmarked transfers from the Federal level, there is certain self-determining capacity of infrastructure projects that may be underutilised. Resources for infrastructure have been underutilised as they are not targeting economic activities.

Chihuahua's public investment growth may have led to better infrastructure, but have not been targeting economic activities. Nearly one-quarter of that investment went to transport and communication projects such as over 200 kms. of motorways and rural roads, as well as improvements to existing motorways, telecommunication stations, completing regional airports and building bridges. The former administration (that ended in October 2010) built 1 138 kms of roads. In 2010, the state government spent more than three times more on urban infrastructure than on building motorways. Chiefly those investments were targeting Juárez and to a lesser extent Chihuahua. Aqueducts, wells and water system maintenance as well as sanitation absorbed MXN 1.7 billion which

represents 17% of all investment in the state. The government spent also that year: MXN 917 million on education and MXN 591 million on security. However, municipalities have spent less in infrastructure (public works) than the national average for municipalities (Figure 1.15). Rural development was a priority concentrating 8% of total investment (Chihuahua State Government, 2010). The new state government headed by Governor César Duarte, has set the commitment with neighbouring states to connect Chihuahua to the wider region through the *Plan Maestro de Infraestructura y Desarrollo Económico Regional del Norte* (Northern Master Plan for Infrastructure and Regional Economic Development). Governor Duarte has also set goals for infrastructure on health and education (Duarte, 2011).

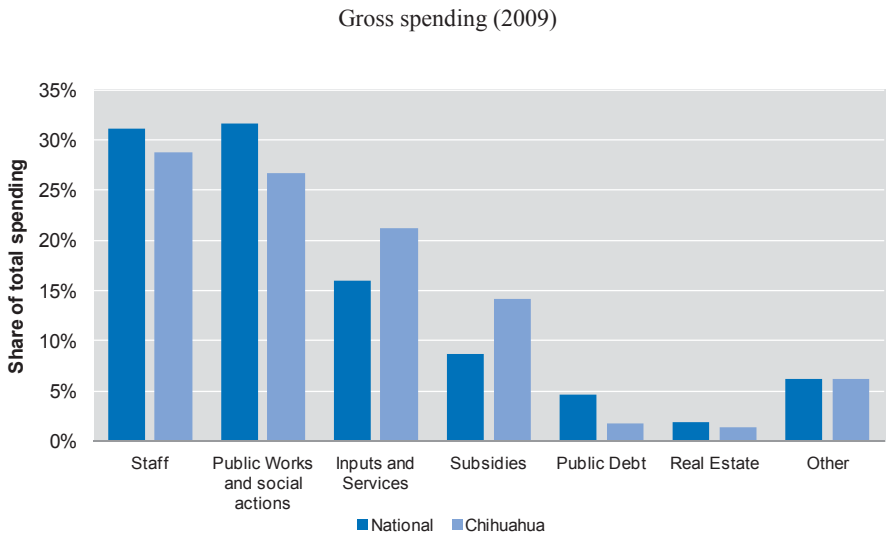
Figure 1.14. **Public investment by Mexican states**

Average annual growth rates for grossed fixed capital formation (2005-09)



Source: Author's calculations based on INEGI (2011) *Gobiernos Estatales y Acumulación de Capital y Cuentas de Producción por Finalidad 2005-09*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

Figure 1.15. **Public expenditure by municipalities in Chihuahua and Mexico**



Source: Author's calculations based on INEGI (2005) Sistema Estatal y Municipal de Bases de Datos (SIMBAD), accessed online at *http://sc.inegi.org.mx/sistemas/cobdem/* on June 15th 2011, Instituto Nacional de Estadística, Geografía e Informática, Mexico.

Chihuahua has experienced solid investment growth rates even during a crisis period. Overall, private investment as measured by total fixed assets grew by an average of 12.6% annually from 2003 to 2008 (Table 1.2). Despite the financial crisis, most sectors still experience some growth. Growth rates for agriculture and other primary activities were solid at 41% average annual growth (Table 1.2). Investment grew also fast in mining at an average annual growth rate of 34%. Investment in all other sectors ranged from average rates between 5 and 15% annually, except for real estate that declined by 12% annually. It is possible that primary-sector activities were modernising during the period. The fact that real estate was the only sector to see its assets contract, may signal the effect of the financial crisis.

However, assets are still heavily concentrated in a few sectors and clear opportunities emerge. Investment grew faster in sectors that had the lowest investment levels following a convergence trend (left-hand side in Figure 1.16). However, only two sectors in Chihuahua's economy concentrate nearly two-thirds of the state's assets: electricity, water and gas (35%) and manufacturing (30%). Investment shares follow a power law (right-hand side in Figure 1.16), which has important implications for policymaking. If investment can spur growth, but the former is heavily biased by a few sectors, easing investment in low-share sectors is an opportunity that can reduce overall risk in the economy by diversifying and can boost investment levels by paying attention to missing opportunities. One such opportunity lies in agriculture, cattle raising, forestry and fisheries. Although the sector had the strongest assets' growth between 2003 and 2008, it also had the second lowest share of total assets with only 0.04%. Given Chihuahua's natural advantages to grow a number of crops, particularly perennial, and for cattle-raising and forestry, the sector is but one example in which Chihuahua can focus to foster investment and growth. It is also a sector that can help bridge the gaps between urban and rural areas in terms of employment and income.

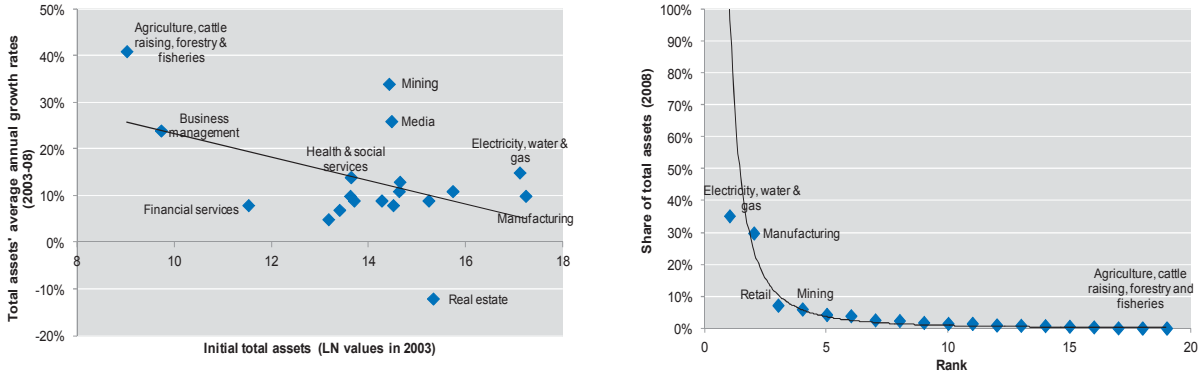
Table 1.2. **Private investment in Chihuahua by sector**

Total fixed assets (2004 and 2009)

Sector	Gross fixed assets MXN 000s at constant prices of 2000 2003	2008	Real average annual growth rates % (2003-08)	Share of total assets % (2008)
Agriculture, cattle raising, forestry and fisheries	8 332	64 341	41%	0.04%
Mining	1 841 990	10 017 897	34%	6.0%
Electricity, water and gas	27 181 812	58 933 508	15%	35.2%
Construction	2 008 806	2 978 742	8%	1.8%
Manufacturing	30 711 106	49 912 311	10%	29.8%
Wholesale	2 301 628	4 406 988	13%	2.6%
Retail	6 837 212	12 018 948	11%	7.2%
Transport	4 160 767	6 506 585	9%	3.9%
Media	1 936 774	7 237 238	26%	4.3%
Financial services	101 889	153 460	8%	0.1%
Real estate	4 566 858	2 498 643	-12%	1.5%
Professional services	664 605	953 699	7%	0.6%
Business management	16 880	56 356	24%	0.03%
Business services	529 238	673 856	5%	0.4%
Education	897 076	1 424 620	9%	0.9%
Health and social services	840 423	1 655 872	14%	1.0%
Cultural, sports and recreational services	828 002	1 398 143	10%	0.8%
Accommodation and catering	2 263 503	3 949 271	11%	2.4%
Other services	1 583 961	2 516 499	9%	1.5%
TOTAL	89 280 862	167 356 975	12.6%	100%

Source: Author's calculations based on INEGI (2005), *Sistema Estatal y Municipal de Bases de Datos (SIMBAD)*, Instituto Nacional de Estadística, Geografía e Informática, *http://sc.inegi.org.mx/sistemas/cobdem/,* accessed 15 June 2011; and INEGI (2007), *Censo Ejidal 2007*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

Figure 1.16. **Sectoral investment growth and shares**



Note: Shares and growth rates were calculated using fixed total assets by sector in Chihuahua on the basis of Economic Census.

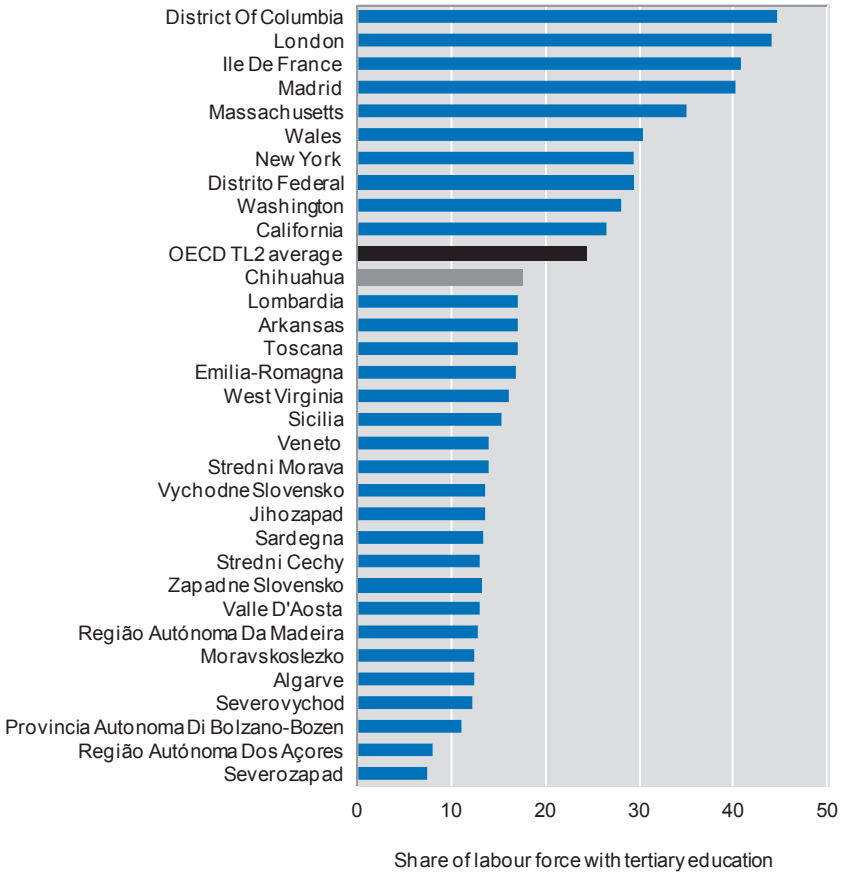
Source: Author's calculations based on data from: INEGI (2004) *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; and INEGI (2010a) *Censos Económicos 2009*; Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

Human capital

Educational attainment in the state is lagging, not only by OECD, but also by Mexican standards. Educational attainment, as measured by the proportion of the labour force with tertiary education, in Chihuahua stood in 2008 at 14.2%, ten percentage points below the OECD average of TL2 regions (Figure 1.17) and slightly lower than the Mexican average for states of 14.7% (Figure 1.18). Skills are important enablers of technology adoption in firms and thereby needed to sustain productivity growth. Skills have an important spatial condition that magnifies their effect more than proportionally. Urban areas become more productive through agglomeration economies and one of the crucial micro-elements of these agglomeration economies is learning through knowledge generation, diffusion and accumulation (Duranton and Puga, 2004). Declining labour productivity since 2004 could be reversed by not only further increasing the quality of education, but also by making it more available to the population thereby increasing economic growth and addressing social inequality.

Figure 1.17. **Skills in selected OECD TL2 regions**

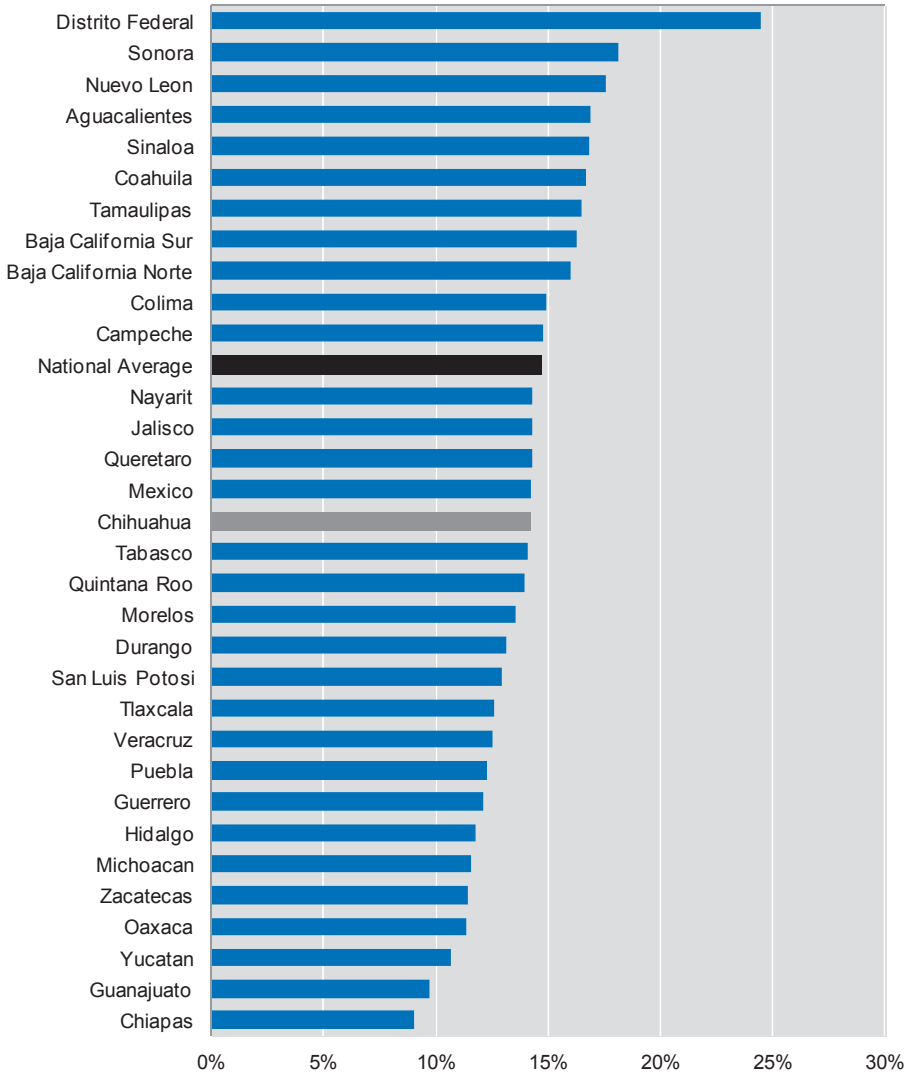
Proportion of the labour force with tertiary education (2008)



Source: OECD (2011), *Regional Database,* accessed online at OECD.Stat on 22 June 2011.

Figure 1.18. **Educational attainment in Mexican states**

Percent of labour force with tertiary education (2007)



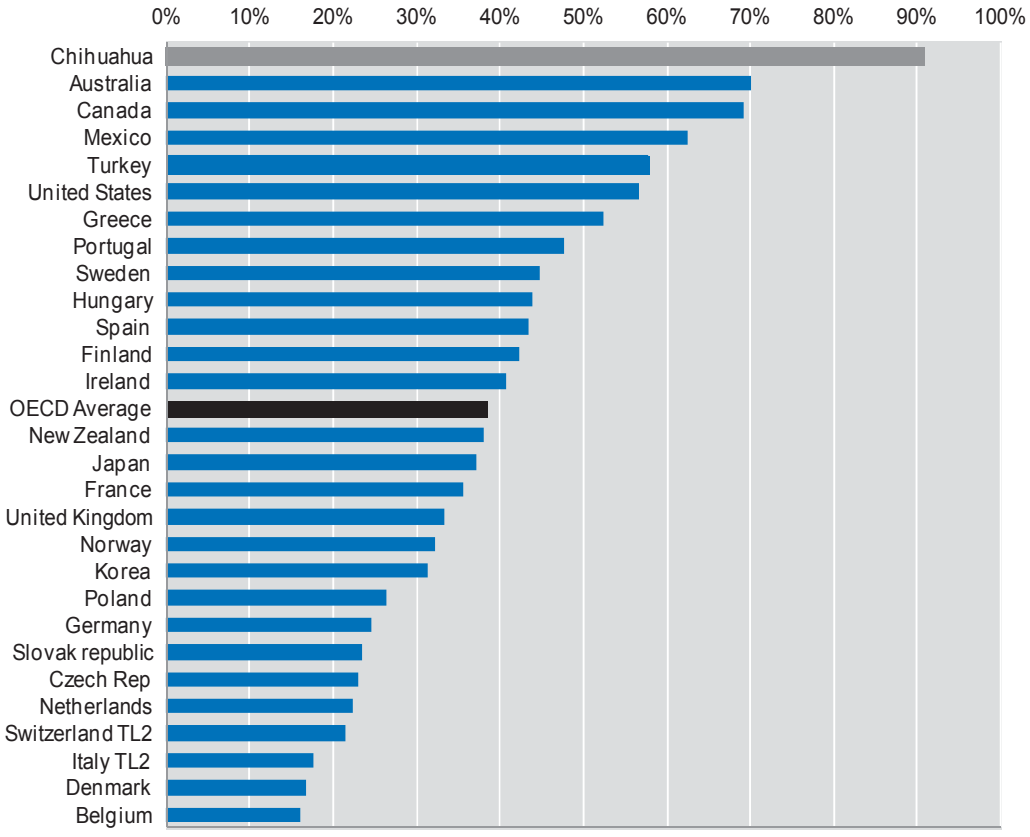
Source: OECD (2011), *Regional Database*, accessed online at OECD.Stat on 22 June 2011.

Skills in Chihuahua are not only relatively scarce, but they are highly concentrated in a few municipalities. Knowledge has been historically concentrated in few places as knowledge production and application are place and societal-specific and cannot be produced nor applied everywhere (Meusburger, 2000). Concentrating skills can have positive effects as demand for highly skilled workers is greater in areas that because of their size enable production and consumption externalities and allows firms in these places to pay wage premiums. Human capital externalities in the form of knowledge spillovers are a driving force for wage premiums being paid in urban areas where skills are concentrated (Halfdanarson, Heuermann and Südekum, 2008). Human capital externalities increase also the efficiency of the labour market by improving job-skills matching (Heuermann, 2009). In fact, because in reality markets are imperfect, activities tend to concentrate as space is heterogeneous (no place is the same) and concentration

brings about positive externalities not only for production, but also for consumption (Fujita and Thisse, 2000). The downside to this natural tendency is that with concentration of knowledge, typically economic disparities are either created or reinforced. Taking into account OECD TL3 level data (groups of municipalities in the case of Mexico), no OECD country – including Mexico – display a higher concentration than Chihuahua. Over 90% of Chihuahua's university graduates are located in 10% of its municipalities (i.e. Chihuahua City, Juárez, Delicias, Parral, Cuauhtémoc and Nuevo Casas Grandes), higher than the 38.2% for the OECD average (Figure 1.19). Skills often tend to agglomerate as they are attracted by higher returns in high productivity places i.e. cities. However, high-return countries driven by innovation such as Finland, South Korea and Sweden display an even lower concentration of skills.

Figure 1.19. **Concentration of skills in the OECD and Chihuahua**

Concentration of population with a university degree in 10% of the regions



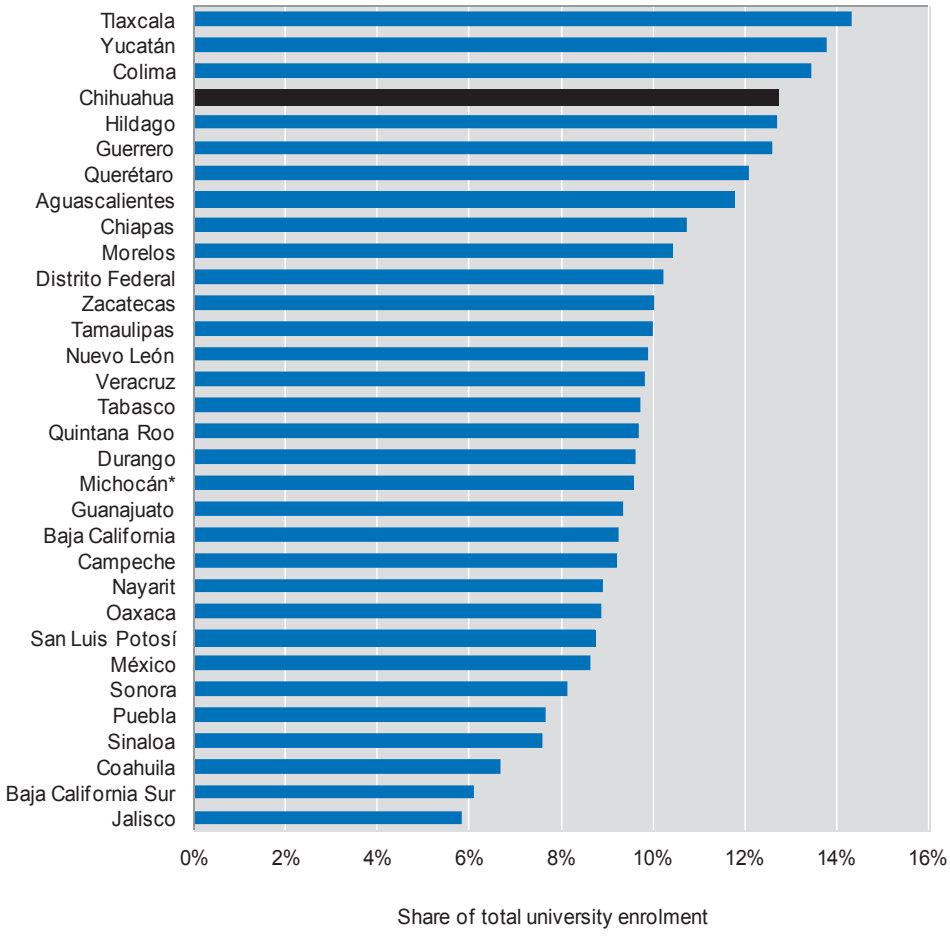
Source: OECD (2009) *Regions at a Glance*, OECD Publishing, Paris; and INEGI (2005) *Sistema Estatal y Municipal de Bases de Datos (SIMBAD)*, *http://sc.inegi.org.mx/sistemas/cobdem/,* 15 June 2011, *Instituto Nacional de Estadística, Geografía e Informática*, Mexico.

Chihuahua's education system seems to be relatively more effective than that of most Mexican states, although the average is poor. As a percent of total university enrolment, Chihuahua graduates 12.7% of its students (Figure 1.20). Only Tlaxcala, Yucatán and Colima had higher outturns than Chihuahua in 2010. Still, failure to complete higher

studies requires attention given that more than 87% of students enrolled for a college degree do not actually conclude. In fact, high dropout rates are an endemic problem in the Chihuahua educational system. In basic education, the state has the sixth largest drop-out rate with 12.3% of students not concluding primary instruction compared to the average for Mexican states at 8.6% (Figure 1.21). Only in Sinaloa and in some of the poorest states in the country such as Chiapas, Guerrero, Michoacán and Oaxaca are dropout rates higher.

Figure 1.20. **Degrees awarded by Mexican universities by state**

Percent of total university enrolment (2007-08)



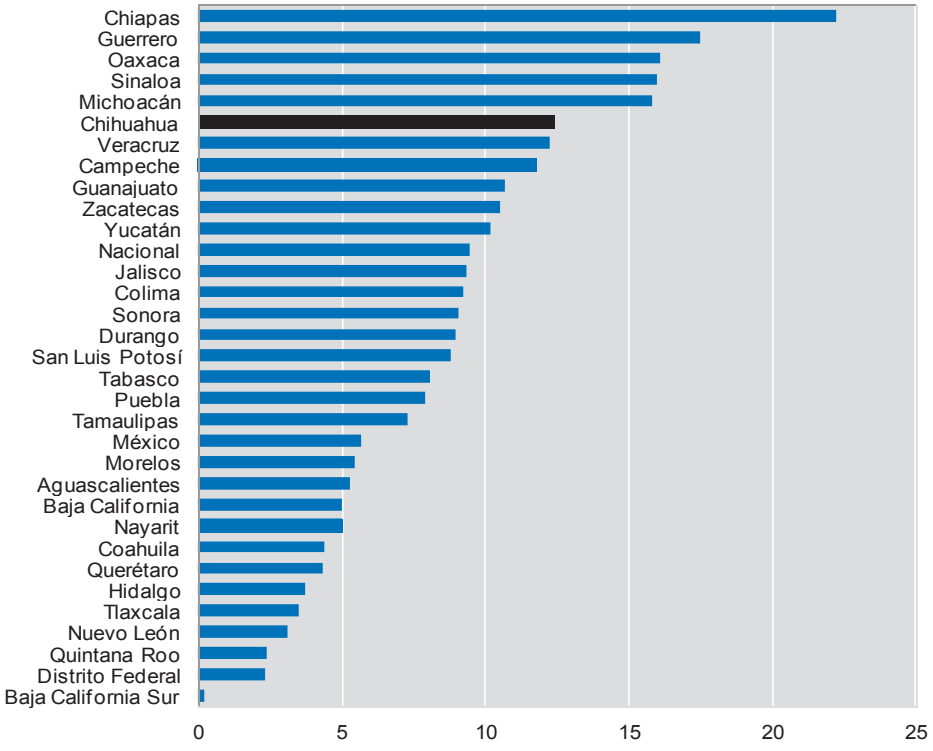
Source: ANUIES (2010), *Estadísticas de Educación Superior*, Asociación Nacional de Universidades e Instituciones de Educación Superior, *http://www.anuies.mx/servicios/e_educacion/index2.php*, accessed 6 July 2011.

Lower-than-average educational attainment rates reflect poor performance in most Chihuahuan municipalities. As a percent of total population – different from the proportion to labour force – Chihuahua City based on the municipality of the same name has the highest rate of tertiary education attainment. Thus, 12.7% of total population in the municipality of Chihuahua has a university degree, which is significantly above the

state's average (7.5%) (Figure 1.22). Other municipalities with above average trends are Delicias (8.7%) and Parral (8.5%). Juárez (7.3%), the largest population centre in the state and one of the largest cities in the country, falls short of the average. Out of the 67 municipalities in the state, 56 show rates lower than 5%. The fact that urban areas display higher educational attainment rates, is related to the wage premium more productive activities in urban areas are able to offer to high skilled workers, resulting in the attraction of that type of skills.

Figure 1.21. **Basic education among Mexican states**

Total dropouts as percent of total enrolment in primary education (2006/2007)

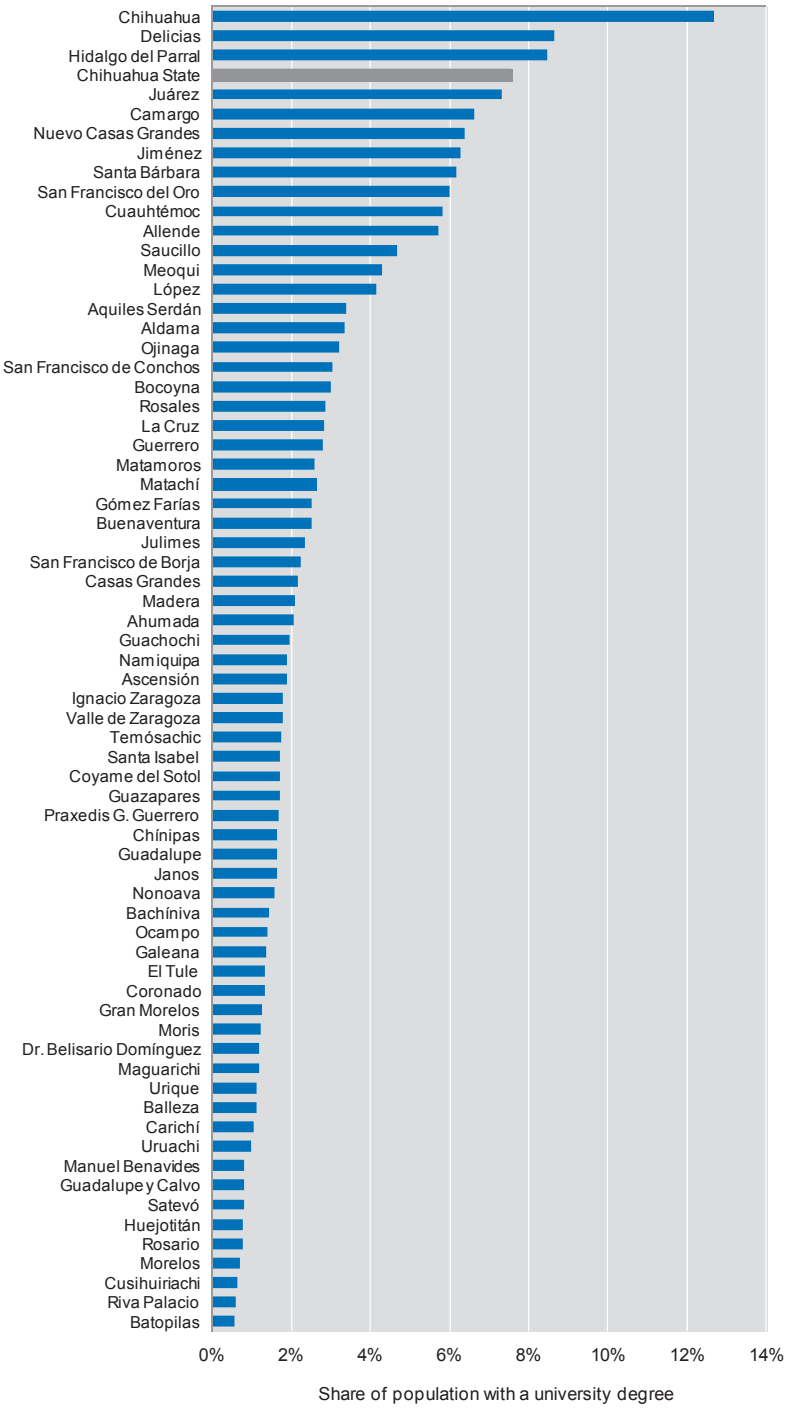


Source: INEE (2008), *Estadísticas Continuas del Formato 9111*, Secretaría de Educación Pública and Instituto Nacional para la Educación Educativa. Mexico.

Chihuahua places an important emphasis on skills demanded in manufacturing. Forty percent of total university enrolment chooses an engineering or technology degree, higher than the 33.7% for the nation (Figure 1.23). Social sciences and management still account for the highest share (41.4%) even if lower than the average for the nation. More worryingly for innovation is the fact that natural sciences or math degrees account for less than 1% of the total.

Figure 1.22. **Skills in Chihuahua by municipality**

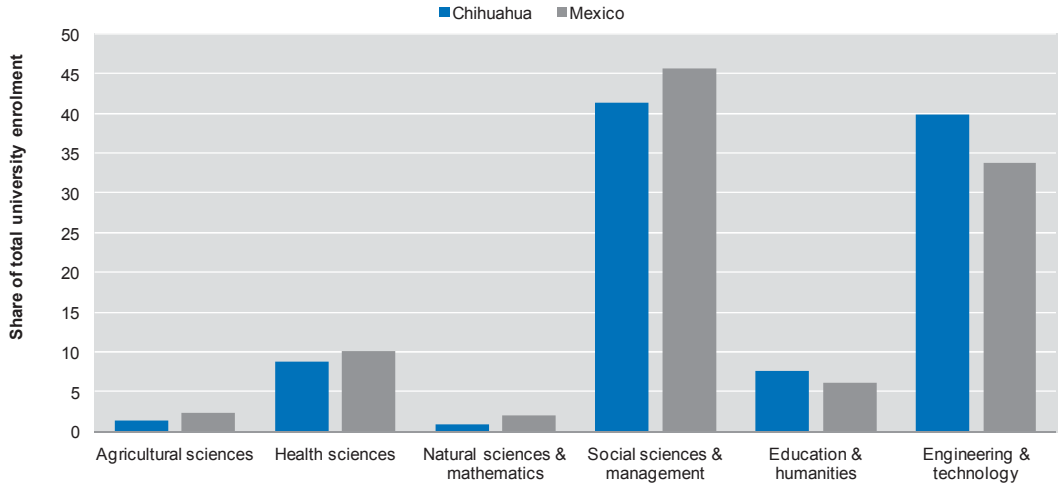
Population with a university degree as a percent of total population (2005)



Source: INEGI (2005) *Sistema Estatal y Municipal de Bases de Datos (SIMBAD)*, Instituto Nacional de Estadística, Geografía e Informática, Mexico, *http://sc.inegi.org.mx/sistemas/cobdem/*, accessed 15 June 2011.

Figure 1.23. **University enrolment in Mexico and Chihuahua by field of study**

Percent of total university enrolment (2007-08)

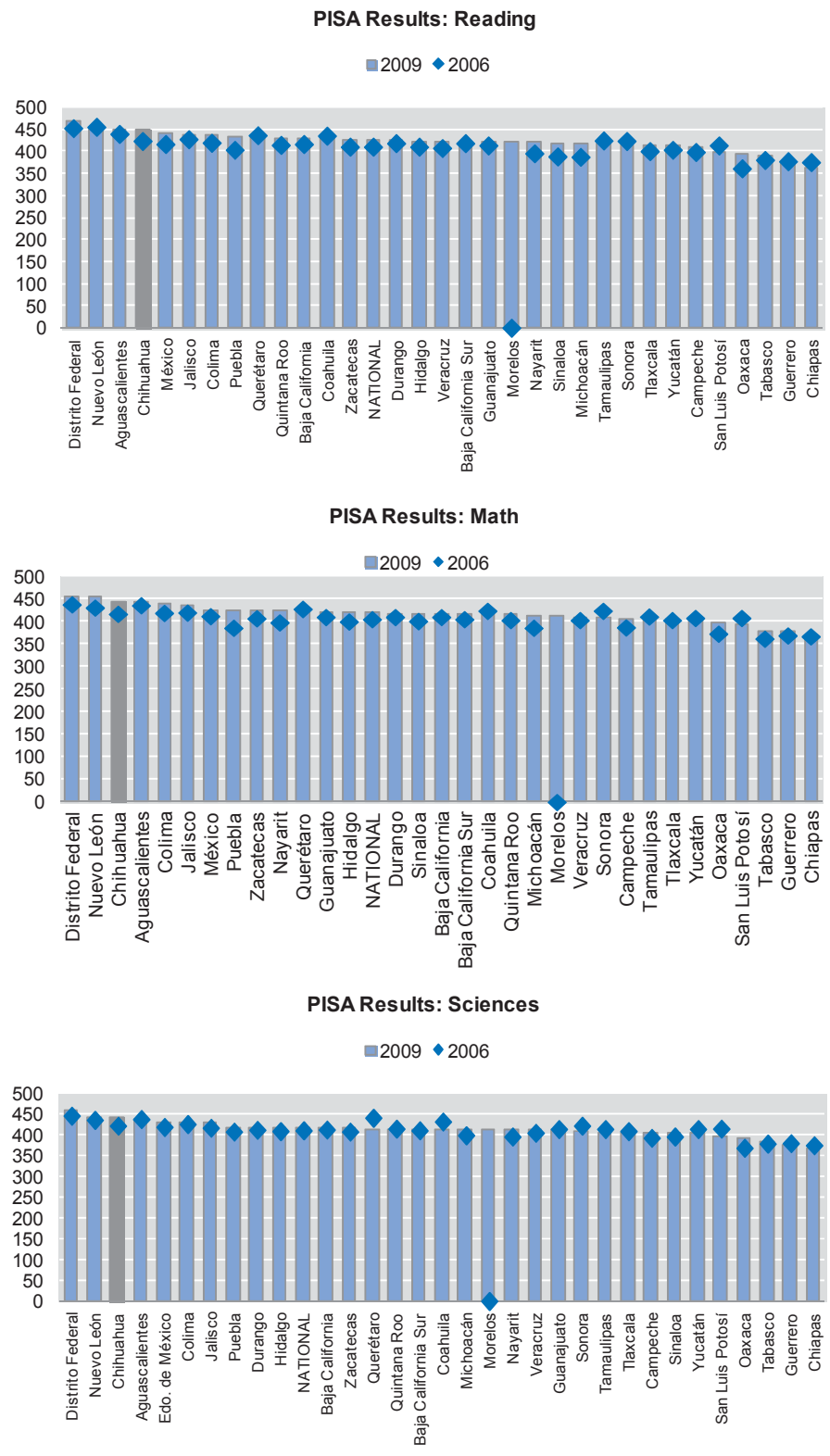


Source: ANUIES (2010), *Estadísticas de Educación Superior*, Asociación Nacional de Universidades e Instituciones de Educación Superior, Mexico, *http://www.anuies.mx/servicios/e_educacion/index2.php,* accessed 6 July 2011.

A key asset for the region is the high quality of schooling. It is not only important to raise the number of graduates, but also to improve the quality of schooling, where some progress has been made. Chihuahua has taken strides at improving the quality of schooling. When secondary schooling students are tested for their abilities on reading, math and sciences through the PISA examination, Chihuahua comes among the top performers in the country. In reading Chihuahua scored 423 points which made it tenth in the country in 2006, three years later, the state moved to third place scoring 449 (tied with Aguascalientes and barely one point behind second place Nuevo León) (Figure 1.24). The trend is even better for math, the scores for which the 2006 PISA results put Chihuahua in tenth place with 418 points; the 2009 PISA results showed Chihuahua in second place behind DF and Nuevo León (tied for first place). In sciences, Chihuahua was eighth in 2006 and climbed to third place by 2009, trailing Nuevo León (second place) by one point.

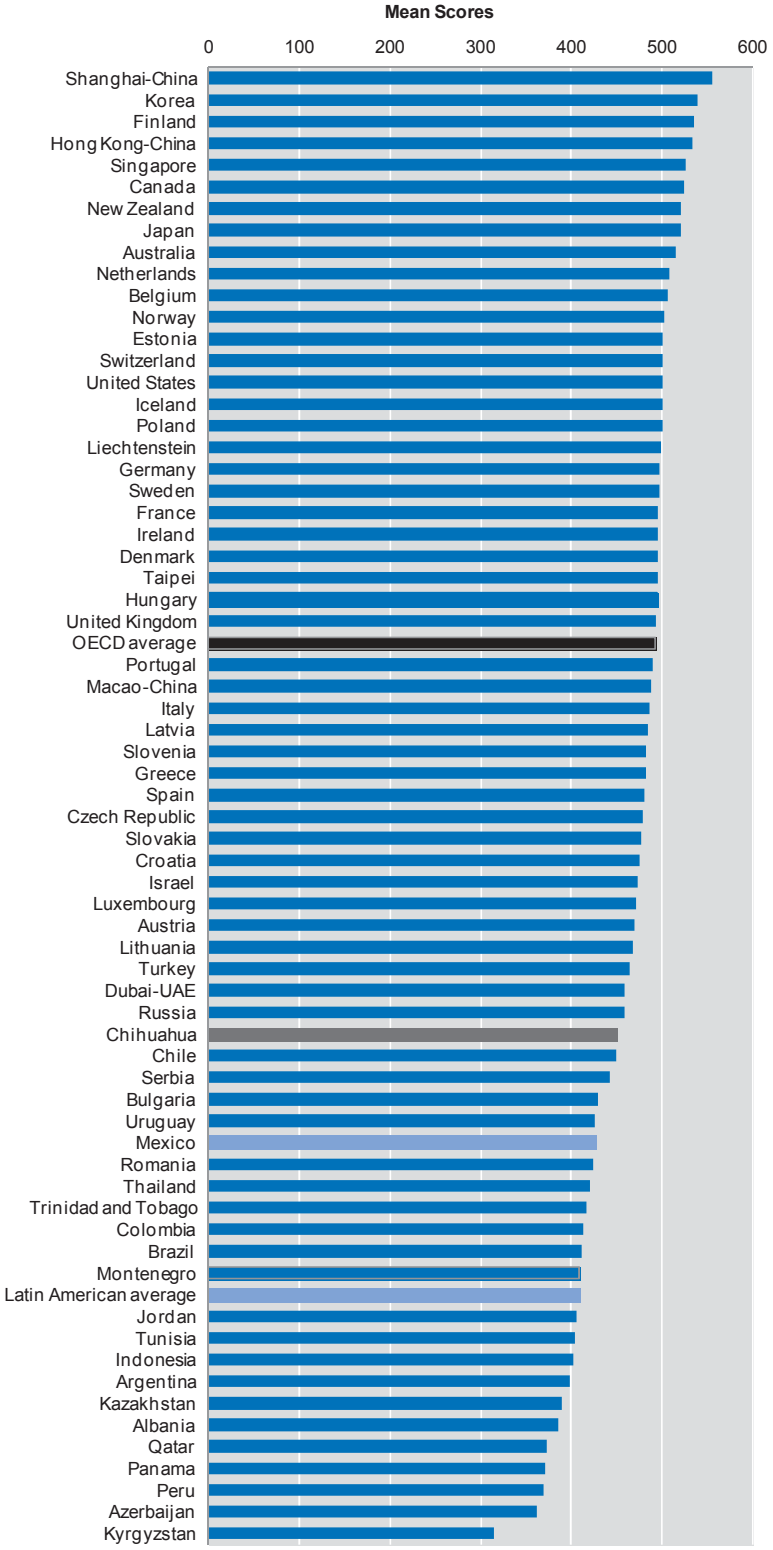
However, Chihuahua is at the top of a low-performing country and therefore is at a disadvantage compared to most competing countries. Even though Chihuahua scores higher than Mexico, it comes consistently well below the OECD average in all three PISA tests. Mexico's students show reading competences (425 points) which are above the Latin American average (408 points). However, Mexico's ranking is in the range of those for Thailand (421 points), Romania (424 points), Uruguay (426 points) and Bulgaria (429 points) (Figure 1.25). The OECD average lies far higher than Mexico's score at 493 points. Results are very similar for the math and sciences tests. In reading skills, Chihuahua outstrips Mexico's results with the same score as Chile and close to the results in Russia, Dubai and Turkey.

Figure 1.24. **Quality of schooling in Mexican states: the PISA test**



Source: INEE (2011) *México en PISA, 2009*, Instituto Nacional para la Evaluación de la Educación, Mexico.

Figure 1.25. **PISA results, 2009**



Source: INEE (2011), *México en PISA, 2009*, Instituto Nacional para la Evaluación de la Educación, Mexico.

Innovation and business environment

Innovation[8] is clearly recognised as the driver of economic growth and a key element that fosters progress in developing regions. A growing body of literature acknowledges the role of innovation as the only factor that allows long-run growth in the presence of decreasing returns to scale (Barro and Sala-i-Martin, 1995; Aghion and Howitt, 1998). That is, as the marginal contribution of capital and labour to economic growth diminishes over time, the only way of expanding the value of output is via innovation. Both the OECD and the European Union (EU) have recently emphasised the crucial role of innovation and the importance of appropriate institutions, policies and governance to support it (OECD, 2010a; European Commission, 2009). Technology and innovation are typically characterised by increasing returns to knowledge adoption and diffusion (Box 1.3). And knowledge has characteristics as both a private as well as public good. It is the differences in knowledge, accumulated learning processes and technical competences (either embodied, in a skilled labour force, in firms or in collective systems, or disembodied, codified in patents, or acquired through external R&D services and technical assistance), that explain the major differences in growth patterns and living standards of different countries and regions (OECD, 2011g).

The 2008 financial and economic crisis reinforced the consensus that innovation, as well as investment in the capacity to innovate, is central for recovery and other social goals. There is greater recognition of the need to move towards new, more inclusive and environmentally sustainable models of growth. It is not only the rate of technical change (i.e. intensifying the introduction of new technologies and devices) but also its direction (in applications and solutions) that can help address societal challenges (OECD, 2011c).

It is well established that innovative activity is not evenly distributed across regions. Evidence shows that almost half of total OECD research and development (R&D) investment is performed in around 13% of its regions, and half of patenting in the top 20%. In addition, OECD growth is concentrated in a handful of large regions. The top 4% of OECD regions accounted for one-third of aggregate OECD growth during 1995-2005. Two-thirds of growth is from the remaining 96% of regions. Improving innovation capacity outside of global hubs, beyond technological R&D support, is therefore vital (Box 1.4).

Despite the progress Chihuahua has made on both attainment and quality of schooling, the state is lagging behind not only most OECD regions, but also many Mexican states in inputs for innovation. Chihuahua comes 17th among Mexican states in its share of high-calibre researchers. Only 1.2% of all researchers inscribed in the *Sistema Nacional de Investigadores* (SNI), were located in the state in 2010 (Figure 1.26).[9] The proportion is the second lowest among states bordering the US and is almost one-third of the proportion in Nuevo León. As a result the local supply of innovation inputs is curtailed by a low level of human capital relevant to the production of R&D. Not surprisingly, Chihuahua produces an extremely low level of patents: one patent application annually per million of inhabitants (Figure 1.27). Such a low level places Chihuahua 11th in the country behind states like Yucatán, Morelos or Baja California Sur that have a lower level of economic development and are also behind the Mexican average. At an average of almost 99 patents per million of inhabitants in other TL2 regions in the OECD, Chihuahua stands very far from developing inputs for innovation that are crucial for economic growth.

Box 1.3. **The meaning of innovation**

The term innovation is used to describe many different phenomena, from scientific discoveries to simply "thinking outside of the box" through creativity and design. The OECD identifies four types of innovation in firms: the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. Such innovations are technological (product or process), as well as non-technological (marketing and organisational). Note that an innovation may have different degrees of novelty. It does not have to be new to the world; it may be new to a market/sector or simply new to the firm/institution. The OECD is considering extending guidelines for innovation measurement to public sector innovation and innovation for social goals.

The latest data on innovation reveals several trends that the tri-state region should bear in mind for policy action:

- ***Intangible assets and innovation beyond R&D:*** innovation results from a range of complementary assets beyond R&D, such as software, human capital and new organisational structures. Investments in these intangible assets is rising and overtaking investment in physical capital (machinery and equipment) in Finland, Sweden and the United States for example.

- ***Mixed modes of innovation:*** firm-level innovation data reveal complementary strategies. Most innovative firms introduce both product and process innovations, as well as marketing or organisational innovations. This is true for firms in both manufacturing and services. There are, of course, differences by sector and firm size. For instance, a larger share of firms in services than in manufacturing introduce only marketing or organisational innovation.

- ***Collaboration and networks are essential:*** firms that collaborate on innovation spend more on innovation than those that do not. This suggests that collaboration is likely to be undertaken to extend the scope of a project or to complement firms' competences more than to save on costs. Collaboration is used in innovation processes whether firms perform a lot of R&D, a little R&D or no R&D at all. In this respect, policies that stimulate collaboration and network initiatives will have an impact on the entire spectrum of innovative firms. Higher rates of collaboration are also observed in the sciences. Production of scientific knowledge is increasingly shifting from individuals to groups, from single to multiple institutions, and from national to international arenas.

- ***Convergence of scientific fields and multi-disciplinary/interdisciplinary research:*** there is evidence that increasingly innovations are achieved through the convergence of scientific fields and technologies. For example, nanoscience research has arisen from the interaction of physics and chemistry and is interdisciplinary in character. Environmental research is one example of multi-disciplinary research. This convergence requires spaces for interaction and cross-fertilisation of different knowledge domains.

Source: OECD (2010), Ministerial report on the OECD Innovation Strategy: Innovation to strengthen growth and address global and social challenges: Key Findings, OECD Publishing, Paris; OECD and Eurostat (2005), Oslo Manual – Guidelines for Collecting and Interpreting Innovation Data, OECD Publishing, Paris; OECD (2010), Measuring Innovation: A New Perspective, OECD Publishing, Paris.

Box 1.4. **Innovation's spatial dimension**

The level of innovation in a country is influenced by the generation and diffusion of new technology and knowledge, which is in turn a function of investment in basic and applied R&D, the technology transfer effort made by the government (and others) and the success of the education system in producing science and engineering graduates. The absorptive capacity of firms is also crucial for innovative ideas to be translated into productivity gains by firms that are not themselves technology generators. Absorptive capacity, in turn, is closely linked to the level of technical and general education of the workforce, as well as cultural traits relating to entrepreneurship and inter-firm collaboration.

Technology and innovation are not usually created in isolated organisations but, rather, where competent organisations and skilled individuals interact in a constructive and complementary way. First, innovation depends on the scientific capacity of actors and institutions (their ability to acquire existing knowledge and concepts, their openness to new knowledge and their ability to assimilate, etc.). But the technological and entrepreneurial capacity of actors (their capacity to perceive usefulness and applicability of knowledge) is also important. And, finally, industrial capacity plays a role (the capacity of actors to transform concepts and ideas into useful, commercially viable products). The focus of policymakers on the concept of innovation "systems" is an example of how the issue of spillovers and inter-linkages is now central to understanding how innovation is generated. The application of concepts of social capital to innovation is another example.

In this context, the importance of place (innovation's spatial dimension) becomes clear. The idea that productivity gains are generated on the back of region-level interaction is supported by a large body of literature. Research into the sources of productivity advantages in successful regions has focused principally on the circulation of people and knowledge, the generation of innovative ideas and the development of new products and technologies. In the past, academic work considered knowledge as a public good and technological progress as an exogenous factor to the economic system that affects all companies, regions and countries in the same way. However, more recent "evolutionary" theories have challenged this basic view, recognising that the generation, adoption and diffusion of new technologies is a complex process and therefore endogenous to growth models (Romer, 1990). This change in thinking is visible in the range of public policies in the science and technology field that have developed a strong geographical and relation-building focus into policy strategies.

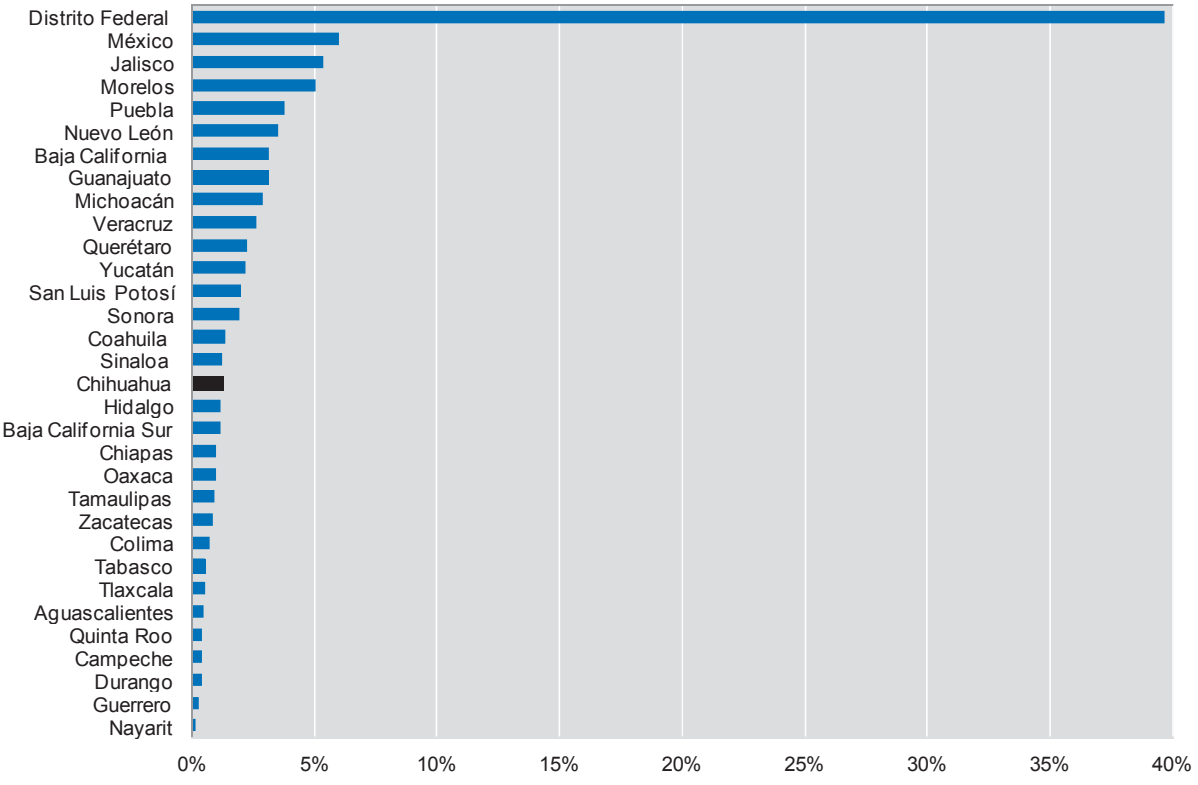
Source: OECD (2008), OECD Reviews of Regional Innovation: North of England, OECD Publishing, Paris.

Skills and knowledge spillovers generated by proximity and human interaction are key to fostering innovation. Intra-national knowledge spillovers are stronger than international ones (Branstetter, 1996). Within nations, regions and more specifically, urban areas are ideal places for innovation to thrive as they bring together people and skills and their interaction produces knowledge spillovers that are essential for greater agglomeration economies (Rosenthal and Strange, 2004). Human capital development produces positive external effects on society through greater productivity (productivity spillovers). On the one hand, individual improvements of human capital increase regional productivity through increases in productivity across workers through learning and sharing (technological externalities). On the other hand, pecuniary externalities can arise due to the complementarities between physical and human capital (Acemoglu, 1996). As a greater accumulation of human capital increases the amount of physical capital, productivity and economic growth tend to increase. The kind of knowledge spillovers that can take place from co-patenting can be inter- or intra-national. In the case of

Mexico, like in many OECD countries, the links in co-authorship for patenting is primarily local, then national and then international. Chihuahua benefits from local and national knowledge spillovers derived from the R&D process through co-patenting. The stronger co-patenting links for Chihuahuan inventors have been located since 1990 in Mexico City and Nuevo León (where Monterrey is located) (Figure 1.28). International links are incipient and mostly focusing on Texas and to a lesser extent other US states such as California, Florida, Massachusetts, Ohio and New Jersey. The only notable European region that is actively co-operating with Chihuahuan inventors is the German region of Bayern. Although face-to-face relationships largely determine knowledge spillovers from R&D in Mexico, the US has a strong influence in determining inventing activity in Mexico and other Latin American countries (Montobbio and Sterzi, 2010). The number of patents and co-patents remains very small compared to neighbouring US states, but in addition to the amount of R&D needed to make any significant contribution to growth, the international scope of knowledge spillovers have been largely overlooked. Being a border region, international spillovers may well mean local spillovers in the case of Chihuahua.

Figure 1.26. **Human capital in science and technology in Mexico by state**

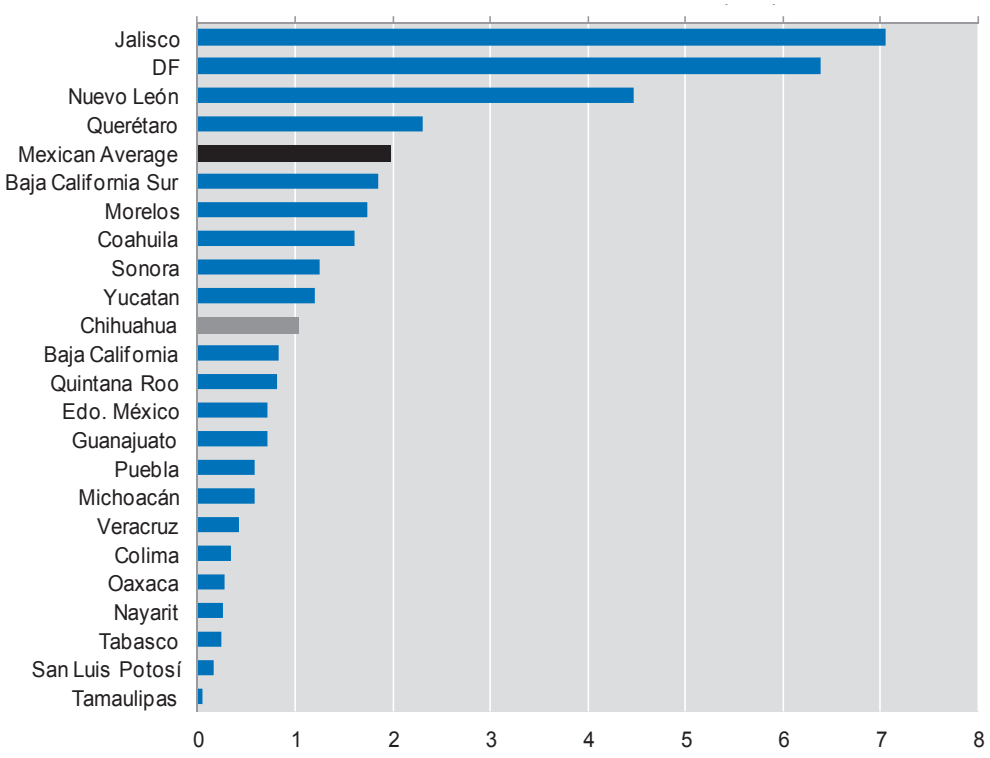
Percent of researchers affiliated to the National Researchers System (2010)



Source: CONACYT (2010), Sistema Nacional de Investigadores, Padron de investigadores vigentes 2009, Consejo Nacional de Ciencia y Tecnología, Mexico.

Figure 1.27. **Patent applications by Mexican states**

PCT patent applications per million inhabitants (2007)



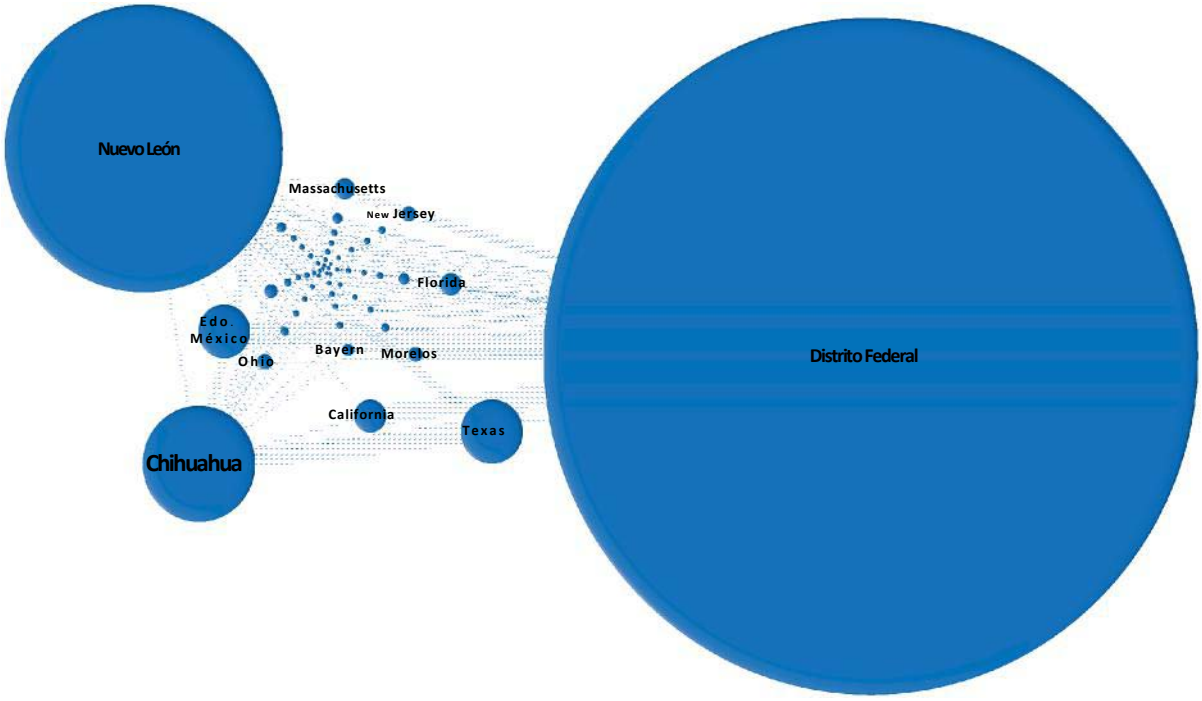
Note: OECD TL2 average (2007) = 98.9 PCT patent applications per million inhabitants.

Source: OECD (2011) *Regional Database*, accessed online at OECD.Stat on 22 June 2011.

FDI has contributed to upgrading Chihuahua's human capital stocks but the need to provide formal schooling remains a challenge. While the benefits of MNE presence for human capital enhancement are commonly accepted, it is equally clear that their importance is significantly less than that of general (public) education. The beneficial effects of training provided by FDI can supplement, but not replace, a generic increase in skill levels. The presence of MNEs may, however, provide a useful demonstration effect, as the demand for skilled labour by these enterprises provides host-country authorities with an early indication of what skills are in demand. The challenge for the authorities is to meet this demand in a timely manner while providing education that is of such general usefulness that it does not implicitly favour specific enterprises. To that effect, the government that took office at the end of 2010 has set the goal of a twofold increase in technological universities and has already managed to offer registration to any student wishing to undertake a university degree (Duarte, 2011).

Figure 1.28. **Chihuahua's links for innovation**

Chihuahua's co-patenting activity with other regions (1990-2009)



1. Co-patenting is defined as a patent with more than one inventor.

2. The width of a bubble represents the number of co-patents.

3. The line connecting bubbles represents the existence of a inter-regional link through co-patenting. The width of such line represents the number of inventors from the Mexican states of Chihuahua, Distrito Federal and Nuevo Leon involved in co-operating activities with other inventors from other regions.

Source: Author's calculations based on the OECD REGPAT Database.

1.3. FDI and clusters

An FDI-based development model: benefits and challenges

Foreign direct investment flows have many benefits that go beyond capital accumulation. FDI is a key component of a well-functioning and open international economic system and a catalyst to development (OECD, 2002a). FDI can bring about several benefits for investment, innovation, skills, internationalisation of production chains, improvement in the business environment, competition, employment and wage improvements. Although these benefits are not automatic and in many cases require certain policies and institutions to be in place in the host country, FDI can be an effective tool for development (Box 1.5). By the same token, a stream of literature has focused on the drawbacks of FDI which can include social polarisation, environmental impacts, destruction of local competitors, as well as the lack of linkages with the local economy and repatriation of profits. The benefits of FDI in terms of economic growth can accrue to host economies through three different channels: capital deepening, technological and knowledge spillovers, and the impact on structural factors. The first of the channels is fairly straightforward as investment leads to augmented capital stocks that lead to productivity and growth. The second of these channels refers to the positive externalities

that are created with the introduction of new technologies and processes. By allowing new technology, local companies can benefit from a technology transfer and the labour force can learn new and more productive ways of doing things which through turnover can lead to learning in other local organisations. The third channel can be related to benefits to the economy when FDI brings about competition and reduces monopolistic behaviour by local firms.

Box 1.5. **FDI effects on developing economies**

The largest proportion of foreign direct investment (FDI) flows in the world is undertaken between developed countries (ECLAC, 2007). This proportion is indicative that FDI is attracted by relatively high skilled labour and strong local institutions. The role of FDI on local economies in developing countries has been more controversial and subject of extensive debates in academic and public policy circles.

In general, the debate about FDI effects on local developing economies focuses on four dimensions: a) local competition; b) prices; c) labour standards; and d) local suppliers. In this respect, it is possible to identify at least three different arguments. On the one hand, it is argued that local markets in developing countries might benefit from the participation of foreign companies as these organisations usually bring superior managerial practices, updated technology and give access to financial resources that might be scarce in the local economy. Due to their superior organisational skills, foreign firms might produce goods and services more efficiently and at lower cost, providing local customers with quality products at lower prices and paying higher salaries to attract local workers. In sum, the impact of foreign corporations on local economies is perceived as an upgrading factor for local competition and labour standards and a strong incentive for local suppliers and better prices and quality products for local consumers (Aspe, 1993).

On the other hand, there is also a more critical perspective on the effect of foreign corporations on local developing economies. In general, this position emphasises the potential problems of asymmetric interactions between large multinational corporations and less powerful local competitors, consumers, workers and institutions. As a result of this, FDI's participation would be less likely to provide substantial benefits in terms of technology or managerial transfers (linkages with local suppliers), upgrading labour standards, or driving down prices for local customers (Cowie, 1999; McMichael, 2004).

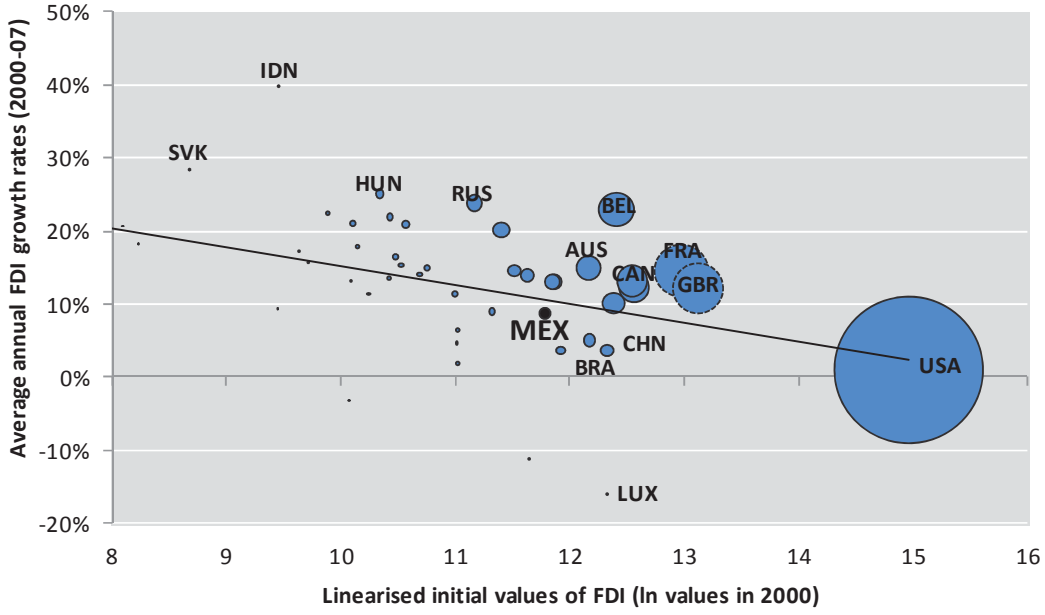
Finally, there is a third or middle point position that argues that the effect of FDI on local developing economies largely depends on the local institutional setting (Álvarez-Galván, 2010). Specifically, it is argued that FDI's potential contribution to improve labour standards, local competition, prices, and bargaining conditions for local suppliers largely depends on how foreign organisations adapt themselves to local institutions. This is to say that FDI might offer substantial contributions to local development if a strong institutional setting is designed to give incentives to such a contribution. To the contrary, if there is no a solid institutional setting, FDI effects on the local economy can be just of minimal benefit (Álvarez-Galván, 2012).

The effects of FDI on local developing economies might be shaped by the aim of the investment either as *efficiency-seeking inward FDI* destination (a type of investment geared towards exports to third markets, especially those of the United States) or a *market-seeking inward FDI*. In 2006, for instance, Mexico received US$18.9 billion of FDI and 38% was invested in services (ECLAC, 2007), a proportion that has been stable over the last few years (about 40%), apart from 2001 when 79% of the FDI in Mexico was spent on services, due to the effect of the acquisition of the Mexican bank Banamex by Citigroup (ECLAC, 2007).

Mexico and Chihuahua have been benefiting from FDI flows but seem to face strong competition. Although by 2000, around 85% of world FDI flows were going to OECD countries, flows going to Mexico have grown at an average annual growth rate of almost 9% since then (Figure 1.29). Mexico's strong FDI growth has nevertheless fallen short of performance in most emerging economies: stronger growth rates between 2000 and 2007 were recorded in Indonesia (40%), the Slovak Republic (29%), Hungary (25%), Russia (24%) and India (23%) among others. Mexico has been lagging behind other OECD countries with already large FDI stocks growing at faster rates: Japan (25%), Belgium (23%), Italy (13%), France (15%) and the UK (12%). Mexico's progress in attracting FDI can be seen in an increase in its share of FDI to GDP. FDI stocks in Mexico went from 15% of GDP in 2000 to almost 27% of GDP in 2007 (Figure 1.30), a share that is comparable to those of Argentina, Colombia or Uruguay. However, the weight of FDI in Mexico is far from those in many OECD countries, where FDI represents between one-third and two-thirds of GDP: Sweden (65%), Denmark (52%), New Zealand (52%), Portugal (51%), France (48%), Austria (44%), the UK (44%), Australia (41%), Spain (41%) and Canada (36%).

Figure 1.29. **Evolution of FDI stocks around the world**

FDI stocks 2000-07

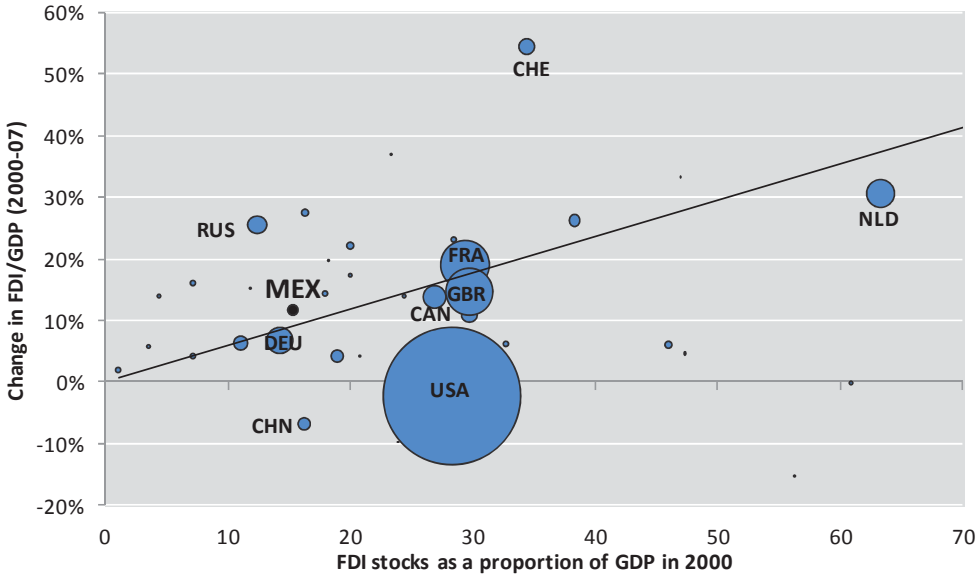


Note: Bubble size represents the stock volume in 2007 for each country.

Source: OECD calculations on the basis of UNCTAD (2011) UNCTADstat.

Figure 1.30. **Relative importance of FDI**

FDI stocks as a proportion of GDP (2000-07)



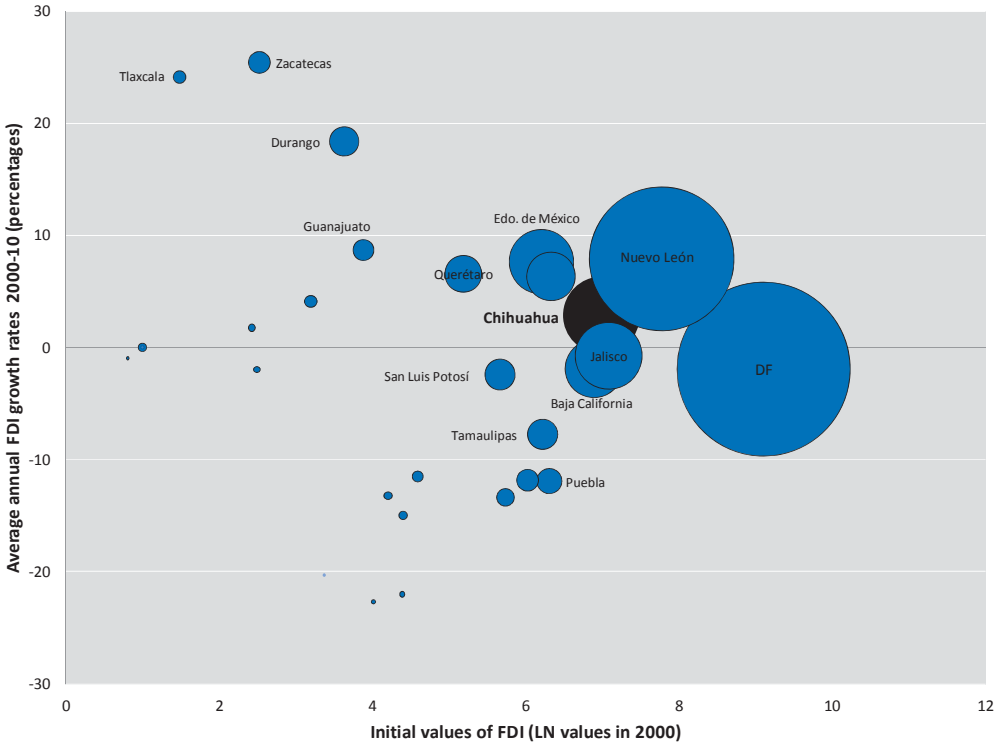
Note: Bubble size represents the stock volume in 2007 for each country.

Source: OECD calculations on the basis of UNCTAD (2011) UNCTADstat.

Chihuahua and other border-states receive the largest share of FDI in Mexico. History matters as more than 80% of *maquiladora* firms remain in border-states where the programme started. Chihuahua contributes with the highest employment figures in the sector. FDI inflows are most important in border-states, DF, Jalisco and the state of Mexico (Figure 1.31). FDI flowing to Chihuahua totalled USD 1.4 billion which placed the state as the third largest recipient in the country just after Mexico City (DF at USD 7.5 billion) and Nuevo León (USD 5.1 billion). However, stronger FDI growth rates were achieved not only in the competing state of Nuevo León (7.9% average annual), but also in non-border states such as Tlaxcala (24%), Zacatecas (25%), Durango (18%), Guanajuato (9%), the state of Mexico (8%) and Querétaro (7%). Mexico City receives the highest share of FDI flows with almost 40% in 2010, but its share could be overestimated due to the fact that the Ministry of Economy in charge of FDI does not necessarily register flows where the actual investment goes, but rather where offices report them. In addition, the financial sector is chiefly based in Mexico City. Despite data issues, the six border-states represented 42% of all flows in 2010 with the remaining 18% distributed in the rest of the country.

Figure 1.31. **Evolution of FDI flows in Mexican states**

Average annual growth rates and initial values (2000-10)



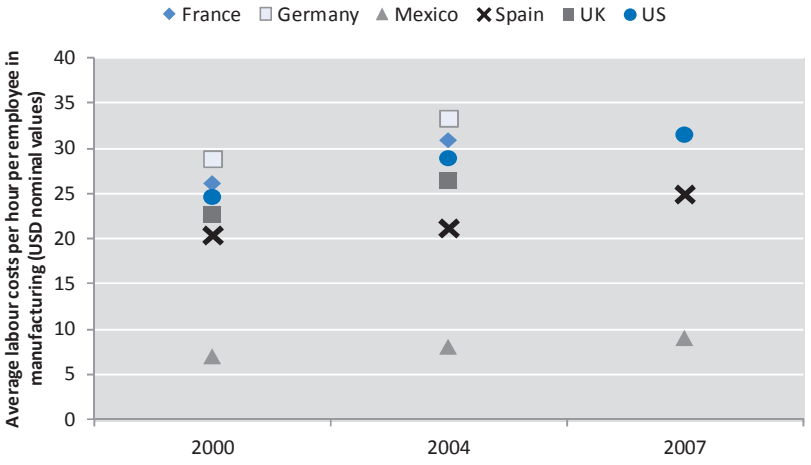
Note: In Mexico, FDI statistics are accounted as the sum of new investments, transactions between firms, and profits re-investment.

Source: Author's calculations based on Secretaría de Economía (2011), *IED Trimestral por País de Origen y Entidad Federativa*, Secretaría de Economía, Dirección General de Inversión Extranjera.

Mexico's attractiveness to FDI is mostly based on its proximity to the US and the relatively lower labour costs, but further progress is curtailed by regulatory restrictions. The attractiveness of the border for manufacturing FDI is based on lower logistics costs due to proximity to the US and lower labour costs. Excluding transport costs, labour costs were reported as the main location determinant for FDI firms until 2003 (Dussel Peters, et al., 2007). Labour costs in Mexico have remained distant from OECD levels. In 2000, manufacturing-sector labour costs stood at an average of USD 7 per hour per employee, which represented around one-quarter of the cost in European countries such as France (USD 26.1), Germany (USD 28.9), Spain (USD 20.4) or the UK (USD 22.7) in that sector. Mexico's average manufacturing labour costs were 28% of the typical US labour costs in that sector (Figure 1.32). The gap has been sustained between Mexico and these countries despite wage increases in Mexico. The country has been experiencing an increase in wages in manufacturing, but such growth is smaller than some of its competitors. Between 2005 and 2008, South Africa's wage increase in manufacturing was almost double that of Mexico (Figure 1.33). Similarly, wages' growth in Costa Rica was approaching three times the speed of increase in Mexico and China's wages increased more than 50% which is more than a fourfold increase compared to that experienced by the manufacturing sector.

Figure 1.32. **Labour costs compared**

Average labour costs per hour and per employee (manufacturing sector in USD nominal values)

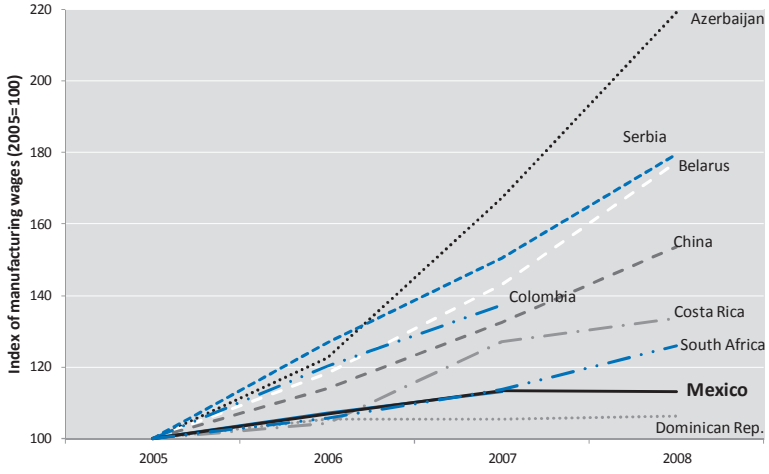


Note: Labour costs are expressed in current nominal USD using ILO labour costs data and the OECD exchange rate series. Labour cost is defined in the Resolution adopted by the Eleventh International Conference of Labour Statisticians (Geneva, 1966): "For the purposes of labour cost statistics, labour cost is the cost incurred by the employer in the employment of labour. The statistical concept of labour cost comprises remuneration for work performed, payments in respect of time paid for but not worked, bonuses and gratuities, the cost of food, drink and other payments in kind, cost of workers' housing borne by employers, employers' social security expenditures, cost to the employer for vocational training, welfare services and miscellaneous items, such as transport of workers, work clothes and recruitment, together with taxes regarded as labour costs" (ILO, 2011).

Source: Author's calculations based on: ILO (2011) *Labour Statistics Database*, http://laborsta.ilo.org/, accessed 7 September 2011, International Labour Organisation; and exchange rates from the OECD reference series at OECD.Stat.

Figure 1.33. **Wage growth in the manufacturing sector**

Index of manufacturing labour costs (2005=100)

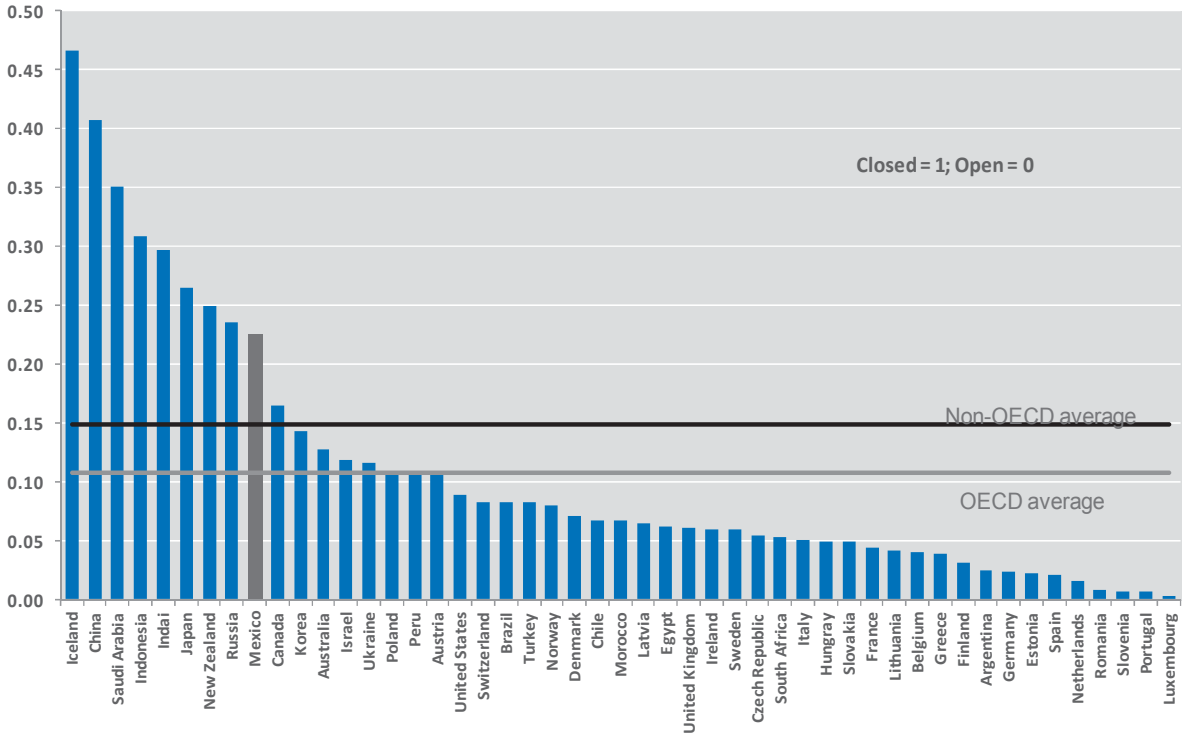


Note: Manufacturing wages' growth are expressed using an index that makes costs in 2005 the base year.

Source: Author's calculations based on ILO (2011) *Labour Statistics Database*, *http://laborsta.ilo.org/*, accessed 7 September 2011, International Labour Organisation; and exchange rates from the OECD reference series at OECD.Stat.

Although proximity to the US will continue to play an important role in Chihuahua's success in attracting manufacturing FDI, it will be limited by Mexico's restrictions on foreign investment. Mexico ranks as the ninth (out of 50) most restrictive country by the OECD FDI Restrictiveness Index (Figure 1.34). Only three OECD countries (out of 34) have a more restrictive framework than Mexico (Iceland, Japan and New Zealand). Scores achieved by Mexico in such an index show that the country's restrictions to FDI are more than twice as strong as the OECD average and more than one-third of those of Brazil. Mexico is particularly restrictive to investments in agriculture, forestry, fisheries, transport (air, maritime and surface), media (radio and TV broadcasting) and communications (fixed telecoms) (OECD, 2011h). In particular, restrictions on agriculture might be preventing the state from accessing higher value-added levels. In addition, restrictions on transport and communications are an important burden for the economy as they are network industries that enable other activities and trade.

Figure 1.34. **OECD's FDI restrictiveness index, 2010**



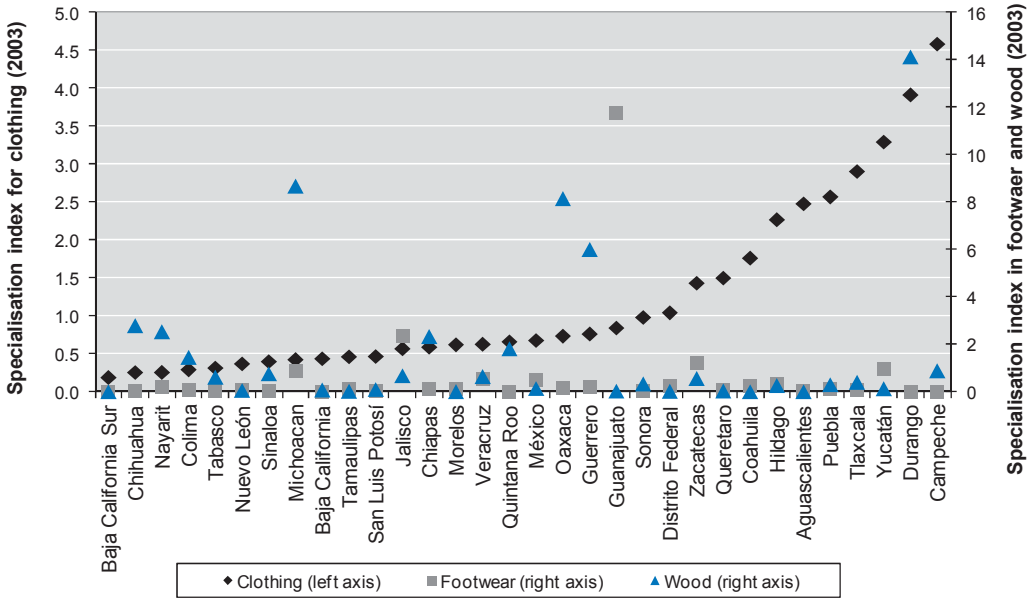
Note: The OECD's FDI Restrictiveness Index measures the restrictiveness of a country's FDI rules by looking at four main types of restrictions: foreign equity limitations, screening or approval mechanisms, restrictions on employment of foreigners as key personnel, and operations restrictions such as restrictions on branching and on capital repatriation or on land ownership.

Source: OECD (2011), *FDI Restrictiveness Index*, *http://www.oecd.org/document/45/0,3746,en_2649_34529562_47216237_1_1_1_34529562,00.html,* accessed 7 September 2011.

Specialisation and clusters

Low-tech activities with labour-intensive processes have been moving away from Chihuahua. There is a long tradition of textile manufacturing in many of Mexico's southern states such as Yucatán and Oaxaca, and perhaps this one reason why those states display higher specialisation levels than northern states. It is also possible that as FDI flows in to northern states, wages are driven up and migration has been insufficient to tapper them down. Wage differentials can persist for decades; Scotland has experienced lower wages than England for well over a century. Hanson (2003) found wage differentials increasing in Mexico over the years and in particular since NAFTA. As clothing manufacture and other textile activities are labour intensive, operating costs in northern states could have driven textiles out to southern states and indeed to Central America. By 2004, Chihuahua recorded one of the lowest specialisation levels in clothing and footwear (Figure 1.35). In contrast, Yucatán and Campeche that represent two-thirds of the peninsula that once thrived on *henequen* (sisal) are among the top states in clothing. States near Mexico City such as Hidalgo, Puebla and Tlaxacala that in 2004 displayed high specialisation indices in clothing could have also benefited from congestion in the country's once main manufacturing belt. Manufacturing activities were traditionally concentrated in Mexico City during the import-substitution industrialisation (ISI) model followed by Mexico until the mid-1980s, but free trade with GATT and NAFTA shifted the relevant market towards the US enhancing industrialisation in border-states (Krugman and Livas Elizondo, 1996; Sanchez-Reaza, 2009).

Figure 1.35. **Specialisation in low-tech activities by state, 2004**



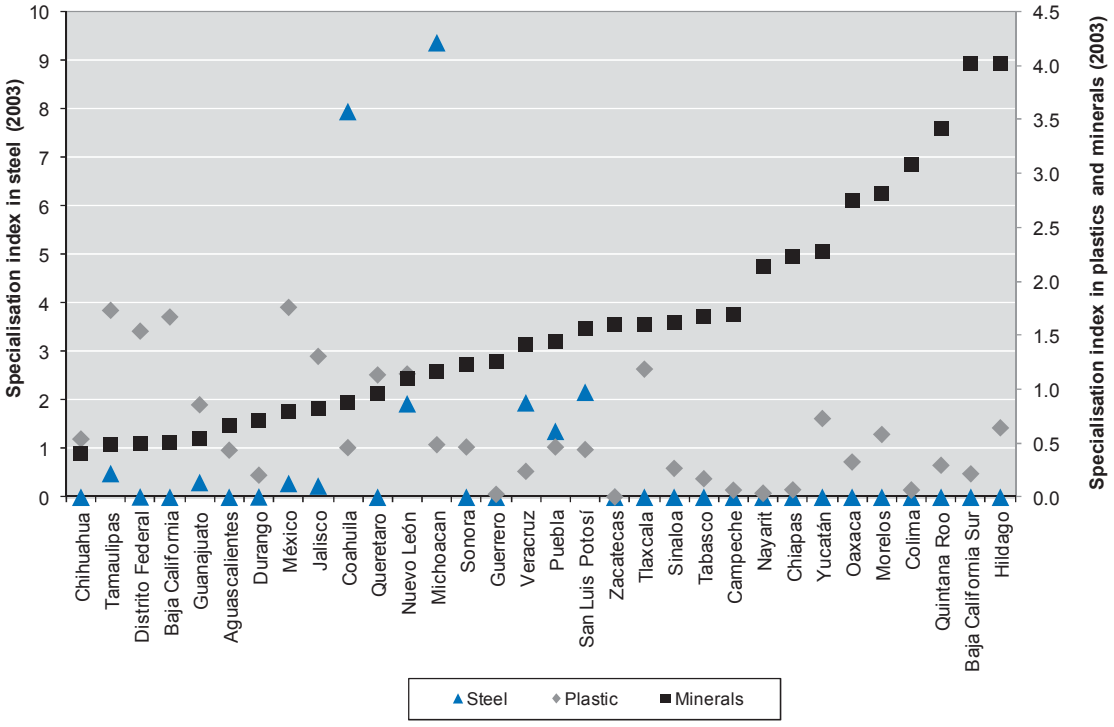
1. Specialisation indices calculated as the share of employment in industry *i* with respect to state's manufacturing employment with respect to national industry *i's* share of national manufacturing employment: (L*ij*/L*j*)/(L*i*/L) where L stands for employment, *i*=state, *j*=manufacturing 4-digit industry.

2. Technological levels were attributed to 4-digit industry following the criteria in the OECD Structural Analysis Database.

Source: Author's calculations based on INEGI (2004), *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

Free trade, geographical location and a long tradition in FDI-based manufacturing, have led to an economic transformation to more technological activities in the state. In addition to low specialisation in low-tech activities, Chihuahua also recorded, the lowest specialisation levels for medium-low tech activities such as steel, minerals and plastics in 2004 (Figure 1.36). In contrast, medium high tech activities have thrived in the state. In 2004, Chihuahua showed the highest specialisation level in the country in automotive and the second highest in electric industries respectively (Figure 1.37). Regarding high-tech activities, Chihuahua was also second in ICT just behind Jalisco and it ranked fourth in electronics (following other border-states such as Baja California, Sonora and Tamaulipas (Figure 1.38). Chihuahua is increasingly moving towards medium-high to high-tech activities that imply capital-intensive processes and semi-skilled and highly skilled labour. Part of the state's success in climbing up the technological ladder lies in geographical location as many of the electric companies producing bulky items (e.g. electric appliances such as fridges and the like) or engines for automobiles among others that incur in high transport costs see location as one key asset. However, the stock of human capital accumulated over decades of FDI in these industries might also explain a large part of Chihuahua's attractiveness.

Figure 1.36. **Specialisation in medium-low tech activities by state**

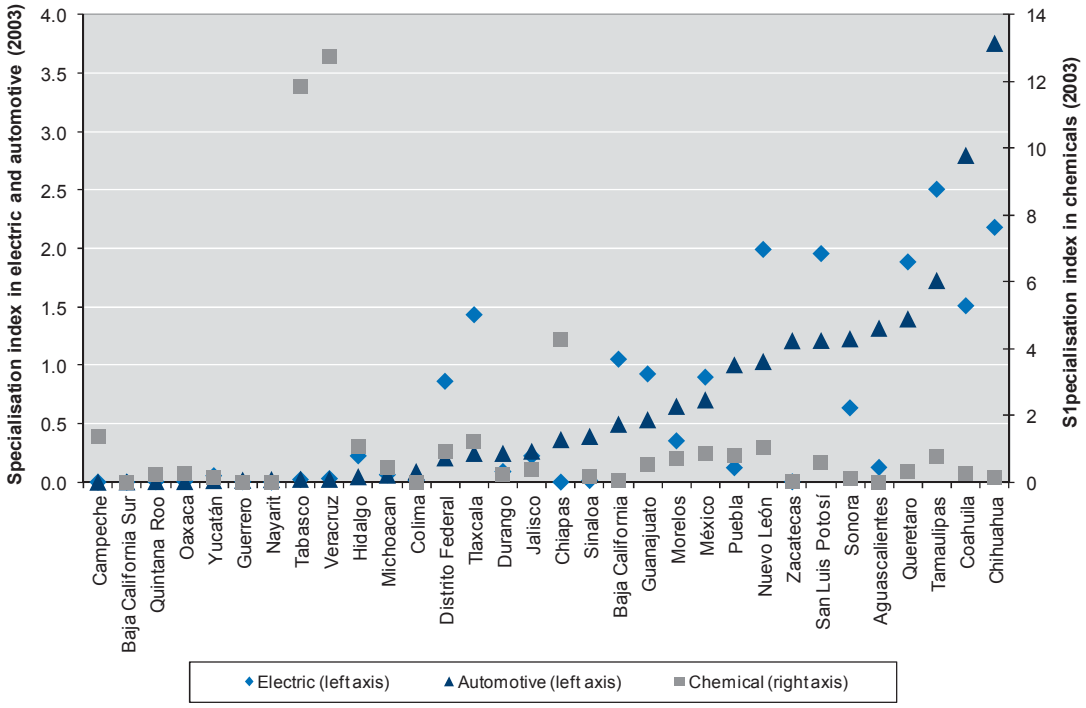


1. Specialisation indices calculated as the share of employment in industry *i* with respect to state's manufacturing employment with respect to national industry *i*'s share of national manufacturing employment: (L*ij*/L*j*)/(L*i*/L) where L stands for employment, *i*=state, *j*=manufacturing 4-digit industry.

2. Technological levels were attributed to 4-digit industry following the criteria in the OECD Structural Analysis Database.

Source: Author's calculations based on INEGI (2004), *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

Figure 1.37. **Specialisation in medium-high technology by state, 2003**



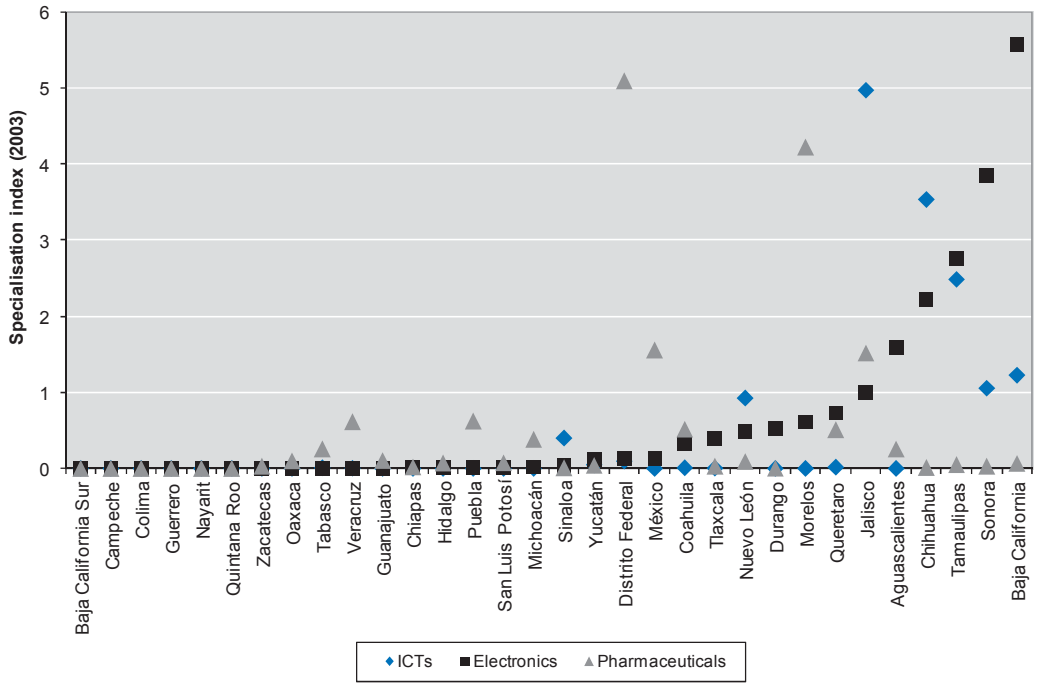
1. Specialisation indices calculated as the share of employment in industry *i* with respect to state's manufacturing employment with respect to national industry *i*'s share of national manufacturing employment: (L*ij*/L*j*)/(L*i*/L) where L stands for employment, *i*=state, *j*=manufacturing 4-digit industry.

2. Technological levels were attributed to 4-digit industry following the criteria in the OECD Structural Analysis Database.

Source: Author's calculations based on INEGI (2004), *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

Specialisation levels have led to the formation of some clusters in Chihuahua. The state has been increasingly specialised in higher value-added activities, but recently some key industries have began to show problems. The main manufacturing employer in the state is the automotive industry (Figure 1.39). Although that industry continues to grow and yield higher specialisation levels, other key industries such as electric, electronics, medical equipment and measurement instruments have in 2009 shown lower specialisation levels than in 1999. It is very likely that shrinking employment in those industries due to dwindling US demand after the financial crisis might have led to lower specialisation levels. Interestingly, IT manufacturing continue to expand in spite of the crisis which might signal that there might be competitiveness issues that are specific to the electric and electronic activities. There has been a noteworthy rise in forestry-related activities (e.g. lumber and veneer) that utilise natural resources from the mountains.

Figure 1.38. **Specialisation in high-tech activities by state, 2003**



1. Specialisation indices calculated as the share of employment in industry *i* with respect to state's manufacturing employment with respect to national industry *i*'s share of national manufacturing employment: (L*ij*/L*j*)/(L*i*/L) where L stands for employment, *i*=state, *j*=manufacturing 4-digit industry.

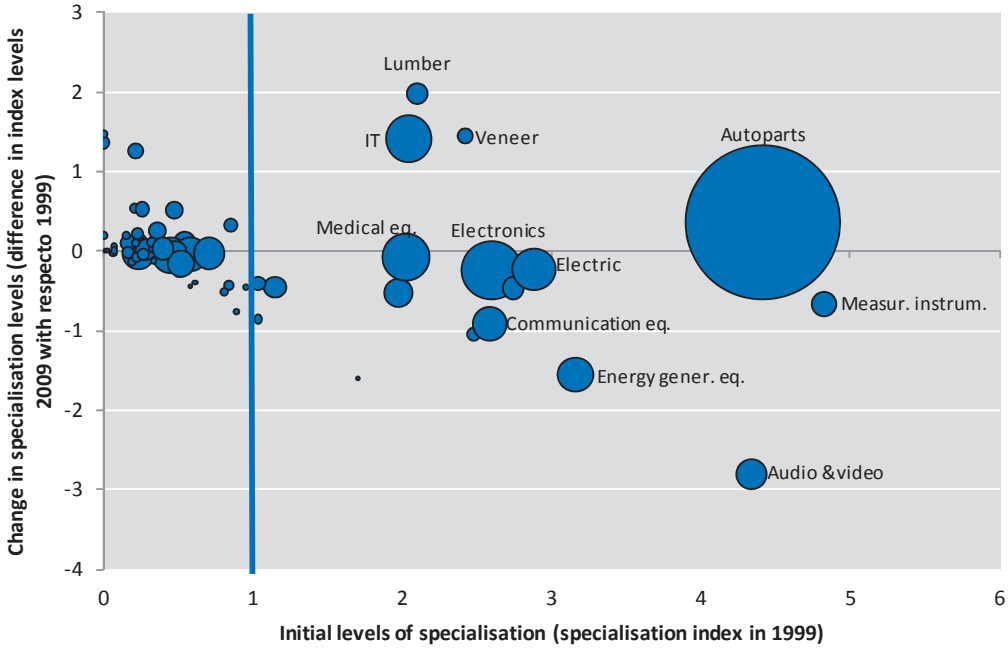
2. Technological levels were attributed to 4-digit industry following the criteria in the OECD Structural Analysis Database.

Source: Author's calculations based on INEGI (2004), *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

The automotive cluster is economically the most important. In 1999, almost one-third of the state's manufacturing GDP took place within the cluster (Unger, 2003). Typically, automotive clusters in Mexican border-states are strongly supported by electric-motors firms' activity. Taking into account the assembly of engines and chassis, as well as the production of different auto-parts, the electric-motor assembly and parts account for the largest share of the clusters' GDP with almost one-fifth of all production (Unger, 2003). However, as final vehicle assembly is not carried out in the state, the value of electric-motor assembly and parts is likely to play a larger role in Chihuahua's automotive cluster compared to most other border states where final vehicle assembly is carried out.

Figure 1.39. **Industrial change in Chihuahua, 1999-2009**

Changes in specialisation indices and employment



1. Specialisation indices calculated as the share of employment in industry *i* with respect to state's manufacturing employment with respect to national industry *i*'s share of national manufacturing employment: (L*ij*/L*j*)/(L*i*/L) where L stands for employment, *i*=state, *j*=manufacturing 4-digit industry.

2. Changes in specialisation indices represent the difference in index levels in 2009 with respect to 1999.

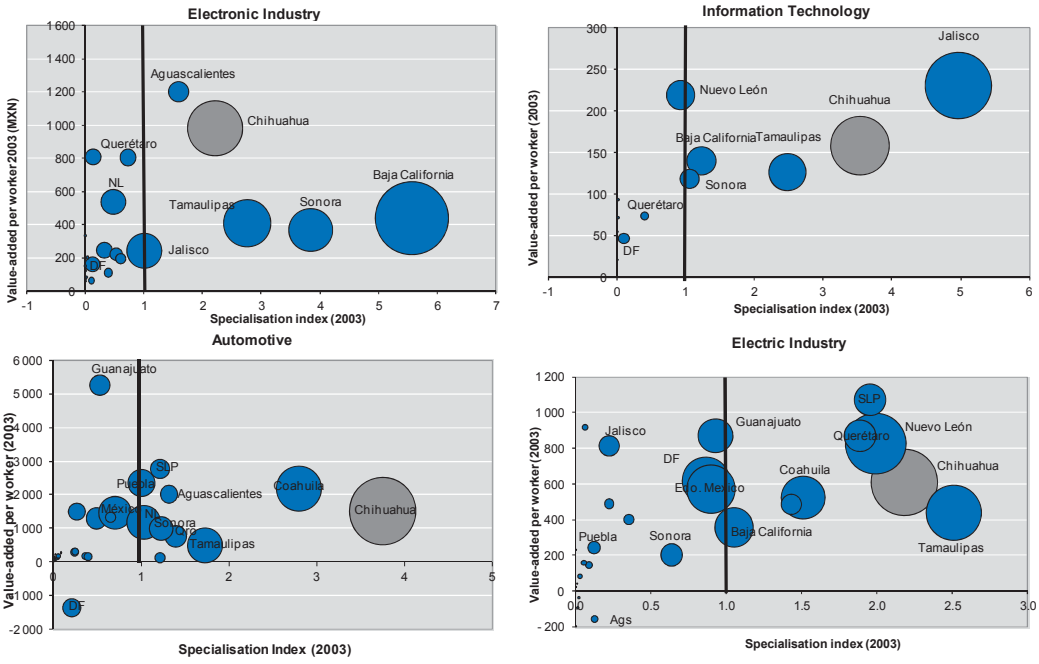
3. Bubble size represents the size of employment by manufacturing branch in 2009.

Source: Author's calculations based on INEGI (1999), *Censos Económicos 1999*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, and INEGI (2010), *Censos Económicos 2009*; Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

Clusters in Chihuahua are key because they contribute with higher value added than elsewhere in the country. Four of the main clusters in Chihuahua, namely automotive, electric, electronic and IT, generally yield higher value added than in other states. Value-added per worker in Chihuahua was the second higher in electronics and the third in IT in 2004 (Figure 1.40). In the electric and automotive industries Chihuahua is the largest employer displaying one of the highest specialisation levels in the country and among the top states in value added per worker.

Figure 1.40. **Chihuahua's main manufacturing industries compared**

Value added and specialisation in Mexican states (2003)



1. Specialisation indices calculated as the share of employment in industry *i* with respect to state's manufacturing employment with respect to national industry *i*'s share of national manufacturing employment: (L*ij*/L*j*)/(L*i*/L) where L stands for employment, *i*=state, *j*=manufacturing 4-digit industry.

2. Bubble size represents the size of employment in electronics in 2003.

3. Value-added per worker is the quotient of gross census value added and total employment.

Source: Author's calculations based on INEGI (2004), *Censos Económicos 2004*, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes.

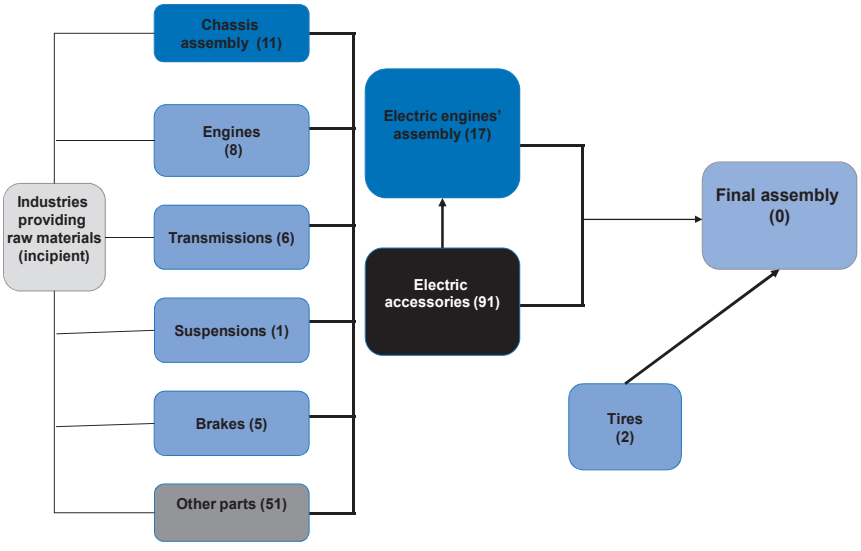
Backward and forward linkages

The benefits stemming from technological spillovers require local linkages among the supply chain and with competing firms in addition to conditions on the labour market and innovation. Technology transfer and diffusion operate via four interrelated channels: vertical linkages with suppliers or purchasers in the host countries; horizontal linkages with competing or complementary companies in the same industry; migration of skilled labour; and the internationalisation of R&D. The evidence of positive spillovers is strongest and most consistent in the case of vertical linkages, in particular, the backward linkages with local suppliers in developing countries. MNEs generally are found to provide technical assistance, training and other information to raise the quality of the suppliers' products. Many MNEs assist local suppliers in purchasing raw materials and intermediate goods and in modernising or upgrading production facilities (OECD, 2002a). However, in Mexico, technological gap between local and MNEs' levels limit the benefits of technological spillovers (Dussel Peters et al., 2007).

However, one of the main constrains to fully reaping the benefits of FDI lies precisely on the lack of local suppliers connected to global firms. Dussel Peters et al. (2007) found that Mexico's raw materials from domestic firms had a negative elasticity to FDI which

suggests national producer's limited ability to integrate to global value chains. The cluster with the largest employment in the state is automotive and its development constrains are similar to other activities. Lack of data on actual sales among firms, or employment data at the local level, prevents us from knowing the size and the direction of commercial flows locally. However, according to Ríos Ramírez and Pico Herrera (2005), there is an incipient provision of raw materials to the rest of the chain. There is a modest presence (one to ten firms) of firms producing key vehicle components such as suspensions (one firm), tires (two), brakes (five firms), transmissions (six firms) and engines (eight firms) – albeit some of them are large and emblematic such as Ford's engine plant in Chihuahua City. A larger number in chassis assembly (11 firms) and electric motors' assembly (17) were located in the state. There was an important presence of other autoparts (up to 75 firms). However, the majority of firms were producing electric accessories, where some vertical integration seems to be taking place as 91 firms produce electric accessories to then be assembled by the 17 companies dedicated to electric motors. As there is no final vehicle assembly, and virtually no raw materials are provided locally, the cluster is made of autoparts. With the notable exception of electric motors industry, the rest of the chain seems to be disconnected: there seems to be no relationship between chassis assembly, brakes, suspension and transmission production and engine assembly (Figure 1.41). A survey of automotive companies located in the state revealed that, in addition to market pressures given the declining US demand, as well as the desire to obtain better incentives and regulation from the government, there were raising pressures to cut operational and input costs that in their opinion can be done through identifying local suppliers (Piedras, 2004). The survey also found that the top problem area lied in labour relationships linked to Federal legislation.

Figure 1.41. **Firms in the automotive value chain in Chihuahua, 2005**



1. Number of firms in each stage of the value chain in brackets.

2. Intensity of colours indicate a greater number of firms.

Source: Adapted from Ríos Ramírez, A. and L. Pico Herrera (2005), *Modelo de Desarrollo Regional Sustentable: Cadenas Productivas del Mueble, Automotriz y Electrónica*, Instituto Tecnológico de Estudios Superiores de Monterrey (ITESM) Campus Chihuahua.

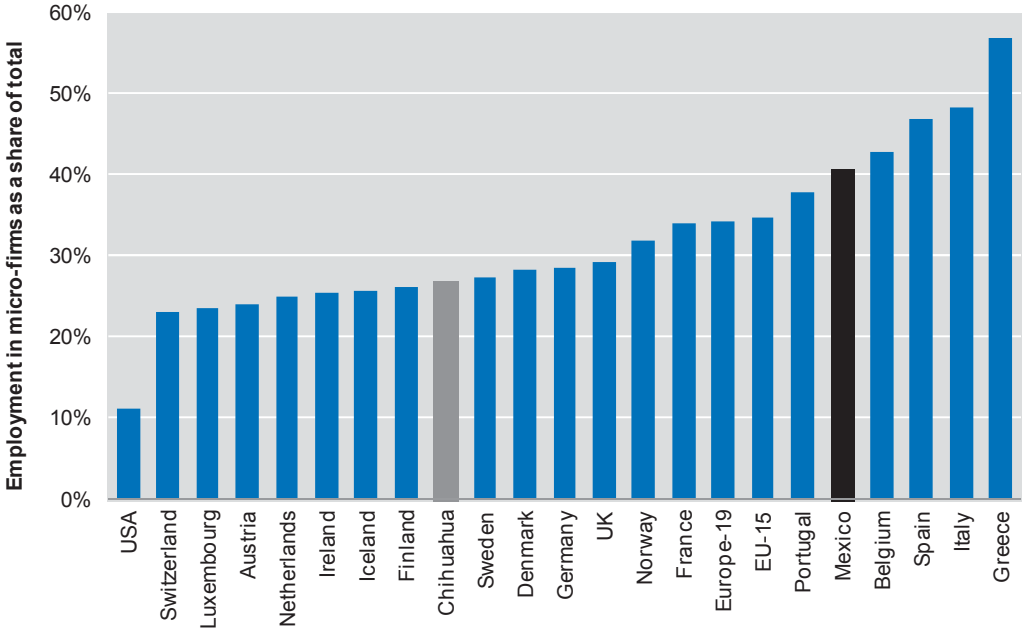
Although vertical integration is still low in Chihuahua, it remains above national levels, particularly in municipalities away from the border. The degree of national integration (the proportion of the value of production that is due to domestic inputs), has over the years been estimated at 2% of total value of production (Carrillo, 1997). Chihuahua's degree of integration has oscillated between 4% and 6% of value of production since 2007. However, while Juárez's ranges between 3% and 4% during the same period, Chihuahua City's has stood at levels above 9%. Moreover, other municipalities' degrees of integration have varied between 16% and 20% of value of production (CIES, 2010).

A model of development in some primary activities can be followed by other firms and other sectors. Dairy farms in Delicias, display a high degree of technological sophistication that has led the region to become the second largest producer of milk in the country. Dairy has been an industry that has acquired technological progress through own means and has successfully positioned itself. Perhaps the industry could benefit from the development of an industrial park for dairy products that integrates the chain from alfalfa to dairy farms and milk plants that can better articulate producers and reach further value-added levels. The dairy industry is an example, but not the only one, as processing of perennial crops such as apples can also be helpful to draw similar conclusions. These industries can further create a sizable amount of jobs at reasonable wages.

The problem of integrating local firms to global value chains in Chihuahua lies, like in the rest of Mexico, on firms' size, access to finance and levels of entrepreneurial development. Micro-firms (firms with up to ten employees) account for 27% of total employment in Chihuahua. Not only is such a share lower than the national level in Mexico (41%) but stands at similar levels than countries like Sweden or Finland (Figure 1.42). However, Chihuahua's level of micro-firm employment contrasts with that of the US (11%) a country where approximately 90% of FDI in Chihuahua comes from. When it comes to number of small and medium enterprises (SMEs that include micro-firms) Chihuahua (92%) trails Mexico (95%) in the share of total firms (Figure 1.43). Micro-firms are characterised by non-standarised processes that often lead to lower productivity levels and an inability to benefit from economies of scale as capital is too expensive to introduce in smaller firms which face problems of access to credit. Only 13% of the 5.1 million Mexican firms had access to credit in 2009 (INEGI, 2010a). While access to credit is a key obstacle for firm development in Mexico, the problem seems to be less acute in Chihuahua's manufacturing sector. Only 5.9% of total employment in manufacturing in Chihuahua takes place in micro-firms in contrast to 23.2% in the country. Weak financial intermediation hits local firms much more than competition from multinational enterprises (MNEs) (OECD, 2002a), and no doubt micro-firms in the state may face similar constraints in access to finance to elsewhere in the country, but the problem for manufacturing in the state could lie in poor levels of entrepreneurial development.

Figure 1.42. **Micro-firms in OECD countries and Chihuahua**

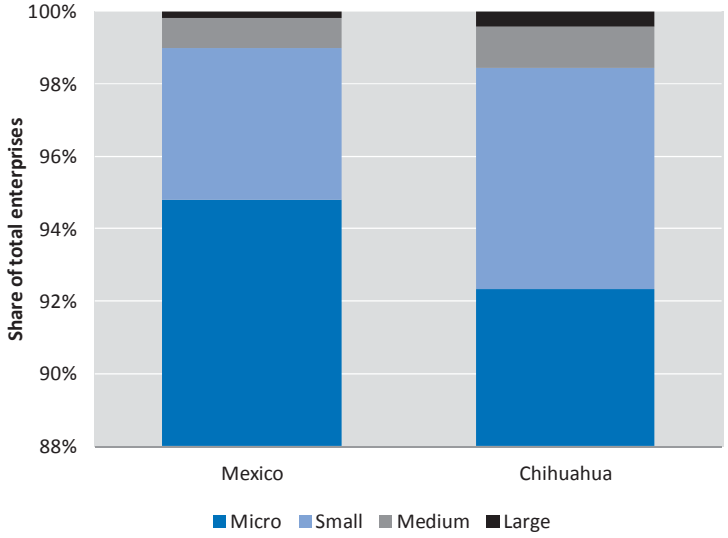
Employment in micro-firms as a proportion of total employment



Note: Micro-firms employ less than 10 workers in all countries.

Source: EU (2007), Observatory of European SMEs; US Census Bureau (2004) 2002 US Economic Census; INEGI (2010) Censos Económicos 2009.

Figure 1.43. **SMEs in Mexico and Chihuahua, 2009**



Source: INEGI (2010), Censos Económicos 2009, Instituto Nacional de Estadística, Geografía e Informática.

Chihuahua might be wasting a golden opportunity to benefit from the knowledge that FDI firms are bringing. *Maquiladora* firms bring about not only employment, but also knowledge and technological spillovers that are reflected in higher productivity levels. Knowledge creation and diffusion has been linked with high-growth entrepreneurship particularly in OECD countries reflecting increasing knowledge intensity. Regardless of firm size, entrepreneurship levels depend on innovation and R&D. Business R&D is particularly important as it is closely related to the creation of new products and production techniques. In addition, it is not only important to foster R&D, but also to seek collaboration. Innovation strategies even for SMEs, are increasingly looking at ways in which they can collaborate and increase their knowledge and success in new products. This new trend can be explained as continuing technological progress, the cost of investments and the difficulty of integrating multidisciplinary research, make collaborating on innovation more attractive and in many cases necessary. Around one in ten of all firms (or one in four innovating firms) in Europe collaborated with a partner (other firms, education institutions or government institutions) for their innovation activities. Large firms are significantly more likely to collaborate than SMEs (although countries differ in this respect). Following the increase in economic globalisation and the corresponding internationalisation of R&D/innovation, firms increasingly co-operate with foreign partners (OECD, 2009e). There are many examples in which FDI has brought about innovation through design and engineering centres. However, the lack of local capacities to engage in innovation with these centres and the lack of spin-offs from FDI companies, slash potential spillover effects in Chihuahua.

Scanty resources for innovation and a bias towards pure scientific research might be crippling entrepreneurial potential in Chihuahua. Finance remains key to develop entrepreneurship and a number of channels are available. First, debt financing and equity financing are the two main sources of finance for entrepreneurial firms. Debt financing involves the acquisition of resources with an obligation of repayment; the investor does not receive an equity stake. It includes a wide variety of financing schemes: loans from individuals, banks or other financial institutions; selling bonds, notes or other debt instruments; and other forms of credit such as leasing or credit cards. Second, venture capital is an important source of funding for entrepreneurial firms, especially young, technology-based firms with high growth potential. Third, business angels provide equity capital and are investors that fall somewhere between formal venture capital funds and informal FFF (founders, friends and family) investors. Recent evidence has shown that business angels play an important role especially in the early-stage financing of entrepreneurial firms (OECD, 2009d). The National Council for Science and Technology (CONACYT) approved through *Fondos Mixtos* (joint funds) 135 projects with MXN 64 million (around USD 4.2 million) during the 2001-07 period (CONACYT, 2008); that is at an average annual rate of around USD 0.6 million. However, not only is finance too small to produce any kind of spillovers, but 94 out of 135 (almost 70% of total projects) were scientific research with no direct links with firms nor new-to-market innovations. Seven projects were to promote scientific research, five for R&D infrastructure in universities, and only 17 (12.6% of total projects) went to technological development that can be related or potentially related to firms and innovation in the market.

Notes

1 . A US temporary migrant programme put in place in 1942 due to labour shortages due to the US involvement in WWII and which was cancelled in 1964.

2. The period under analysis stops before the economic crisis of 2008 as the results would be biased by that atypical period.

3 . Gross value of production refers to adding intermediate inputs and taxes net of subsidies to gross value-added.

4 . Inactivity rates as defined by the residual of subtracting participation rates from 100% considered in the working-age population are lower in OECD countries than in Mexico. Although there is a wide variance on these rates, the OECD average stands at 30%, but many countries are even lower, e.g. 19% for Switzerland, 24% for the UK and 29% for Germany.

5 . The financial sector has developed relatively accessible mortgage schemes. As a result, the demand for land that is to be developed for housing, has also increased.

6 . For instance, Renault and Nissan merged in March 1999 and soon after they announced projects for Aguascalientes and Morelos (Dussel Peters, 2000).

7 . The state of Chihuahua, and in particular its major cities, have suffered from an upsurge in levels of criminality in recent decades. Chapter 2 presents some sobering statistics and description of this problem. Crime is mostly drug-related, but extortion and kidnapping have also become more common. The increased feeling of insecurity faced with this development could deter both foreign and domestic investment, encourages law-abiding citizens to move elsewhere, and imposes substantial deadweight losses on the local economy. If crime continues at high levels, the state's economic development could be compromised. Although some progress has been made recently in combating crime and breaking up the drug gangs, more and better resources need to be devoted to policing, investigating and prosecuting.

8 . The capacity to introduce new products, processes, services, business models and organisational methods in firms.

9 . The *Sistema Nacional de Investigadores* (SNI/National Researchers' System), is the nation's network of researchers that have fulfilled high-quality research criteria established by the National Council for Science and Technology (CONACYT).

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