MEXICO SOUTHERN STATES STUDY

SECTOR ASSESSMENT: AUTOMOTIVE INDUSTRY IN CHIAPAS

WORLD BANK GROUP
THE WORLD BANK IBRD • IDA
IFC International Finance Corporation

Mexico Southern States Study

Sector Assessment: Automotive Industry in Chiapas

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A forthcoming Country Private Sector Diagnostic (CPSD) will provide a broader view on the main challenges and opportunities for private sector development in Mexico, complementing the findings of these Deep Dives at the regional level. The CPSD and the Deep Dives will be mutually reinforcing, as the national coverage of the former will offer a more comprehensive view of the economic structure, constraints and opportunities for private sector investment in the country while the latter offers more granular analytics on the state of the economy and the private sector in Mexico's poorest region.

Abbreviations

Bancomext	*Banco Nacional de Comercio Exterior* (National Exterior Commerce Bank)
Banobras	*Banco Nacional de Obras y Servicios Públicos*
CNBV	*Comisión Nacional Bancaria y de Valores*
DENUE	*Directorio Estadístico Nacional de Unidades Económicas*
EBITDA	earnings before interest, tax, depreciation, and amortization
EDUTIH	*Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares*
EMIM	*Encuesta Mensual de la Industria Manufacturera*
ENCRIGE	*Encuesta Nacional de Calidad Regulatoria e Impacto Gubernamental en Empresas* (National Survey of Regulatory Quality and Government Impact on Enterprises)
ENOE	*Encuesta Nacional de Ocupación y Empleo* (National Survey of Occupation and Employment)
FDI	foreign direct investment
GDP	gross domestic product
GCF	gross capital formation
GM	General Motors
GWh	gigawatt hours
HS	Harmonized System
km	kilometer
kV	kilovolt
INDSTAT	Industrial Statistics Database
IMTA	*Instituto Mexicano de Tecnología del Agua*
INEGI	*Instituto Nacional de Estadistica y Geografia* (National Institute of Statistics and Geography)
ISIC	International Standards Industrial Classification
Nafin	*Nacional Financiera*
NAICS	North American Industry Classification System
OEM	original equipment manufacturer
PIGOO	*Programa de Indicadores de Gestión de Organismos Operadores*
R&D	research and development
SCT	*Secretaría de Comunicaciones y Transportes* (Secretariat of Infrastructure, Communications and Transportation)
SE	*Secretaría de Economía* (Secretariat of Economy)
SENER	*Secretaría de Energía* (Secretariat of Energy)
SIE	*Sistema de Información Energética* (Energy Information System)

SMEs	small and medium enterprises
UNIDO	United Nations Industrial Development Organization
USMCA	United States-Mexico-Canada Agreement

Overview

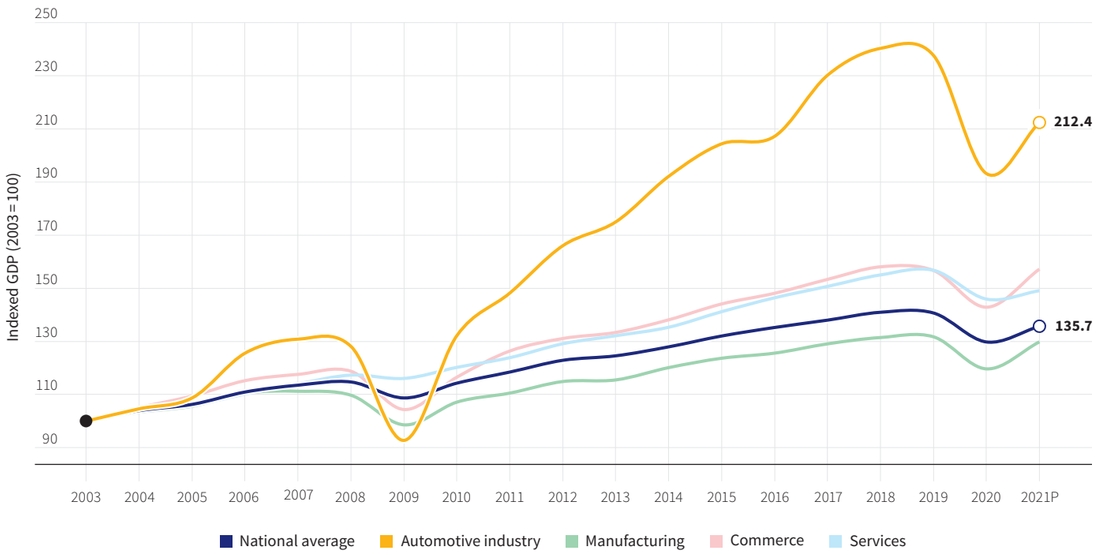
Mexico is a significant player in the global automotive industry, ranking seventh in production and fourth in exports. Globally, the country is responsible for almost 4 percent of vehicle production and 8 percent of automotive exports. Between 2000 and 2021, Mexico's vehicle production grew by 3.1 percent annually, the third highest among top vehicle producing countries (behind China and India). However, the automotive industry in Mexico is concentrated in the North and Bajío regions, with very little presence in southern states. A combination of revised trade agreements, new regional content requirements, the global reshoring and nearshoring trends, and the diversification of existing automotive clusters into more knowledge-intensive segments of the value chain present an opportunity for the southern states of Mexico—particularly in Chiapas—to enter the industry. The initial focus for these states would be to engage in the most labor-intensive activities of the automotive value chain.

To harness this opportunity, a targeted, proactive, and consistent strategy should be implemented. Chiapas can leverage its incipient presence in motor vehicle parts manufacturing to produce related products and substitute imports. The manufacturing of electric and electronic components presents an especially valuable opportunity, given its synergies with the automotive and information and communication technology industries. Although labor-intensive activities are vulnerable to offshoring and automation, consolidating a tightly integrated mass of Tiers 2 and 3 firms[1] specializing in different segments of the value chain could anchor the long-term development of more knowledge-intensive activities. A strategic transition towards complex products should be implemented gradually, driven by demand and through collaboration between the public and private sectors over a timeframe of 10–15 years.

MARKET ANALYSIS

In recent decades, the automotive industry has been an engine for growth and development in Mexico. Between 2003 and 2021, the value added by the country's automotive sector more than doubled, growing at an average year-on-year rate of 6.2 percent (figure O.1). The industry represents 17.1 percent of Mexico's manufacturing output and 2.9 percent of gross domestic product (GDP). After 2009, growth of the sector saw a rapid acceleration, outperforming all other economic activities. Between 2003 and 2021, the automotive industry received 13.7 percent of Mexico's foreign direct investment (FDI) inflows, or US$75.8 billion, with auto parts accounting for almost 60 percent.

FIGURE O.1
Value Addition in the Mexican Automotive Industry



Source: Based on data from INEGI's National Accounts (various years).
Note: GDP = gross domestic product; P = preliminary.

Following the signing of the North American Free Trade Agreement (NAFTA), Mexican automotive exports grew by 8.6 percent per year, from US$11.9 billion in 1995 to US$101.3 billion in 2021, outpacing the global automotive average growth rate of 4.7 percent per year. Meanwhile, the sector's contribution to Mexico's merchandise exports rose from 14.9 to 20.5 percent. Prior to the pandemic in 2019, the sector's commercial balance was almost twice the value of inbound remittances and almost five times the commercial balance of tourism. The country's automotive exports are concentrated in three subsectors: passenger cars and other motor vehicles (39.4 percent), motor vehicles for transporting goods (30.3 percent), and motor vehicle parts (30.1 percent). More than three-fourths of the sector's exports originate in eight states in the North and Bajío regions: State of México (16.1 percent), Coahuila (13.9 percent), Puebla (11.5 percent), Guanajuato (9.4 percent), Aguascalientes (8.1 percent), Chihuahua (5.9 percent), Sonora (5.6 percent), and Mexico City (5.1 percent).

Between 1995 and 2021, automotive imports increased from 5.0 to 6.9 percent of total imports in Mexico, while its share in global automotive imports increased from 1.0 to 2.7 percent. Almost 60 percent of inputs utilized by the Mexican automotive industry are imported, indicating substantial scope for southern states to supply the existing automotive sector with intermediate goods that they could produce competitively. Automotive firms in the North and Bajío regions primarily import parts and accessories for cars and other passenger vehicles. The strategic imperative for manufacturers in these regions to diversify into more knowledge-intensive segments, combined with high rates of staff turnover, intense competition for skilled labor, and increasing labor costs, underscores the opportunity for the southern states to integrate into the automotive industry.

The new United States-Mexico-Canada Agreement (USMCA) establishes a regional minimum content value of 75 percent for the automotive industry, up from 62.5 percent established under the NAFTA. This requirement could foster import substitution of components from non-USMCA countries (mainly China), which before the pandemic supplied more than 80 percent of the global auto industry, and could even prompt the reshoring or nearshoring of upstream manufacturing activities. Imports account for 75–90 percent of all components used in the production of auto parts, a subsector that represents about 38 percent of Mexico's total automotive industry. Building a highly reliable and integrated base of Tiers 2 and 3 suppliers would reduce the need for Tier 1 firms to import. Although the North and Bajío regions are expected to provide a significant portion of the additional content required by the USMCA, there is also an opportunity for the southern states, especially Chiapas, to participate. This can be achieved by implementing the right incentives and policies that encourage a deeper development of the automotive industry in these states.

As of 2018, among selected states,[2] Chiapas has the greatest number of firms in the auto parts segment, one of the most promising for import substitution and nearshoring investments. Moreover, promoting the labor-intensive production of auto parts could generate jobs and productive opportunities with spillovers in the Northern Triangle of Central America, with the opportunity to consolidate a cross-border auto-part cluster. Since 2003, automotive production[3] in Chiapas has increased by 136 percent in terms of value added, reflecting an average year-on-year growth rate of 15.8 percent. The state has a comparative ad-

vantage in motor vehicle parts exports that could be leveraged to further boost production. It is estimated that Chiapas has the third lowest cost index nationwide among a set of main cities analyzed, 0.9 percent lower than the baseline (Mexico City).[4] Chiapas also has the lowest labor and facilities costs. However, transportation costs are relatively high in the state. Table O.1 lists the products with high growth potential in Chiapas.

Two locations are especially well positioned to support the development of the automotive industry in Chiapas (map O.1). The first is the southwestern coastal region from Ciudad Hidalgo on the Guatemalan border to Arriaga, close to Salina Cruz, which is one of the poles of the Interoceanic Corridor of the Isthmus of Tehuantepec. The second is the corridor from Arriaga to Tuxtla Gutiérrez (the state capital), which includes the cities of Cintalapa and Ocozocoautla de Espinosa. These locations fulfill four main criteria: (1) labor force availability, (2) sufficient availability of private land, (3) access to electricity and transportation infrastructure, and (4) the presence of existing auto parts production plants, demonstrating the local viability of the automotive sector.

ECONOMIC POTENTIAL

The expansion of the automotive industry in Chiapas would extend the benefits of a more diversified and globally integrated economy into the southern states. According to estimates, a 10 percent increase in automotive exports would lead to a 0.3 percent increase in Mexico's GDP and the creation of over 83,000 additional jobs, with over half of which in motor vehicle parts manufacturing.[5] Moreover, every additional US$1 million dollar in revenue generated by the automotive industry is linked to the creation of approximately 10 direct and indirect jobs.[6] The average hourly wage in the automotive industry is around 20 percent higher than the average for the manufacturing sector.[7] The average automotive firm has more capital and employs more workers compared to the average manufacturing firm in other sectors. Each additional US$100 of production value in the automotive industry generates US$61.2 in spillovers to the national economy, as the industry affects 165 out of the 259 branches of economic activity.[8]

TABLE O.1

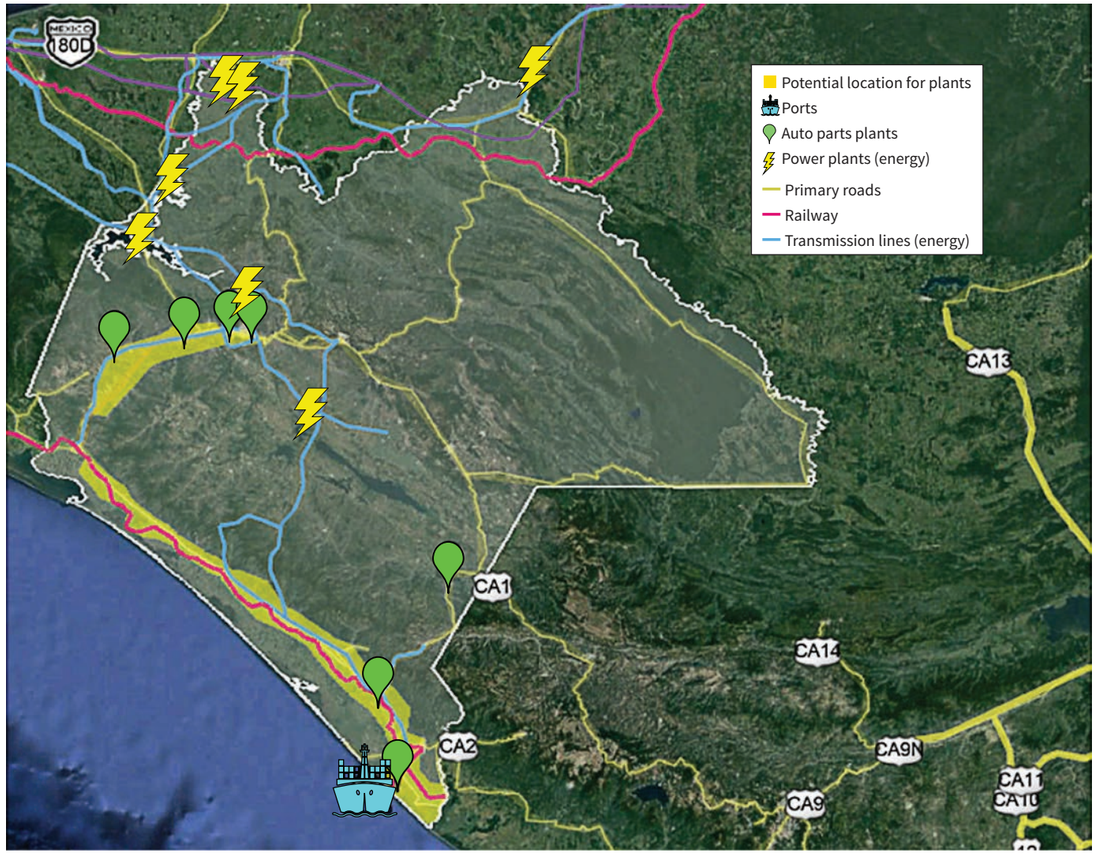
Main Products with Growth Potential in Chiapas

Electric and electronic components	Interiors	Other labor-intensive components
➔ Batteries, door locks, security systems (for example, airbag sensors), dashboard accessories, wire harnesses, capacitors and solenoids ➔ Electrical ignition or starting equipment used for spark-ignition or compression-ignition internal combustion engines* ➔ Electrical lighting or signaling equipment, windshield wipers, defrosters, and demisters* ➔ Revolution counters, taximeters, odometers, speedometers, and tachometers*	Seats, airbags, seat belt components (retractors, reel, covers), instrument panels, arm rests, headliners, and related accessories	Radiator hoses, plates and supports, brakes and driveshaft components, and motor pulleys

Source: Based on Criscuolo 2015; MGI 2015; Mexico Atlas of Economic Complexity.
*Products were identified using a Harmonized System of four-digit codes.

MAP O.1

Potential Regions to Develop the Automotive Industry in Chiapas



Source: Base map for primary roads, railways, ports, and transmission lines was elaborated using ArgGIS with shapefiles from INEGI's *Biblioteca Digital de Mapas* 2019 edition.
Note: The symbols are only indicative and are not meant to reflect exact locations.

BINDING CONSTRAINTS FACED BY THE SECTOR

The automotive industry in Chiapas is in its early stages. In 2021, it contributed about 0.1 percent to the state's GDP and 1.5 percent to its manufacturing activities. The industry employs 1.3 percent of all workers in Chiapas and accounts for only 0.02 percent of all firms in the state. Chiapas accounts for just 0.1 percent of Mexico's automotive exports and is home to 0.4 percent of all automotive exporters. Investment levels in the automotive industry are low, even when considering the overall investment levels in Chiapas, which are already low. Between 2003 and 2021, the automotive industry received only 2.1 percent of total

FDI inflows in the state. Productivity levels in Chiapas fall below the national average for the automotive industry and have shown a decline in recent years. The average labor productivity in the Mexican automotive industry is up to 37 times higher than that for Chiapas.

Human capital appears to be a constraint on the development of the automotive industry in Chiapas. Although statistical evidence is inconclusive, empirical evidence points to a lack of qualified workers as a significant obstacle to developing more sophisticated stages of production. It is documented that the "*usos y costumbres*"[9] system inhibits labor mobility, while population dispersion and high transportation costs undermine the advantage of low labor costs in the state. To overcome these challenges, Yazaki, the leading auto parts firm in Chiapas, adopted a decentralized approach. It initially started operations in Tuxtla Gutiérrez and then expanded to other smaller communities within the state. Because of the lack of affordable public or private transportation options, Yazaki had to provide transportation to its workers.[10]

Infrastructure gaps also pose serious challenges. Auto parts manufacturing is often the starting point for establishing a large and diverse automotive industry. However, the subsector is energy-intensive, and despite being a significant power producer in Mexico, Chiapas faces challenges in electricity transmission and distribution. Furthermore, poor logistics and communications systems further compound the infrastructure challenges. The automotive industry relies on a highly integrated, time- and cost-sensitive value chain that typically operates under "just-in-time" systems. Inadequate road networks and port infrastructure create additional challenges for the industry, as it requires efficient transportation and timely delivery of components. Moreover, underdeveloped communications systems could also inhibit the expansion of the auto parts subsector, which requires good communications for its operations.

Expanding the automotive sector in Chiapas requires better public-private coordination. Government support has played a key role in attracting investment to the automotive industry in the North and Bajío regions. In Chiapas, the establishment of Yazaki was made possible through deliberate public-private efforts focused on the state after the wake of the Zapatista uprising in 1994, but no subsequent efforts to consolidate the state's automotive industry have been implemented. The automotive sector is not considered in the latest state development plans, and there is a lack of state support programs aimed at fostering its growth. Several institutional constraints further hinder the development of the automotive industry. Firstly, communal land covers 59 percent of the state's territory, limiting the ability of investors to purchase the land necessary to establish manufacturing plants or industrial parks. Secondly, social conflicts and road blockades negatively impact logistics in the state. Lastly, the lack of public transportation and affordable housing near potential manufacturing centers contributes to low labor mobilization.

In the medium-term, developing a design and engineering center in Chiapas will be critical to consolidate the automotive industry in the region. Research and development (R&D) centers have played a vital role in the growth of the automotive industry in the North and Bajío and regions, enabling local producers to continually enhance the quality and complexity of their products. Conversely, there are no R&D centers in any of the selected states, with the closest one

located in the state of Puebla. Establishing an R&D center in Chiapas is essential to enable producers to access more sophisticated segments of the value chain.

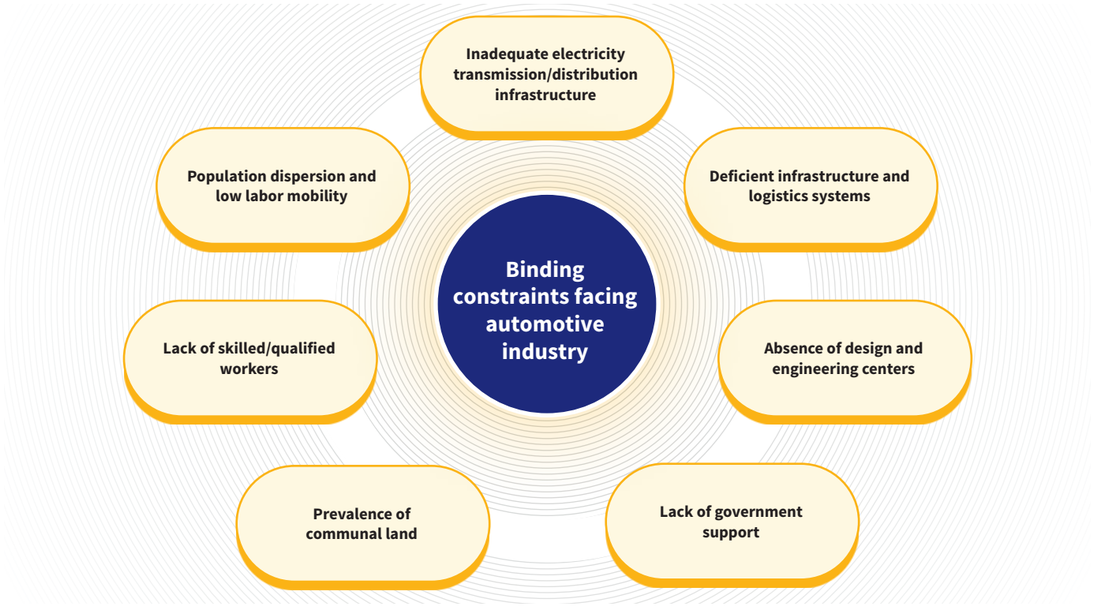
Although financing may not appear to be a binding constraint for the development of the automotive industry in the short-term, it could restrict the expansion of local Tiers 2 and 3 suppliers. Interest rates charged to automotive firms are among the lowest nationwide. However, 24 out of the 124 municipalities in Chiapas lack financial access points,[11] and inadequate access to credit combined with a low portfolio balance relative to GDP could inhibit the expansion of small and medium firms in the sector.

Figure O.2 summarizes the binding constraints for developing the automotive sector in Chiapas.

OPPORTUNITIES FOR GROWTH: WHAT WOULD IT TAKE TO DEVELOP THE SECTOR?

Fostering the development of the automotive industry in Chiapas will require incentivizing the formation of an auto parts manufacturing cluster to maximize economies of scale and scope, increase productivity, and facilitate the dissemination of knowledge. Creating a public trust to acquire and manage the land necessary for industrial parks or anchor firms in feasible locations (identified in coordination with the private sector) would help overcome challenges around land ownership. The over 500 hectares previously secured land for the cancelled special economic zone close to Puerto Chiapas and within the zone

FIGURE O.2
High-Level Overview of Binding Constraints Facing the Automotive Industry in Chiapas



eligible for temporary tax breaks, could serve as the initial land for industrial development. Once adequate land has been acquired and prepared for economic activities (including the provision of last-mile infrastructure), private operators could gradually develop, manage, and upgrade industrial areas.

To accelerate the formation of an industry cluster, a public-private partnership could be created and tasked with identifying, attracting, retaining, and expanding investment in auto parts manufacturing. The government could provide financial support for working capital and equipment investments, as well as assistance in obtaining required certifications and implementing the standardization processes necessary to integrate into the automotive supply chain. These efforts could be complemented by nondistortionary incentives and outreach efforts to attract key industry players.

Implementing demand-driven programs for suppliers would improve their production capacity, strengthening backward linkages while alleviating supply constraints. The government could provide financial support in working capital and equipment investments, as well as assistance in obtaining required certifications and implementing the standardization processes necessary to integrate into the automotive supply chain. These programs should be targeted towards segments where key North and Bajío firms are engaged, as coordination with established firms and potential investors would guarantee sufficient demand for products. Creating a directory of automotive enterprises in Chiapas could form the basis for a marketplace that matches these firms with local input suppliers and service providers. Supporting informal firms to transition into the formal economy could further accelerate the growth of local suppliers.

Investments in inter and intraregional transportation infrastructure is necessary to connect firms in Chiapas with established automotive clusters in the North and Bajío regions and international markets via Port Chiapas. Efficient public transportation systems would also help overcome constraints on labor availability.

Modernizing the curricula of local universities and establishing technical institutes to serve industry-specific workforce skill requirements would increase the competitiveness of the state to gradually attract firms of more sophisticated segments of the value chain.

Finally, the government can foster innovation and technological upgrading in the automotive industry by promoting the establishment of a dedicated R&D center in Chiapas. This center could be founded in collaboration with local universities, the *Consejo Nacional de Humanidades, Ciencias y Tecnologias* (National Council of Humanities, Science, and Technology), and major industry firms, and it could be complemented by an R&D support program. Chiapas could be the second state within the South-Southeast region with such facilities (after Puebla). This would improve the productive capacities and quality of manufactured products in the state.

Table O.2. summarizes the main policy recommendations for developing the automotive sector in Chiapas.

TABLE O.2

Matrix of Policy Recommendations

	Infrastructure
	➜ Define an infrastructure plan identifying a pipeline of regional infrastructure projects and potential financing sources (public and private) and conduct individual projects feasibility studies. Improve interregional infrastructure outside of Chiapas to connect the state with the North and Bajío regions (road corridors, highways, and railways) and international markets (Port Chiapas). ➜ Facilitate access to natural gas through public and/or private investments in pipelines connecting to the state, potentially enabling the supply to Central America as well. ➜ Design and implement housing programs benefitting the workers of industrial parks or anchor firms installed in the state and enhance public transportation to connect rural and urban areas.
	Sector-specific support
	➜ Support land acquisition and preparation for automotive clusters to maximize economies of scale, increase productivity, and facilitate the dissemination of knowledge. • Create a public trust to acquire and manage the land in consultation with the private sector through business chambers such as the *Asociación Mexicana de Parques Industriales Privados* (Mexican Association of Industrial Parks) ➜ Create a public-private agency responsible for identifying and attracting potential investments from Tiers 2 and 3 segments linked to the industry requirements in the North and Bajío regions. ➜ Implement demand-driven supplier development programs for local firms to improve their production capacity for inputs required by the industry. ➜ Collaborate with the responsible sectorial agencies (central and subnational) to modernize curricula and academic programs of local universities and establish automotive technical institutes. ➜ Establish a research and development center for the automotive industry in the state, in collaboration with universities, the *Consejo Nacional de Humanidades, Ciencias y Tecnologías* (National Council of Humanities, Science, and Technology), and major industry firms.
	Investment climate, competition, and government interventions
	➜ Create a single window or one-stop shop for the automotive industry, in coordination with all government levels to integrate, minimize and facilitate regulations compliance for new investments or expanding existing firms. ➜ Level the playing field for foreign direct investment (FDI) attraction by expanding federal government efforts beyond the typically targeted North and Bajío regions to include all states, and enhance the state's capacities to attract investment. ➜ Explore the adoption of incentives to promote FDI joint ventures or alliances with Mexican Tiers 1, 2, and 3 companies enabling productive knowledge and technology sharing between foreign and domestic firms. Eventually, the incentives can be phased out once the agents benefit from the agglomeration externalities.

1

Automotive Industry in Mexico and Chiapas

The global automotive industry encompasses various manufacturing activities, many of which are distributed across vast international value chains.[12] In 2019, its value added was estimated at more than US$1.33 trillion, representing 10.8 percent of the global manufacturing output.[13] Between 2005 and 2019, value added by the industry grew at an average annual rate of 4.7 percent, exceeding the 4.3 percent growth rate of the global manufacturing sector. Employment in the automotive industry reached 18.8 million workers in 2018, representing 9.3 percent of manufacturing employment worldwide. In addition, among Organisation for Economic Co-operation and Development countries, the automotive industry attracted 8.2 percent of total foreign direct investment (FDI) inflows.

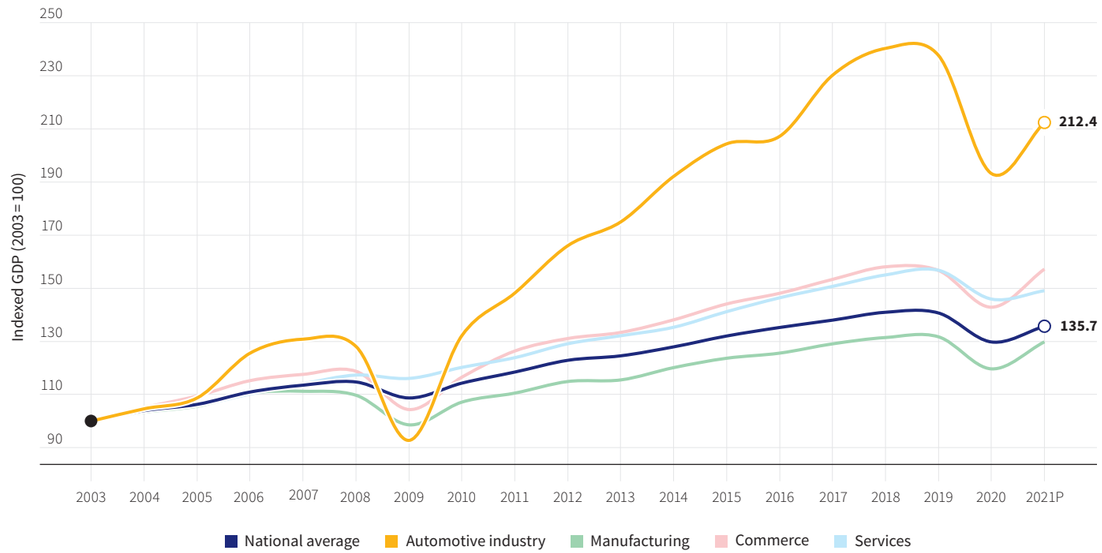
The COVID-19 severely impacted the automotive industry, and its recovery is facing challenges. The pandemic has caused not only contractions in demand but also disruptions in global supply chains, especially for components such as semiconductor chips.[14] The situation has been further aggravated by additional supply chain disruptions resulting from the invasion of Ukraine by the Russian Federation. In the short term, these challenges are anticipated to persist. They are not isolated to the automotive industry alone; the growing demand for limited semiconductor supplies from the information and communication technology industry and the production of various electronic devices is creating a competitive environment. With a rigid supply of these components and multiple sectors vying for their share, the recovery of the automotive industry production is expected to be slow and complex.

In Mexico, the automotive industry[15] has been an engine for the growth of the manufacturing sector and the country's development in recent decades. Between 2003 and 2021, the value added by the country's automotive sector grew at an annual growth rate of 6.2 percent (figure 1.1). The industry represents 17.1 percent of Mexico's manufacturing output, 2.9 percent of gross domestic product (GDP), 4.8 percent of total employment, and 0.1 percent of Mexican firms, with an average size of 381.8 workers per firm.[16]

In the last two decades, Mexico's automotive industry grew at an explosive pace, outperforming all other major economic activities. Between 2003 and 2021, the automotive industry attracted 13.7 percent of the country's total FDI inflows (US$75.8 billion), of which auto-parts manufacturing accounted for

FIGURE 1.1

Value Addition in the Mexican Automotive Industry



Source: Based on data from INEGI's National Accounts (various years).
Note: Data for 2021 are preliminary.

57 percent. According to the 2019 Economic Census,[17] gross capital formation (GCF) in the industry totaled Mex$57.8 billion, representing 29.2 percent of GCF in the manufacturing sector and 7.7 percent of GCF in the overall economy. Since 2000, vehicle production in Mexico has increased by 64.4 percent. It reached a peak in 2018 but has experienced a decrease in production since then. In 2021, Mexico was the world's seventh largest vehicle producer, representing 3.9 percent of global vehicle production (figures 1.2 and 1.3).

Mexico's increasing participation in the global automotive industry has been driven by the North and Bajío regions, whereas automotive manufacturing in the South remains very limited. Firms in northern Mexico benefit from their proximity to the United States, while those in the Bajío have access to the main domestic markets and some of the country's best infrastructure and services. The policies of federal and state governments have also played an important role in attracting, retaining, and expanding multinational automotive firms, with these efforts being most intense in those regions (see boxes 1.1 and 1.2).

In southern Mexico, Chiapas is among the few states with an automotive industry, although it is still at a nascent stage in its development. Among selected states, Chiapas has the highest number of firms in the auto parts segment,

BOX 1.1

The Automotive Industry in Northern Mexico

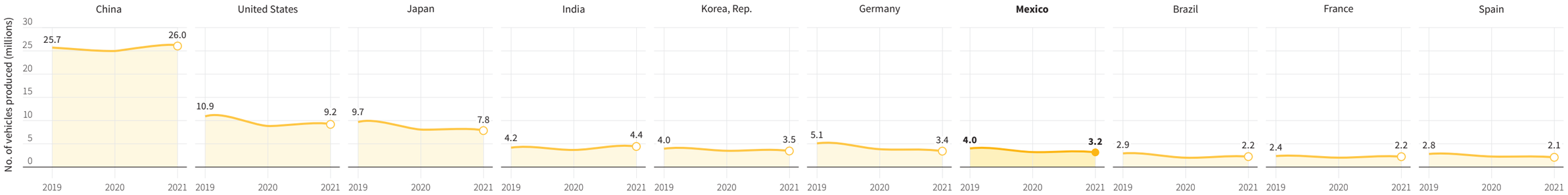
The growth of the automotive industry in Mexico's northern border states began in the late 1970s and early 1980s, when increasing pressure from Japanese competitors prompted Chrysler, Ford, and General Motors to seek lower-cost manufacturing options outside the United States. At the national level, industrial decentralization efforts in the early 1970s, followed by the 1978 National Urban Development Plan, accelerated the relocation of manufacturers to the northern states. Policy makers facilitated this process by loosening the regulatory framework as part of an effort to address Mexico's balance of payments crisis, which included a considerable trade deficit in the automotive industry. Mexican authorities also offered direct incentives, including investment credits and strong government support. By the early 1980s, U.S. automakers were opening their first plants in northern Mexico, led by Chrysler and General Motors in 1981 in Ramos Arizpe and Ford followed in 1983 in Chihuahua.

The relocation of the automotive industry to Mexico's northern states had a strategic, demand-driven purpose: producing and assembling light vehicles for the U.S. market. However, these states offered more than just competitive costs. They offered advantageous conditions for (1) developing highly sophisticated plants to compete with Japanese manufacturers in the Mexican and U.S. markets, (2) consolidating their position in Mexico's auto parts market through increased scale and lower costs, and (3) proximity to U.S. subassembly or assembly plants, enabling just-in-time production and better quality control reactiveness—considered to be the most important feature by firms. Automotive assembly was the first segment of the value chain to appear, followed by auto parts manufacturers. The formation of auto-industry clusters was facilitated by trade agreements, including the General Agreement on Tariffs and Trade in 1984 and North American Free Trade Agreement in 1994 (recently substituted by the United States-Mexico-Canada Agreement), as well as the Mexican government's IMMEX (*Industria Manufacturera, Maquiladora y de Servicios de Exportación*; Manufacturing, Maquiladora, and Export Services Industry) program launched in 2006.

Sources: Ramírez and Unger 1997; Vieyra 2001; Miranda 2007; Daville 2014; Trujillo 2015; Ruiz 2016; Carbajal, Carrillo, and de Jésus 2016; Municipal Government of Ramos-Arizpe.

FIGURE 1.2

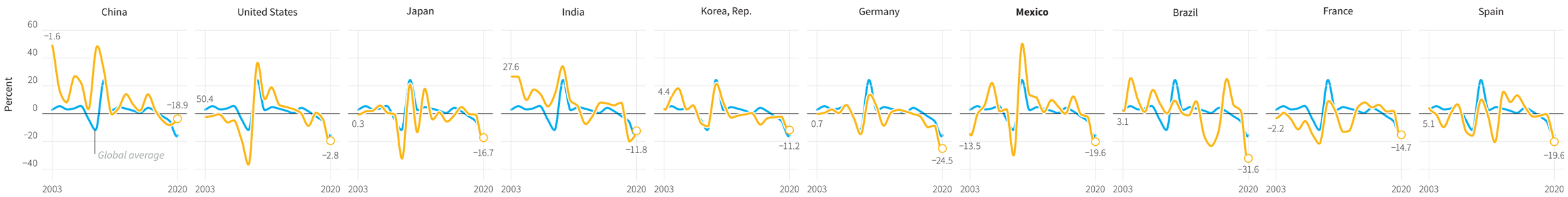
Top 10 Vehicle Producers in the World



Source: Based on data from Fitch Connect platform.

FIGURE 1.3

Growth of Vehicle Production Among the Top Ten Producers



Source: Based on data from Fitch Connect platform.

BOX 1.2

Automotive Development in the Bajío Region: The Case of Guanajuato

Known as the "golden diamond of Mexico," the states of Aguascalientes, Guanajuato, Querétaro, and San Luis Potosí in the Bajío region have a flourishing automotive industry. This is because of several factors. Automotive firms consider the input availability and customer market demand. Small- and medium-sized cities in the region attract original equipment manufacturer (OEM) firms, while larger population centers are preferred by auto parts manufacturers. Moreover, incentives offered by state governments have also played an important role in defining the location for starting operations in the sector.[a]

Expansion of the automotive industry in the Bajío started with the development plan of Guanajuato state to attract investments. In the early 1990s, the state government, along with academic institutions and private and nonprofit organizations prepared a report called "*Guanajuato Siglo XXI.*" This report identified the main barriers hindering the development of key economic sectors in the state, including the automotive industry. These barriers included competitive disparity in the value chain, lack of raw materials, tools, and specialized equipment providers, insufficient infrastructure, and lack of consensus on the sector's importance among local authorities, among others. It also identified some advantages of the state for developing the automotive industry, including:

1. **Location:** The region has several logistical advantages including railway connections to major cities in Mexico and the U.S.-Mexican border (Ferromex and Kansas City Southern de México), ports on both coasts of the country (Altamira, Lázaro Cárdenas, and Manzanillo), roads granting access to all cities in the north and center of Mexico, and proximity to the Salamanca refinery in Guanajuato and various fuel pipelines in the region.
2. **Safe and healthy work environment:** The labor force in the region is mostly young and low cost, and because of other existing manufacturing activities relatively skilled, easy to train, and without many labor unions.
3. **Reasonable social infrastructure:** The region has hospitals, schools, universities, parks, public transportation, among others.

Capitalizing on these advantages, the state government and other regional entities (private and academic) developed a mid-term strategy with three main goals. First, they aimed to attract major automotive players like Chrysler, General Motors (GM), or Nissan, which was achieved with the establishment of the GM plant in Silao, Guanajato in 1995. Second, they sought to foster agreements and alliances with local, national, and international investors producing intermediate products. Third, they targeted another OEM firm. To support the second and third goals, the state government established a public trust to acquire and manage land properties for industrial parks. The land reserves were granted to industrial investors responsible for providing last-mile infrastructure and collaborating with the state government to define the business strategy of the industrial parks. This model is exemplified by the creation of Puerto Interior in Silao.[b] In addition, the state government improved existing economic (roads to access ports and north cities and to increase airport, and railway capacity) and social (schools, hospitals, parks, and urban facilities) infrastructure, to enhance the attractiveness of the state to industry companies. The other states in the Bajío region followed a similar strategy, the state governments worked together with federal agencies to promote their infrastructure and incentives abroad and established promotional offices in key automotive industry regions (Detroit in the United States, Germany, and Japan) to attract foreign direct investment (FDI).

In recent years, the states of the Bajío region have been enhancing their labor capabilities, focusing on improving academic plans to meet the technical and soft skills required by the industry. A notable characteristic of these states is they behave as a cohesive and collaborative "borderless" region, where state agencies actively cooperate rather than compete for investments in their states.[c] Multiple state government administrations have given continuity to the strategy, spanning over four periods.

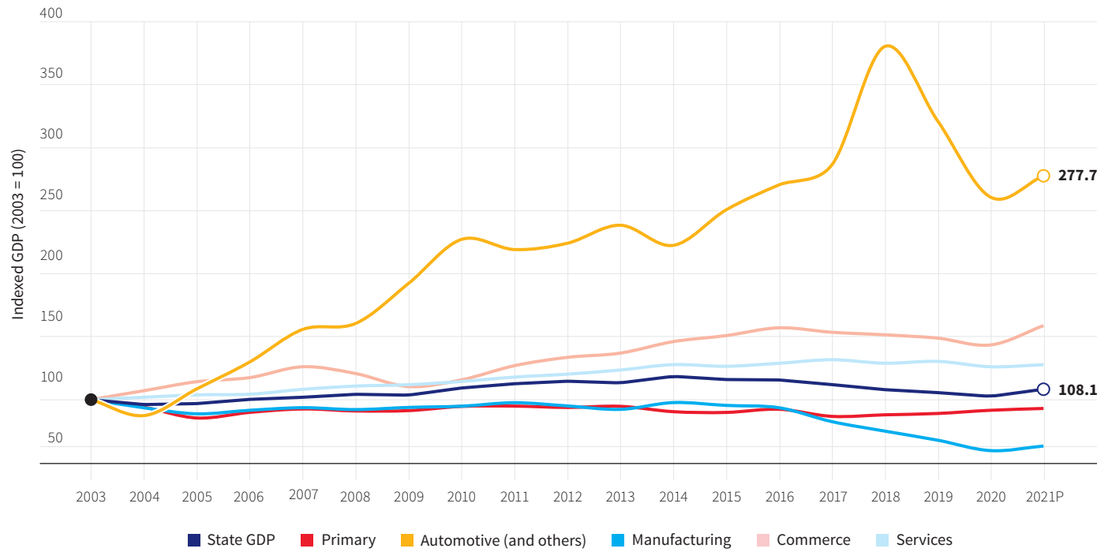
Today, there are 10 OEM plants in the region: three in Aguascalientes (two Nissan plants and the Cooperation Manufacturing Plant), four in Guanajuato (General Motors, Honda, Mazda, and Volkswagen), two in San Luis Potosí (BMW and GM), one in Jalisco (Honda), and several auto parts manufacturers in Querétaro and other large cities in the region. The future looks promising for the automotive industry in the Bajío region, as the four states were the primary recipients of FDI in the sector in recent years and nearshoring will potentialize this trend.

a. Unger and Chico 2004.
b. The dry port is the biggest in Latin America (1,227 hectares). Its four industrial parks host more than 120 firms whose investments totaled more than US$4.5 billion and generated more than 27,000 jobs (Guanajuato Puerto Interior. n.d.).
c. Global Business Reports 2016.

which is concentrating a high share of nearshoring investments and offers labor-intensive opportunities, with potential spillover effects not only for the state but also for the *Northern Triangle* of Central America (main origin of the migratory crisis in the region), and opportunity to consolidate a cross-border auto-part cluster. Disaggregated GDP data are not available at the state level, but combined with other manufacturing activities (North American Industry Classification System sectors 333 to 336),[18] the automotive industry in Chiapas contributed 0.1 percent in GDP and 1.5 percent to the state's total manufacturing sector in 2021 (figure 1.4). Between 2003 and 2021, the value added by automotive manufacturing and similarly classified activities increased at an average annual growth rate of 9.9 percent. The automotive industry directly employs

FIGURE 1.4

Growth Performance of Selected Sectors in Chiapas



Source: Based on data from INEGI's National Accounts (various years).
Note: GDP = gross domestic product. Data for 2021 are preliminary.

about 1 percent of all workers in Chiapas and accounts for 0.02 percent of all firms in the state, with an average size of 165.8 workers per firm (table 1.1).

Overall investment levels in Chiapas are low, especially in the automotive industry. During 2003–21, the state's automotive industry received 2.1 percent of total FDI inflows (US$57.7 million) registered in Chiapas.[19] As of 2018, the automotive industry contributed 9.2 percent of GCF in the state's manufacturing sector and 0.5 percent to its total investment (Mex$65.7 million).[20]

TABLE 1.1

Automotive Industry Firms and Workers in Chiapas, 2018

NAICS code	Description	No. of firms	No of workers
3362	Motor vehicle body and trailer manufacturing	22	79
3363	Motor vehicle parts manufacturing	11	5,724
326192	Resilient floor covering manufacturing	2	…
	Total	35	5,803
Overall total in the state		186,996	554,589
Automotive industry's share in total (%)		0.02	1.0

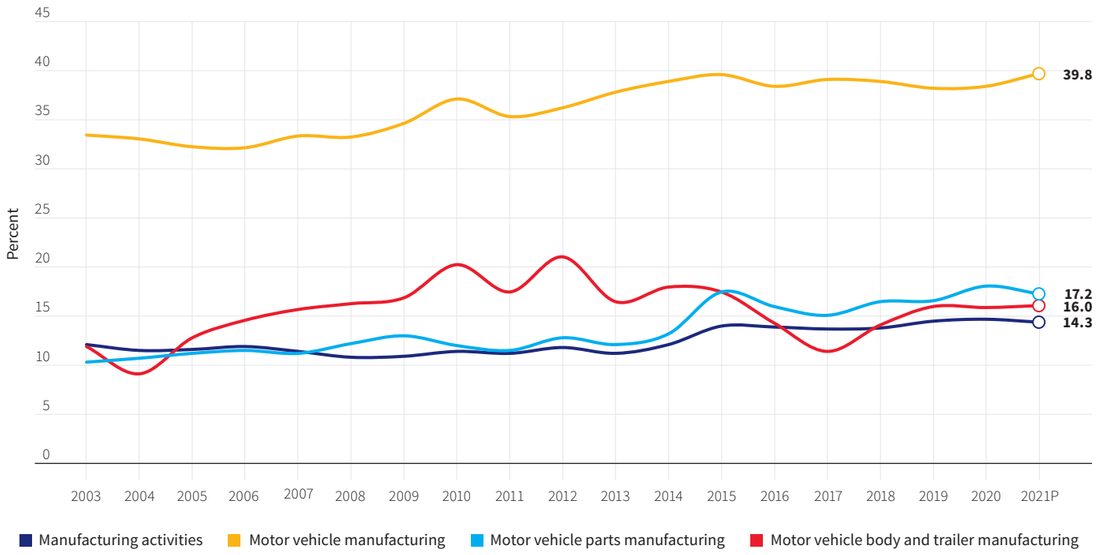
Source: Based on data from INEGI 2019.
Note: Missing values reflect data gaps or confidentiality requirements. NAICS = North American Industry Classification System.

Chiapas and other southern states have an opportunity to produce automotive inputs competitively, particularly labor-intensive auto parts that are currently imported, mainly from Asia.[21] Approximately 58.5 percent of the inputs used by the Mexican automotive industry are sourced from overseas.[22] While the value of local content that is exported into global value chains represented 39.8 percent of total motor vehicle manufacturing in 2021, this share decreases to 16 percent for motor vehicle body and trailer manufacturing and 17.2 percent for motor vehicle parts manufacturing (figures 1.5). There is a sizeable market opportunity across various auto parts that could be addressed by increasing domestic production (figure 1.6). Although existing industry clusters in the North and Bajío regions are well positioned to increase domestic production, challenges including high staff turnover, shortages of skilled workers, and rising labor costs has created an opportunity to shifting less sophisticated stages of the value chain to the southern states. However, it is crucial to progressively improve the local workforce's skills and ensure that labor conditions meet new requirement under the USMCA.[23]

Promoting the growth of the automotive industry in Chiapas could help diversify the state's economy, integrate it into global value chains (GVCs) and create new productive capabilities. The development of the industry can bring significant benefits to the state by shifting towards a sophisticated sector with a high emphasis on research and development (R&D).[24] This integration into GVCs can lead to the generation of more well-paid formal jobs in the state, with sal-

FIGURE 1.5

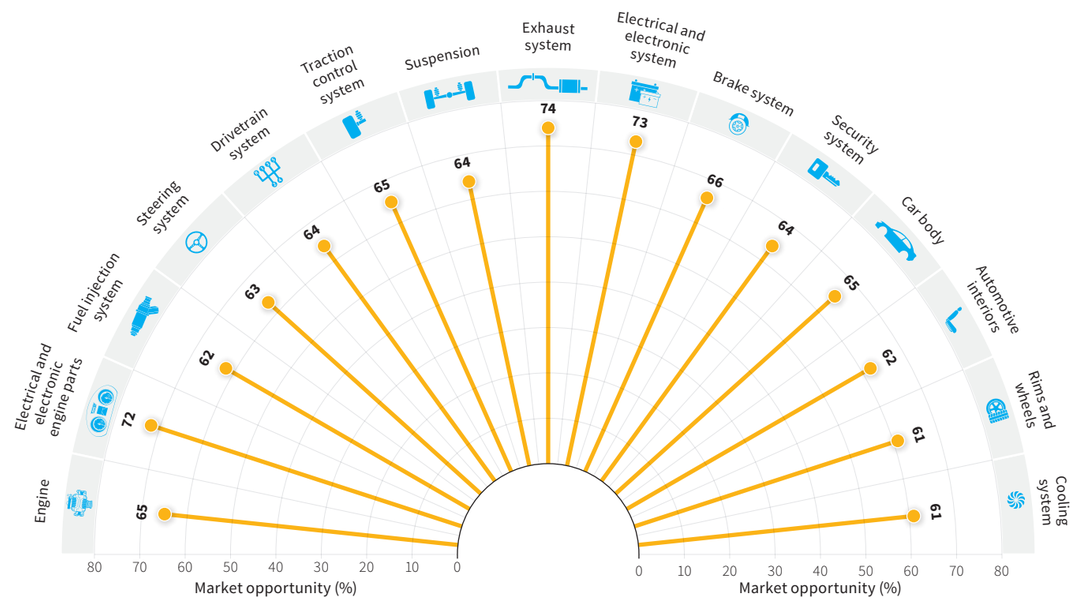
Domestic Value Added Exported Into Global Value Chains as a Share of Total Vehicle Manufacturing in the Mexican Automotive Industry



Source: Based on data from INEGI's National Accounts (various years).
Note: Data for 2021 are preliminary.

FIGURE 1.6

Market Share Not Supplied Domestically, 2014



Source: Adapted from Proméxico 2016.

aries 20 percent higher than the average in the manufacturing sector. Furthermore, the automotive industry can create new productive capabilities, allowing for the development of more complex sectors in Chiapas, similar to what has been observed in other states in the North and Bajío regions, given the industry's upstream and downstream activities.

The Mexican automotive industry generates around one million direct jobs and another million indirect jobs nationwide. Furthermore, a 10 percent increase in automotive exports could boost the country's GDP by 0.3 percent and gen-

BOX 1.3

Arnecom-Yazaki: An Auto-Parts Industry Success Story in Chiapas

The development of the automotive industry in Chiapas started with a joint venture of two companies over 20 years ago. One of them is the Yazaki Corporation, a global supplier of electric harnesses, power distribution systems, electric wires, components, and electric parts for various car models produced in Mexico and abroad. The other is Xignux, an industrial consortium based in Nuevo León that specializes on energy and food production. Yazaki, which operates in Chiapas as Arnecom, has seven electrical-harness plants in Chiapas and employs about 6,000 workers. In 2018, its latest plant opened in the municipality of Tapachula, a US$350 million investment responsible for creating 1,500 jobs.

Investing in Chiapas was not solely based on Yazaki's corporate strategy but was also the result of a public-private effort to create productive opportunities in the wake of the Zapatista uprising in 1994. The federal and local governments provided land concessions, support for the construction of industrial buildings, initial employment subsidies, and reduced income taxes. Industrial knowledge and human capital were brought from existing plants in Nuevo León to new plants in Chiapas. However, graduates from universities in Chiapas are now replacing the first generation of managers who relocated from northern states.

Sources: SHCP 2016a and 2016b; Hausmann, Cheston, and Santos 2015.

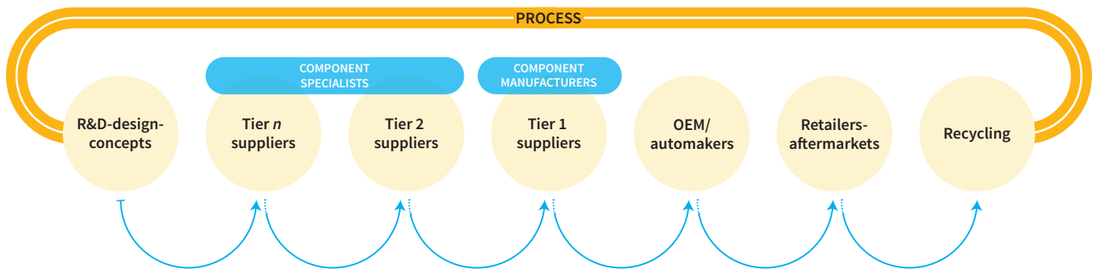
erate an additional 83,000 jobs. Over half of these new jobs would be in motor vehicle parts manufacturing, a subsector in which 9 out of 10 workers in the industry are employed and is already present in Chiapas with potential for further growth in the near term.[25] Moreover, for every Mex$100 in automotive output, an estimated Mex$61.2 in spillover is generated for the national economy, impacting 165 out of the 259 branches of economic activity.[26] In Chiapas, the automotive industry generates 71 jobs per Mex$1 million of value added, far higher than the ratios observed in the North and Bajío regions (1.7) and the national average (1.3).[27] Moreover, the industry's purchasing power is significant, as it buys more inputs from other sectors than it sells to them: for every monetary unit in outputs sold by the automotive industry, it purchases up to two monetary units in inputs from other sectors. The automotive industry's contribution to other economic activities represents 5.8 percent of combined sales from all sectors (with motor vehicle parts manufacturing accounting for 95 percent).[28]

VALUE-CHAIN ANALYSIS

Although global automotive production is led by a small group of firms and countries, the sector's increasingly complex value chain links a vast number of firms and industrial clusters in countries across the globe. Figure 1.7 illustrates the main segments of this value chain. Numerous specialized firms operate as Tiers 1, 2, 3, and 4 suppliers for original equipment manufacturers (OEMs), who design and assemble the final vehicle.

- **Tiers 3 and 4 firms:** These suppliers contribute a wide range of inputs to the value chain, ranging from raw materials to less-sophisticated components such as autobody subassemblies and their parts, metal and plastic pressings, exhaust pipes, and windscreen wipers.[29]
- **Tier 2 firms:** Focusing on moderate-complexity parts, Tier 2 firms provide items such as fuel-pump housing, computer chips, simple engine parts, lights, and locks. These firms also supply similar inputs to firms outside the automotive industry.[30]
- **Tier 1 firms:** Specializing in the most complex components, Tier 1 firms produce sophisticated parts for engines, transmissions, and brakes, as well as complex preassembled modules. These firms work directly with automakers to offer highly customized products. Spatial proximity to OEMs' assembly operations is especially important for Tier 1 firms, as it enables them to reduce transportation and logistical costs, synchronize just-in-time production, and provide technical assistance as needed.[31]

FIGURE 1.7
The Auto-Industry Value Chain



Source: Adapted from OECD 2016.
Note: OEM = original equipment manufacturers; R&D = research and development.

The shift in the automotive industry from vertical integration to a dispersed production network has increased supplier competition among suppliers. OEMs now prioritize factors such as cost, quality, R&D capacity, and proximity to development centers when selecting partners.[32] This competitive landscape becomes particularly intense during the design or launch of a new vehicle model. Both Tier 1 and Tier 2 suppliers vie for stable contractual arrangements that typically last five years or more, on average. The reason for this intense competition is because once a business is awarded to a Tier 1 supplier, the switching costs for OEMs is high.[33]

LEGAL FRAMEWORK AND GOVERNMENT PROGRAMS FOR THE AUTOMOTIVE SECTOR

1. **Free trade agreements.** Under Mexico's numerous free trade agreements, exporters have preferential access to 45 countries, which include the United States, Canada, Japan, and the European Union.[34]
2. **Official Mexican standards.** The Mexican authorities apply three types of standards to the automotive industry: safety, emissions, and consumer information. Each type is overseen by a different government entity (table 1.2).[35]
3. **The Automotive Sectoral Promotion Program and "Eighth Rule."** The program allows automobile manufacturers to import most raw materials duty free. In cases where the program is not applicable, registered companies can use a "Eighth Rule" permit (tariff code 9802.00.19) to obtain a zero percent tariff rate. To be eligible, companies must comply with specific criteria.
4. **The automotive decree.** Under Mexico's 2003 Decree to Support the Competitiveness of the Terminal Automotive Industry and the Development of Domestic Market for Automobiles, light vehicle manufacturers (a) are considered "manufacturing companies" under the Customs Law; (b) are allowed to import vehicles produced using Mexican content duty-free, on an ad valorem basis, and under the tariff rate quota, in an amount up to 10 percent of the previous year's production; and (c) are automatically classified as manufacturing companies in the Automotive Sectoral Promotion Program.
5. **Financial programs and products.** The Mexican government supports the development of the automotive sector through financial programs offered by development banking institutions such as Nafin and Bancomext. Those programs include favorable credit and factoring terms, technical support, and specialized advice on international trade.

TABLE 1.2

Official Mexican Standards for Light and Heavy Vehicles

Subject/competent authority	Light vehicles		Heavy vehicles	
Safety (SCT)	NOM-067	Minibuses	NOM-068	Physical and mechanical conditions
	NOM-194-SCFI-2015	Brakes and provision of airbags	NOM-012	Weights and dimensions
Emissions (SEMARNAT)	NOM-042	Emission limits for new vehicles not more than 3,857 kg that use gasoline, liquefied petroleum gas, natural gas, and diesel	NOM-044	Emission limits for vehicles greater than 3,857 kg that use diesel
	NOM-079	Noise limits from the exhaust new vehicles	NOM-045	Opacity limits for vehicles that use diesel
	NOM-076	Emission limits for new vehicles weighing more than 3,857 kg that use liquefied petroleum gas, natural gas, or other alternate fuels		
	NOM-041	Emission limits for vehicles that use gasoline		
	NOM-050	Emission limits for vehicles that use liquefied petroleum gas, natural gas, or other alternate fuels		
	NOM-080	Noise limits from the exhaust of motor vehicles, motorcycles and motorized tricycles		
Consumer information (SE)	NOM-050-SCFI-2004	Product labeling	NOM-050-SCFI-2004	Product labeling
	NOM-116-SCFI-2018	Lubricating oils	NOM-116-SCFI-2018	Lubricating oils

Source: SE 2020.
Note: kg = kilogram; NOM = *Normas Oficiales Mexicanas*; SCT = *Secretaría de Comunicaciones y Transportes*; SE = *Secretaría de Economía*; SEMARNAT = *Secretaría del Medio Ambiente y Recursos Naturales*.

6 **State-level support.** The state government of Chiapas does not currently offer specialized programs or projects for the automotive sector, but it does offer a financial support program for small and medium enterprises that is available to automotive firms.[36]

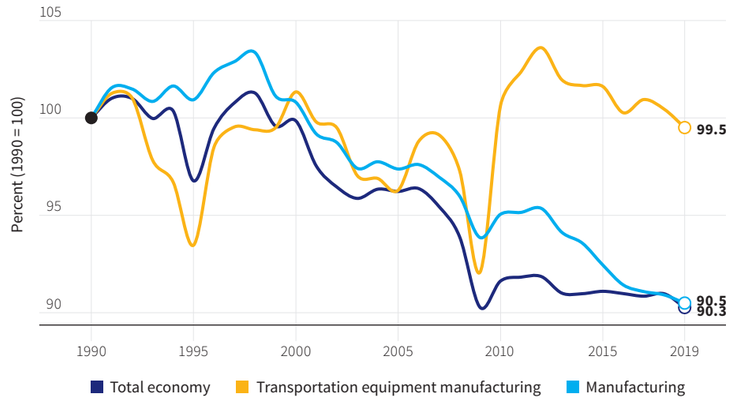
PRODUCTIVITY, LABOR AND CAPITAL INTENSIVENESS, AND WAGES

Between 1990 and 2019, transportation equipment manufacturing had a slight decline of 0.5 percent in total factor productivity.[37] However, the subsector performed better than the overall economy and manufacturing sector, which had higher cumulative productivity declines of 9.7 and 9.5 percent, respectively, over the period (figure 1.8). Moreover, in terms of labor productivity, motor vehicle manufacturing and motor vehicle body and trailer manufacturing had a sharp increase in value added per worker between 2003 and 2018 (figure 1.9). Consequently, average labor productivity in motor vehicle manufacturing is now 5.4 times higher than that of transportation equipment manufacturing. The average labor productivity in tire manufacturing and retreading also increased significantly over the period.

Automotive productivity levels in Chiapas are below the national average, consistent with the state's overall low productivity. In recent years, automotive productivity has decreased, mirroring the decline in overall manufacturing productivity across the state. Among automotive subsectors, only motor

FIGURE 1.8

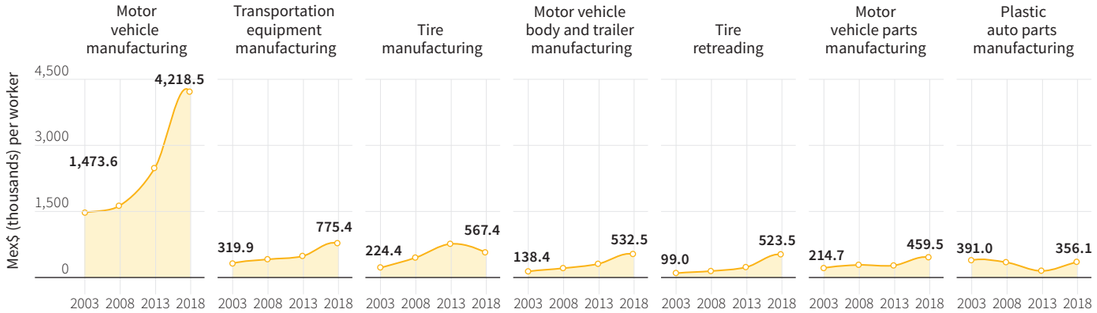
Total Factor Productivity in Selected Sectors



Source: INEGI.

FIGURE 1.9

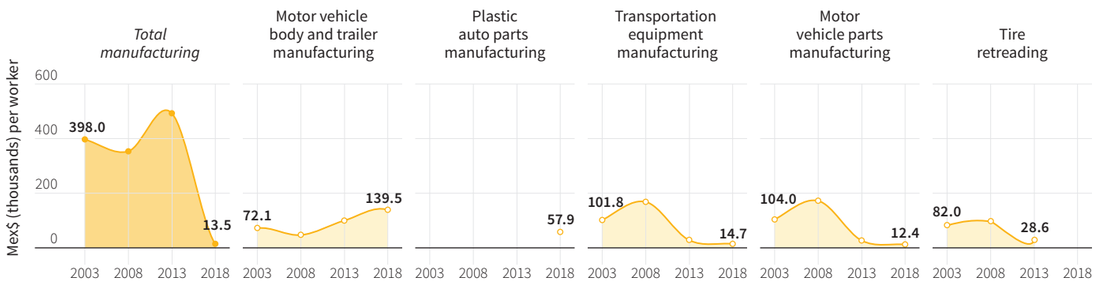
Labor Productivity in Transportation Equipment Manufacturing and Automotive Subsectors



Source: INEGI's Economic Censuses.

FIGURE 1.10

Labor Productivity in the Automotive Industry in Chiapas



Source: INEGI's Economic Censuses.
Note: No plastic auto parts manufacturing activity was reported in the state for the years 2003, 2008, and 2013, and no tire retreading activity was reported for 2018; tire manufacturing was not reported in any year.

vehicle body and trailer manufacturing had an increase in productivity between 2003 and 2018, rising by 93.5 percent. Its productivity now exceeds that of transportation equipment manufacturing and overall manufacturing by a large margin (figure 1.10). However, despite this increase, the subsector represents less than 2 percent of automotive production in Chiapas. Meanwhile, motor vehicle parts manufacturing accounts for close to 98 percent of automotive production in Chiapas, yet labor productivity in this subsector had a decline from Mex$104,000 per worker in 2003 to Mex$27,000 in 2013, reaching Mex$12,400 in 2018. Nationwide, the average labor productivity for motor vehicle parts manufacturing is Mex$459,500, which is 37 times the level observed in Chiapas.

Firms in the automotive industry tend to be much larger than the average for the state and national levels. According the 2019 Economic Census, the identified 55 motor vehicle manufacturers had an average capital of Mex$3.6 billion per firm, a capital-to-worker ratio of Mex$1.8 million, and an average of 1,943.8 workers per firm. Similarly, other automotive subsectors also had more workers per firm compared to the overall economy and to the manufacturing sector. Motor vehicle parts manufacturing firms had the second-highest labor intensity, with an average of 548.1 workers per firm. In Chiapas, similar patterns are observed, where the average motor vehicle parts manufacturing firm employs 520.4 workers, slightly below the national average. However, motor vehicle body and trailer manufacturing firms in Chiapas employ an average of just 3.6 workers, far below the national average of 37.2 (table 1.3).

The average salary in the automotive industry is around 20 percent higher than that in the manufacturing sector. In the automotive industry, motor vehicle manufacturing had the highest hourly wage at almost 200 percent the manufacturing sector's average in 2021. Furthermore, motor vehicle parts manufacturing also had an average wage that is 9 percent higher than that in the manufacturing sector (figure 1.11).[38]

TYPICAL COST STRUCTURE AND PROFITABILITY

A study of the automotive industry in Mexico revealed its strong competitive advantage in labor costs and facilities (figure 1.12).[39] Among a set of main cities analyzed, Chiapas ranked third with lowest cost index, having the lowest labor and facilities costs. However, its transportation costs were higher than average. Raw materials and other costs represent 66 percent of the costs across all locations and sectors (figure 1.13).[40]

The cost structure of the automotive industry was analyzed, dividing it into two categories (1) automobile and light-duty motor vehicles and (2) vehicle parts. It is estimated that raw materials and other expenses (including transportation) represent the majority of production costs for both industries, with 95.1 and 90.3 percent, respectively.[41] Electricity is the primary utility used in both industries, with 1.2 and 2.4 percent of total costs, respectively. Labor represents a higher value for vehicle parts, with 6.7 percent (versus 3.3 percent for automobile and light-duty motor vehicles). Water and combustibles represent a small percentage of the overall cost structure.

TABLE 1.3

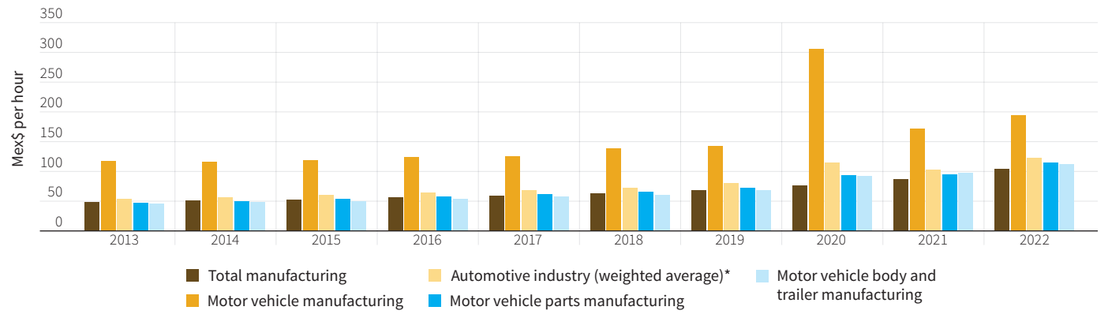
Capital and Labor in the Automotive Industry, 2018

	National	Chiapas
	Capital per firm (Mex$, thousands)	
Overall	2,413.3	1,017.8
Total manufacturing	5,116.1	933.1
Motor vehicle manufacturing	3,570,212.6	n.a.
Motor vehicle body and trailer manufacturing	12,691.1	656.2
Motor vehicle parts manufacturing	206,921.9	31,500.1
Plastic auto parts manufacturing	88,608.0	n.a.
Tire manufacturing	903,070.9	…
Tire retreading	4,469.0	…
	Capital per worker (Mex$, thousands)	
Overall	426.9	343.2
Total manufacturing	456.9	310.1
Motor vehicle manufacturing	1,836.8	n.a.
Motor vehicle body and trailer manufacturing	341.4	182.7
Motor vehicle parts manufacturing	377.6	60.5
Plastic auto parts manufacturing	500.4	n.a.
Tire manufacturing	2,271.9	…
Tire retreading	291.9	…
	No. of workers per firm	
Overall	5.7	3.0
Total manufacturing	11.2	3.0
Motor vehicle manufacturing	1,943.8	n.a.
Motor vehicle body and trailer manufacturing	37.2	3.6
Motor vehicle parts manufacturing	548.1	520.4
Plastic auto parts manufacturing	177.1	n.a.
Tire manufacturing	397.5	…
Tire retreading	15.3	…

Source: Calculations based on data from INEGI 2019.
Note: n.a. = not available.

FIGURE 1.11

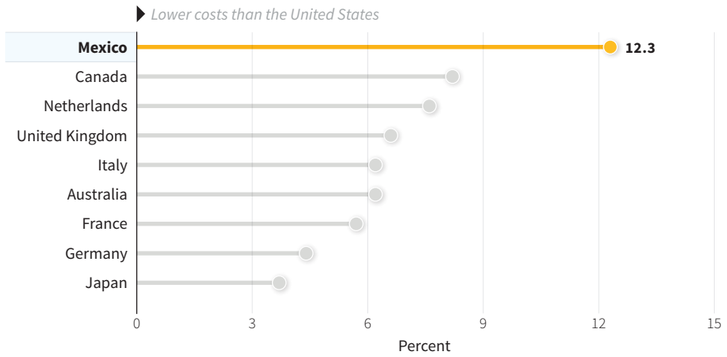
Average Wages in the Manufacturing Sector and in the Automotive Industry



Source: Based on data from INEGI's EMIM database.
*Automotive weighted average is based on the percentage of workers in motor vehicle, motor vehicle body and trailer, and motor vehicle parts manufacturing.

FIGURE 1.12

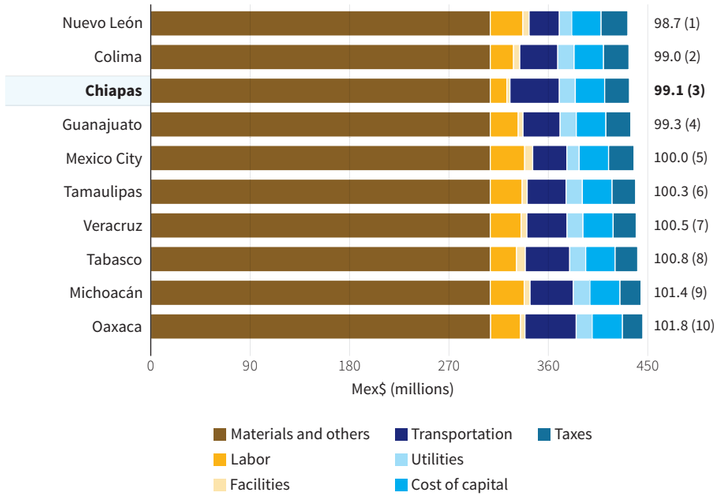
Cost Index for the Automotive Industry, 2016



Source: KMPG 2016.
Note: Business costs scores above zero indicate lower costs than the United States (baseline).

FIGURE 1.13

Cost Index and Cost Structure in Selected States, 2016



Source: World Bank and MMK Consulting 2016.
Note: Index scores below 100 represent a lower cost of business than Mexico City (baseline). Representative cities were considered for each state.

Worldwide, profitability in the automotive sector hinges on production scale and innovative production processes.[42] In 2019, automobile and light-duty motor vehicle firms registered annual earnings before interest, tax, depreciation, and amortization (EBITDA) margins ranging from 4.1 to 7.0 percent and annual net margins ranging from 3.1 and 5.2 percent. Meanwhile, vehicle parts industries registered annual EBITDA margins between 8.3 and 10.5 percent and annual net margins between 4.8 and 6.3 percent.[43]

INDUSTRY LEADERS

According to the International Organization for Automobile Producers, there are 50 major producers of automobile and heavy-duty motor vehicles globally.[44] In terms of production market share in 2017, Toyota leads with 10.8 percent, followed by Volkswagen with 10.7 percent. In auto parts manufacturing, Robert Bosch is on top of the list with US$49.5 billion in sales in 2018, followed by Denso with US$42.8 billion, and Magna International with US$40.8 billion. Aisin Seiki, Continental, Faurecia, Hyundai Mobis, Lear, Valeo, and ZF Friedrichshafen complete the top 10, with sales ranging from US$19.7 billion to US$30 billion.

Most of the firms in the automotive industry in Mexico have a global presence. In terms of units sold in 2019, Nissan leads with 20.3 percent (of 1,317,931 vehicles), followed by General Motors with 16.1 percent, Volkswagen with 10.9 percent, Toyota with 8.0 percent, KIA with 7.3 percent, and the remaining 37.4 percent split between 30 other companies. In terms of auto parts production, Delphi Automotive is the largest with 46 plants across Mexico, followed by Lear with 22 plants, Continental with 16 plants, Yazaki and Faurecia with 13 plants each, ZF Friedrichshafen AG with 11 plants, and Johnson Controls with 10 plants, while seven other firms each operate fewer than 10 plants. Automobile and heavy-duty motor vehicle production and heavy-duty vehicle plants are concentrated in the Valley of Mexico and the North and Bajío regions. Over 50 percent of vehicle parts production is in the North, 29.8 percent is in the Bajío, and the remaining 14.2 is dispersed across other regions. Chiapas accounts for just 0.2 percent of vehicle parts production, mainly from Arnecom-Yazaki's seven plants.[45]

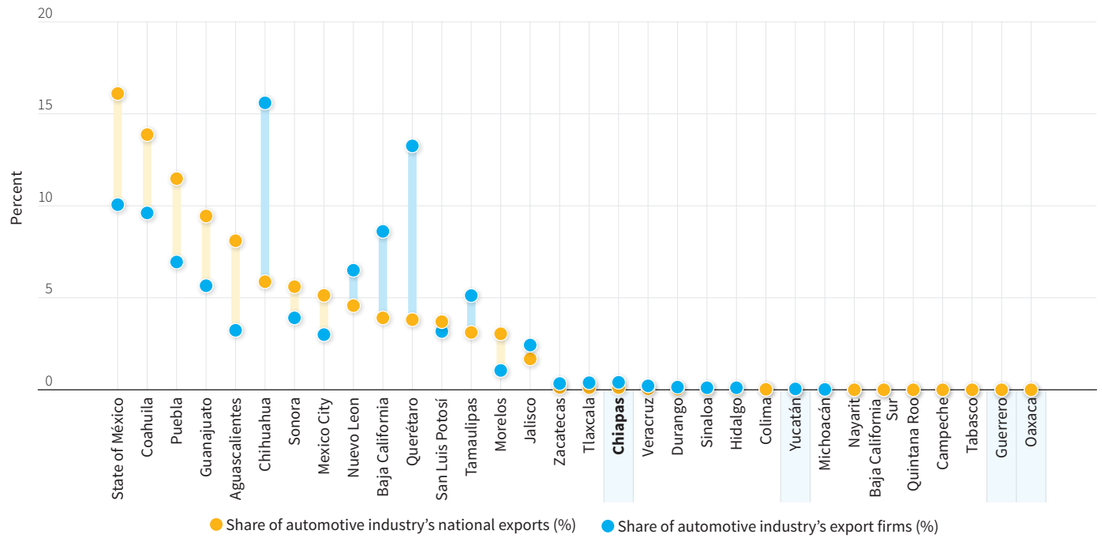
2
Market Potential

EXPORTS

In 2021, the automotive industry represented 6 percent (US$1.3 trillion) of total world merchandise exports, a decrease from 8.3 percent in 1995. Almost 70 percent of total exports are concentrated in 10 countries: Germany (16.9 percent), Japan (10.1 percent), the United States (8.4 percent), Mexico (7.9 percent), China (6.2 percent), the Republic of Korea (5.1 percent), Spain (3.9 percent), France (3.4 percent), Canada (3.3 percent), and the Czech Republic (3.1 percent). Between 1995–2021, global automotive exports grew 4.7 percent annually (from US$388.4 billion to US$1.285 trillion). During the same period, Mexico's automotive exports grew 8.6 percent annually, outpacing the global average. Driven by the North American Free Trade Agreement, Mexico's share increased from 3.1 to 7.9 percent, exceeding that of Canada, which dropped from 10.4 to 3.3 percent. As a result, Mexico is now the fourth largest exporter of vehicles globally. The automotive sector's contribution to Mexico's total merchandise exports rose from 14.9 to 20.5 percent. Prior to the pandemic in 2019, the sector's commercial balance of US$68.8 billion was almost twice as large as remittance inflows (US$36.4 billion) and 4.7 times larger than the commercial balance of tourism (US$14.7 billion).

More than 75 percent of the automotive industry's exports are generated in eight states. The State of México accounted for 16.1 percent, followed by Coahuila (13.9 percent), Puebla (11.5 percent), Guanajuato (9.4 percent), Aguascalientes (8.1 percent), Chihuahua (5.9 percent), Sonora (5.6 percent), and Mexico City (5.1 percent) (figure 2.1). These states also concentrated around 60 percent of all exporting firms in the sector (map 2.1).[46]

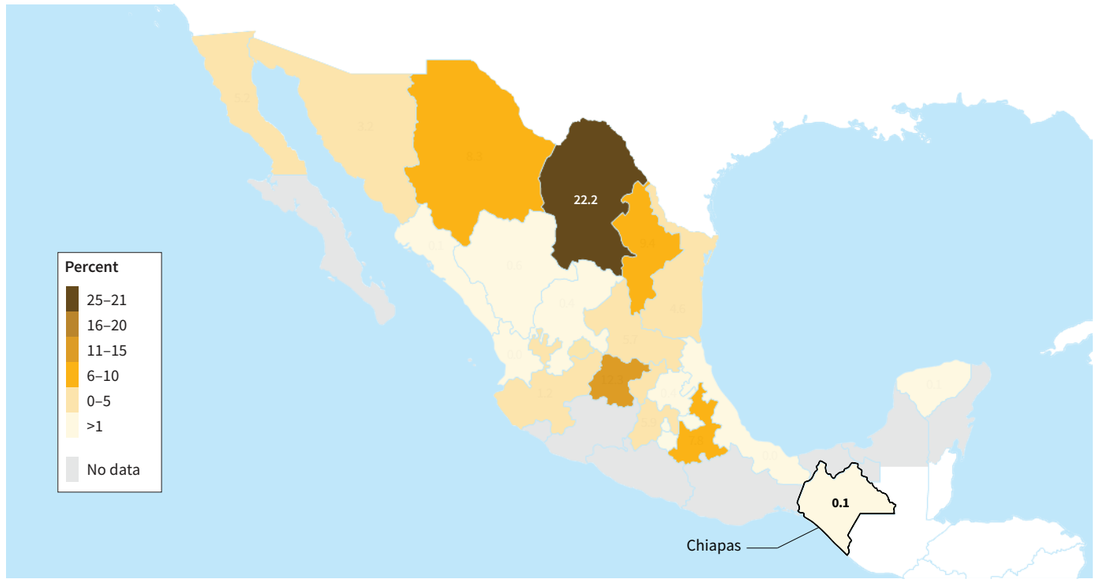
FIGURE 2.1
Automotive Exports and Exporting Firms by State, 2014



Source: Calcultaions based on data from the Mexico Atlas of Economic Complexity.

MAP 2.1

States' Share of Transportation Equipment Manufacturing Exports, 2021



Source: Calculations based on data from INEGI.

Among selected states, only Chiapas and Yucatán have a marginal participation in Mexico's automotive exports.[47] Together, these states represented only 0.25 percent of the country's transportation equipment manufacturing exports in 2021. However, more specific data available for 2014 suggests that Chiapas has a comparative advantage[48] in motor vehicle parts. While Yucatán had a smaller automotive industry presence at that time, it has experienced a growth in recent years.

IMPORT-SUBSTITUTION ANALYSIS

Between 1995 and 2021, Mexico's automotive imports rose from 5.0 to 6.9 percent of total imports.[49] Most of those imports came from the United States, (50.5 percent), followed by China (11.8 percent), Germany (8.2 percent), Japan (8 percent), Canada (4.6 percent), and Korea and India (3.5 percent each). More than 75 percent of the sector's imports are parts and accessories of motor vehicles. Key imports include gear boxes, drive axles, steering wheels, suspension systems, clutches, and automobiles with spark-ignition engines of 1,000–1,500 cubic centimeters (table 2.1). Parts and accessories of motor vehicles concentrated more than 82 percent of Chiapas's automotive industry imports.

TABLE 2.1

Mexico's Top Automotive Imports*

Rank	HS code	Description	Value, 2021 (US$, millions)	Share in total automotive imports, 2021 (%)	CAGR, 2003–21 (%)
1	870840	Vehicle parts; gear boxes and parts thereof	5,109.9	15.3	9.2
2	870829	Vehicles; parts and accessories of bodies, other than safety seat belts	4,739.2	14.2	3.4
3	870899	Vehicle parts and accessories nes	4,026.2	12.0	2.5
4	870323	Vehicles with only spark-ignition internal combustion reciprocating piston engine, cylinder capacity over 1,500 cc but not over 3,000 cc	3,021.3	9.0	−1.3
5	870850	Vehicle parts; drive-axles with differential, whether or not provided with other transmission components, and nondriving axles parts thereof	2,352.3	7.0	9.5
6	870894	Vehicle parts; steering wheels, steering columns, and steering boxes parts thereof	1,874.0	5.6	10.4
7	870322	Vehicles with only spark-ignition internal combustion reciprocating piston engine, cylinder capacity over 1,000 cc but not over 1,500 cc	1,833.5	5.5	23.8
8	870880	Vehicle parts; suspension systems and parts thereof (including shock-absorbers)	1,687.7	5.0	16.2
9	870324	Vehicles with only spark-ignition internal combustion reciprocating piston engine, cylinder capacity over 3,000 cc	1,228.3	3.7	−1.9
10	870870	Vehicle parts; road wheels, and parts and accessories thereof	926.1	2.8	6.7
11	870893	Vehicle parts; clutches and parts thereof	782.4	2.3	12.0
12	870431	Vehicles with spark-ignition internal combustion piston engine for transport of goods of a gross vehicle weight not exceeding 5 tons, nes	634.4	1.9	−4.8
13	870892	Vehicle parts; silencers (mufflers) and exhaust pipes and parts thereof	412.5	1.2	7.5
14	870891	Vehicle parts; radiators and parts thereof	302.0	0.9	4.5
15	870810	Vehicles; bumpers and parts thereof for the vehicles of heading no. 8701 to 8705	216.7	0.6	3.8

Source: UN Comtrade.
Note: cc = cubic centimeter; HS = Harmonized System; nes = not elsewhere specified.
*The import substitution analysis looks at a narrower time horizon (starting 2003) to capture more recent trends in imports.

3

Main Products and Potential Locations

Domestic and external circumstances offer an opportunity for Chiapas to expand its participation in Mexico's automotive industry.

Factors such as increased domestic content requirements under the United States-Mexico-Canada Agreement for this sector (75 percent, up from the 62.5 percent required under the North American Free Trade Agreement), the strategic need for producers in the North and Bajío regions to diversify into more knowledge-intensive segments of the value chain, and the nearshoring trend spurred by the COVID-19 pandemic and other geopolitical trends create an enabling environment for Chiapas to boost its production of relatively simple, low capital expenditure, labor-intensive components. To leverage this opportunity, coordinated federal and state governments support policies are necessary. This coordination should also involve industry leaders from the North and Bajío regions to identify target niches to develop in Chiapas. The aim is to assess their potential interest in sourcing components and services from suppliers in Chiapas or expanding their operations to this state while also ensuring that the state is regarded as a viable destination for automotive investment. This should be complemented by a competitive benchmarking of the potential products, based on the access to raw materials and other inputs, labor and capital requirements, costs, size of market, and logistics responsiveness to supply to the main clients. In the short term, efforts should focus on attracting and consolidating Tiers 2 and 3 auto parts suppliers, given their higher labor weight in total costs (up to 50 percent, excluding larger Tier 2 firms) and their preference for labor-intensive production methods.[50] Chiapas offers a cost advantage in this regard. Moreover, auto parts represent around 38 percent of total automotive industry production in Mexico, amounting to US$94.8 billion in 2021. However, addressing the fragmentation among Tiers 2 and 3 suppliers is crucial for the formation of economies of scale and scope.

Chiapas can leverage the presence of its small but strategic motor vehicle parts manufacturing base to expand its automotive value chain participation. Seven Arnecom-Yazaki plants currently manufacture electric and electronic components in Chiapas, mainly wires and harnesses. These products, despite having slim margins, provide easy access to buyers and show considerable growth potential in the global market (table 3.1).[51] The subsector's contribution to total value added in the automotive industry is relatively small, and its labor-intensive nature makes

TABLE 3.1

Main Products with Growth Potential in Chiapas

Electric and electronic components
➜ Batteries, door locks, security systems (for example, airbag sensors), dashboard accessories, wire harnesses, capacitors, and solenoids
➜ Electrical ignition or starting equipment used for spark-ignition or compression-ignition internal combustion engines*
➜ Electrical lighting or signaling equipment, windshield wipers, defrosters, and demisters*
➜ Revolution counters, taximeters, odometers, speedometers, and tachometers*
Interiors
Seats, airbags, seat belt components (retractors, reel, covers), instrument panels, arm rests, headliners, and related accessories
Other labor-intensive components
Radiator hoses, plates and supports, brakes and driveshaft components, and motor pulleys

Sources: Based on Criscuolo 2015; MGI 2015; Mexico Atlas of Economic Complexity.
*Products were identified using a Harmonized System of four-digit codes.

it vulnerable to renewed offshoring or automation. Nevertheless, establishing a cluster of Tiers 2 and 3 firms specializing in different segments would foster collaboration and synergies, enabling Chiapas producers to gradually increase the knowledge content of their output. In addition, the high value-to-weight ratio of certain goods can help mitigate the state's higher logistics costs compared to the North and Bajío regions.

Electric and electronic components show great promise, with existing production in the state and potential for economies of scale and scope. This includes technological synergies with components for electric cars and other high-tech vehicles. The growing share of these components in total vehicle content is causing demand growth in this segment to exceed overall demand growth for finished vehicles. To harness this opportunity, close collaboration between the private sector and local universities is required to redefine their academic curriculum and develop specialized skills needed for these growing segments.

Finally, the locations to develop the automotive industry in Chiapas could have the following criteria:

1. **Regions with the highest population density:** The municipalities with the highest population in the state are Tuxtla Gutiérrez, Tapachula, San Cristóbal de las Casas, Ocosingo, Comitán, Chilón, Las Margaritas, and Palenque. The regions with the highest population densities are mainly around the urban areas of Tuxtla Gutiérrez, Tapachula, and Palenque. Additionally, the road corridor from Tapachula to Tuxtla Gutiérrez along the Federal Highway 200 also has an important population density, with over 5,000 people per community.

2. **Land ownership:** Common land property represents 59 percent of the state's total area. This type of property presents challenges for many industries because of difficulties to obtain land rights, potential social conflicts, and disruptions to their operations. The regions of Selva Lacandona, De los Llanos, and Altos Tsotzil-Tseltal have the highest concentration of common land parcels. In the southern and metropolitan regions, common land parcels are also present but are more fragmented and smaller. Tapachula and Pijijiapan, located on the coast, have the least number of parcels under this type of property.

3. **Access to infrastructure:** Some segments of the automotive industry can be relatively intensive in the use of energy (electricity) and transportation infrastructure. Indeed, connectivity is another relevant criterion for plant location. Chiapas benefits from relatively more access to energy, railways, primary roads, and ports in the southern and metropolitan regions. Regions within the state with road networks connected to ports in the Gulf of Mexico for shipping containers of parts to U.S. plants, may have logistics advantages to consider. In the case of national shipments, locations with good road transportation are recommended.

4. **Existing plants:** Yazaki's existing plants are strategically located along Tapachula-Arriaga and Arriaga-Tuxtla Gutiérrez corridors. This reference is based on the assumption that the firm has located their plants where the infrastructure and human capital constraints are less severe.

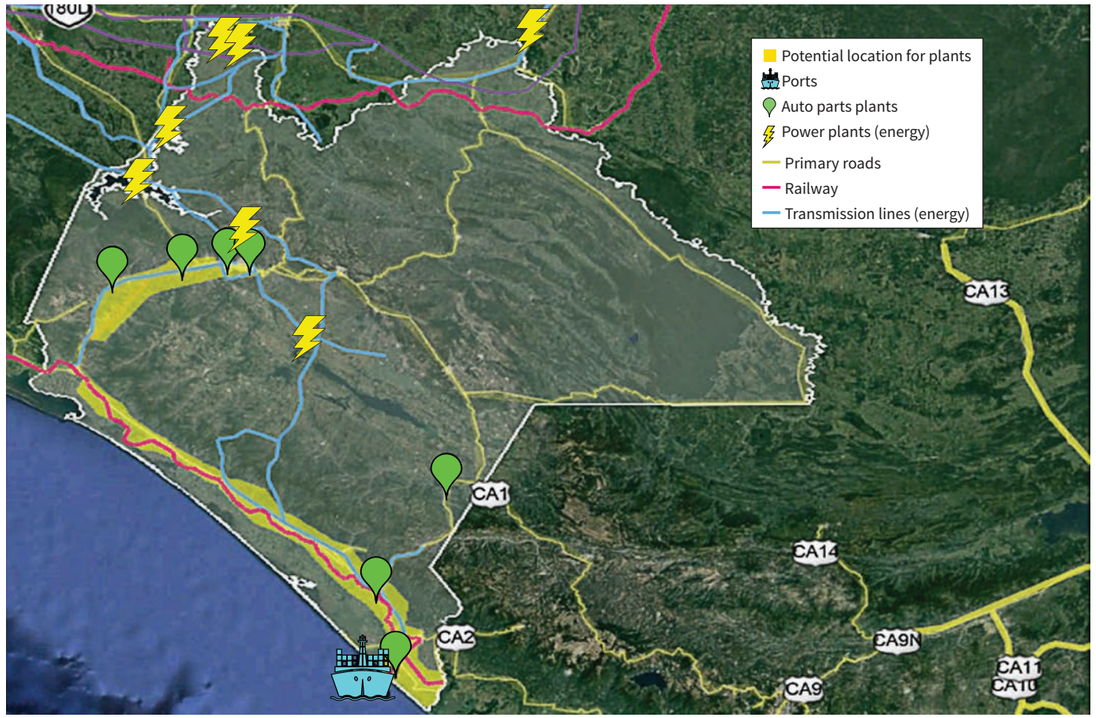
Arnecom-Yazaki's existing plants are strategically located in areas of high population density and closer proximity to transportation and energy infra-

structure. The plants in the south of the state are between one and three hours from Puerto Chiapas (in Tapachula) and near Federal Highway (Fed.) 200 and the railway that connects Tehuantepec in Oaxaca with Ciudad Hidalgo on the Guatemalan border. The plants in the metropolitan region are near the Fed. 190 and 145D. Although they are more than five hours from Puerto Chiapas, they are less than four hours from the ports of Coatzacoalcos, Veracruz and Salina Cruz, Oaxaca.[52]

An analysis of local conditions reveals two strategic locations for automotive development in Chiapas. Map 3.1 shows these regions within the state. The first is the coastal region from Ciudad Hidalgo to Arriaga, which includes border areas offering special tax incentives,[53] the population centers of Tapachula, Huixtla, Mapastepec, Pijijipan, and Tonalá, and important roads, railways, and electricity transmission lines. Communal land ownership is also somewhat less common in this area. The second strategic location is the corridor from Arriaga to Tuxtla Gutiérrez,[54] around the cities of Cintalapa and Ocozocoautla de Espinosa. Communal land ownership is also less common in this region, which has access to roads and transmission lines, as well as possible links to the *Corredor Interoceánico del Istmo de Tehuantepec* (Interoceanic Corridor of the Tehuantepec Isthmus)[55] via Salina Cruz in Oaxaca.[56]

MAP 3.1

Potential Regions to Develop the Automotive Industry in Chiapas



Source: Base map for primary roads, railways, ports, and transmission lines was elaborated using ArgGIS with shapefiles from INEGI's *Biblioteca Digital de Mapas* 2019 edition.
Note: The symbols are only indicative and are not meant to reflect exact locations.

4

Key Challenges and Sector-Specific Constraints

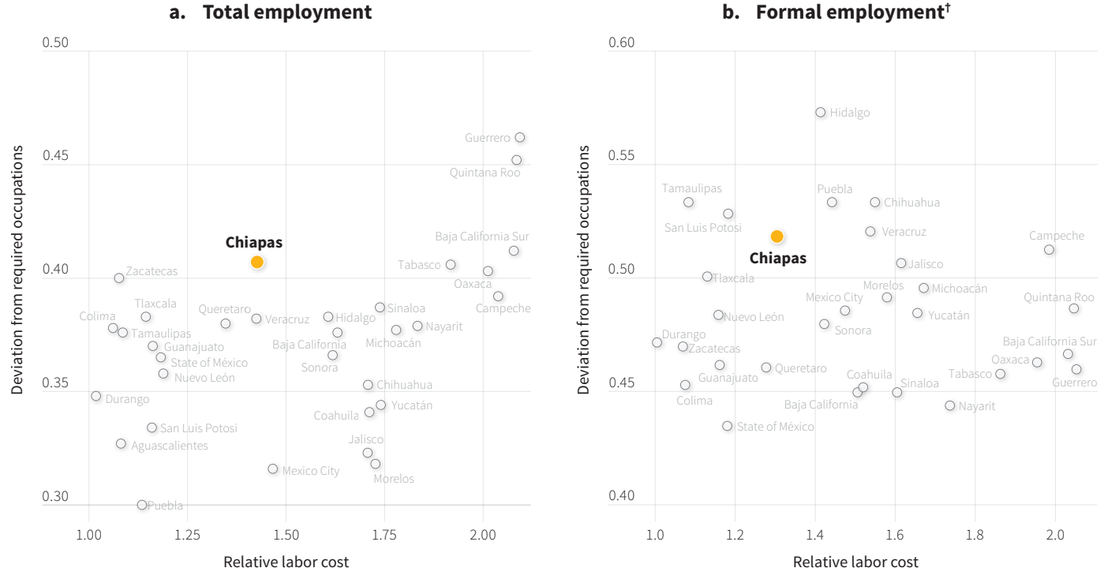
To identify the main constraints for the consolidation of the automotive industry in Chiapas, this section adapts the growth diagnostics decision tree developed by Hausmann, Klinger, and Wagner (2008) at the sectoral level.[57] Applying this framework to Chiapas, the main constraints identified for the automotive industry include human capital gaps, deficiencies in electricity, transport and communications infrastructures, policy and coordination failures, and limited access to finance for small-scale suppliers.

HUMAN CAPITAL[58]

Human capital is an important challenge for the automotive industry in Chiapas, especially for firms striving to access more sophisticated segments of the value chain, although the statistical evidence that this is the main binding constraint in the short-term is inconclusive. While the state has the fourth and seventh highest skill gaps for all workers and formal labor force, respectively, no apparent wage premium is being offered to attract skilled workers—which could reflect that other costs associated with acquiring the human capital in Chiapas are not reflected in the salary alone (figure 4.1).

The dispersed population in Chiapas is a serious challenge for manufacturers who rely on economies of scale in labor-intensive production. Indeed, Arnecom-Yazaki, the leading motor vehicle parts manufacturer in the state, adopted a peculiar expansion model by splitting its production processes and establishing smaller plants across the state near the labor force, instead of expanding its main plant in Tuxtla Gutiérrez. This was a response to the fact that population is scattered around and the lack of labor mobility that has been associated with the high cost of transportation among localities (because of the absence of public transportation options), and the low migration propensity of the state's population, given the rooting of the people to their communities for associated

FIGURE 4.1
Skill Deviations and Labor Cost in Transportation Equipment Manufacturing†



Source: Calculations based on the methodology implemented by Barrios and others (2018a; 2018b) using data from INEGI's ENOE database.
Note: In both panels, the x-axis is the ratio of the average hourly wage ratios at national and state levels, and y-axis is the deviation in occupation shares between national and state levels (using the symmetric mean absolute percentage error), in the first quarter of 2019. In cases where a state has no workers engaged in a particular occupation, the highest salary among all states for that occupation was assigned to reflect the scarcity of workers in that field, necessitating a premium to attract qualified workers.
*Because of the limited disaggregation level of ENOE data, specific automotive subsectors were not analyzed.
†Aguascalientes is excluded from the formal sector analysis because its value is less than three standard deviations (0.325), which falls below the average (0.481). Therefore, it is considered an outlier in this analysis.

risk of losing their share of communal land (main property regime) and other penalties related to the "*usos y costumbres*" system that prevails in most of the state's rural areas (which concentrate more than half of the state population).[59] By implementing this strategy, Yazaki not only found the capable workers they need but also accessed cheaper labor force, because the opportunity cost of this population is in subsistence agricultural activities.

Yazaki's expansion model in Chiapas was possible because its core industrial process, wiring harnesses, is relatively low capital expenditure intensive and the economies of scale to produce very specific auto-parts are relatively low. Yazaki's process allows for the operation of multiple plants instead of a single large one, unlike other kinds of automotive components (for example, vehicle body parts stamping or steel foundries). This suggests that attracting low capital expenditure investments focused on light parts manufacturing activities in Chiapas might be more feasible, as these labor-related issues persist. Nonetheless, Yazaki faced other human capital challenges in operating its first plants in Chiapas, including the lack of an "industrial culture" among the workforce, resulting in high staff turnover and absenteeism, and a shortage of bilingual personnel and employees with technical training, particularly for more sophisticated activities.

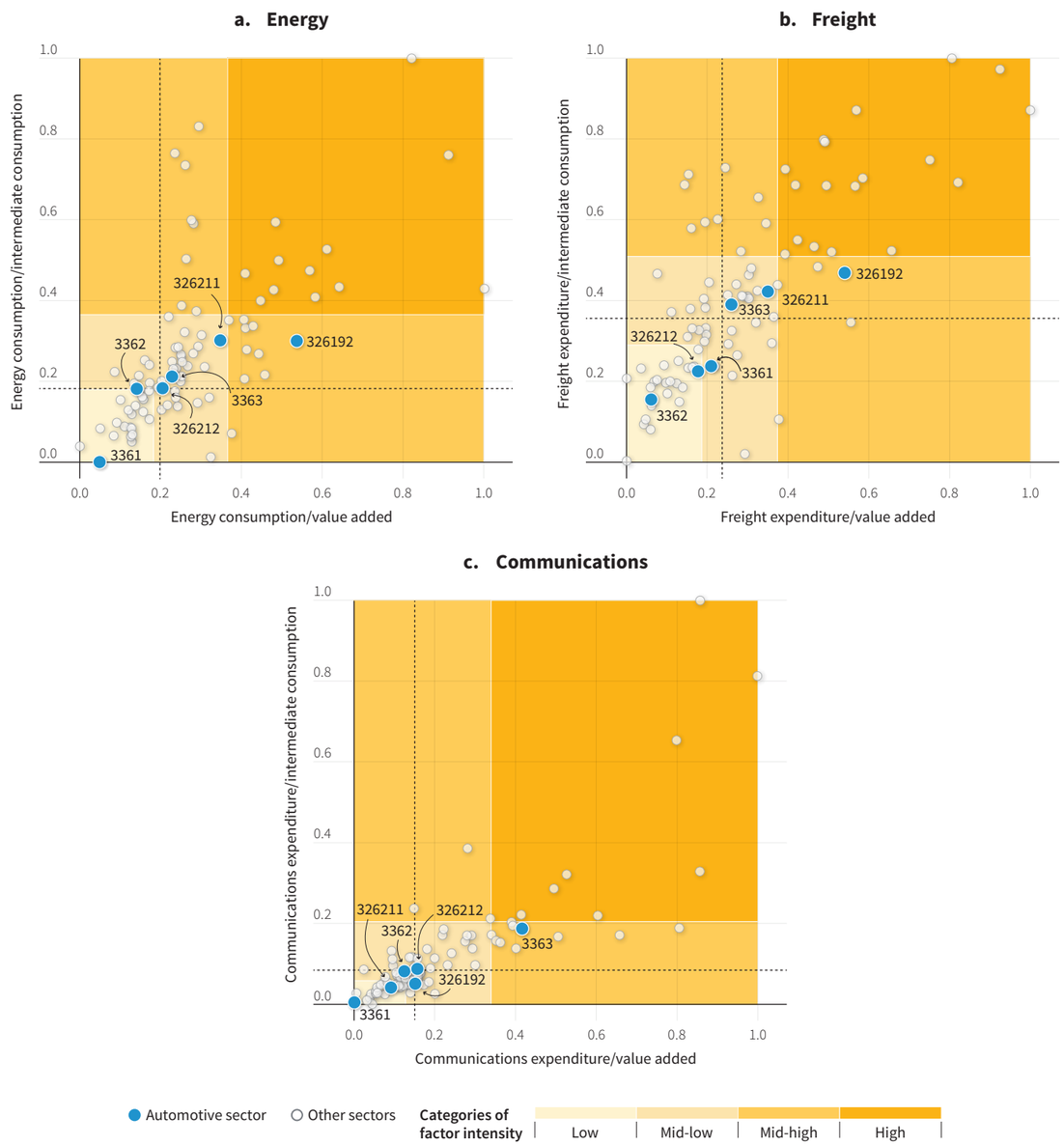
INFRASTRUCTURE AND FACTOR INTENSITY[60 AND 61]

Despite being a significant power producer in Mexico, Chiapas faces electricity transmission and distribution infrastructure challenges and satisfaction of firms with energy services is low. Consequently, electricity access could impose a binding constraint for more energy-intensive segments of automotive production. Although motor vehicle manufacturing and motor vehicle body and trailer manufacturing have relatively low marginal energy requirements, other segments such as motor vehicle parts manufacturing, tire manufacturing, and tire retreading have a mid-low energy intensity. Motor vehicle plastic parts is more energy-intensive, with energy consumption as a percentage of value added exceeding the average for the state's most competitive sectors. Therefore, special attention must be given to auto parts, given their higher energy intensity compared to other activities in the automotive industry (figure 4.2).

Transportation infrastructure is also a potential constraint for certain types of automotive production in Chiapas. Motor vehicle body and trailer manufacturing and tire retreading have the lowest freight requirements compared to the state's competitive sectors. However, motor vehicle manufacturing, motor vehicle parts manufacturing, and tire manufacturing are more transportation-intensive, while motor vehicle plastic parts production has the highest marginal freight requirements. Chiapas has federal highways connecting its main cities, but only three toll roads—Tuxtla Gutiérrez–San Cristóbal de las Casas (Federal Highway [Fed.] 190D), Tuxtla Gutiérrez–Arriaga (Fed. 190D), and Ocozocoautla-Coatzacoalcos (Fed. 145D)—that do not connect to important logistics centers such as Tapachula and Puerto Chiapas. Additionally, Puerto Chiapas has limited capacity and requires dredging every year, which limits its usability. These limitations in logistics capacity and road and port infrastructures could inhibit the development of more transportation-intensive segments of the automotive value chain, notably the auto parts segment.

FIGURE 4.2

Selected Factors Intensity by Sector, 2014 and 2019 Averages



Source: Calculations based on data from INEGI 2014; 2019.
Note: Sectors are classified using the North American Industry Classification System (NAICS). Dashed lines represent the average normalized value of the sectors with a revealed comparative advantage greater than one for Chiapas and those are NAICS sectors 3111, 3112, 3113, 3115, 3116, 3117, 3118, 3119, 3121, 3149, 3219, 3231, 3323, 3328, 3371). Blue points represent group industries of automotive sector in NAICS.

Most automotive activities in Chiapas require low to moderate levels of communications, but some may test the limits of the state's communications infrastructure. Motor vehicle manufacturing and tire retreading are the least communications-intensive, while motor vehicle plastic parts, motor vehicle body and trailer manufacturing, and tire manufacturing have a mid-low communications intensity. Motor vehicle parts manufacturing is the most communications-intensive that is higher than the state's competitive sectors. Limited communications infrastructure in Chiapas could pose a challenge for this sector, as auto parts manufacturers require good telecommunication systems to interact efficiently with their clients and suppliers.

Finally, water and fuel availability does not seem to impose an important constraint on the automotive industry in Chiapas. Most segments of the industry require modest amounts of water and fuel, and both are available in adequate quantities in the state, although challenges in quality of water services remain.

Summing up, deficient electricity, logistics, and communications infrastructure could impose important constraints on auto-parts production, which is the most promising subsector for the state.

INSTITUTIONAL AND MARKET FAILURES

Land tenure is one of the main deterrents to investment in Chiapas.[62] About 59 percent of all land in Chiapas is communal, and the process of establishing private property titles is long and onerous, making it harder to purchase land for manufacturing plants or industrial parks. Communal land rights and other penalties related to the "*usos y costumbres*" system deter migration, especially in rural areas, while a lack of public transportation hinders labor mobility. Although 46 percent of the state's population lives within a 30-kilometer radius of Comitán, San Cristóbal de las Casas, Tapachula, and Tuxtla Gutiérrez, the high transportation cost keeps rural workers isolated from more productive job opportunities. In addition, the government's main housing policy (*Instituto del Fondo Nacional de la Vivienda para los Trabajadores*; Institute of the National Fund for Workers' Housing) is financed by a payroll contribution in formal jobs which increases labor costs and discourages formalization. The use of a payroll contribution to finance affordable housing also creates a paradox: informal rural workers cannot migrate to the urban formal sector because they lack housing, yet they lack housing largely because they are not part of the formal economy.[63] Social conflict and road blockades compound these challenges, further inhibiting industrial development in the state, as highly integrated GVCs demand timely delivery and precise coordination.

Despite previous government intervention that facilitated the establishment of Arnecom-Yazaki in Chiapas, subsequent public policies to attract investment in the automotive sector have been lacking. Unlike the North and Bajío regions, and even the southern state of Puebla, which have witnessed active state productive development policies, the automotive sector is not included in the latest state development plans and lacks specific support programs.

Several market failures prevent the development of more complex economic activities in Chiapas, including coordination failures, information asymmetries, and self-discovery externalities. The absence of design and engineering centers, both in Chiapas and across most of the southern states (except for Puebla), is

a particularly serious constraint to spur the automotive industry in the region. These centers have been crucial to the development of the automotive industry in the North and Bajío regions, which enabled their firms to upgrade productive capacities and integrate into sectoral value chains by continually increasing the quality of the products they manufacture and implementing modern technologies.[64] Addressing this and other market failures will require close collaboration between the public and private sectors.

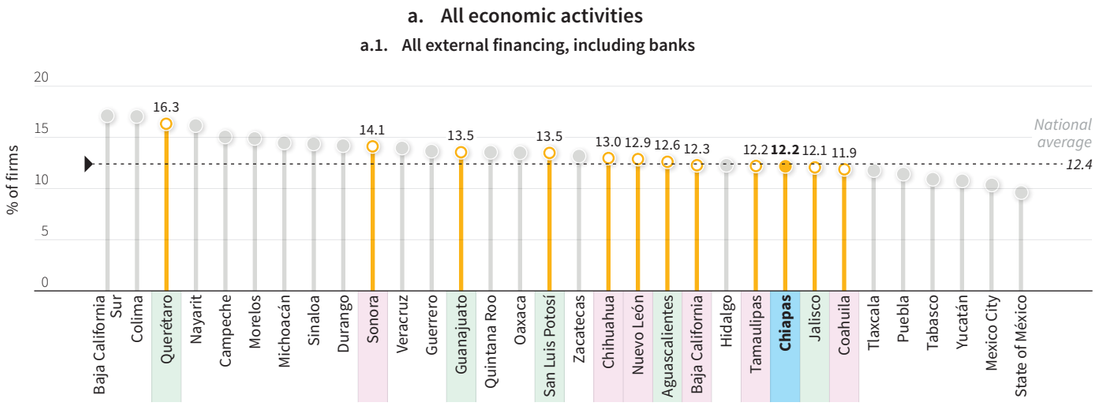
ACCESS TO FINANCE

There is a disparity between large multinational firms in the global automotive industry, which have easy access to international capital markets, and the limitations faced by firms in Chiapas because of the lack of financial services. Although interest rates for automotive firms at the national level are among the lowest for all economic activities, suggesting there is no scarcity of credit supply, the situation in Chiapas is different. The weak financial penetration in the state restricts credit access, potentially hindering investment and growth. In addition, almost one-fifth of municipalities in Chiapas (24 out of 124) lack financial access points. The state has the lowest rate of financial access points per 10,000 adults (only 7.6) in the country.[65] In 2019, the total credit portfolio balance to the private sector was equal to 6.6 percent of the state's nonoil gross domestic product, well below than the levels observed in the North and Bajío regions. Furthermore, firms in the automotive sector in Chiapas are less likely to seek financial support compared to their counterparts in other states, including those in the North and Bajío regions (figure 4.3, panel b). This reluctance to seek finance from banks or other sources could hinder the emergence or growth of local suppliers of goods and services required to support the industry.

According to the 2019 Economic Census, automotive firms in Chiapas primarily use external financing for purchasing inputs domestically and investing

FIGURE 4.3

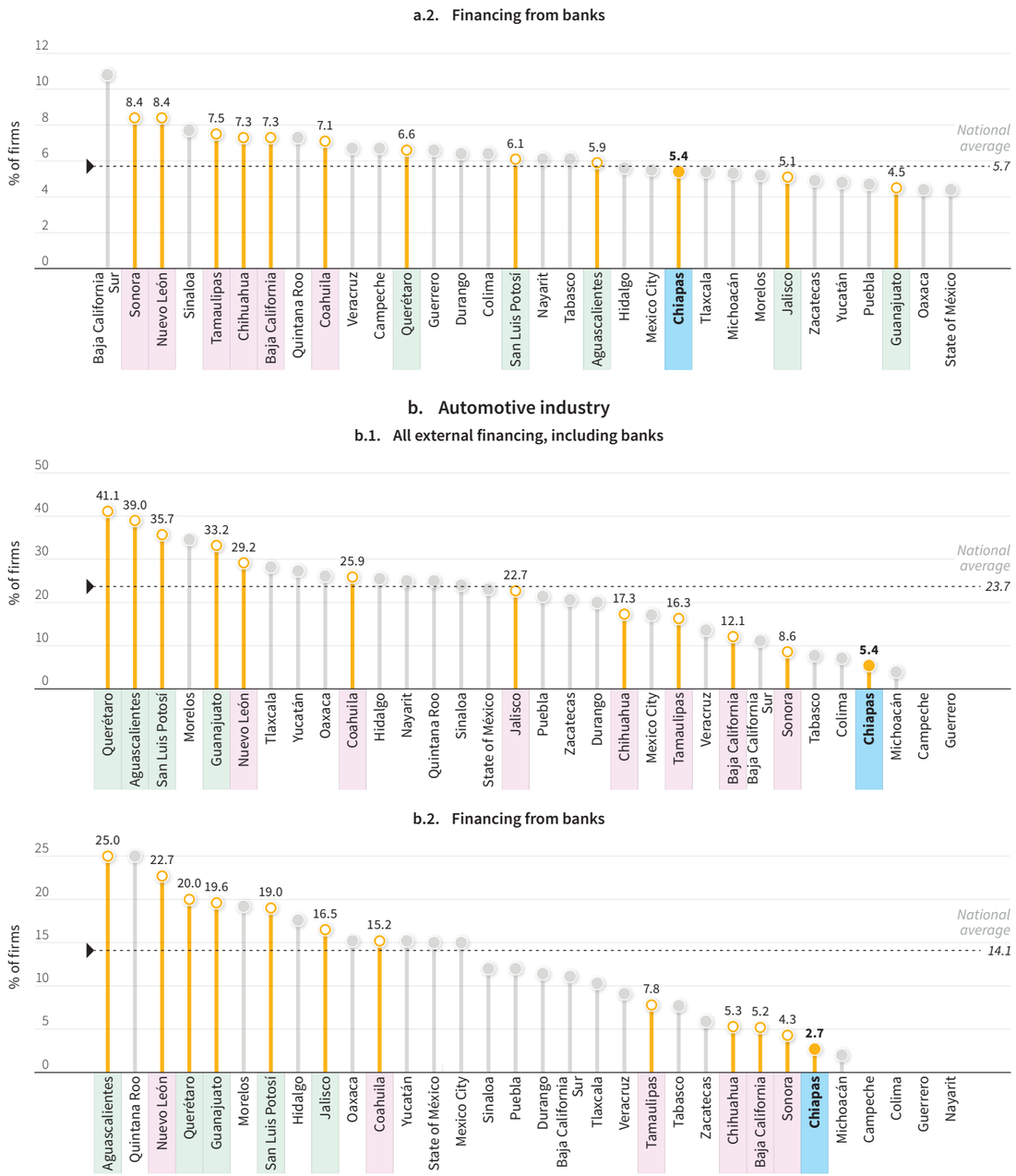
Firm-Level Access to Finance Across States, 2018



(Figure continues next page)

FIGURE 4.3

Firm-Level Access to Finance Across States, 2018 *(continued)*



Source: INEGI 2019.

Note: Automotive industry refers to firms in the transportation equipment manufacturing (North American Industry Classification System three-digit code 336) sector. States in the North region are higlighted in purple and states in the Bajío region are highlited in green. For panel b, it was reported that firms in Campeche and Guerrero did not seek external financing.

in business development.[66] This suggests that firms in Chiapas have similar financing patterns to those in the North and Bajío regions. However, the data reveals that no firm in Chiapas reported using resources from external sources to purchase inputs from abroad, launch initial operations, repay debt, purchase retail space, buy a vehicle, or pay wages. The inadequate access to finance in Chiapas could inhibit the competitiveness of the automotive industry, particularly for small firms and startups as they might face barriers to entry because of high costs in obtaining the necessary financing.[67]

OTHER RISKS AND CHALLENGES

Trends in the global automotive industry present important risks and challenges. Rapid urbanization has led to increased congestion and pollution in cities worldwide.[68] Transportation is a large contributor, generating about 15 percent of total greenhouse gas emissions, including over half of all carbon dioxide and nitrogen oxide (in the United States, this percentage rises to 28 percent).[69] Governments are responding to these challenges by implementing emissions controls, restricting older and high-pollution vehicles, and providing incentives for more environmentally friendly and energy-efficient vehicles. Some countries and cities are even planning to gradually phase out fossil-fuel models altogether.[70] Consumer demand is also having similar trends. An estimated 78 percent of Mexicans born between 1981 and 1996 prefer alternatives to traditional vehicles. Many aspire to own a gas-electric hybrid (38 percent), a plug-in hybrid (15 percent), or a fully electric vehicle (11 percent).[71] The rise of these alternative vehicles will create new automotive value chains for batteries, hybrid engine parts, and related technologies.[72] In April 2021, General Motors (GM) announced a US$1 billion investment in a plant in Coahuila. The plant will produce its first electric vehicles in 2023 and will be the fifth GM plant in North America dedicated to electric-vehicle production by 2035.

While global automotive production transitions away from fossil fuels, a parallel increase in information technology–embedded vehicles is driving the demand for more sophisticated components. In 2023, Tesla announced a US$5 billion investment for the construction of its world's largest plant in Nuevo León, Mexico. As demand for more technologically advanced vehicles rise, Mexican automakers and suppliers must upgrade their industrial capabilities to keep pace. The low production costs and proximity to key markets in the United States, Canada, and Latin America alone will not be enough to meet the demand for knowledge-intensive inputs.

The transition to more sophisticated production methods among established automotive clusters offers an opportunity for Chiapas and other southern states to access labor-intensive segments of the value chain that are currently dominated by firms in the North and Bajío regions or overseas. Nevertheless, firms in Chiapas should aim to upgrade their production capacity for electric and electronic components of high-tech vehicles and avoid relying exclusively on labor-intensive components that eventually could be replaced by new technologies and whose share of the total value added of the industry is low, as the "smile curve" distribution along the value chain indicates for components manufacturing.[73] This strategic push toward more complex products must be carried out gradually. It requires developing the competitive advantages specific to components with positive market prospects over the next 10–15 years.

5
Comparative Advantages to Support

The following analysis is based on the four dimensions outlined in Michael Porter's diamond framework for assessing competitive advantages (figure 5.1).

1. **Factor conditions.** Chiapas has one of the lowest cost indices in the country. The state is highly competitive in terms of the cost of raw materials, capital, utilities, labor, and facilities. However, its labor productivity is below the national average, land fragmentation and unclear property rights deter investment, education indicators are weak, population dispersion and low labor mobility hinder the formation of economies of scale, and informality is pervasive. Chiapas lacks a design and engineering center. The development of the automotive industry in Chiapas will also require new public and private investments in electricity, transportation, and logistics infrastructure.

2. **Demand conditions.** Mexico has preferential access to nearly 50 external markets, including the United States, the European Union, and major Asian countries. Mexican environmental standards for vehicle fuel consumption are on par with those of the United States but lag those of many Asian and European countries, posing a challenge to export growth and diversification. Mexico also has a large domestic market for automobiles. However, access to international and domestic markets is concentrated in the North and Bajío regions. Relatedly, Chiapas is close to the Central American market, an underserved market for Mexican exports of intermediate and final goods.

3. **Supporting and related industries.** The Mexican automotive industry benefits from low interest rates at the national level; however, underdeveloped financial infrastructure in Chiapas could hinder the industry's growth. In addition, inadequate transportation services reduces worker mobility. As a result, automotive production in Chiapas has been limited to decentralized labor-intensive models, which may only be suitable for certain components and market segments, inhibiting the development of economies of scale and agglomeration effects.

4. **Context for strategy and rivalry.** Mexico's automotive industry has grown rapidly in the last two decades, outperforming other economic activities and attracting significant foreign investment. Mexico is tightly integrated into the automotive global value chains and is among the top exporters in the sector worldwide. However, three-quarters of automotive exports is concentrated in eight states in the North and Bajío regions, while Chiapas contributes only marginally. Chiapas has the opportunity to position itself as a supplier to established clusters in other states. This can be achieved by taking advantage of the increased regional content requirements established in the United States-Mexico-Canada Agreement and the transition of some existing firms into more complex segments of the value chain.

FIGURE 5.1

Key Comparative Advantages to Develop in Chiapas

Source: Adapted from Porter 2008.
Note: FTAs = free trade agreements; R&D = research and development; USMCA = United States-Mexico-Canada Agreement.

6
Policy Recommendations

To accelerate the growth of the automotive industry in Chiapas, this chapter offers a set of policy recommendations on creating and strengthening public (or semipublic) goods and addressing market failures through interventions.[74] To avoid unintended consequences and ensure effectiveness, the interventions need a comprehensive design, implementation, and evaluation processes. They must have a strong business rationale, be proportionate to the market failure being addressed, and be adjusted to the institutional capacity of the federal and subnational governments.

PUBLIC GOODS

1 **Support the development of automotive clusters** to enable the formation of economies of scale and agglomeration effects, increase productivity, and facilitate the dissemination of knowledge.

- **Create a public trust to acquire, manage, and allocate land for establishing industrial parks** in partnership with the *Asociación Mexicana de Parques Industriales Privados* (Mexican Association of Industrial Parks). The over 500 hectares of land previously allocated for the cancelled special economic zone (SEZ) close to Puerto Chiapas, eligible for tax incentives, could serve as a first land bank for establishing industrial development. Management rights for the parks should be awarded on a concessional basis to private operators via a transparent tender process.
- **Create efficient public transportation systems** linking industry clusters with population centers and establish housing programs to facilitate rural-urban migration.

2 **Modernize local universities' curricula and establish automotive technical institutes to meet industry-specific workforce skills requirements,** which include business-proficient level of English and other languages.

3 **Improve inter and intraregional transportation infrastructure** to connect the state and its potential automotive clusters with established production centers in the North and Bajío regions and international markets via Puerto Chiapas.

4 **Create an effective mechanism for public-private collaboration to facilitate the creation of productive links between the North and Bajío regions and Chiapas.** The collaboration would focus on attracting and retaining Tiers 2 and 3 firms to the state. These firms will bring knowledge transfer to local counterparts as they integrate into domestic and international value chains.[75]

- **Establish a state-level public-private agency responsible for identifying, attracting, and retaining investors in the automotive industry.** The agency would organize high-level outreach efforts to attract automotive firms with limited or no presence in Mexico. The initial focus should be on replacing Asian imports with local production that is currently not supplied at competitive production scale, as well as foreign plants interested in locating in Mexico to comply with the new regional value content requirement under the United States-Mexico-Canada Agreement or harness the nearshoring trend.
- **Implement demand-driven supplier-development programs** to help small and medium enterprises (SMEs) improve their production capacity. It should be complemented by financial support for working capital and technical assistance to obtain the necessary certifications to integrate into the automotive supply chain. The program should be targeted towards segments where original equipment manufacturer and Tier 1 firms in the North and Bajío regions are engaged. The program should foster collaboration between SMEs and established firms to ensure adequate demand for the outputs produced in Chiapas and to facilitate future production upgrades through interfirm links.

- **Create an online platform that would serve as a connecting point between large automotive producers across the country with supplier firms in Chiapas.** The goal is to enable the sourcing of inputs from supplier firms in Chiapas to meet the need of the automotive producers.

5 **Create a single window for regulatory compliance for the automotive industry,** in coordination with the operations of public agencies at all levels of government to minimize the administrative burden associated with new investments or the expansion of existing firms. It could also serve as a focal point for accessing necessary support services offered by the public sector, including soft landing assistance, aftercare, and aid with formalization.

6 **Establish a thematic research and development (R&D) center in Chiapas,** in collaboration with state universities, the *Consejo Nacional de Humanidades, Ciencias y Tecnologías* (National Council of Humanities, Science, and Technology), and major industry firms, to improve local productive capacities and enhance the quality of industrial products.

MARKET INTERVENTIONS

1 **Complement support for the consolidation of automotive clusters with well-designed fiscal incentives and long-term financial programs offered by development banks,** to promote joint ventures between foreign and domestic Tiers 1, 2, and 3 firms and enable knowledge transfer. Eventually, the incentives can be phased out once the firms benefit from the agglomeration externalities of the developing cluster.

2 **Establish an incentives program for R&D activities and technology transfer** to promote the gradual upgrading of the automotive industry in Chiapas and enable firms to access more sophisticated market segments. Possible incentive mechanisms include subsidies, special purpose funds, tax breaks, and support for filing patents.

Appendixes

APPENDIX A

Detailed Policy Recommendations

This appendix presents a set of public policy recommendations organized in measures aimed at creating or strengthening public goods, and others at correcting market failures through market interventions. These policies are not exhaustive and should be complemented, deepened, and adapted to the particularities of the state, target market, products to be developed and specific investments aimed to be attracted, retained or expanded. A comprehensive and continuous public-private interaction is crucial to complement the diagnostic and calibrate the proposals. This coordination should involve not only local actors but also leading firms, potential investors, academic institutions, and successful governments in similar productive strategies. The focus should be not only in increasing the competitiveness environment to develop the sector but also in potentializing the benefits and spillover effects and minimizing any potential negative externality.

PUBLIC GOODS

1 Implement a medium- and long-term strategy plan to foster the growth of strategic economic sectors, including the automotive industry. An amendment to the Planning Law of Chiapas to mandate that state development plans include a 20-year industrial policy is recommended. This would promote consistency among local administration in prioritizing strategic sectors and effectively allocate public resources to support their development.

2 Develop and execute an infrastructure plan with a pipeline of state and regional projects, prioritizing based on feasibility and impact on the development of the automotive industry in Chiapas. The plan should identify potential financing sources (public and private) and conduct feasibility studies for project implementation. The plan should consider projects that:

- Improve inter and intraregional transportation infrastructure to connect the state with the North and Bajío regions (road corridors, highways, and railways) and with international markets (notably Port Chiapas).
- Improve electricity transmission and distribution infrastructures to guarantee a constant and reliable energy supply.
- Facilitate access to natural gas through public and/or private investments in pipelines that connect to the state, potentially enabling the supply of Central America as well.
- Establish efficient public transportation systems connecting productive areas and main population settlements, which can serve as a potential source of labor force.

3 Establish a public-private agency responsible for identifying and attracting potential investments from Tiers 1, 2, and 3 segments aligned with industry needs in the North and Bajío regions. The agency would coordinate public-private actions to meet the requirements of these firms. The short-term goal should be to attract domestic or foreign firms specializing in manufacturing auto parts to substitute Asian imports that are not being supplied at a competitive scale, ensuring compliance with the new regional value content requirements established in the United States-Mexico-Canada Agreement. The long-term goal should be to attract at least one major assembly plant along with its main suppliers. The strategy of the agency should include the following:

- Establish a partnership with the main stakeholders from the North and Bajío automotive clusters, supported by the federal government (through its development banks, as well as the *Secretaría de Hacienda y Crédito Público* (Secretariat of Finance and Public Credit) and the *Secretaría de Economía* (Secretariat of Economy; SE). This partnership would be coordinated through a sectoral working group.
- Incentivize the formation of an auto parts manufacturing cluster in the state to maximize economies of scale, increase productivity, and facilitate knowledge dissemination.
- Foster the development of industrial real estate for automotive manufacturing activities, similar to the experience in the North and Bajío regions, where the state governments created a public trust to acquire, manage, and provide the land for establishing anchor firms or industrial parks, while private entities provided the infrastructure and supporting services. The government of Chiapas could lead this effort, with support from the federal government and its development banking institutions. The over 500 hectares of land previously allocated for the cancelled special economic zone near Puerto Chiapas and within the area where temporal

tax breaks are granted, could serve as a first land bank for this purpose. Support could be provided for developers and operators to obtain the Authorized Economic Operator certification to ensure safe and secure trade with Canada and the United States. Establishing a partnership with the *Asociación Mexicana de Parques Industriales Privados* (Mexican Association of Industrial Parks) is strongly recommended for this purpose.

- Implement demand-driven supplier development programs for small and medium enterprises to improve their production capacity for industry-required inputs. The program should include financial support for working capital and equipment investments, as well as assistance in obtaining required certifications and standardization processes to integrate into the automotive supply chain. The programs should be targeted towards segments where procurement offices of key North and Bajío firms, or potential anchor firms considering installation in the state, are engaged. This would ensure a minimum scale and demand for products with potential for upgrading.
- Develop a directory of enterprises in Chiapas that have potential involvement in the automotive value chains, either directly or indirectly, through product provision or complementary services. This platform should eventually evolve into a marketplace where companies could post their needs and be connected with local companies that would fulfill them. Authorities should provide administrative support to help informal firms transition into the formal economy, allowing them to join the platform and benefit from the sector's development. The SE's *Sistema de Información Empresarial Mexicano Digital* (Enterprise Information System) platform could be leveraged to develop alpha and beta versions of the directory.
- Create a single window or one-stop-shop for the automotive industry, in coordination with all levels of government, to streamline and simplify the regulatory compliance for new investments and existing firms' expansions. It could also serve as a focal point for accessing necessary support services required for a soft landing and aftercare of foreign direct investment (FDI).
- Organize high-level roadshows to attract key automotive industry players, prioritizing Asian companies like Kia and Toyota as well as Chinese firms such as Byd, Geely, and Saic, because of their limited presences in Mexico, compared to Ford, General Motors, Nissan, and Volkswagen. In addition, establishing contact with Tesla Motors, which has manufacturing activities in China and recently announced a US$5 billion investment in Northern Mexico, is recommended to identify potential supply requirements.
- Collaborate with sectoral agencies at the central and subnational levels to modernize the curricula and academic programs of local universities, and establish automotive technical institutes to serve specific industry skill requirements. These institutes would focus on developing occupational skills, labor competencies, and business-proficient levels of English and other foreign languages. Initially, these centers could be hosted by local universities.

4. Level the playing field for FDI attraction by expanding federal government efforts beyond the typically targeted North and Bajío regions to include all states, and enhance the state's capacities each state's capacities to attract investment.

5. In the medium term, establish a research and development center for the automotive industry in the state, collaborating with universities, the *Consejo Nacional de Humanidades, Ciencias y Tecnologías* (National Council of Humanities, Science, and Technology), and major industry firms, to improve the local productive capacities and quality of manufactured products. In so doing, Chiapas would become the first state in the south with a specialized institution for the sector. Among the facilities to consider are test and metrology labs, design centers, software labs, and vehicle testing centers, which are essential to drive technology development in the industry.

MARKET INTERVENTIONS

1. Explore the adoption of incentives to attract anchor firms and promote FDI joint ventures or alliances with key companies across different tiers. This would enable the productive knowledge and technology sharing between foreign and domestic firms. Eventually, the incentives can be phased out once the firms benefit from the agglomeration externalities of the developing clusters.

APPENDIX B
Assessment of Human Capital Constraints

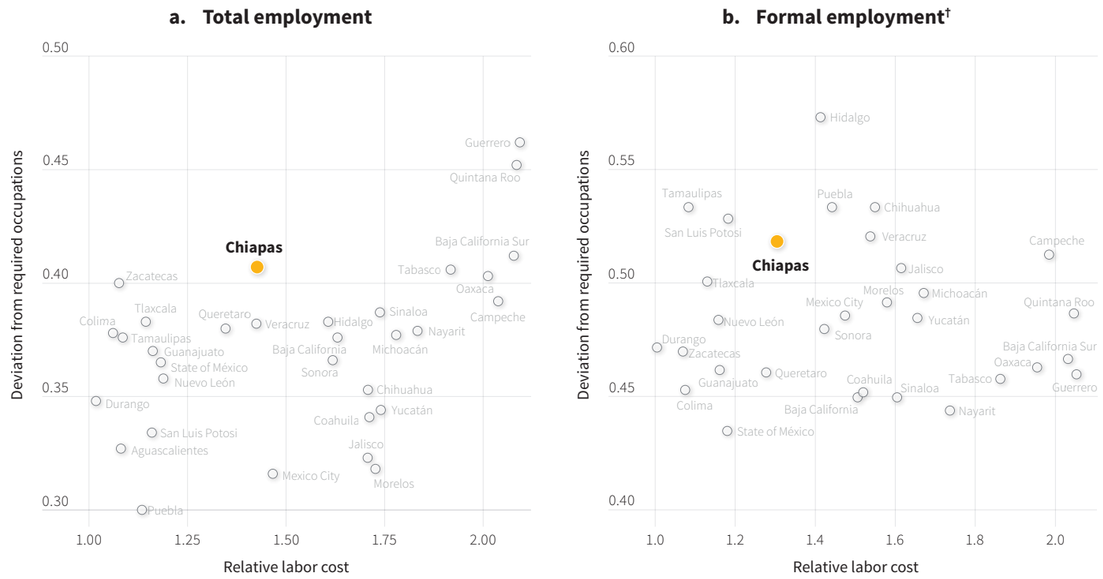
Human capital seems to be a significant barrier to the development of the automotive industry in Chiapas, especially if the state aims to participate in more complex stages of the value chain. Nevertheless, it is important to estimate the current extent to which this constraint is limiting the growth of the industry. For this purpose, an analysis of the availability and cost of labor force is carried out, following a methodology implemented by Barrios and others (2018a; 2018b), using data from the *Encuesta Nacional de Ocupación y Empleo* (National Survey of Occupation and Employment; ENOE) and information from the *Sistema Nacional de Clasificación de Ocupaciones* (National Classification System for Occupations). Because of the limited disaggregation level of ENOE data, the analysis focuses on the broader transportation equipment manufacturing category, which includes the automotive industry. First, we calculate the deviation between the share of existing occupations at the national and state levels, using the symmetric mean absolute percentage error to measure the availability of workers performing the occupations required. Second, we compare the relative labor costs in each state to the national level to measure the relative availability or scarcity of qualified human capital reflected in the price.[76] The analysis considers the total employment (formal and informal) and only the formal sector, taking into account the high prevalence of informality in Chiapas and the salary gap between formal and informal jobs.

From this approach, the evidence of human capital as the main binding constraint is inconclusive. Figure B.1 shows that Chiapas exhibits one of the highest deviations from the required occupations considering both formal and informal workers (fourth highest among Mexico's 32 states) and only formal jobs (seventh highest). In terms of relative salaries, Chiapas ranks in the lower half among

all states, which applies to all workers and formal jobs. This implies that there is no wage premium to incentivize workers to join the sector. Yet, it is possible that there are other costs associated with acquiring the necessary human capital that are not adequately reflected in the salary alone.

The challenge of finding capable labor force in Chiapas for the most basic subsector in the automotive industry has been acknowledged by Hausmann, Cheston, and Santos (2015) and Levy and others (2016). Arnecom-Yazaki, the leading motor vehicle parts manufacturer in Chiapas, adopted a unique expansion model by splitting its production processes and establishing smaller plants across the state near the labor force, instead of expanding its main plant in Tuxtla Gutiérrez. This strategy required a special transportation system centered around the main plant. This was influenced by the scattered population and limited labor mobility in the region. High transportation costs among localities, resulting from the absence of public transportation options, along with the strong attachment of the population to their communities, contributed to a low inclination for migration. This attachment was reinforced because of the risk of losing their share of communal land (main property regime) and other penalties related to the "*usos y costumbres*" system that is predominant in most of the state's rural areas, where more than half of the population resides. By im-

FIGURE B.1
Skill Deviations and Labor Costs in Transportation Equipment Manufacturing*



Source: Calculations based on the methodology implemented by Barrios and others (2018a; 2018b) using data from INEGI's ENOE database.
Note: In both panels, the x-axis is the ratio of the average hourly wage ratios at national and state levels, and y-axis is the deviation in occupation shares between national and state levels (using the symmetric mean absolute percentage error), in the first quarter of 2019. In cases where a state has no workers engaged in a particular occupation, the highest salary among all states for that occupation was assigned to reflect the scarcity of workers in that field, necessitating a premium to attract qualified workers.
*Because of the limited disaggregation level of ENOE data, specific automotive subsectors were not analyzed.
†Aguascalientes is excluded from the formal sector analysis because its value is less than three standard deviations (0.325), which falls below the average (0.481). Therefore, it is considered an outlier in this analysis.

plementing this strategy, Yazaki not only found the capable workers they need but also accessed cheaper labor force, because the opportunity cost of this population is in subsistence agricultural activities. This is possible because the core industrial process of Yazaki, which specializes on wiring harnesses, requires relatively less capital expenditure. It is made of a wide array of single, production cells or lines dedicated to a specific set of harnesses for a specific vehicle model or range of models. Consequently, the economies of scale related to the manufacturing process are relatively low. Yazaki's process allows for the operation of multiple small plants instead of a single large one, unlike for other kinds of automotive components (for example, vehicle body parts stamping or steel foundries). This suggests that attracting low capital expenditure investments focused on light parts manufacturing activities in Chiapas might be easier, as these labor related issues persist. Nonetheless, Yazaki faced other challenges in operating its first plants in Chiapas, including the lack of an "industrial culture" among the workforce, resulting in high staff turnover and absenteeism. Furthermore, there was a shortage of bilingual personnel and employees with technical training, particularly for more sophisticated activities.[77]

APPENDIX C

Infrastructure Conditions in Chiapas

To identify potential infrastructure-related constraints that could hinder the development of the automotive industry in Chiapas, this appendix presents the analysis of key inputs for the production processes, namely electricity, water, combustibles, transport, telecommunications infrastructure and other sector-specific infrastructure. The findings in this appendix are combined with the analysis of use intensity of each input by the automotive subsectors (see appendix D) to determine whether potential mismatches between the provision of infrastructure services and their demand are limiting the growth of the sector. [78]

ELECTRICITY

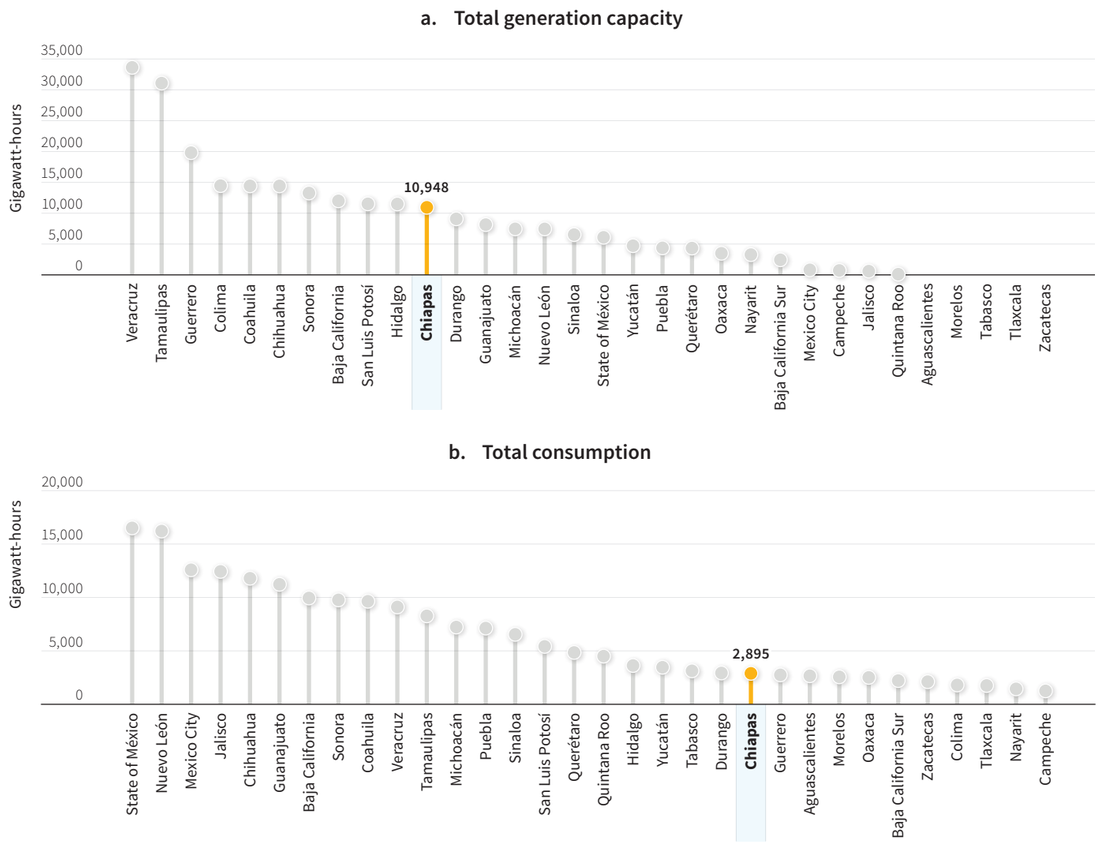
To assess the condition of electricity infrastructure in Chiapas, various comparisons are made across states regarding factors such as generation, consumption, and balance, as well as access, satisfaction levels, and distribution capacities.

In Chiapas, the difference between generation and consumption is considerable, with 278 percent higher generation capacity (figure C.1, panel c). This surplus is because of the several hydroelectric power plants in the central and northern part of the state, which makes electricity production not a problem for it. However, despite some improvements in terms of household electricity access in Chiapas during the last decade, figure C.2 shows that the state's proportion is the second lowest in the country (97.7 percent as of 2020).

Figure C.3 shows that only 35 percent of firms say they were satisfied with the overall electricity services in Chiapas, which is well below the national average (46.2 percent) and one of the lowest shares in the country. Moreover, although 68.8 percent of firms consider that the service is continuous, a similar

FIGURE C.1

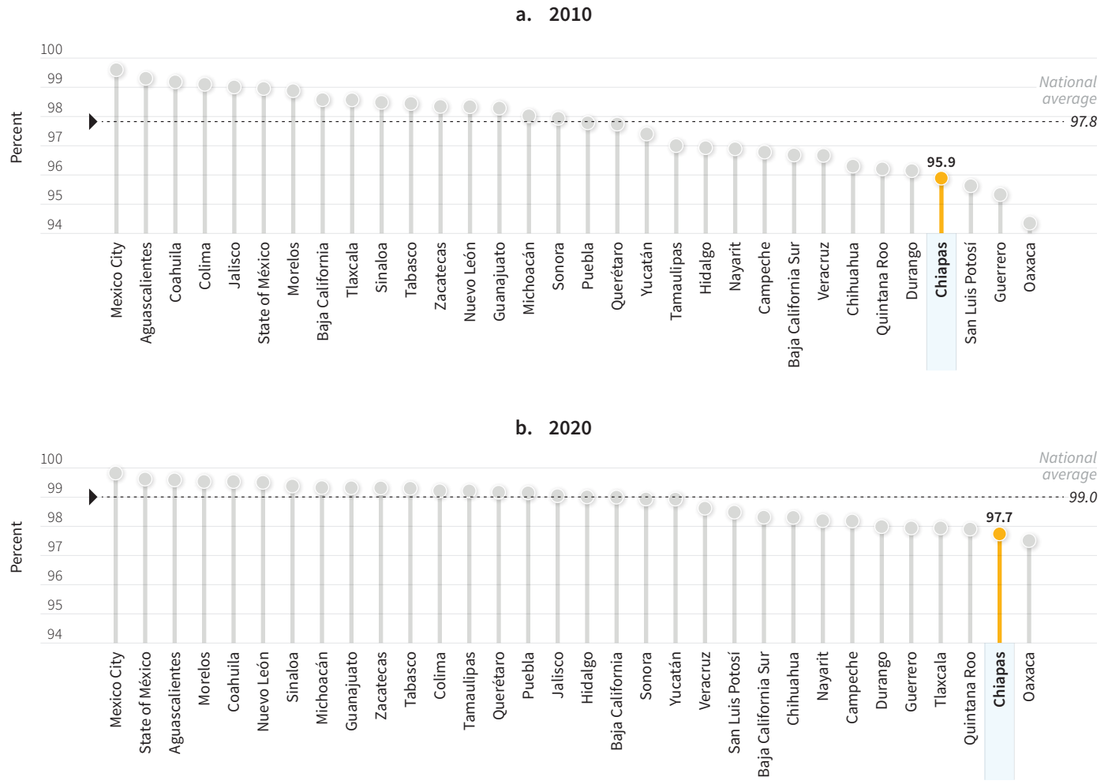
Electricity Generation and Consumption, State Comparison, 2017



Source: Calculations based on data from SENER's SIE database.
Note: The most recent available electricity generation and consumption data is for 2017.

FIGURE C.2

Households with Access to Electricity, State Comparison



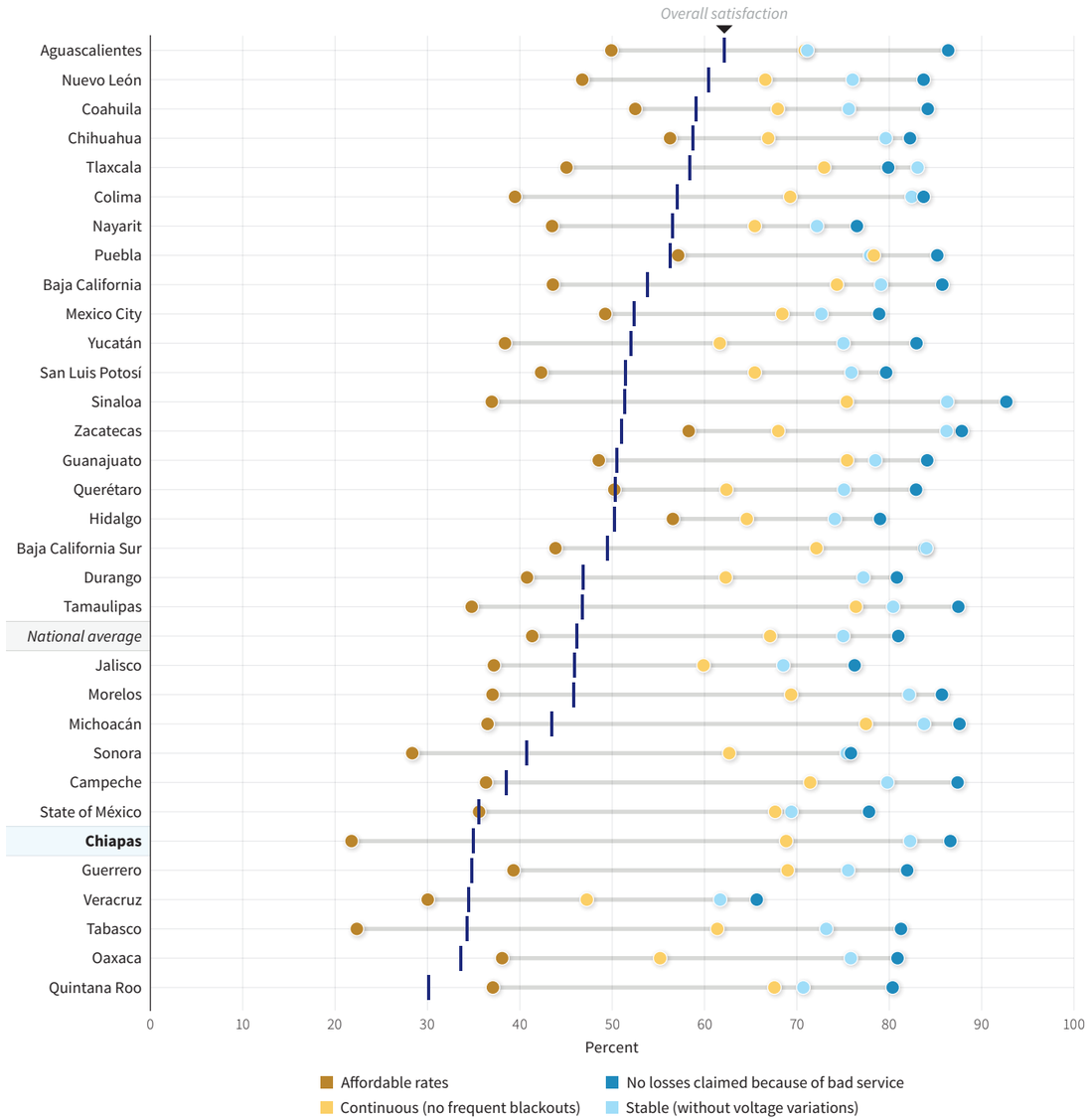
Source: Based on data from INEGI 2010; 2020.

proportion to the national level (67.1 percent), only 21.8 percent consider electricity to be affordable, half the perception at the national level (41.3 percent).

An important consideration for understanding the potential electricity availability is the existing infrastructure of the national electricity system. As map C.1 illustrates, Chiapas has a main transmission line (400 kilovolts [kV]) that goes from Tapachula to Tuxtla Gutiérrez and intersects through the state of Tabasco. However, the rest of Chiapas lacks transmission lines of 400 kV or 230 kV. This makes the distribution of high energy volumes to the rest of the state's regions more difficult.

FIGURE C.3

Firms' Satisfaction with Electricity-Related Services, 2016



Source: Based on data from INEGI 2016.
Note: The survey included an assessment of energy services only until 2016.

MAP C.1

Mexico's National Electricity System, Southern and Peninsular Regions, 2018

Source: CENACE 2018.
Note: kV = kilovolts.

WATER

To determine whether the provision of water services could pose a challenge to the productive development of Chiapas, we used a series of indicators to understand how much water is available and how its supply is perceived for production processes.

First, the availability of water resources is evaluated. Maps C.2 and C.3 show that the availability of superficial and underground water in Chiapas is adequate. Therefore, this is not a constraint for productive activities requiring this input.

The second factor looks at the level of satisfaction of firms with the water provision services. Figure C.4 shows that Chiapas has the lowest levels of satisfaction for water services in 2020. Moreover, between 2016 and 2020, the share of satisfied firms dropped by half, from 29.6 to 15.1 percent. The greatest deteriorations were observed in the proportion of firms considering that water is pure and clear, potability is adequate, and its quality does not affect their machinery, which dropped to 19.4, 19.7, and 19.9 percent, respectively. Yet, the perception of service affordability increased to 84.9 percent (figure C.5). Although these results reflect the impact of the pandemic, the quality of water services must be improved to guarantee an adequate supply for industries that are intensive in its water use.

To evaluate whether the quality of water supply is compromised by a pricing and collection system unable to ensure the financial sustainability for operation, figure C.6 shows a comparison of costs, fares, and the efficiency of local water

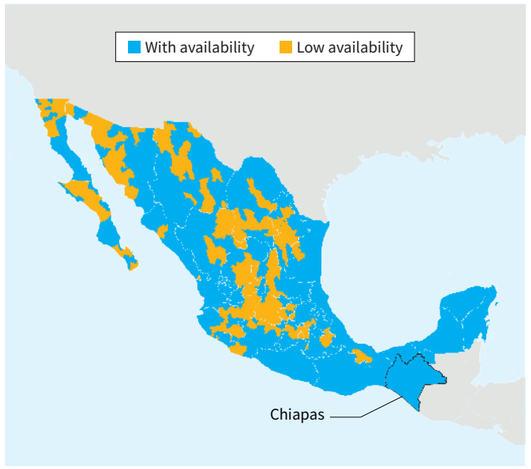
MAP C.2

Superficial Water Availability in Mexico, 2016

Source: CONAGUA 2017.

MAP C.3

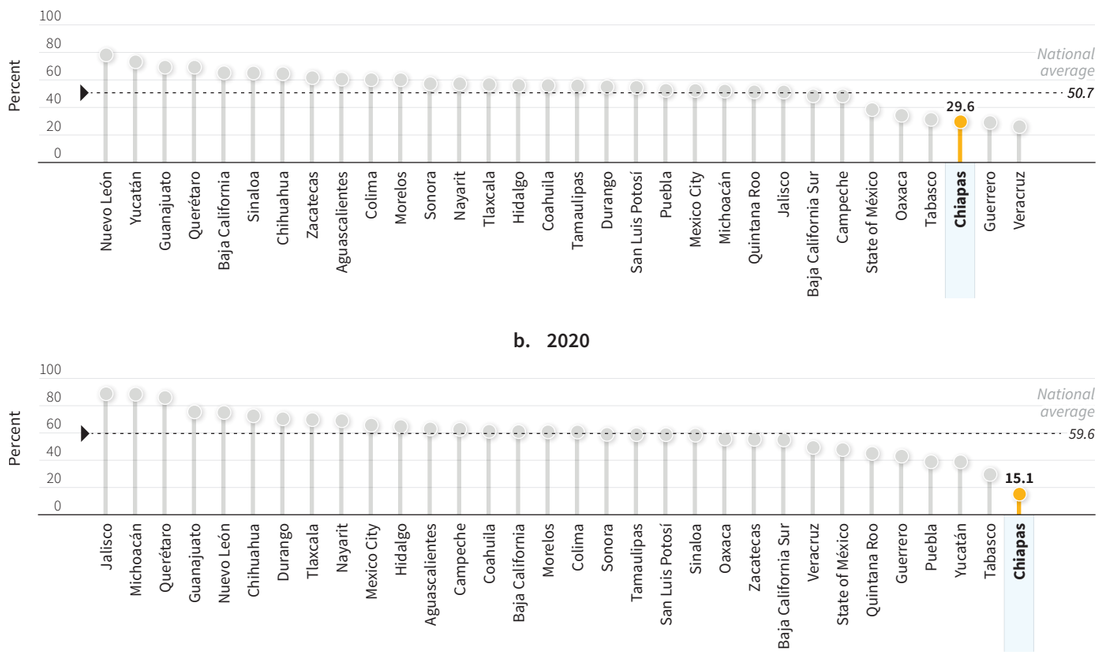
Underground Water Availability in Mexico, 2016



Source: CONAGUA 2017.

FIGURE C.4

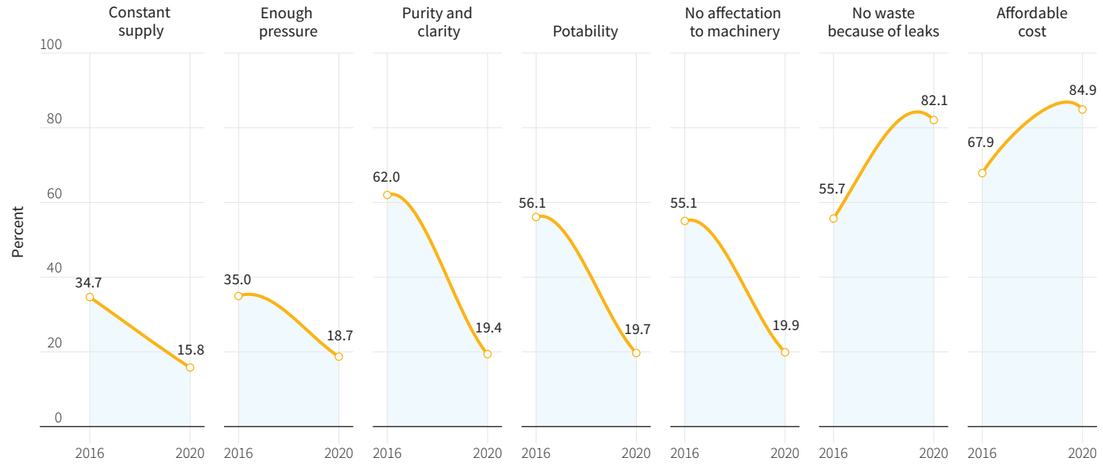
Firms' Satisfaction with Water-Related Services



Source: Based on data from INEGI's ENCRIGE database.

FIGURE C.5

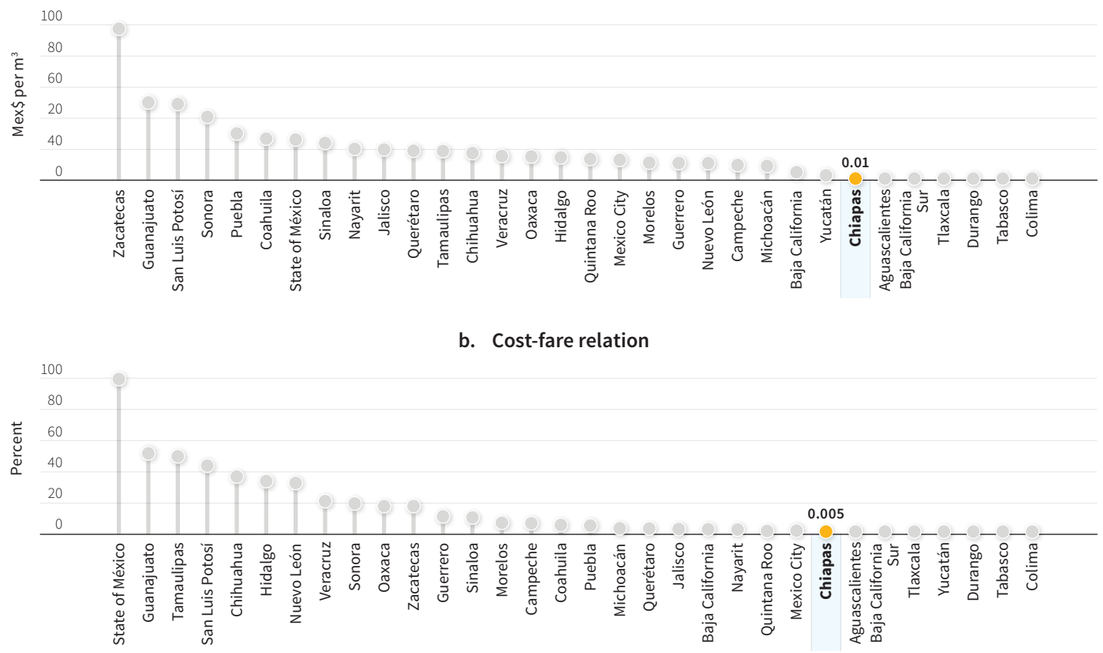
Indicators of Firms' Satisfaction of Water Services in Chiapas



Source: Based on INEGI's ENCRIGE database.

FIGURE C.6

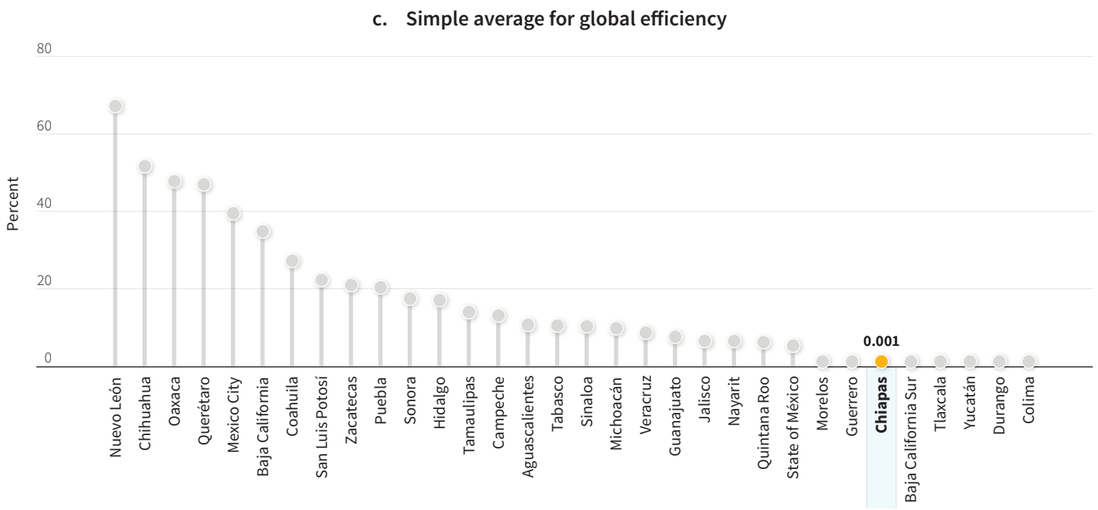
Water Costs and Fares Indicators in Mexico, 2017



(Figure continues next page)

FIGURE C.6

Water Costs and Fares Indicators in Mexico, 2017 *(continued)*



Source: Based on data from CONAGUA and IMTA 2017.
Note: m^3 = cubic meters. Panel c shows the volume of water collected by volume produced.

utilities across states. Chiapas has one of the lowest costs per volume produced, at Mex$0.01 per cubic meter. However, the cost-fare ratio (0.005) and efficiency of the local agency in charge of water supply are also low. This suggests that the water utility does not have a whole coverage for collecting fares within the state.

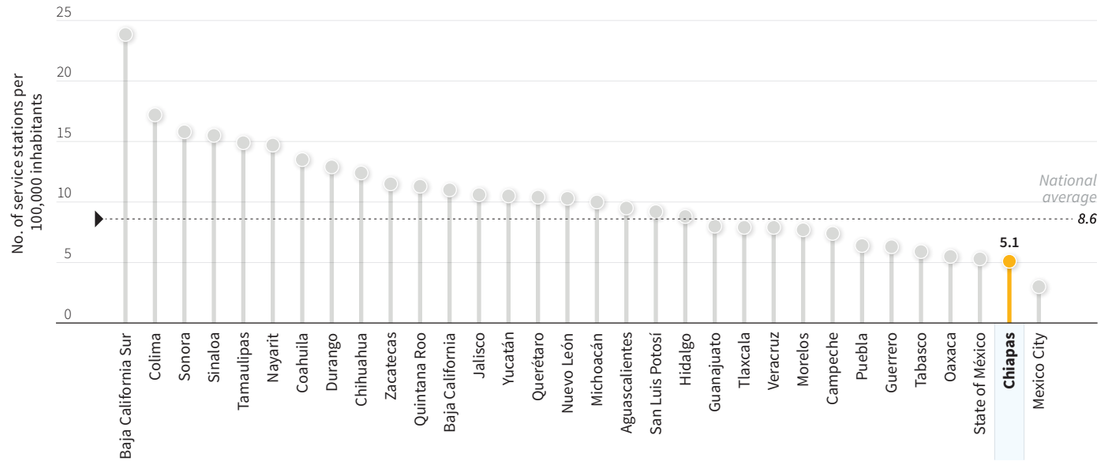
In conclusion, for water-intensive industries, the quantity of water in Chiapas would not be a constraint. However, water quality in the state should be improved.

ACCESS TO COMBUSTIBLES

To determine whether access to combustibles is a constraint, factors including the physical infrastructure, consumption, and satisfaction levels have been analyzed. In terms of gasoline and diesel service stations, Chiapas is below the national average, with a rate of 5.1 stations per 100,000 inhabitants, which is the second lowest in the country (figure C.7). Moreover, Chiapas has low connection to Sistrangas (*Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural*; National Interconnected System of Natural Gas) that prevents it to offer competitive delivery of natural gas (map C.4). Some projects attempted implementation but were deemed economically unviable because of low current demand for natural gas. In 2019, on average, Chiapas consumed 43.5 million cubic feet per day, which is one of the lowest in the country (figure C.8). Despite the low availability of physical infrastructure, Chiapas has the highest proportions of firms satisfied with the delivery of combustibles in the country, with 57.2 percent (figure C.9). This may imply low consumption levels because of limited demand from existing firms in the state.

FIGURE C.7

Number of Service Stations per 100,000 Inhabitants, 2017



Source: Based on Pemex 2019.
Note: Service stations are those that supply gasoline and diesel.

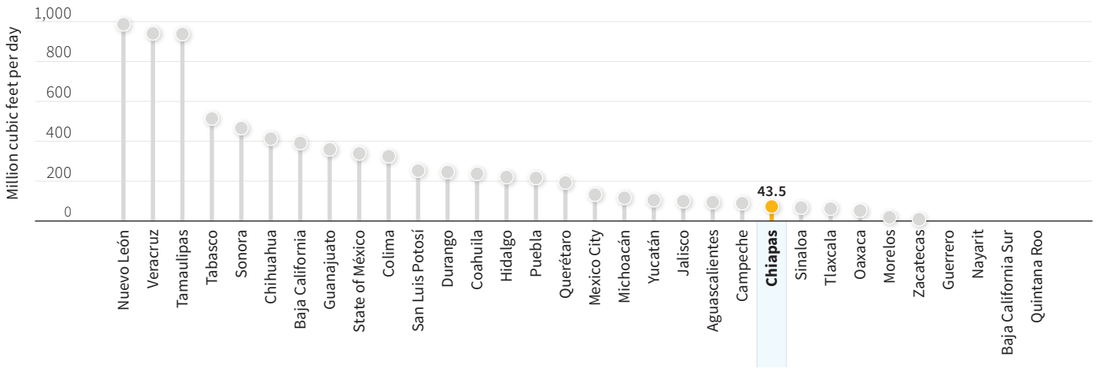
MAP C.4

Mexico's Natural Gas System (Sistrangas), 2019

Source: Based on information from the *Secretaría de Energía*.

FIGURE C.8

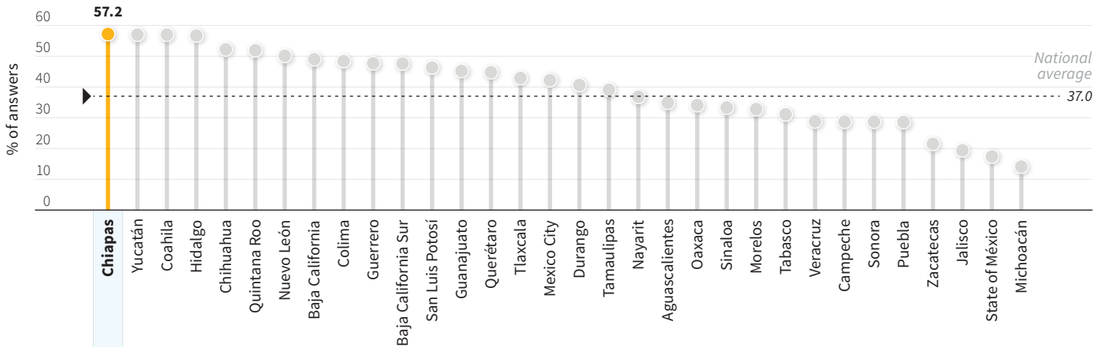
Consumption of Natural Gas per State, 2019



Source: Based on data from SENER's SIE database.

FIGURE C.9

Firms' Satisfaction with Combustibles-Related Services, 2016



Source: Based on data from INEGI's ENCRIGE database.
Note: The survey included an assessment of combustible-related services only until 2016.

TRANSPORTATION

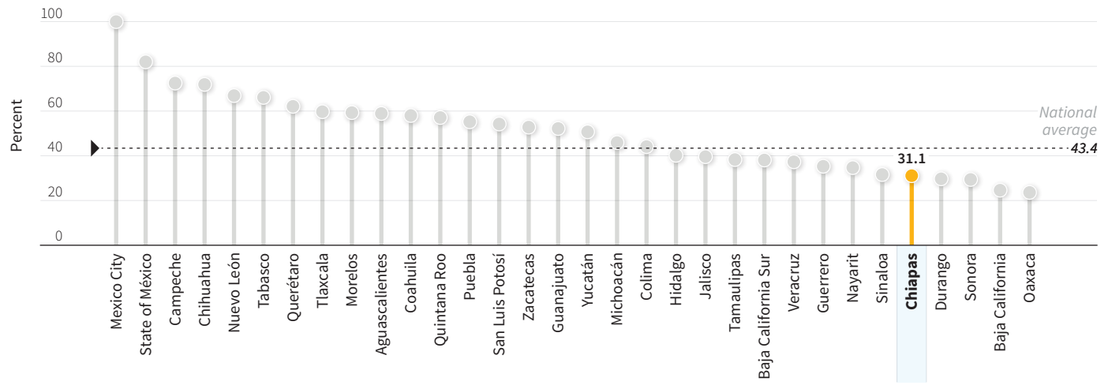
To evaluate whether transportation infrastructure conditions are a binding constraint in Chiapas, three transport modes intensively used by manufacturing industries are assessed: roads, ports and railways. Figure C.10, panel a, shows that Chiapas is well below the national average (43.4 percent) in terms of paved roads, with 31.1 percent, the fifth lowest rate in the country. The state also has low proportions of roads with four or more lanes, with 1.4 percent, the second lowest rate in the country (figure C.10, panel b).

Figure C.11 shows that Chiapas has 14.9 kilometers (km) of roads per 10,000 inhabitants, which is slightly below the national average, but figure C.12 shows that its paved roads per 100 square km of 9.7 km is above the national average.

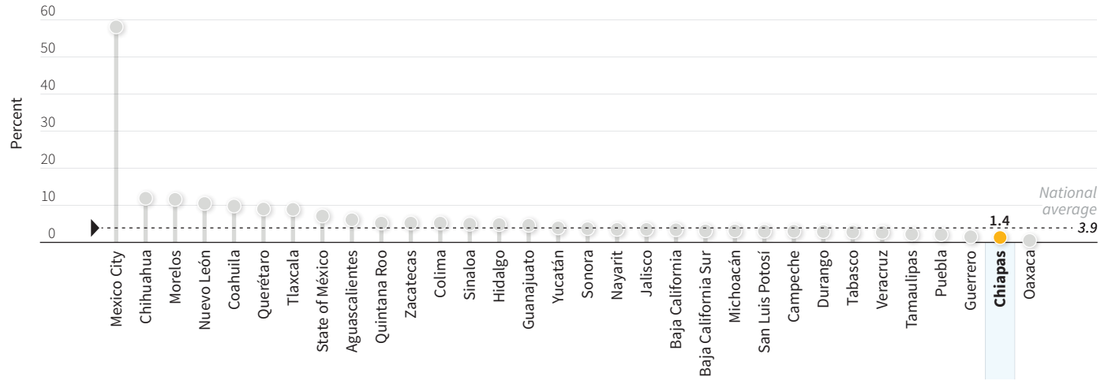
FIGURE C.10

Road Conditions At National Level, 2018

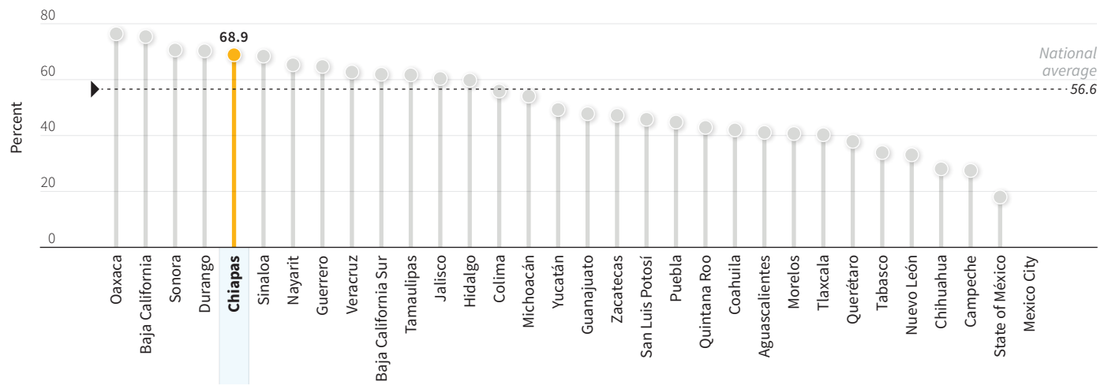
a. Share of paved roads



b. Share of roads with four or more lanes

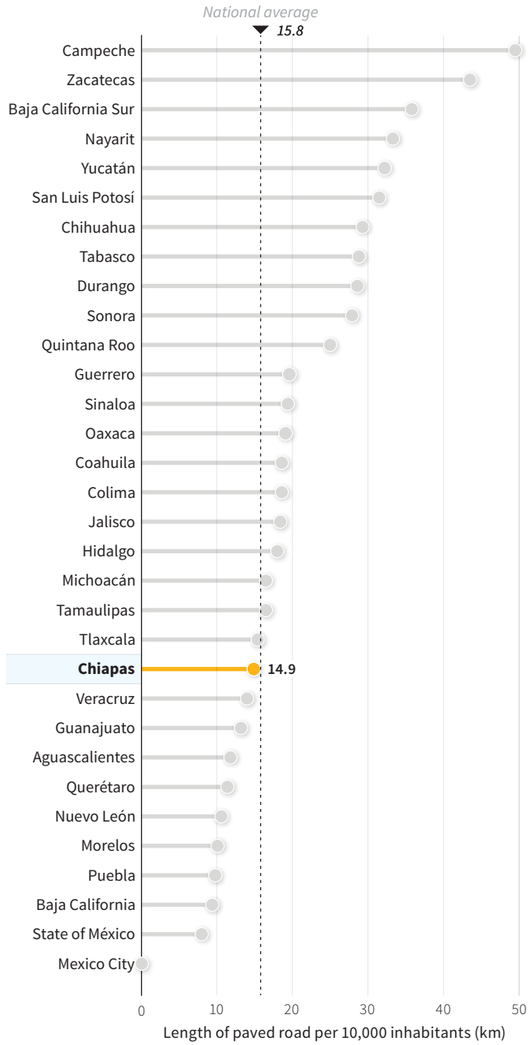


c. Share of unpaved roads



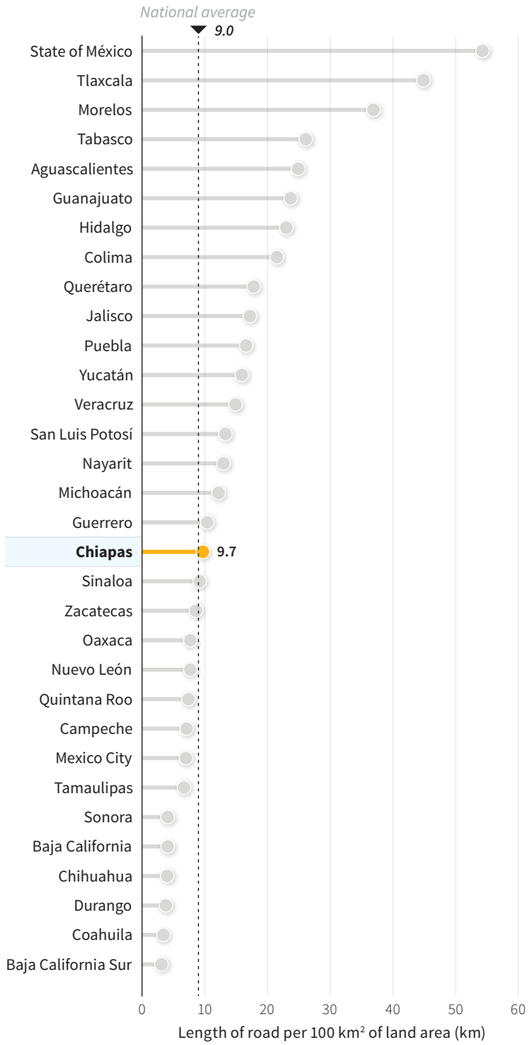
Source: SCT 2020.

FIGURE C.11
Length of Paved Roads per 10,000 Inhabitants, 2018



Source: Calculations are based on data from SCT 2018.
Note: km = kilometer.

FIGURE C.12
Length of Paved Roads per 100 km² Extension, 2018



Source: Calculations are based on data from SCT 2018.
Note: km = kilometer, km² = square kilometer.

Paved roads are mostly administrated and maintained by local, state, and federal government; however, toll roads are usually given to a private entity or to a public-owned agency for management. Federal roads are the main routes interconnecting the regions of the states to other places of the country. Many of these roads tend to have free access which results in traffic congestion, especially in urban areas, resulting in reduced average speeds and longer travel times. Private operators control the toll roads that tend to have restricted accesses. These roads are frequently more efficient, reducing travel times because of higher average speed limits, and more competitive and attractive for logistics purposes for firms. As map C.5 shows, Chiapas only has three toll roads: Tuxtla Gutiérrez–San Cristóbal de las Casas (Federal Highway [Fed.] 190D), Tuxtla Gutiérrez–Arriaga (Fed. 190D), and Ocozocoautla-Coatzacoalcos (Fed. 145D). These roads connect the capital to other main cities in the state, but they are not linked to important logistics centers such as Tapachula where the port of Chiapas is located.

Figure C.13, panel a, shows that, in 2016, only 9 percent of firms were satisfied with the quality of toll-free roads in Chiapas, the lowest proportion in the country. In 2020, figure C.13, panel b, shows that this metric dramatically improved to 81.6 percent (the third highest proportion), but, because there has not been significant enhancements to these roads in the last years, this change of perception could be a result of lower use and congestion during the pandemic.

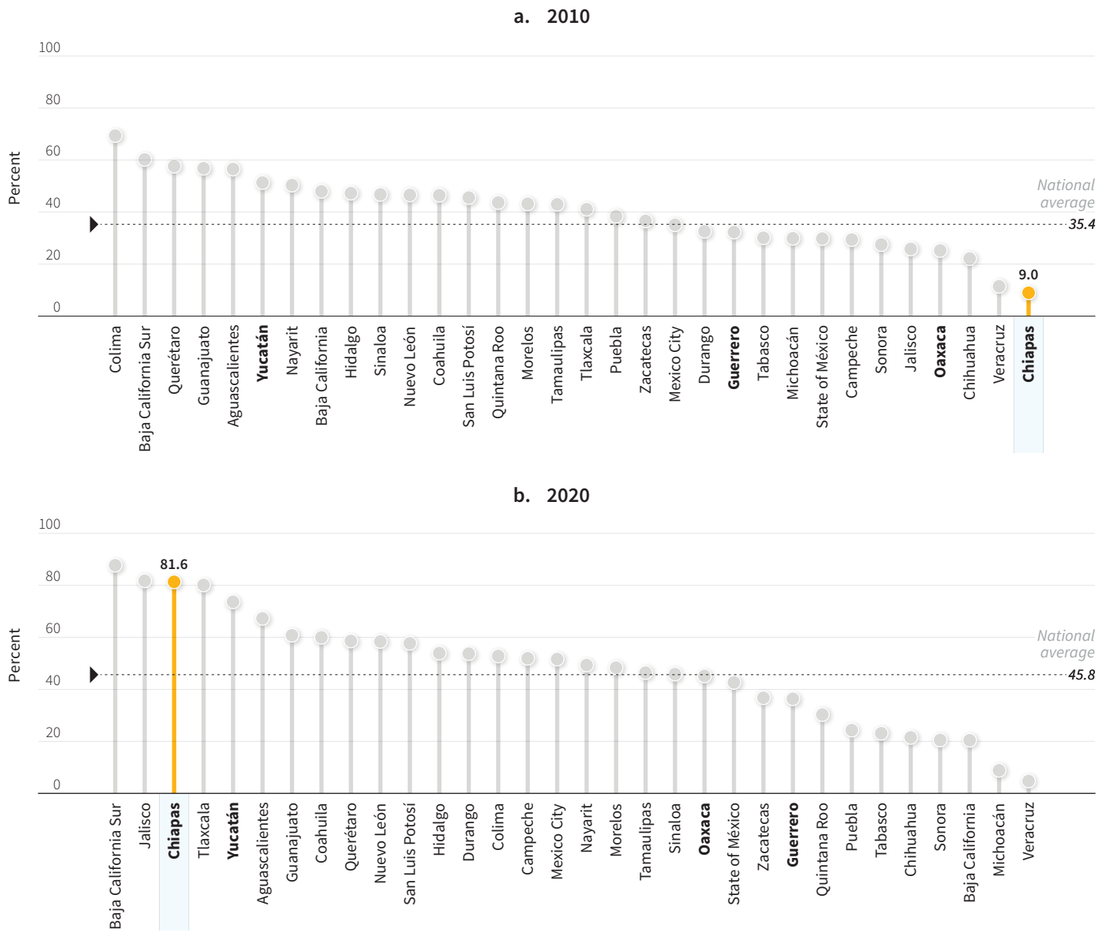
Regarding port infrastructure and operations, Chiapas only has one port, Puerto Chiapas, with both national and international trade. Figure C.14 compares three indicators evaluating the feasibility of arriving at selected ports from the main economic regions of the states where they are located: time, cost, and distance. The analysis show that Chiapas has a low performance in time and distance from its main city of Tuxtla Gutiérrez to its port of Puerto Chiapas, but toll fares are at less than Mex$150.

MAP C.5
Federal and Toll Roads, Selected States, 2019

Source: Adapted from SCT-IMT's *Red Nacional de Caminos*.

FIGURE C.13

Firms' Satisfaction with Roads



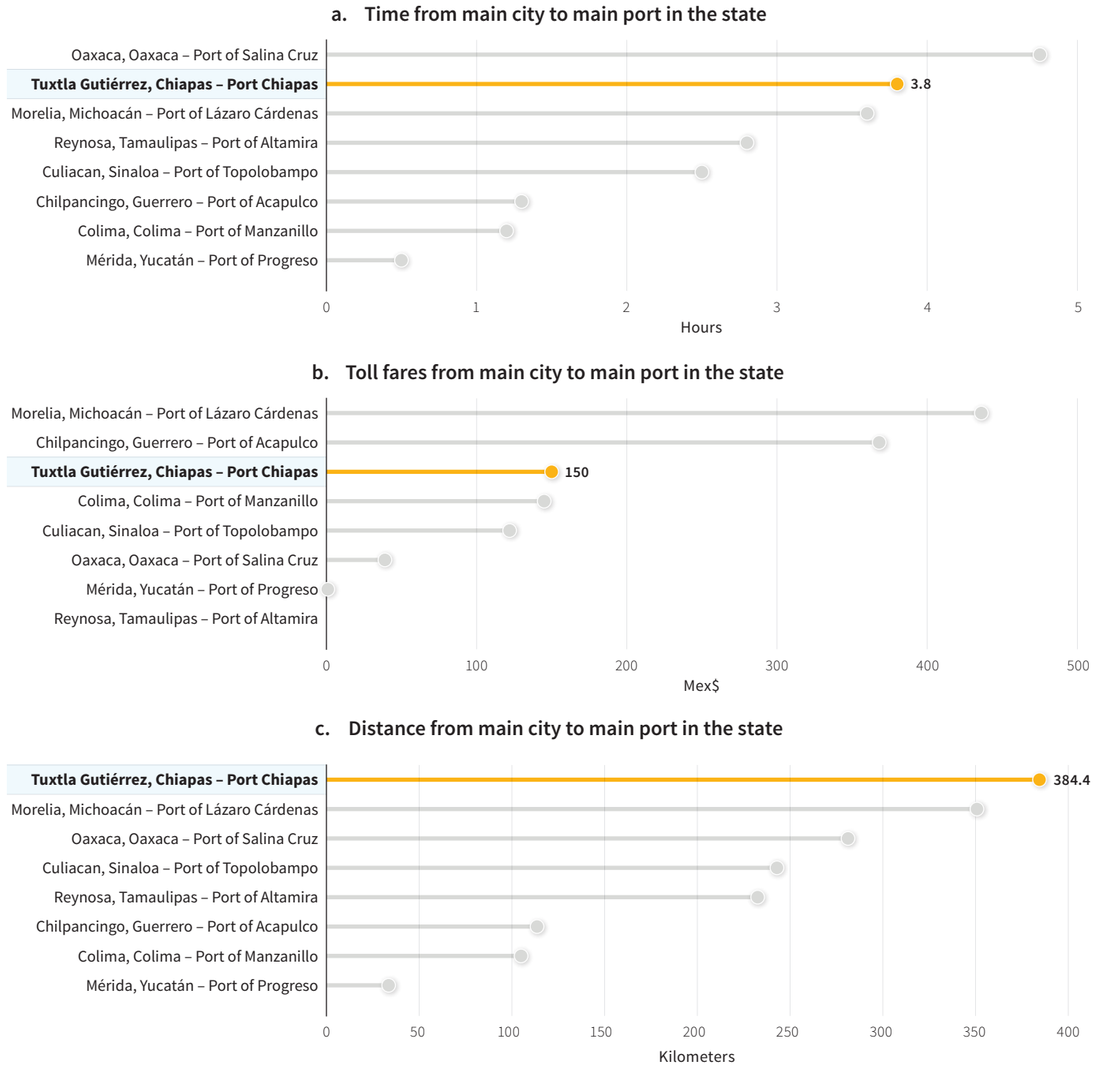
Source: ENCRIGE 2016 and 2020.
Note: Toll roads are excluded from the figure.

Figure C.15 shows the levels of saturation of selected ports as well as their capacities to show the potential use of incoming firms with existing infrastructure. In this regard, Puerto Chiapas is the least saturated port among the selected states, with a saturation of 14.5 percent (figure C.15. panel a). However, with a capacity of only 3 million tons, the port may get saturated if industries requiring maritime transport grow (figure C.15. panel b).

Figure C.16 compares the satisfaction levels of firms using the port infrastructures closest to each state of the country and shows that Chiapas has the seventh lowest satisfaction rate (41.5 percent) among firms, 13.5 percentage points below the national average.

FIGURE C.14

Indicators of Ports Availability to the Main Cities, Selected Ports, 2020

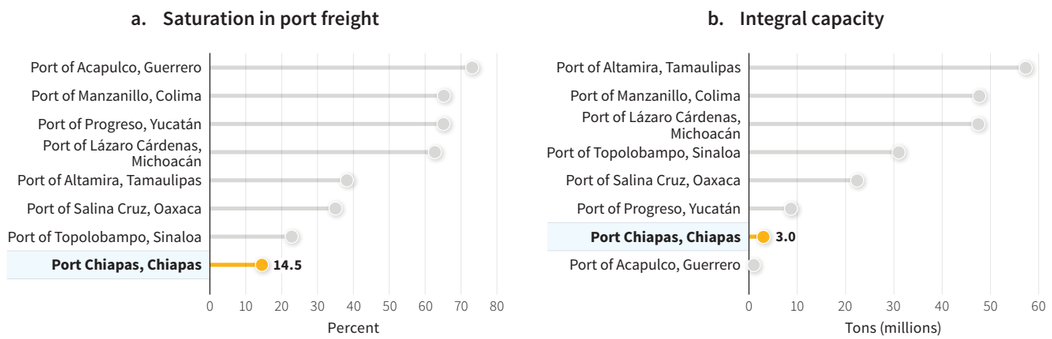


Source: Based on data from SCT's MAPPIR application.
Note: For panel b, toll fares were estimated for an automobile.

Puerto Chiapas has terminals for containers, agriculture bulks, and cruises, as well as a customs facility (*recinto fiscalizado*). However, the port has a maximum draft of only 10.5 meters, which restricts the size of vessels it can accommodate. Additionally, being located outside a natural port, it requires annual dredging to maintain its depth. In spite of this, because of the high cost of dredging, this is not performed as frequently as needed. Therefore, in-

FIGURE C.15

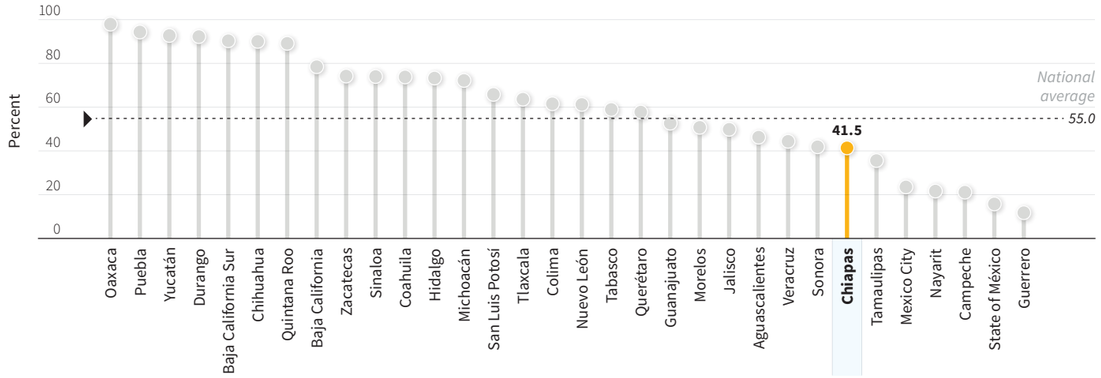
Level of Saturation and Capacity of Selected Ports, 2017



Source: Calculations based on data from CGPMM 2018; Idom Consulting 2017.

FIGURE C.16

Firms' Satisfaction with Port Infrastructure, by State, 2016



Source: Based on INEGI's ENCRIGE database.
Note: The survey included an assessment of port services only until 2016.

vestments for expansion and maintenance of the port is required to offer an advantage to potential industries that desire to install in the state and use this infrastructure.

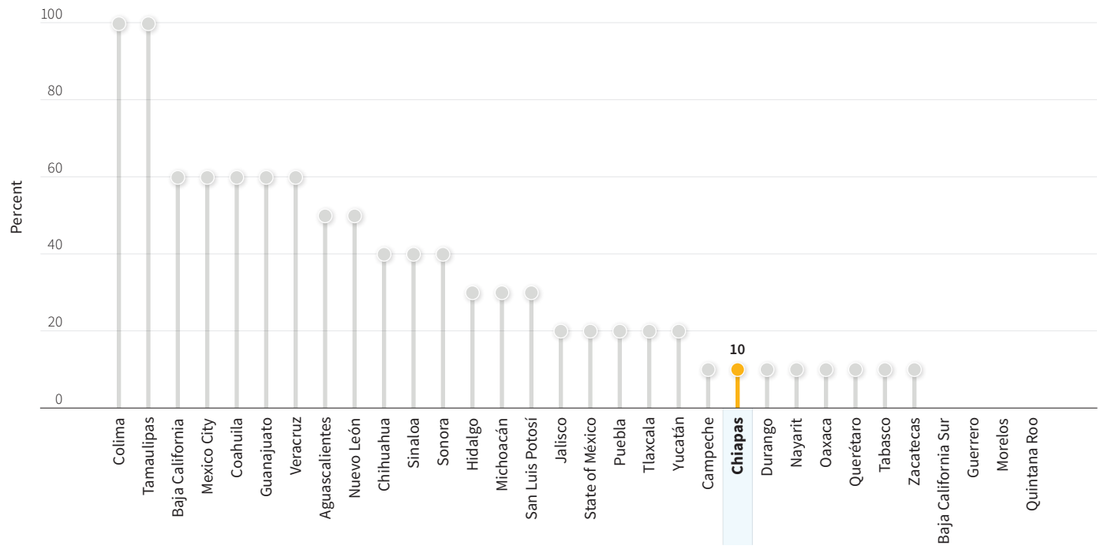
To complete the assessment of the transportation infrastructure in Chiapas, its railway infrastructure is analyzed. Figure C.17 shows that Chiapas has an index of density of freight moved by railways of 10 percent, one of the lowest in the country.

To better understand the previous assessment, map C.6 shows Mexico's railway system. Chiapas shares the same line with Oaxaca and Yucatán, the Chiapas-Mayab Line, which is linked to the Isthmus of Tehuantepec Railway.

Regarding the airport infrastructure, map C.7 shows that in 2021 Mexico's system had 77 airports, 64 of them with international routes, and 1,492 aerodromes (sites for taking-off and landing of small airships). In Chiapas, there are

FIGURE C.17

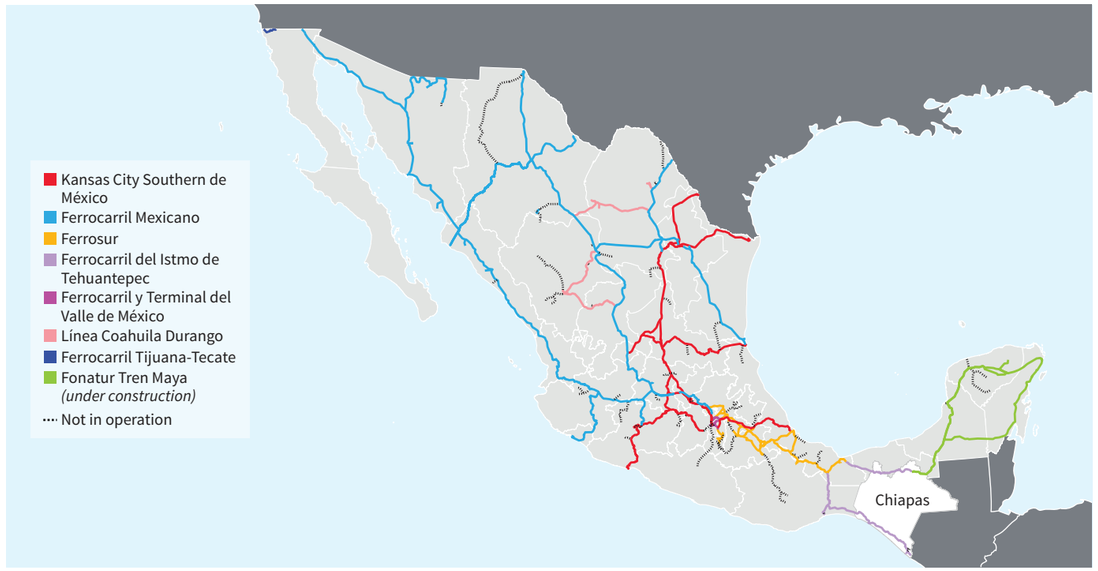
Index of Density of Freight Moved by Railways, by State, 2018



Source: ARTF 2018.
Note: Normalized values are based on total products transported using the available rails within each state. A value of 100 percent represents a high density, 10 percent represents a low density, and 0 percent represents either no movement of products or no railways available for freight.

MAP C.6

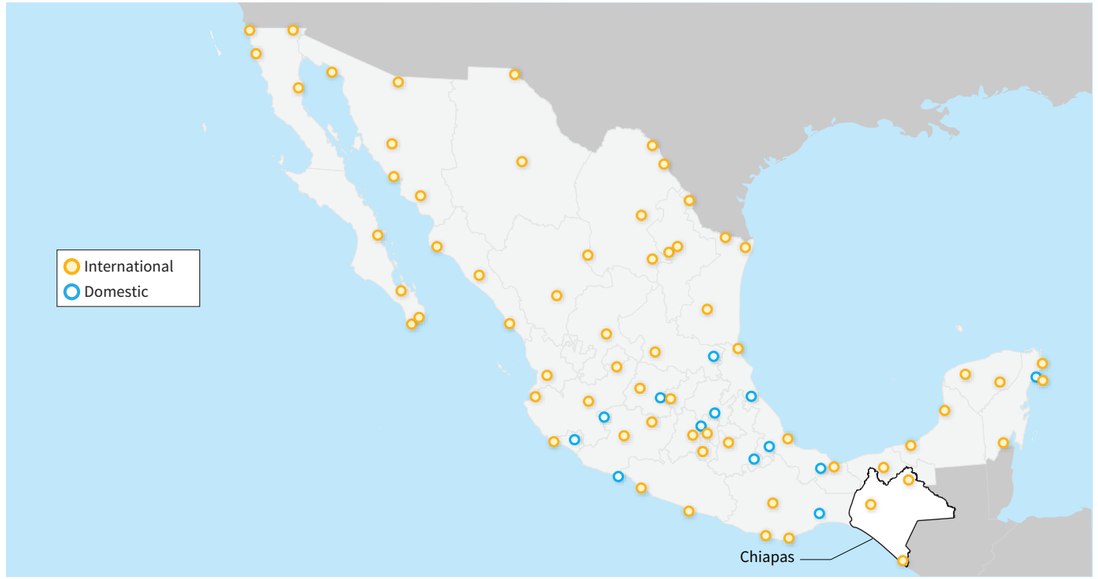
Mexico's Railway System, 2021



Source: ARTF 2022.

MAP C.7

Main Airports in Mexico, 2021



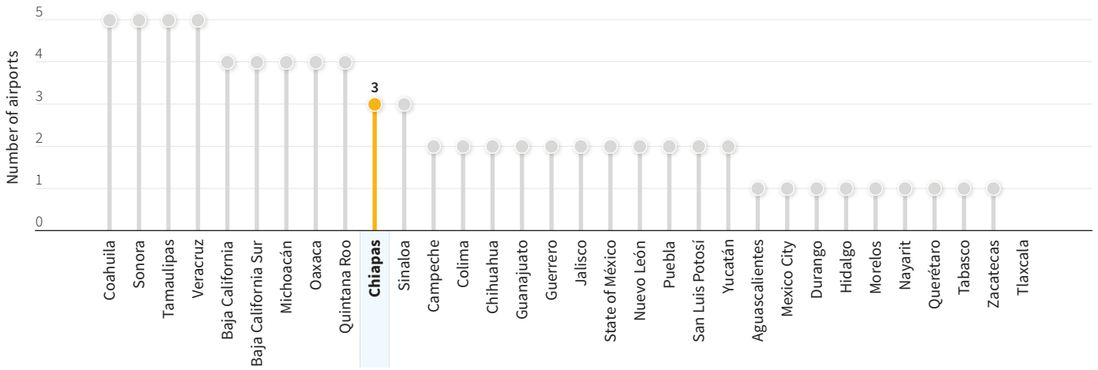
Source: SCT 2022.

three airports in the cities of Palenque (currently with no operations), Tapachula, and Tuxtla Gutiérrez and 35 aerodromes (figures C.18 and C.19).

Figures C.20 and C.21 show the volume of passengers and freight mobilized by state. Mobilization of passengers and freight by plane in Chiapas is in the middle among Mexico's 32 states, but very far from the top performers.

FIGURE C.18

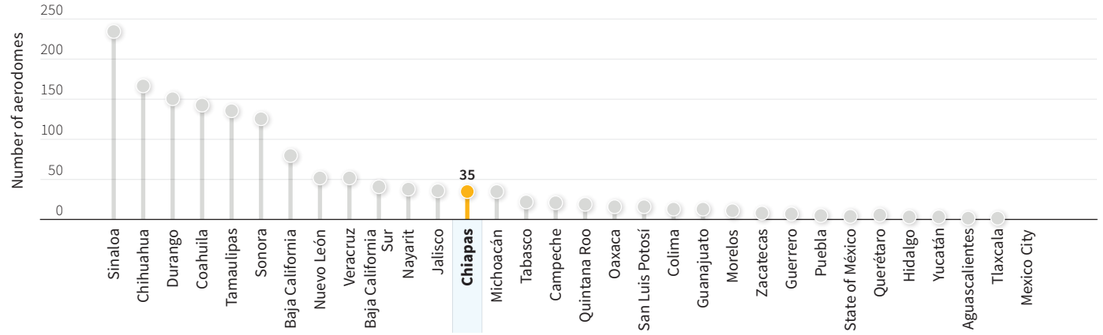
Number of Airports by State, 2021



Source: SCT 2022.

FIGURE C.19

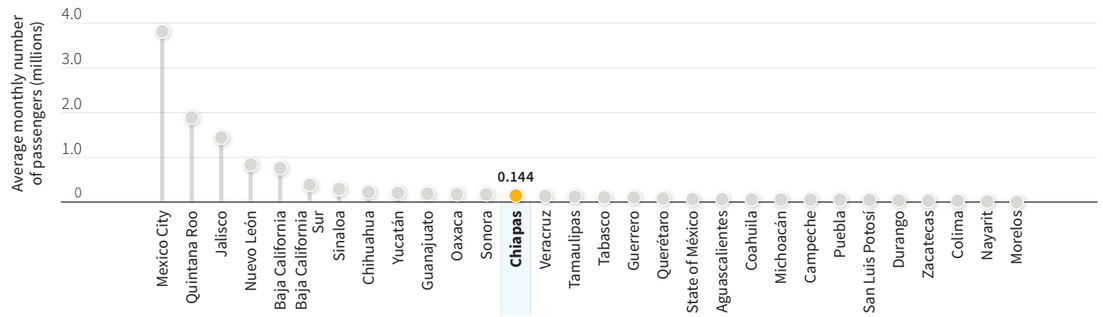
Number of Aerodromes by State, 2021



Source: SCT 2022.

FIGURE C.20

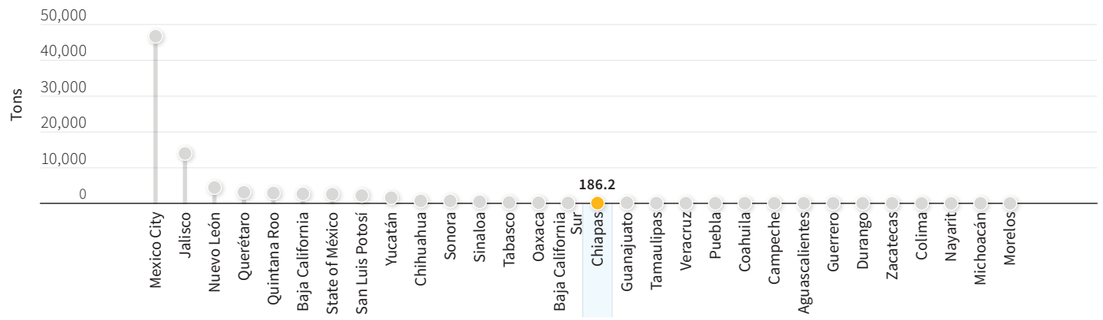
Monthly Average Number of Passengers Mobilized by State, 2015–19



Source: Calculations based on data from SCT's *Estadística Operativa de Aeropuertos, Dirección General de Aeronáutica Civil*.
Note: The figure corresponds to the months of November from the years considered.

FIGURE C.21

Monthly Average of Freight Transported by State, 2015–19



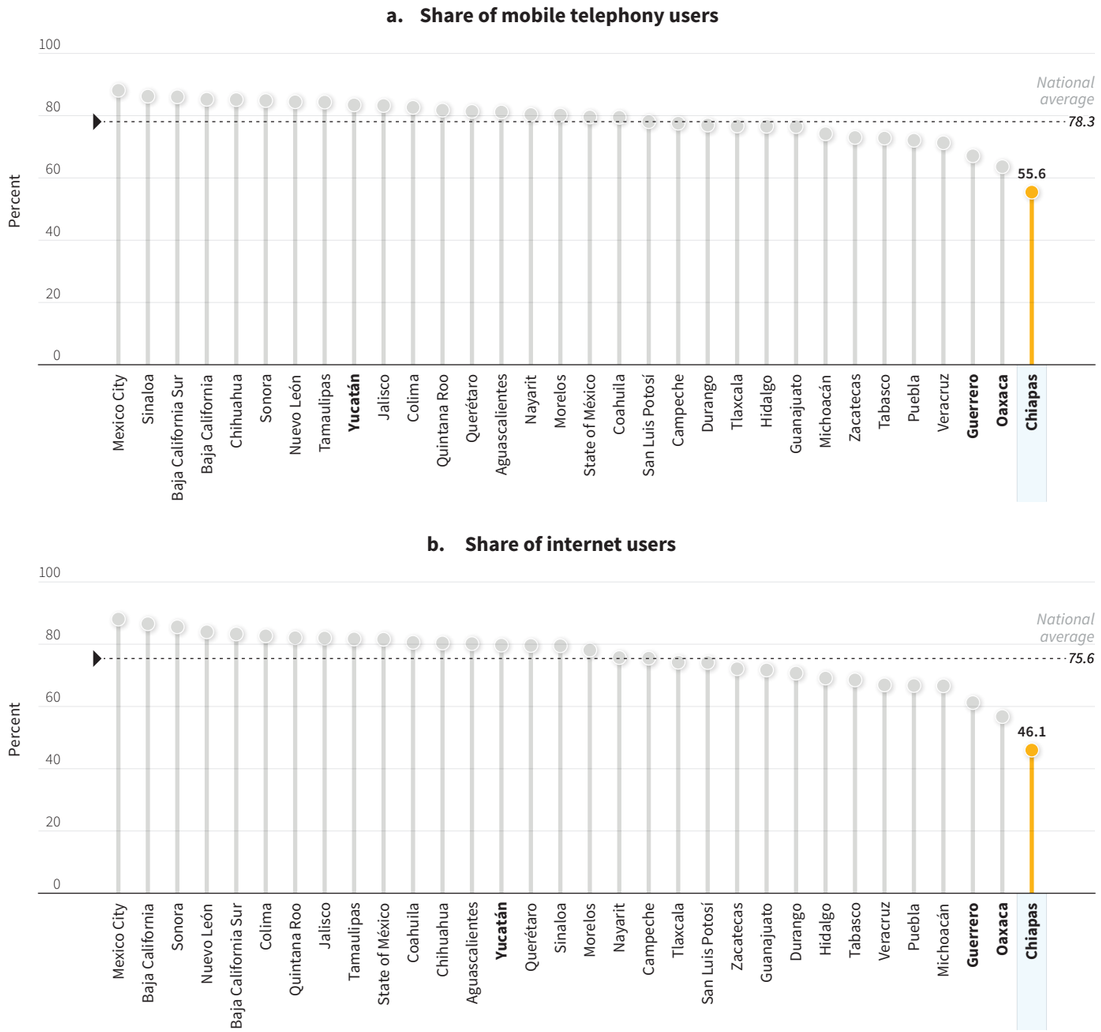
Source: Calculations based on data from SCT's *Estadística Operativa de Aeropuertos, Dirección General de Aeronáutica Civil*.
Note: The figure corresponds to the months of November from the years considered.

TELECOMMUNICATIONS

Figure C.22, panels a and b, show that Chiapas has the lowest shares of population using the internet and mobile telephony in the country, with 46.1 and 55.6 percent, respectively. Figure C.22, panel c, shows that the state also has the lowest proportion of households with internet connection (30.8 percent). For industries with intensive use of these telecommunications technologies, these low shares could make it hard to operate.

FIGURE C.22

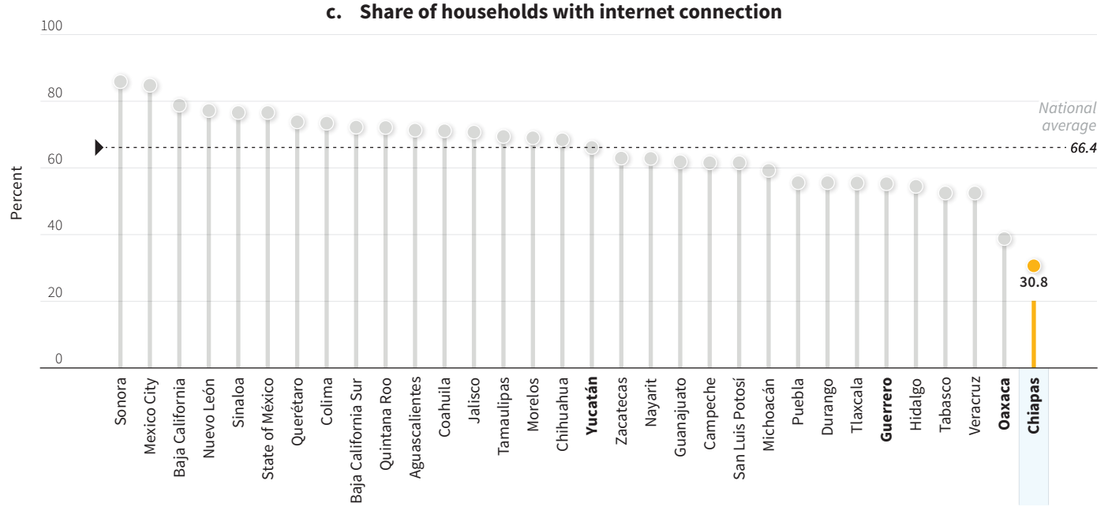
Access to Telecommunication Services, 2021



(Figure continues next page)

FIGURE C.22

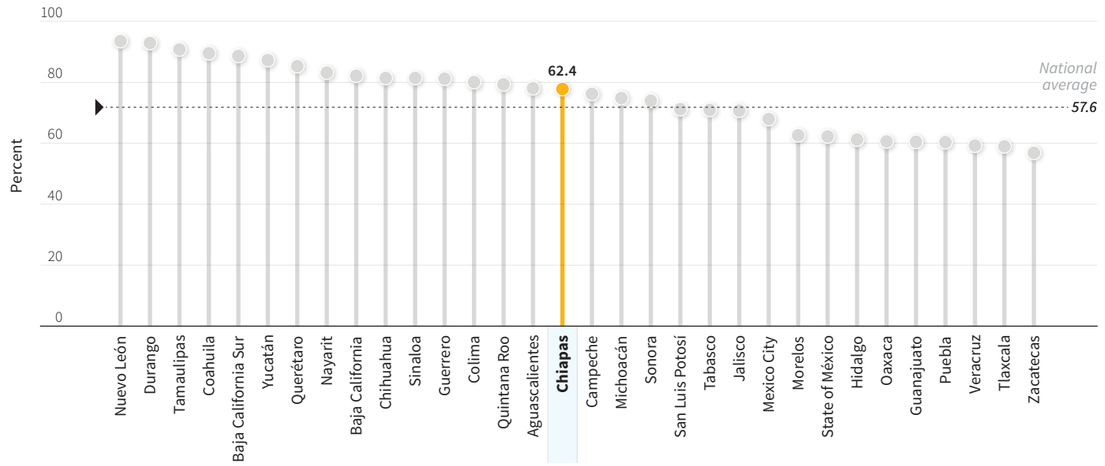
Access to Telecommunication Services, 2021 *(continued)*



Despite the poor levels of coverage, figure C.23 show that 62 percent of firms in Chiapas are satisfied with the internet service, above the national average (58 percent). However, in terms of mobile telephony service, this is not the case. Chiapas has the lowest proportion of satisfied firms at 29 percent, which is almost half the national average (56 percent) (figure C.24).

FIGURE C.23

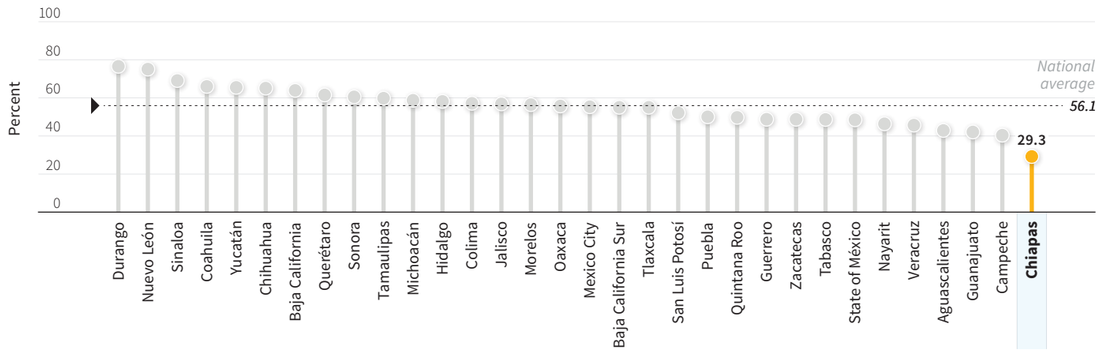
Firms' Satisfaction with Internet Service, 2016



Source: Based on INEGI's ENCRIGE database.
Note: The figure reflects the latest available data for internet services.

FIGURE C.24

Firms' Satisfaction with Mobile Telephony Service, 2016



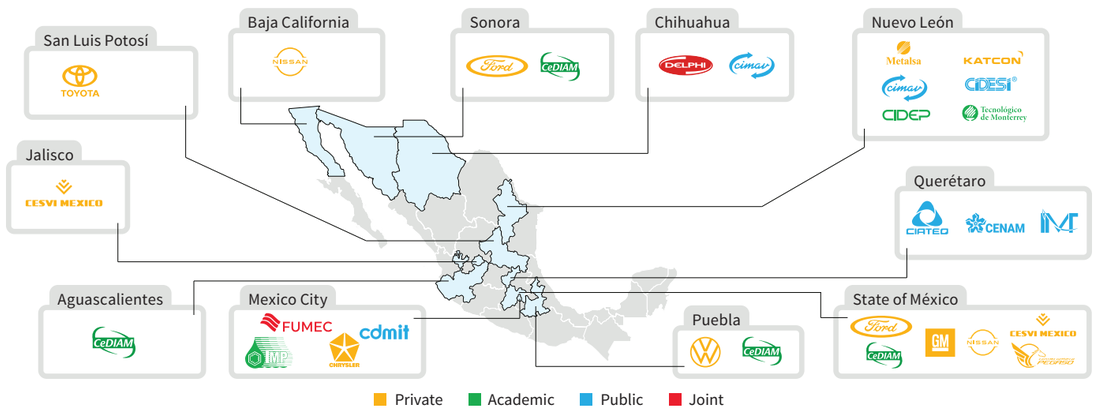
Source: Based on INEGI's ENCRIGE database.
Note: The figure reflects the latest available data for mobile telephony services.

INFRASTRUCTURE FOR THE AUTOMOTIVE INDUSTRY

For infrastructure specifically for the automotive industry, we review the number of specialized research and development (R&D) centers that exist in the country. Map C.8 shows that in 2018, Mexico had 28 R&D centers for the industry. Of these, 13 are private and are associated with major automotive firms and suppliers, seven belong to academic institutions, seven are public, and one is funded with mix capital. These centers provide technical assistance to firms entering the industry and are aligned with the goals and needs of the automotive industry. They are concentrated in the North and Bajío regions and Valley of Mexico. There is only one R&D center located in the South-Southeast region, located in Puebla.

MAP C.8

Automotive Industry R&D Centers in Mexico, 2018



Source: AMIA 2018.
Note: R&D = research and development.

APPENDIX D

Factor Intensity

To identify infrastructure-related constraints hindering the development of the automotive industry in Chiapas, we analyze the use of key inputs in the production process including energy (electricity), water, combustibles, logistics (freight) and communications, and then we contrast these intensities with the availability of each input (see appendix C). [79]

Based on firm level data, we measure how various manufacturing activities at the national level perform using two metrics of factor usage intensity: (1) consumption or expenditure of a factor, as a percentage of intermediate consumption and (2) consumption or expenditure of a factor, as a percentage of value added. If a sector is intensive in the use of one of these factors in which the state has deficiencies, this could be a binding constraint.

Two benchmarks to reflect the intensity of use of those factors were considered. The first is the national average for all existing manufacturing activities. The second is the average of those manufacturing activities in which the state of Chiapas has a revealed comparative advantage greater than one (a competitive sector in the state). Following the methodology of Barrios and others (2018a; 2018b), the intensity of factor usage was classified into four categories: (1) high intensity, for industry groups with a dependence of the factor higher than the sum of the national average and half a standard deviation for both metrics (dark yellow quadrant); (2) mid-high intensity, for industry groups with a dependence of the factor higher than the sum of the national average and half a standard deviation in one of the metrics (medium-dark yellow quadrant); (3) mid-low intensity, for those groups with a dependence of the factor below half a standard deviation of national average in both or one of the metrics, but with the other metric below the sum of the national average and half a standard deviation (medium-light yellow quadrant); and (4) low

intensity, for those industry groups with a factor below the difference of the national average and half a standard deviation in both metrics (light yellow quadrant).

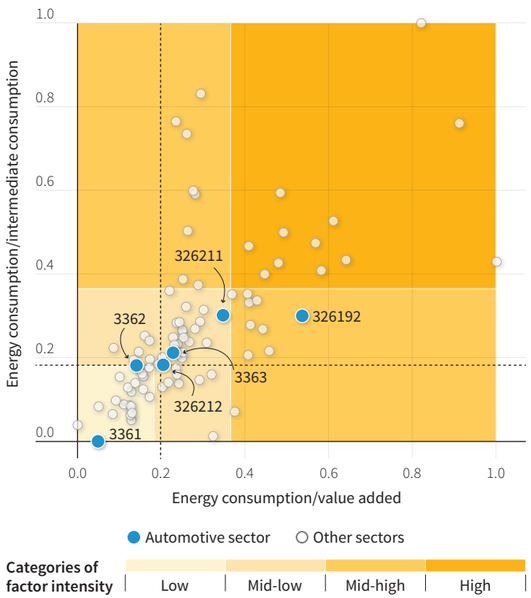
As figure D.1 shows, the energy use of motor vehicle manufacturing (North American Industry Classification System [NAICS] code 3361) and motor vehicle body and trailer manufacturing (3362) fall in the low intensity quadrant. However, the latter is close to the state's average for energy consumption as a percentage of intermediate consumption in competitive sectors. In contrast, motor vehicle parts manufacturing (3363), tire manufacturing (326212), and tire retreading (326211) are in the mid-low intensity quadrant and above the state's average for both metrics in competitive sectors. Motor vehicle plastic parts (326192) fall in the mid-high quadrant and above the state's competitive sectors when both metrics are considered, with a greater energy consumption as a percentage of value added. Special attention must be given to auto parts because of their relatively higher energy intensity compared to other activities in the automotive industry. Despite being one of the main power producers in the country, Chiapas faces infrastructure constraints in energy transmission and distribution within its territory, which could become a binding constraint.

On water consumption, figure D.2 shows that half of the activities fall in the low intensity quadrant: NAICS 3362, 326212, and 326211. These activities are also below the state's average for both metrics in competitive sectors. Meanwhile, sectors 3361 and 3363 also fall in the mid-low quadrant and below the state's average for both metrics in competitive sectors. Finally, sector 326192 falls in the mid-high quadrant and above the state's average for water consumption as a percentage of value added in competitive sectors. Consequently, water availability does not seem to be a constraint for further development of the automotive industry in Chiapas, considering that it is not an issue (although improvements in service quality are still required).

Focusing on the use of combustibles, figure D.3 shows that most existing automotive industry activities in Chiapas are in the low intensity quadrant and only NAICS sectors 326192 and 326212 use this factor more intensively, falling in the mid-low and high intensity quadrants, respectively. The automotive industry is concentrated below the average for the group of industries where Chiapas has a comparative advantage, except for sector 326212. This factor is not a constraint for the state's automotive industry because of the relatively low intense combustibles use of its activities.

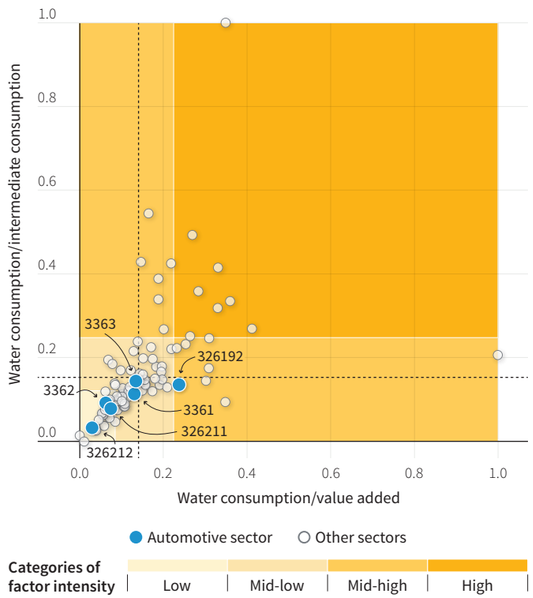
In figure D.4, the graph shows that activities in the automotive industry have a more heterogeneous use of freight. NAICS sectors 3362 and 326212 fall in the

FIGURE D.1
Energy Intensity by Sector, 2014 and 2019 Averages



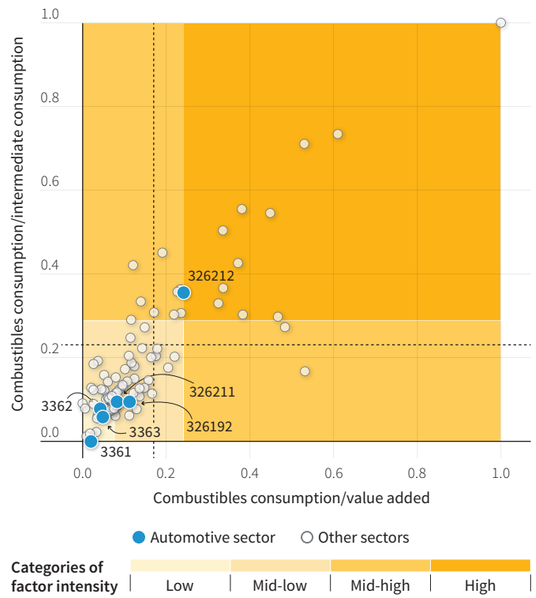
Source: Calculations based on data from INEGI 2014; 2019.
Note: Sectors are classified using the North American Industry Classification System (NAICS). Dashed lines represent the average normalized value of the sectors with a revealed comparative advantage greater than one for Chiapas and those are NAICS sectors 3111, 3112, 3113, 3115, 3116, 3117, 3118, 3119, 3121, 3149, 3219, 3231, 3323, 3328, 3371). Blue points represent group industries of automotive sector in NAICS.

FIGURE D.2
Water Intensity by Sector, 2014 and 2019 Averages



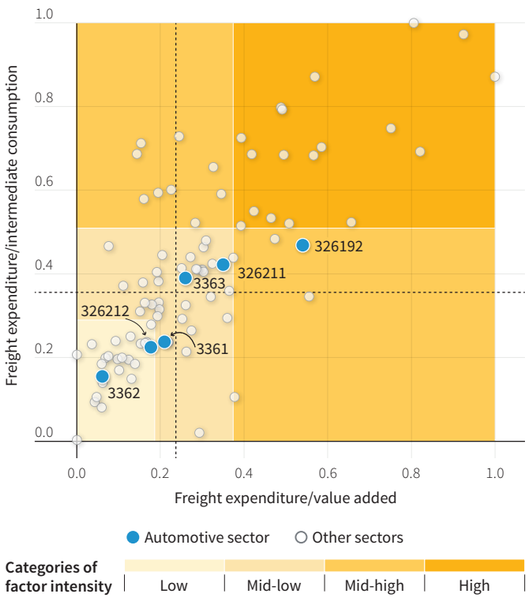
Source: Calculations based on data from INEGI 2014; 2019.
Note: Sectors are classified using the North American Industry Classification System (NAICS). Dashed lines represent the average normalized value of the sectors with a revealed comparative advantage greater than one for Chiapas and those are NAICS sectors 3111, 3112, 3113, 3115, 3116, 3117, 3118, 3119, 3121, 3149, 3219, 3231, 3323, 3328, 3371). Blue points represent group industries of automotive sector in NAICS.

FIGURE D.3
Combustibles Intensity by Sector, 2014 and 2019 Averages



Source: Calculations based on data from INEGI 2014; 2019.
Note: Sectors are classified using the North American Industry Classification System (NAICS). Dashed lines represent the average normalized value of the sectors with a revealed comparative advantage greater than one for Chiapas and those are NAICS sectors 3111, 3112, 3113, 3115, 3116, 3117, 3118, 3119, 3121, 3149, 3219, 3231, 3323, 3328, 3371). Blue points represent group industries of automotive sector in NAICS.

FIGURE D.4
Freight Intensity by Sector, 2014 and 2019 Averages



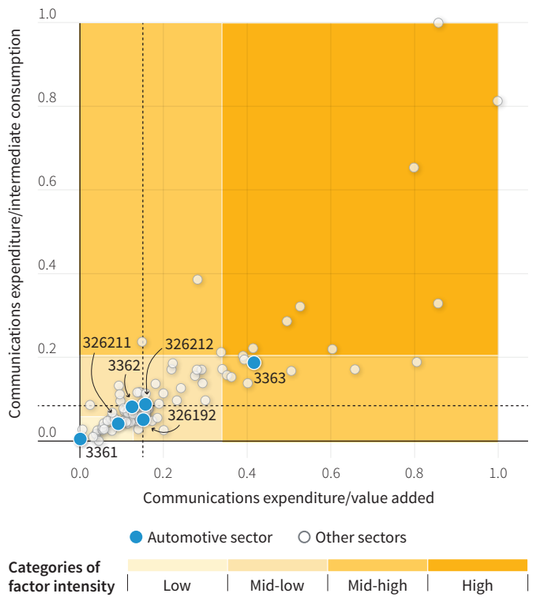
Source: Calculations based on data from INEGI 2014; 2019.
Note: Sectors are classified using the North American Industry Classification System (NAICS). Dashed lines represent the average normalized value of the sectors with a revealed comparative advantage greater than one for Chiapas and those are NAICS sectors 3111, 3112, 3113, 3115, 3116, 3117, 3118, 3119, 3121, 3149, 3219, 3231, 3323, 3328, 3371). Blue points represent group industries of automotive sector in NAICS.

low intensity quadrant and below the state's average for both metrics in competitive sectors. Three activities fall in the mid-low quadrant: sectors 3361, 3363, and 326211. Sector 326192 fall in the medium-high intensity quadrant, close to the high intensity quadrant. Hence, it seems that logistics and transportation costs could be an important constraint for the industry, particularly to produce auto parts, considering the roads and port infrastructure deficiencies in Chiapas.

Finally, figure D.5 shows that most existing automotive activities in the state fall in the low and mid-low intensity quadrant in terms of their communication systems use. NAICS sectors 3361 and 326211 are in the low intensity quadrant. While sectors 326192, 3362, and 326212 are in the mid-low quadrant. In contrast, sector 3363 is in the mid-high intensity quadrant and above the state's averages for both metrics in competitive sectors. Considering that the provision of communication systems in Chiapas is deficient, this could be a constraint for developing the auto parts segment. Auto parts makers particularly need good telecommunication systems to interact with their clients and suppliers.

FIGURE D.5

Communications Intensity by Sector, 2014 and 2019 Averages



Source: Calculations based on data from INEGI 2014; 2019.
Note: Sectors are classified using the North American Industry Classification System (NAICS). Dashed lines represent the average normalized value of the sectors with a revealed comparative advantage greater than one for Chiapas and those are NAICS sectors 3111, 3112, 3113, 3115, 3116, 3117, 3118, 3119, 3121, 3149, 3219, 3231, 3323, 3328, 3371). Blue points represent group industries of automotive sector in NAICS.

APPENDIX E

Access to Finance

Given the global nature of the industry multinational companies, lack of access to international capital markets to raise debt or equity and finance ongoing or new operations may not be considered a binding constraint to develop the automotive industry in Mexico and Chiapas in particular.

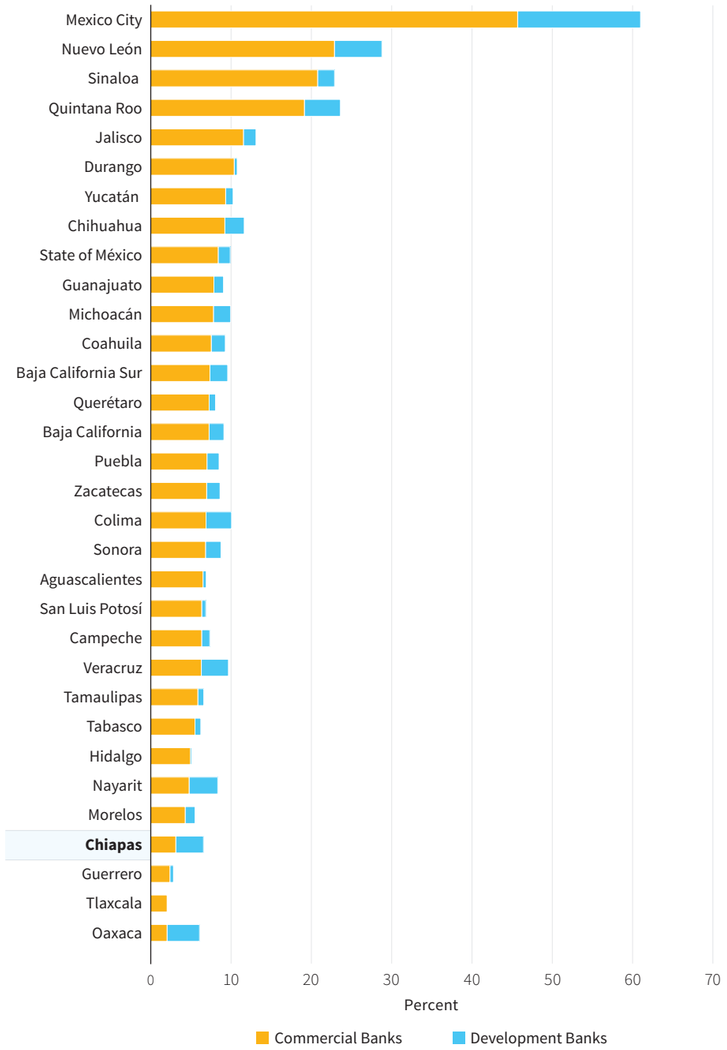
Nonetheless, small local firms producing auto parts face restrictions to credit that may prevent them from expanding their operations. Several indicators of supply and demand in the country's financial services can provide evidence on whether financing can be a constraint to develop the auto parts industry in Chiapas. Regarding the supply of financial services, Chiapas is among the worst-performing states in the country. The state has 24 municipalities without access points (out of 124), falling behind Yucatán (27 out of 106), Puebla (54 out of 217), and Oaxaca (344 out of 570). Furthermore, Chiapas has the lowest coverage of financial services for its adult population, with only 7.6 financial access points per 10,000 inhabitants.[80]

The demand side data mirrors those patterns observed in the supply side. In 2019, Chiapas had a portfolio balance as a percentage of nonoil gross domestic product of only 6.6 percent, significantly lower than the states in the North and Bajío regions. More than half of this percentage represents the portfolio held by development banking institutions (figure E.1).

At the national level, firms in the automotive industry are charged low interest rates. As of October 2022, interest rates charged by commercial banks and development banking institutions to firms in this sector are among the lowest compared to other economic activities in the country (12.9 and 10.0 percent, respectively) (figure E.2). This suggests there is no evidence of limited supply relative to demand of credit.

FIGURE E.1

Total Portfolio Balance as a Percentage of Nonoil GDP, End 2019

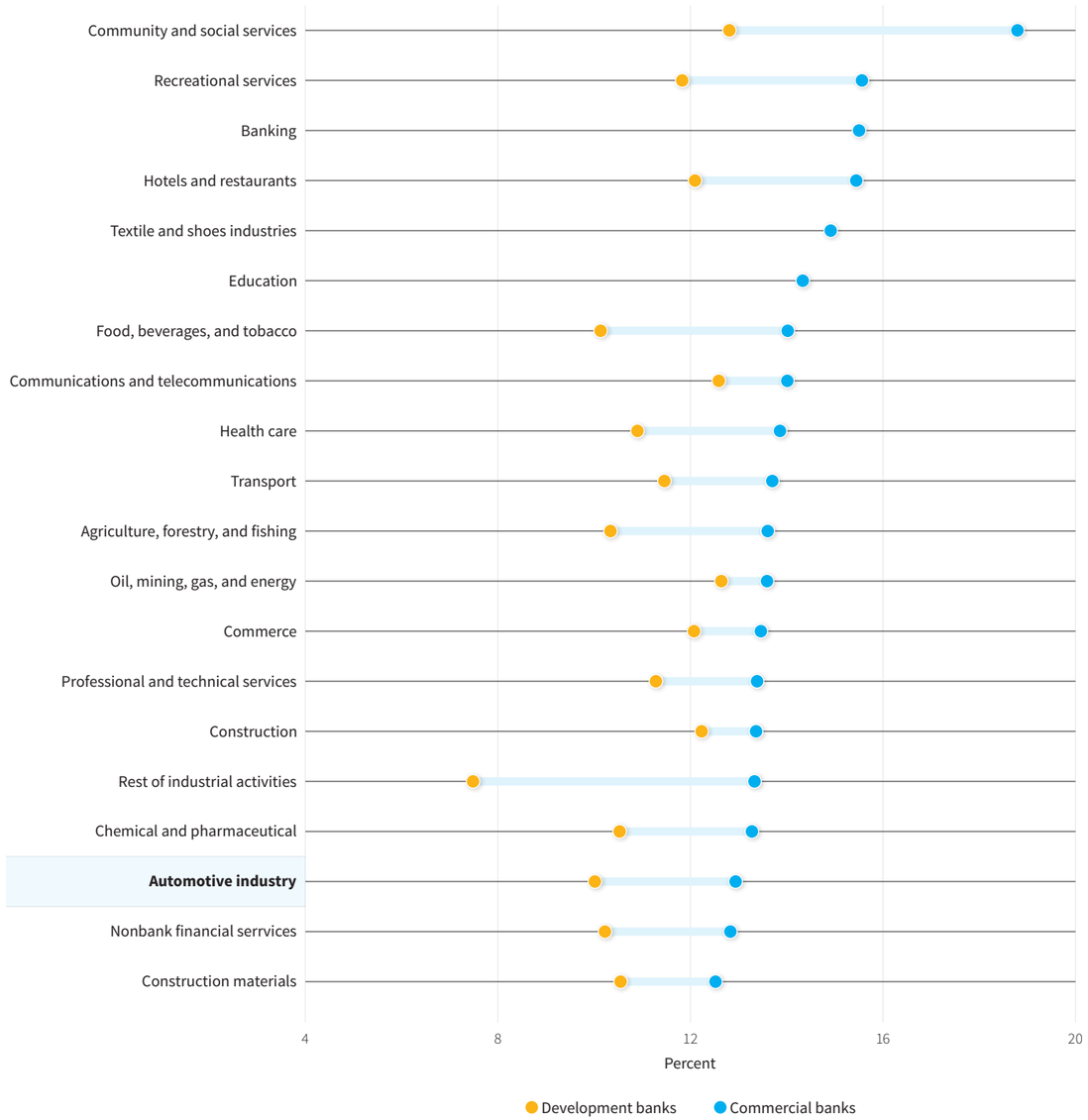


Source: Based on data from Banxico and INEGI's National Accounts.
Note: Figure refers to the credit portfolio for all sectors, as state-level data is not disaggregated by public and private sectors. Bars are ordered by the size of commercial bank's credit portfolio as percentage of nonoil GDP. GDP = gross domestic product.

Interest rates by firm size by sector are also analyzed. As expected, in general, interest rates for micro enterprises are the highest, followed by small, medium, and large enterprises. Focusing on firms in the automotive industry, except for small enterprises, interest rates are among the lowest when compared against other sectors (figure E.3). For large firms, interest rates are the lowest across all

FIGURE E.2

Weighted Average Interest Rates Paid by Firms in Various Industries, 2022

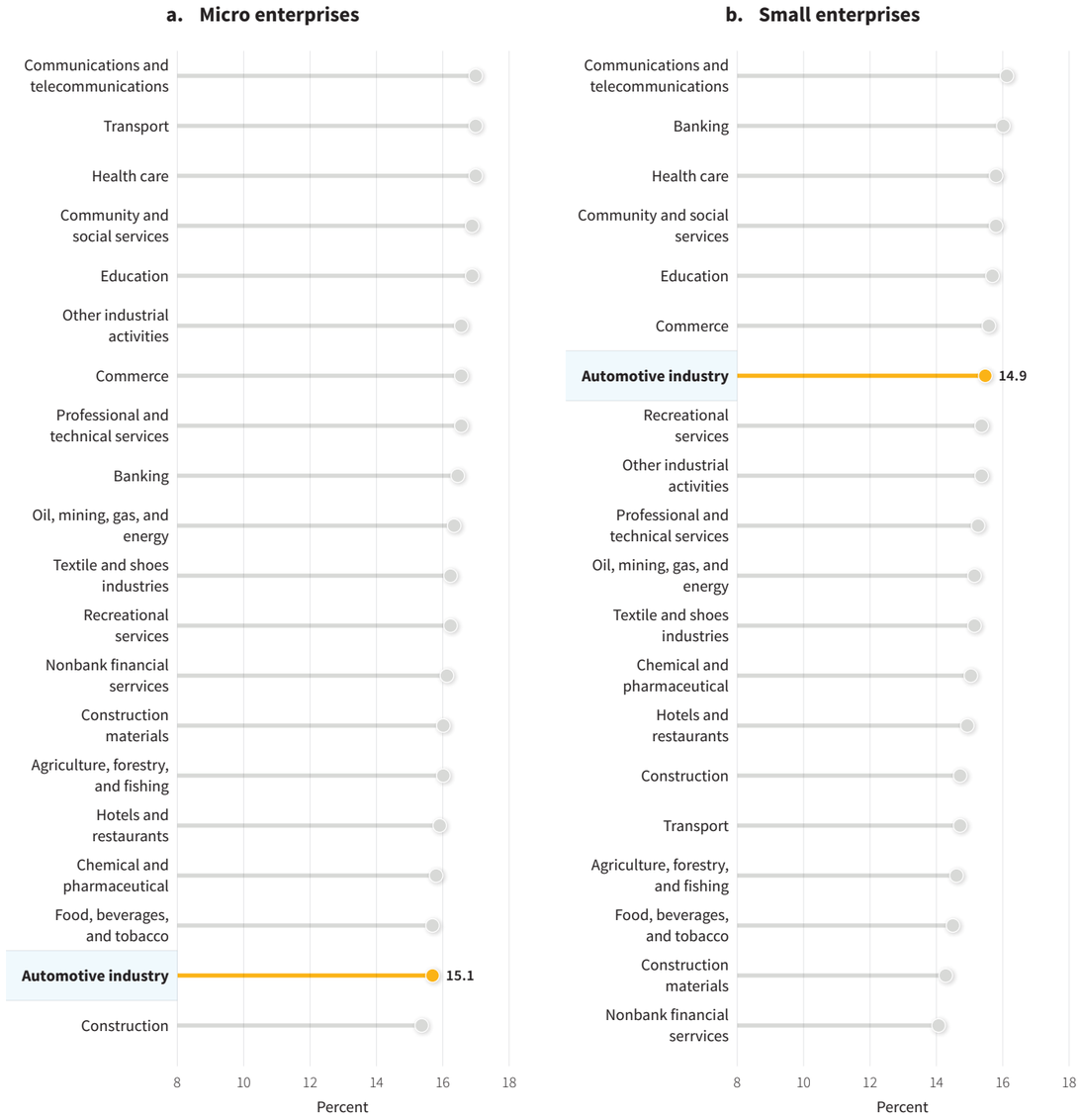


Source: Based on data from CNBV's *Portafolio de Información* (Information Portfolio) for December 2016 and October 2022; Banxico.
Note: The figure only considers credits in local currency. The CNBV's latest Information Portfolio does not provide interest rate data at the sector level. To estimate the interest rates charged to firms by sector, the spread between (1) the monetary policy rate from December 2016 and (2) the weighted average interest rate charged by commercial and development banks by sector in December 2016 (the latest year for which the CNBV's previous information portfolio offers data), was calculated. By maintaining the spread constant for each sector, the interest rates for October 2022 were estimated using the monetary policy rate from October 2022 (the latest month for which the CNBV's latest portfolio provides data). Development banking institutions, which include Nafin, Bancomext, and Banobras, had no reported interest rates for the sectors of education, textiles, footwear, and banking services. CNBV = *Comisión Nacional Bancaria y de Valores*.

economic activities. This suggests that there is no evidence of prices being affected by limited supply relative to demand of credit.

FIGURE E.3

Interest Rates Paid by Enterprises in Various Industries, by Size, October 2022

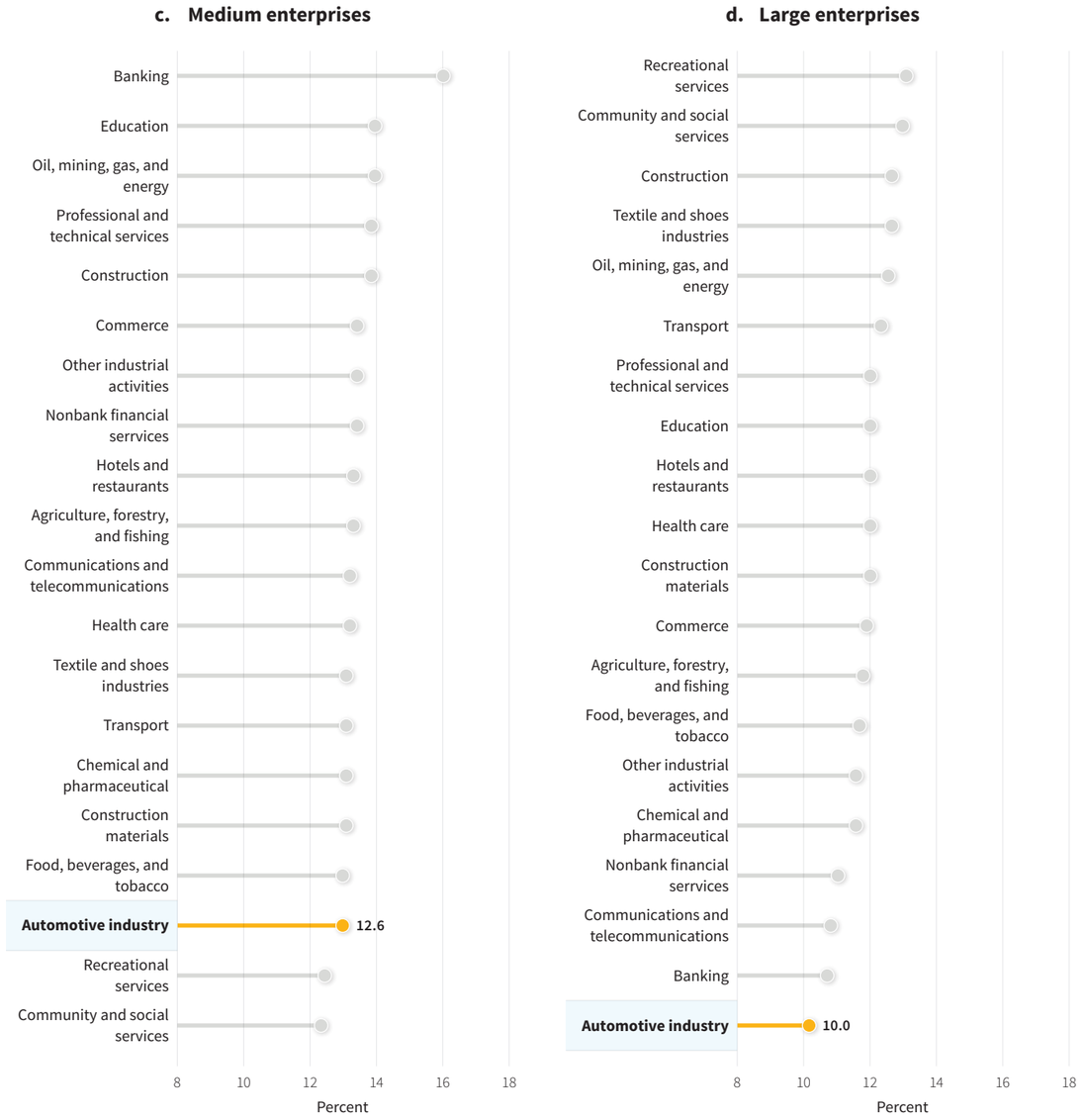


(Figure continues next page)

Data from INEGI's (2019) most recent Economic Census on financial access of firms suggests that those in the automotive industry are likely to seek finance

FIGURE E.3

Interest Rates Paid by Enterprises in Various Industries, by Size, October 2022 *(continued)*



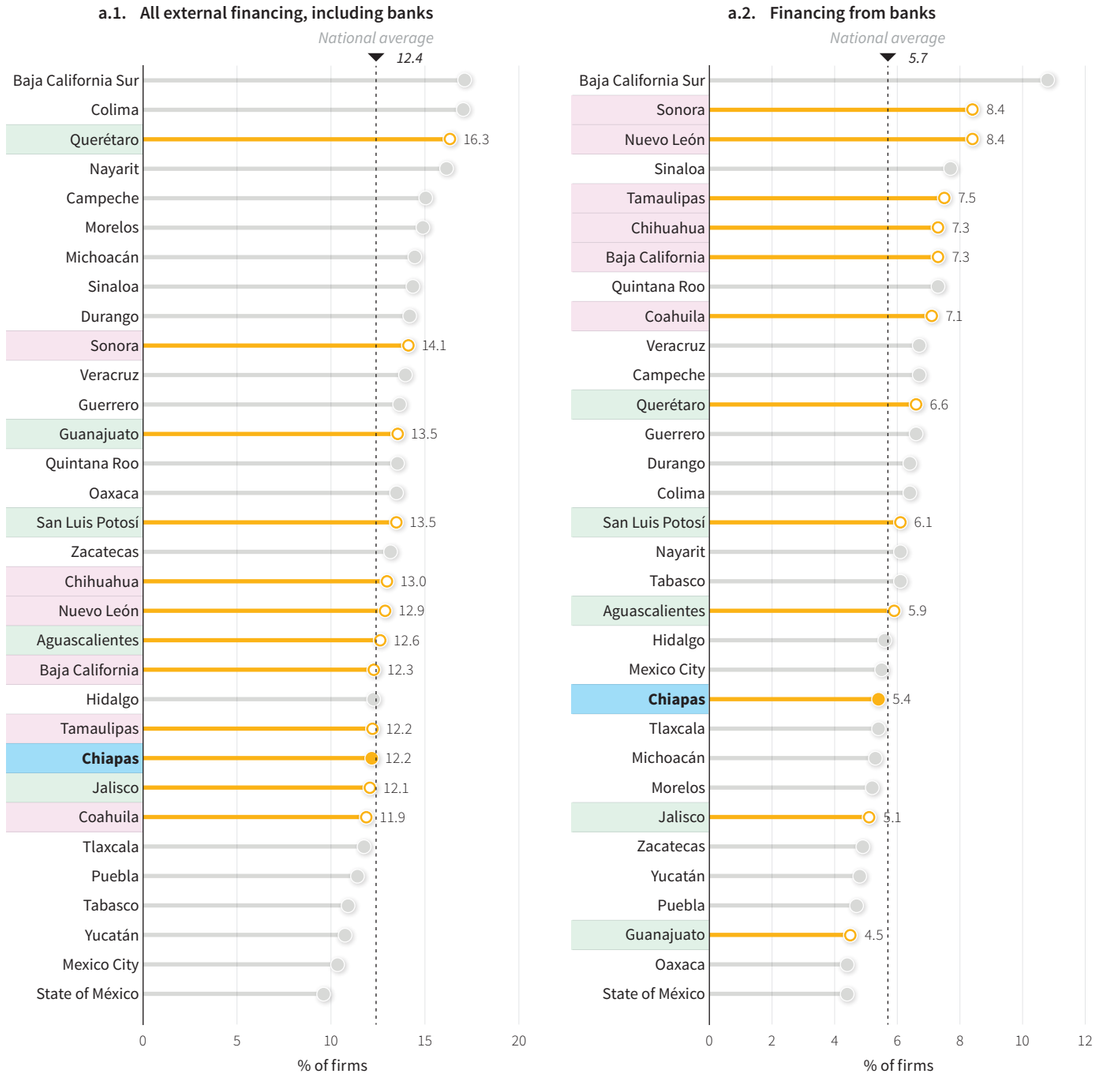
Source: Based on data from CNBV's *Portafolio de Información* (Information Portfolio) for December 2016 and October 2022; Banxico.
Note: The figure only considers credits in local currency. The CNBV's latest Information Portfolio does not provide interest rate data at the sector level. To estimate the interest rates charged to firms by sector, the spread between (1) the monetary policy rate from December 2016 and (2) the weighted average interest rate charged by commercial and development banks by sector in December 2016 (the latest year for which the CNBV's previous information portfolio offers data), was calculated. By maintaining the spread constant for each sector, the interest rates for October 2022 were estimated using the monetary policy rate from October 2022 (the latest month for which the CNBV's latest portfolio provides data). Development banking institutions, which include Nafin, Bancomext, and Banobras, had no reported interest rates for the sectors of education, textiles, footwear, and banking services. CNBV = *Comisión Nacional Bancaria y de Valores*.

from external sources. As the benchmark, in figure E.4, the states in the North (purple) and Bajío (green) regions are also highlighted in the graphs. There is a noticeable trend indicating that firms in the automotive sector in Chiapas are less likely to seek finance, in general and from banks, compared to their counterparts in other states, including those in the North and Bajío regions.

FIGURE E.4

Firms' Access to External Financing, State Comparison, 2018

a. All economic activities



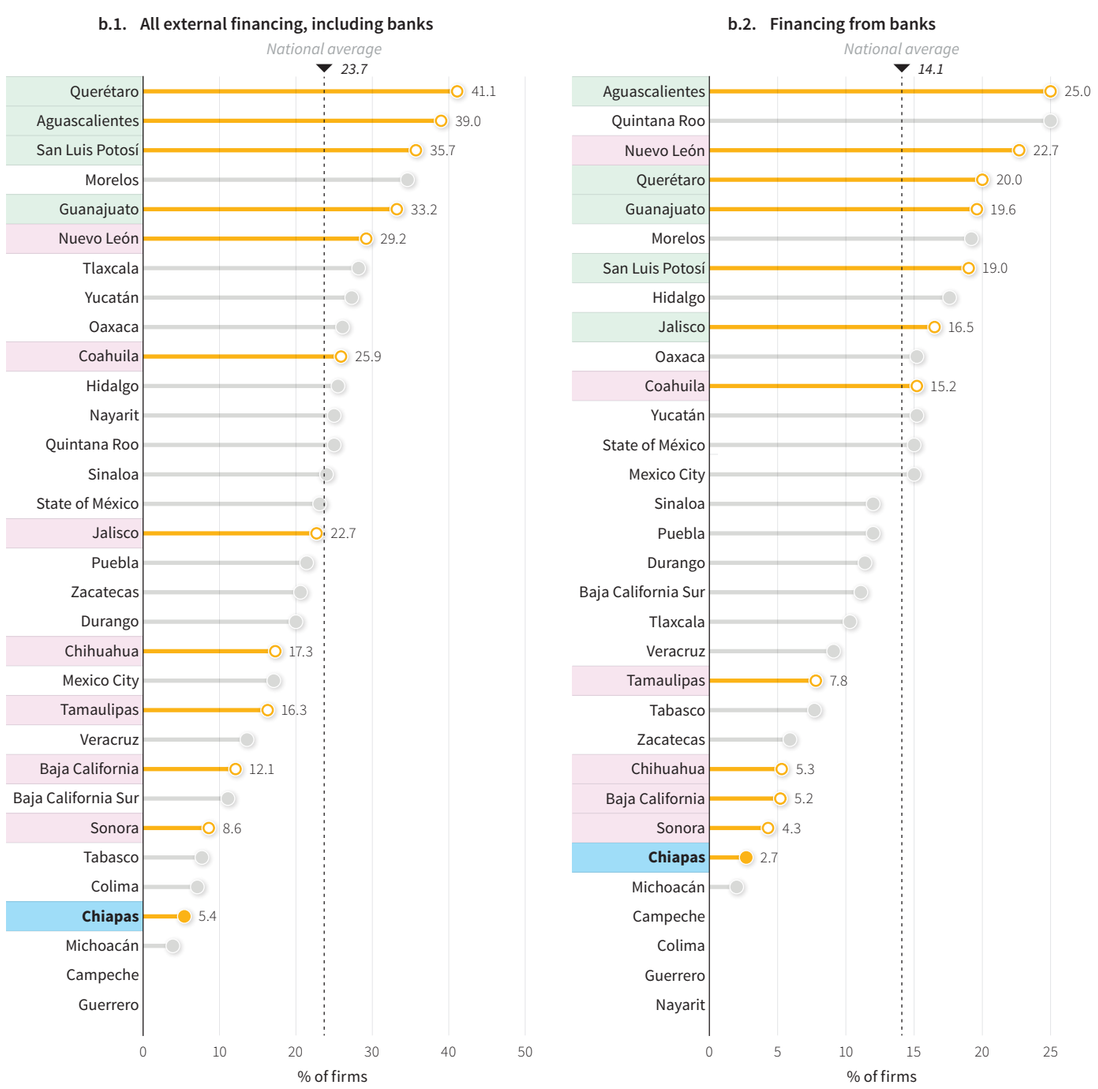
(Fiaure continues next page)

Finally, according to INEGI's 2019 Economic Census, firms in the automotive industry in Chiapas primarily use external financing for purchasing inputs domestically and investing in business development (purchasing equipment or expanding business) (figure E.5). This suggests that firms in Chiapas have sim-

FIGURE E.4

Firms' Access to External Financing, State Comparison, 2018 *(continued)*

b. Automotive industry

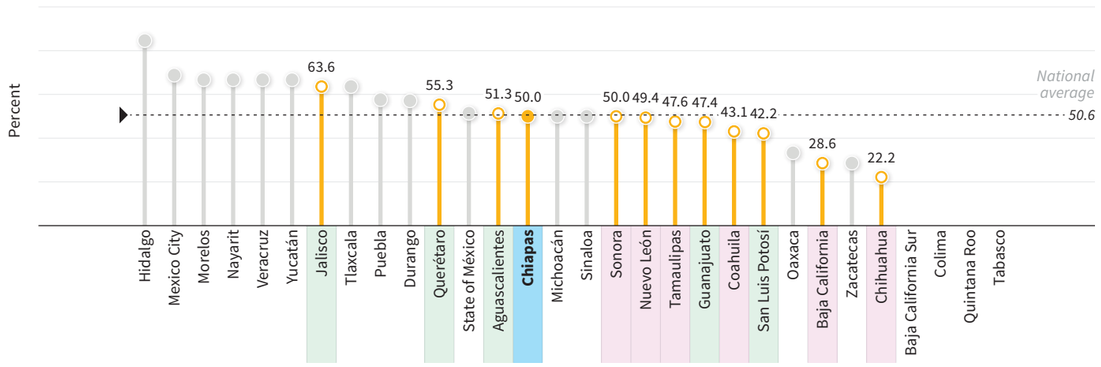


Source: INEGI 2019.
Note: Automotive industry refers to firms in the transportation equipment manufacturing (North American Industry Classification System three-digit code 336) sector. States in the North region are higlighted in purple and states in the Bajío region are highlited in green. For panel b, it was reported that firms in Campeche and Guerrero did not seek external financing.

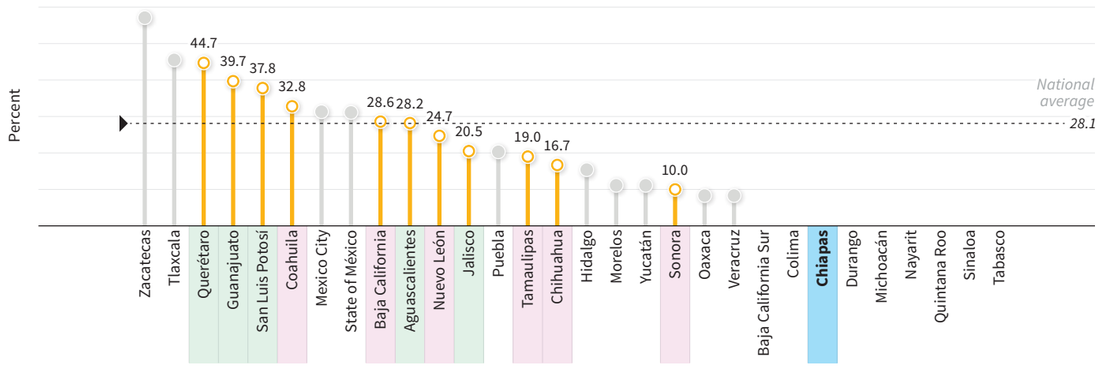
FIGURE E.5

Automotive Industry Firms' Use of Financial Resources, State Comparison, 2018

a. Purchased inputs domestically



b. Purchased inputs abroad



c. Invested in business development*

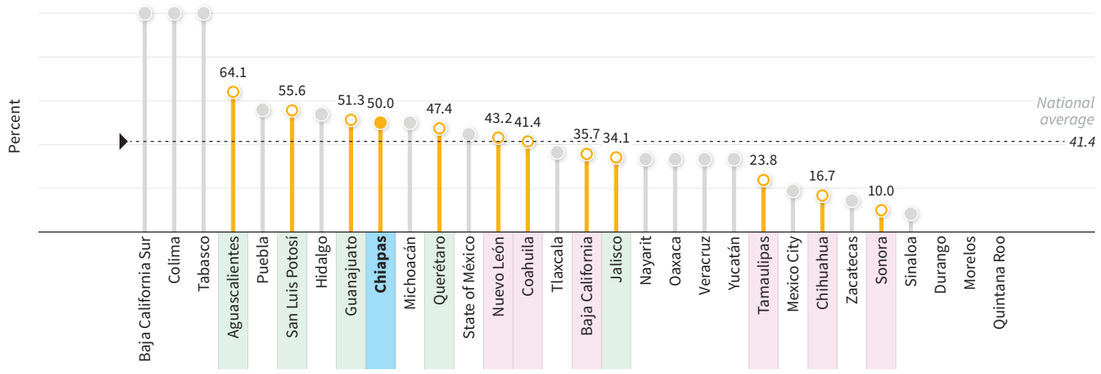


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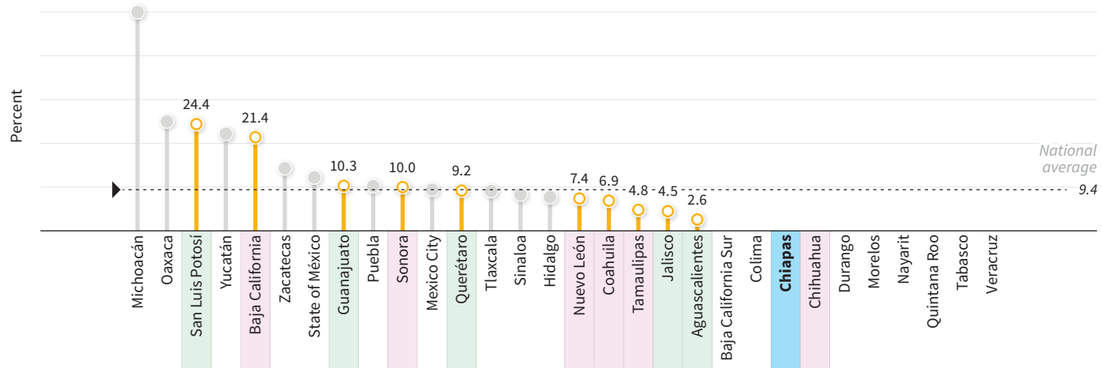
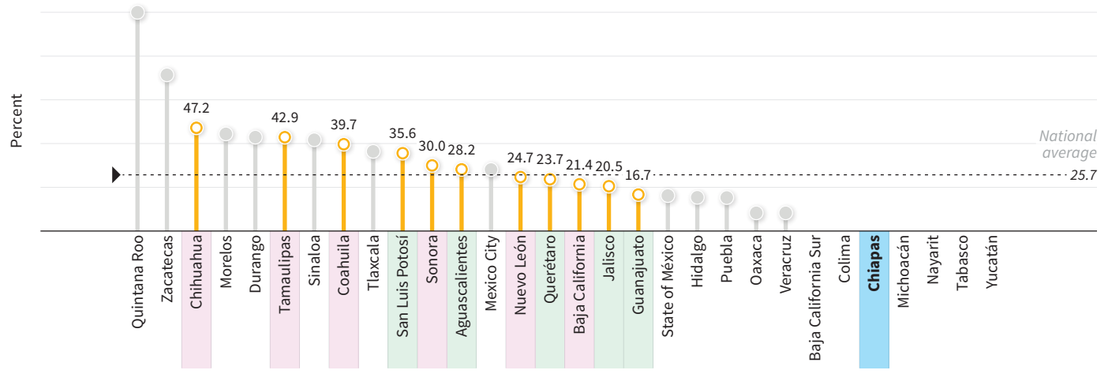
FIGURE E.5

Automotive Industry Firms' Use of Financial Resources, State Comparison, 2018 *(continued)*

d. Started a business



e. Paid down debt



f. Purchased retail space or a vehicle

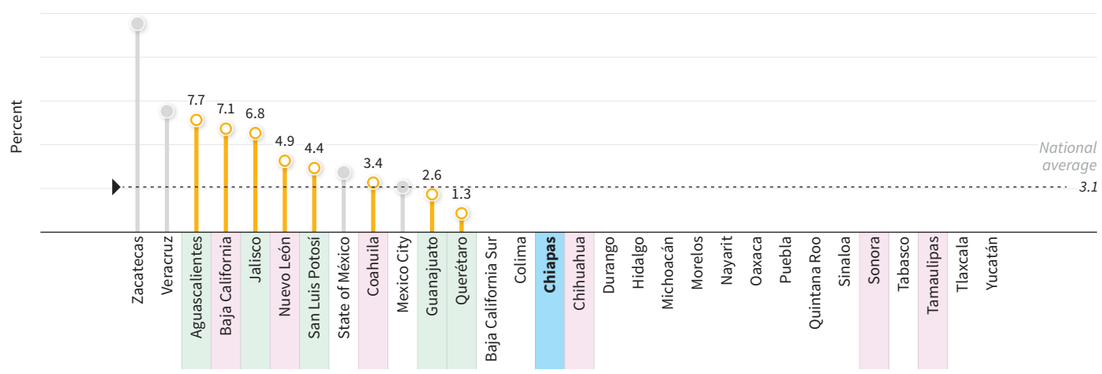


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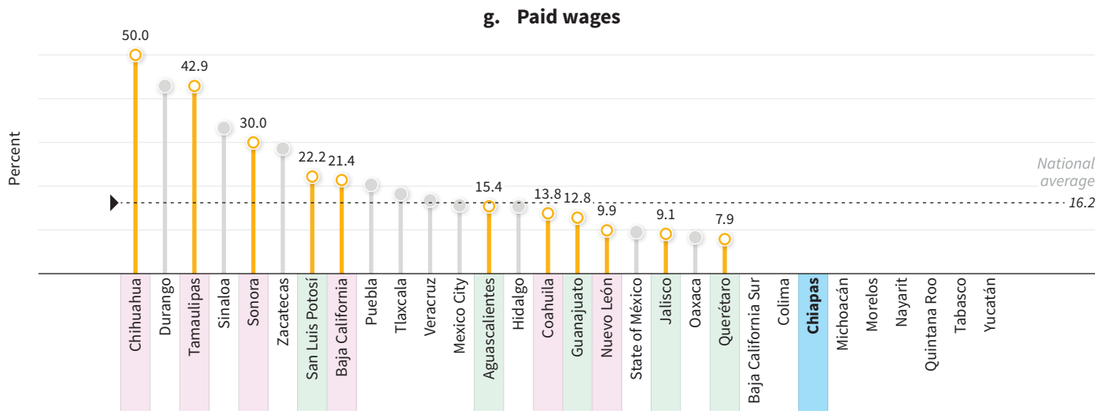
FIGURE E.5

Automotive Industry Firms' Use of Financial Resources, State Comparison, 2018 *(continued)*



Source: Based on data from INEGI 2019.
Note: The figures show percentages out of the firms that had access to external financing. States in the North region are higlighted in light purple and states in the Bajío region are highlited in light green. For panel b, it was reported that firms in Campeche and Guerrero did not seek external financing.
*Refers to purchase equipment or expansion of business.

ilar financing patterns to those in the North and Bajío regions. However, the data reveals that no firm in Chiapas reported using resources from external sources to purchase inputs abroad, start operations, pay debt, purchase retail space, buy a vehicle, or pay wages. The inadequate access to finance could be problematic for furthering the development of the sector in the state, especially for small suppliers and new firms as they might face barriers to entry because of high costs in obtaining the necessary financing.

Limited financial access is a constraint for small-scale input suppliers in the automotive value chain, especially for those that are entering the market (inputs is the segment of the value chain that is most feasible to grow in Chiapas). The low rate of firms seeking access to finance, together with the poor supply of finance, suggests that access to finance is a constraint for developing the automotive industry in Chiapas.

APPENDIX F
Government Programs

TABLE F.1

Government Support Programs for the Automotive Industry

Institution	Name of program	Description
Federal level		
Nacional Financiera S.N.C. (NAFIN)	Cadenas Productivas (Productive Chains)	Financial support for customers and suppliers that includes credits for working capital and equipment, technical support, and favorable factoring arrangements.
	Impulso Económico NAFIN + Estados (NAFIN + States Economic Boost)	Financial support for SMEs, including those in the automotive industry in Aguascalientes, Jalisco, Nuevo León, Querétaro, San Luis Potosí, and Zacatecas, to have access to credit for working capital and fixed assets under special conditions.*
	Garantía Selectiva (Selective Guarantee)	Provides up to 50 percent guarantees for loans of up to Mex$20 million to finance working capital, fixed-asset purchases (except land), infrastructure investment, technical support, environmental improvements, supply-chain upgrades, and liability restructuring. The guarantee is provided through a financial intermediary.
Bancomext (Banco Nacional de Comercio Exterior; National Bank of International Trade)	Apoyo Financiero al Sector Automotriz (Financial Support for the Automotive Industry)	Provides financial support for Tiers 1 and 2 firms in the automotive industry, including credit and guarantees for production, trade, and investments; credit required must exceed US$3 million; support is provided through a financial intermediary.
	Crédito PyMEx (MexSME Credit)	Provides loans of US$3 million or less to SMEs involved in trade-related activities, as well as financial support and access to specialized products for international trade under special conditions; support is provided through a financial intermediary.
State level		
Secretaría de Medio Ambiente e Historia Natural del Estado de Chiapas (Secretariat of Economy of the State of Chiapas)	Programa Microcréditos (Microcredit Program)	Provides credits for materials and equipment purchases by SMEs in amounts ranging from Mex$5,000–15,000 and with maturities of up to 48 months.

Note: SME = small and medium enterprises.
*Out of Mexico's 32 states, 29 offer this program to SMEs operating in sectors defined as strategic by their state governments, including Chiapas. However, Chiapas does not classify the automotive industry as a strategic sector.

APPENDIX G

Potential Investors

Table G.1 lists potential investors for the automotive industry at the national level. Because the sector in Chiapas is in its early stages, these investors are auto parts producers from different tier levels. They were identified based on investment announcements or interest demonstrated in previous polls with private firms.[81] However, they did not express particular interest for any location in Mexico and, therefore, could be a potential opportunity for Chiapas.

TABLE G.1

Potential Investors in the Automotive Industry in Mexico

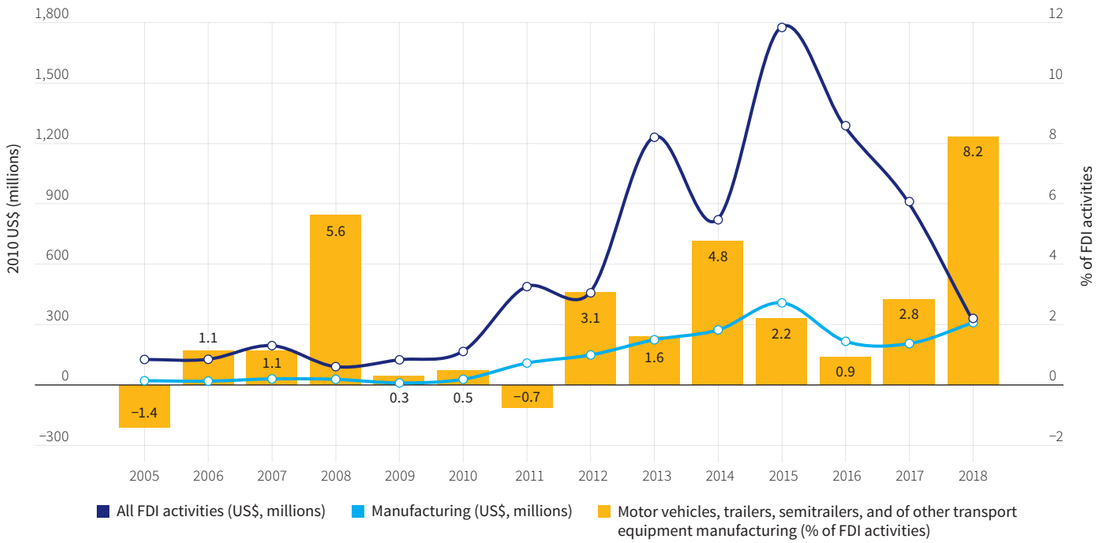
Company	Automotive industry tier level	Reason
Arbomex	Tier 1	The company is dedicated to providing iron and aluminum products for the OEM and other industries (shafts, axles, and supports).
Magna International Inc.	Tier 1	The largest auto parts manufacturer in North America. It produces parts for General Motors, Ford, Fiat Chrysler Automobiles (now Stellantis), BMW, Mercedes, Volkswagen, and Tesla Motors.
Metalsa	Tier 1	The company specializes in auto parts for OEM companies. It currently has facilities in Apodaca, Nuevo Léon.
Nemak México	Tier 1	The company is dedicated to auto parts (motor parts) for OEM companies like General Motors.
Rassini Frenos	Mostly Tier 1, with Tier 2 activities	The biggest producer of braking and suspension systems in the world. It has operations in Coahuila, Puebla, the State of México, and Querétaro as well as offices in Mexico City.
Delphi México	Tier 1	Major manufacturer of electronic pieces for vehicles. It has operations in Chihuahua.
GST Autoleather de México	Tier 1	Major manufacturer of interior in the world. It has operations in Coahuila, Guanajuato, and Tamaulipas.
Kromberg and Schubert Mexico	Tier 1	The company produces wiring systems for the automotive industry.
Pirelli México	Tier 1 and aftermarket	The company is dedicated to tires manufacturing. Its headquarters is in Italy but with Chinese owners.
Motorcar Parts of America	Aftermarket	Major aftermarket manufacturer of various products such as motors and other systems for vehicles.
Yazaki	Tiers 1 and 2	Yazaki is the only automotive industry firm with operations in Chiapas (operating under Arnecom S.A. de C.V.). It produces harnesses and might expand into other electric products.
Grupo Leer	Aftermarket	A regional leader in producing campers for trucks in Jalisco.
Leoni Cable México	Tiers 1 and 2	Manufacturer of electric and electronic for automotive and other industries. It has operations in Chihuahua.
ZF Friedrichshafen	Mostly Tier 1	Manufacturer of auto parts specializing in braking and suspension systems.

Source: El Financiero 2018; SHCP 2017b.
Note: All firms listed in the table expressed interest in either establishing a new operation or expanding their operations in Mexico's cancelled SEZs. SEZ = special economic zone; OEM = original equipment manufacturers.

Among those firms listed in table G.1, Arnecom-Yazaki is the only firm in the automotive sector (North American Industry Classification System code 336320) that has a presence in Chiapas. The company operates seven plants in the state: two in Tuxtla Gutiérrez, two in Tapachula, one in Huixtla, one in Ocozocoautla de Espinosa, and one in Villaflores.[82]

APPENDIX H
Additional Statistics and Information

FIGURE H.1
FDI Inflows to the Automotive Industry in OECD Countries



Source: Based on data from OECD's Stat database.
Note: FDI = foreign direct investment; OECD = Organisation for Economic Co-operation and Development. The number of reporting countries is not consistent throughout the time period, so this chart should not be taken as definitive, but rather as an approximation of how the automotive industry FDI inflows behaved within OECD countries.

TABLE H.1
Official Mexican Standards for Light and Heavy Vehicles

Subject/competent authority	Light vehicles		Heavy vehicles	
Safety (SCT)	NOM-067	Minibuses	NOM-068	Physical and mechanical conditions
	NOM-194-SCFI-2015	Brakes and provision of airbags	NOM-012	Weights and dimensions
Emissions (SEMARNAT)	NOM-042	Emission limits for new vehicles not more than 3,857 kg that use gasoline, liquefied petroleum gas, natural gas, and diesel	NOM-044	Emission limits for vehicles greater than 3,857 kg that use diesel
	NOM-079	Noise limits from the exhaust new vehicles	NOM-045	Opacity limits for vehicles that use diesel
	NOM-076	Emission limits for new vehicles weighing more than 3,857 kg that use liquefied petroleum gas, natural gas, or other alternate fuels		
	NOM-041	Emission limits for vehicles that use gasoline		
	NOM-050	Emission limits for vehicles that use liquefied petroleum gas, natural gas, or other alternate fuels		
	NOM-080	Noise limits from the exhaust of motor vehicles, motorcycles and motorized tricycles		
Consumer information (SE)	NOM-050-SCFI-2004	Product labeling	NOM-050-SCFI-2004	Product labeling
	NOM-116-SCFI-2018	Lubricating oils	NOM-116-SCFI-2018	Lubricating oils

Source: SE 2020.
Note: kg = kilogram; NOM = *Normas Oficiales Mexicanas*; SCT = *Secretaría de Comunicaciones y Transportes*; SE = *Secretaría de Economía*; SEMARNAT = *Secretaría del Medio Ambiente y Recursos Naturales.*

TABLE H.2

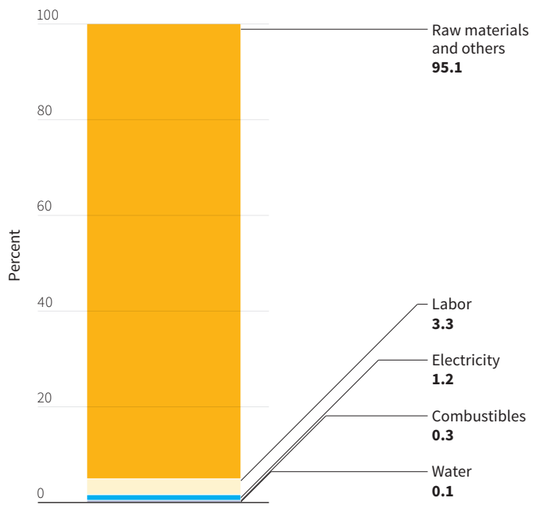
Summary of Rules of Origin for Automotive Products Defined in Mexico's Trade Agreements

FTA/economic cooperation agreement	Rules of origin for automotive products
United States-Mexico-Canada Agreement	– RCV must be 75 percent by 2023 (up from 62.5 percent in NAFTA). – At least 70 percent of a vehicle producer's steel and aluminum purchases must originate in North America. – A certain percentage (30 percent with annual increases reaching 40 percent in three years) of vehicle value added must be produced by employees making a minimum hourly wage of $16 per hour.*
European Union	To be granted original status, the value of all the materials used for the manufacturing of the product must not exceed 40 percent of its manufacturing price.
European Free Trade Association member states	To be granted original status, the value of all the materials used for the manufacturing of the product must not exceed 40 percent of its manufacturing price.
Mercosur (*Mercado Común del Sur*; Common Southern Market)	Brazil and Argentina: RCI must not be less than 60 percent; Uruguay: RCI not less than 50 percent; Mexico: RCI not less than 30 percent.
Colombia	RCV from 35 percent to 50 percent.
Chile	RCV of at least 32 percent, using the transaction value method, or RCV of at least 26 percent using the net cost method.
Bolivia	RCV of at least 40 percent using the net cost method.
Costa Rica and Nicaragua	RCV of at least 40 percent using the net cost method.
El Salvador, Guatemala, and Honduras.	RCV of at least 50 percent.
Israel	RCV of 40 percent, using the transaction value method, or 30 percent, using the net cost method.
Peru	RCV of at least 35 percent.
Japan	RCV of at least 65 percent.

Source: Secretaría de Economía and Proméxico.
Note: FTA = free trade agreement; NAFTA = North American Free Trade Agreement; RCI = regional content index; RCV = regional content value.
*The 40 percent is calculated as follows: 25 percent for expenses in materials and high-wage labor force; no more than 10 percent in technology expenses, and no more than 5 percent in high-wage assembly expenses.

FIGURE H.2

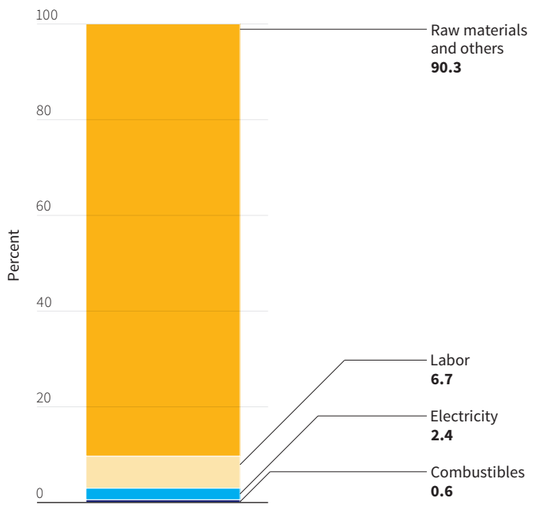
Cost Structure in Automobile and Light-Duty Motor Vehicle Industries, National Level



Source: SHCP 2017a.

FIGURE H.3

Cost Structure in Vehicle Parts Manufacturing, National Level



Source: SHCP 2017a.

TABLE H.3

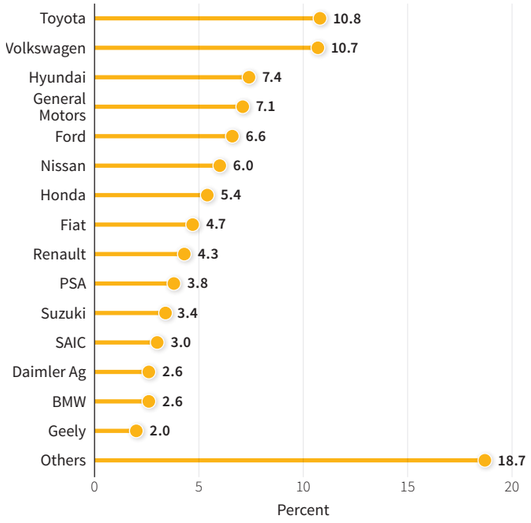
Typical Cost Structure by Component Systems for an Automotive Vehicle

Component system	Cost per vehicle (US$)	Share of total (%)
Engine	2,555	18.3
Body and structural	2,375	17.0
Electronic components	1,825	13.0
Transmission	1,335	9.5
Interior	1,285	9.2
Axles, driveshafts, and components	825	5.9
Climate control and engine cooling	715	5.1
Suspension	480	3.4
Braking	435	3.1
Steering	380	2.7
Fuel system	360	2.6
Passenger restraints	350	2.5
Audio and telematics	335	2.4
Wheels and tires	305	2.2
Exhaust	295	2.1
Body glass	145	1.0
Total	14,000	100.0

Source: Bank of America Merril Lynch Global Research 2014.

FIGURE H.4

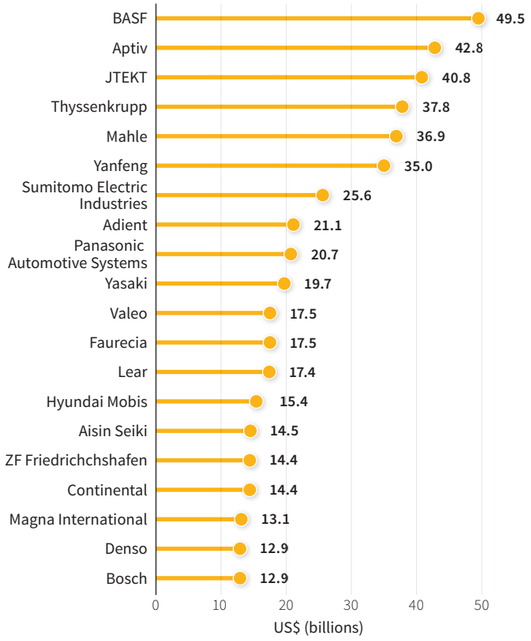
Market Share for Automobile and Heavy-Duty Motor Vehicles by Units Produced, 2017



Source: OICA 2017.

FIGURE H.5

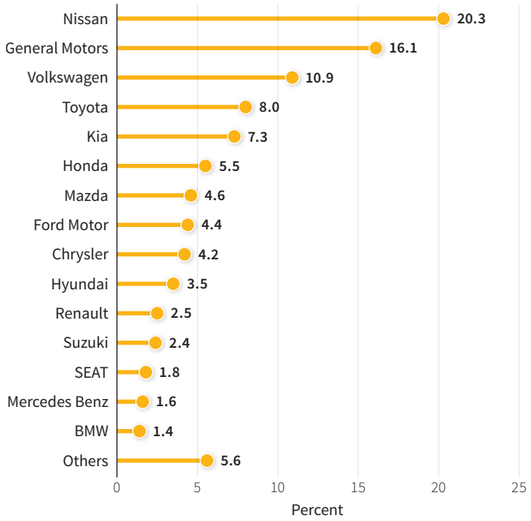
Top 20 Firms for Auto Parts Production by Sales, 2019



Source: Automotive News 2019.

FIGURE H.6

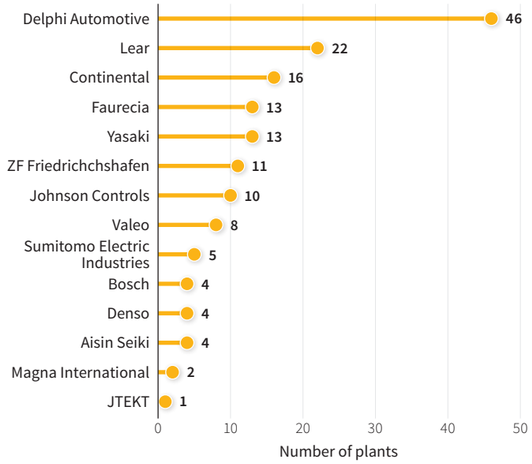
Market Share for Automobile Vehicles by Units Sold in Mexico, 2019



Source: Based in data from INEGI's *Registro Administrativo de la Industria Automotriz de Vehículos Ligeros* database.
Note: The figure does not include heavy vehicles because available data is not broken down by firm at the national level. "Others" include Acura, Alfa Romeo, Audi, BAIC, Bentley, Fiat, Infiniti, Isuzu, JAC, Jaguar, Land Rover, Lincoln, Mini, Mitsubishi, Motornation, Peugeot, Porsche, Smart, Subaru, and Volvo.

FIGURE H.7

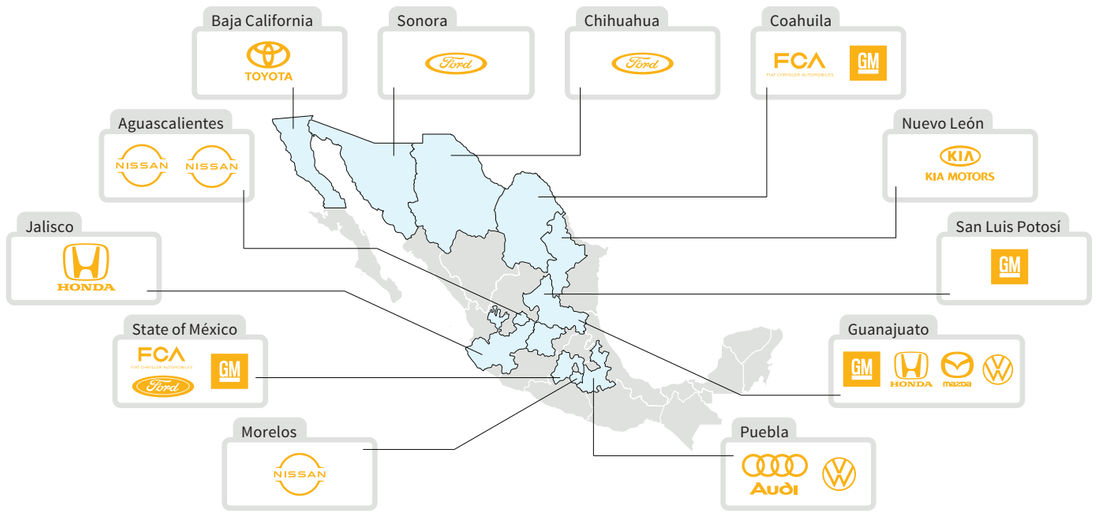
Main Vehicle Parts Manufacturing Firms in Mexico, 2017



Source: CEPAL 2017.

MAP H.1

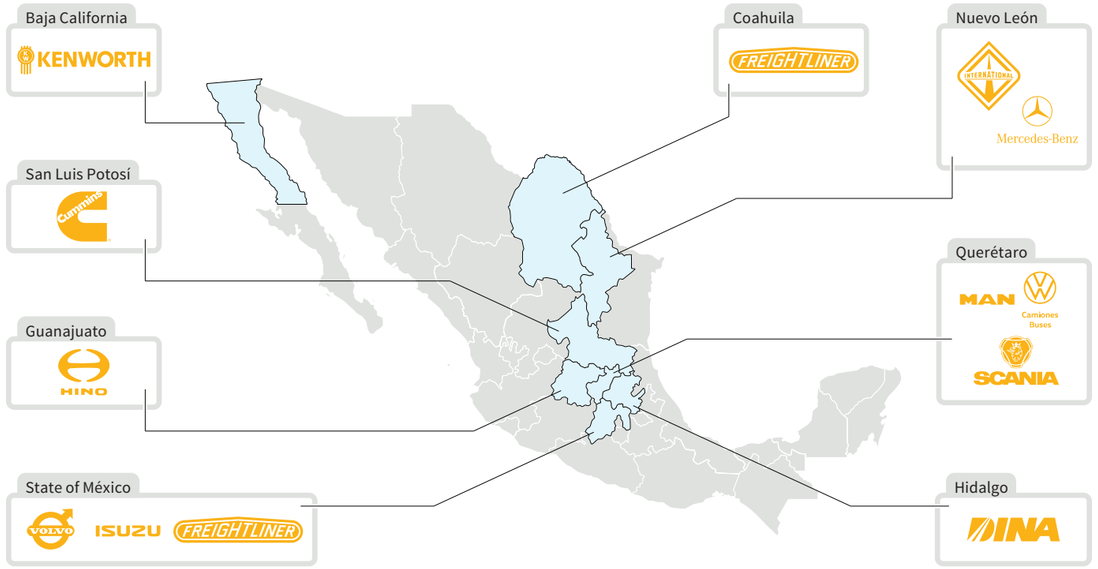
Location of Vehicle Production Plants in Mexico



Source: AMIA 2018.

MAP H.2

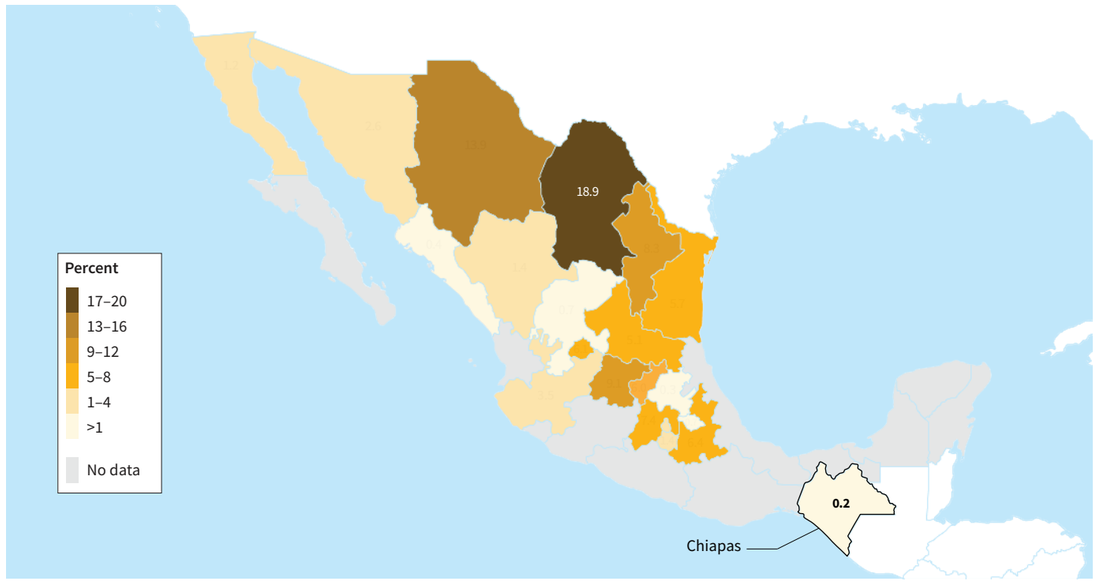
Location of Heavy-Duty Vehicles Production Plants in Mexico



Source: AMIA 2018.

MAP H.3

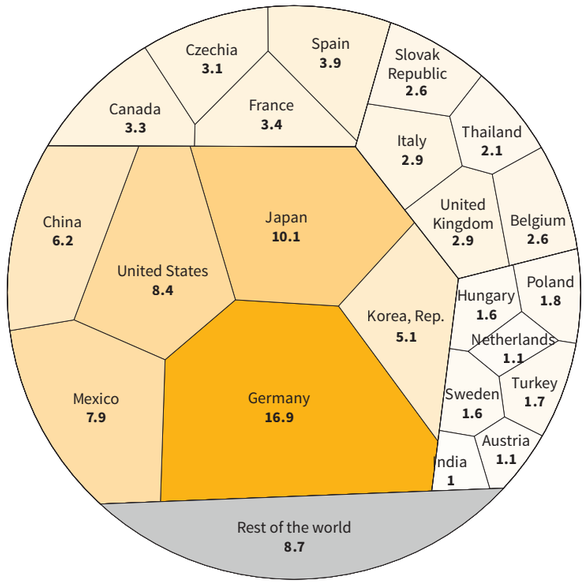
Share of Vehicle Parts Production by State in Mexico, 2018



Source: AMIA 2018.

FIGURE H.8

Share of Global Automotive Exports by Country, 2021



Source: Based on data from UN Comtrade.

TABLE H.4

Mexico's Share of Exports and CAGR in the Automotive Sector

Subsector/product	World			Mexico		
	Product exports value, 2021 (US$, billions)	Share in global automotive exports, 2021 (%)	CAGR, 1995–2021 (%)	Share in global product exports, 2021 (%)	Product exports value, 2021 (US$, billions)	CAGR, 1995–2021 (%)
Buses	12.1	0.9	3.7	0.0	…	…
Cars	714.7	55.6	4.4	5.6	39.9	6.6
Motor vehicles for transporting goods	142.0	11.1	4.9	21.6	30.7	11.4
Vehicle chassis fitted with engines	2.0	0.2	−1.2	0.2	0.0	−14.0
Vehicle bodies	7.4	0.6	4.3	2.1	0.2	4.9
Parts of motor vehicles	406.8	31.7	5.3	7.5	30.5	10.6
Total	1,285.0	100.0	4.7	7.9	101.3	8.6

Source: Calculations based on data from UN Comtrade.
Note: CAGR = compound annual growth rate.

TABLE H.5

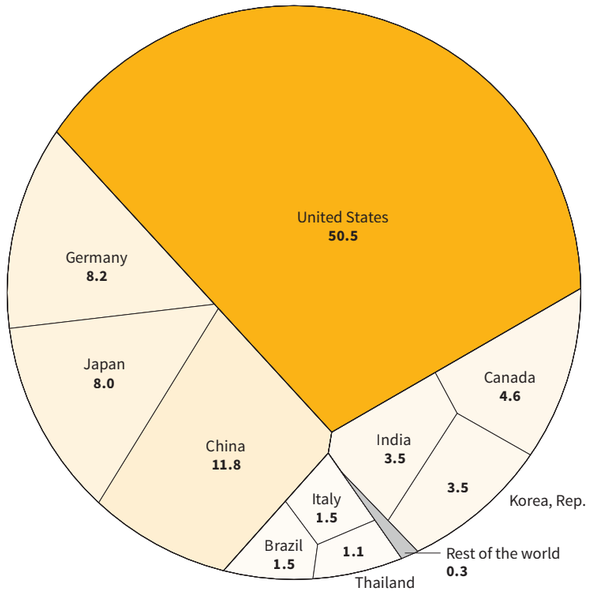
Contribution to Automotive Exports At the State and National Levels by Subsector, Selected States, 2014

	Buses	Cars	Motor vehicles for transporting goods	Vehicle chassis fitted with engines	Vehicle bodies	Parts of motor vehicles
Aguascalientes						
Share in state's exports (%)	0.0	59.9	13.1	0.0	0.0	27.0
Share in national exports (%)	0.0	11.6	3.8	0.0	1.5	7.2
Chihuahua						
Share in state's exports (%)	0.0	44.1	2.4	0.0	0.0	53.5
Share in national exports (%)	0.0	6.2	0.5	0.0	1.1	10.3
Coahuila						
Share in state's exports (%)	0.0	23.5	44.1	0.1	0.1	32.2
Share in national exports (%)	0.0	7.8	22.1	46.5	16.9	14.7
Guanajuato						
Share in state's exports (%)	0.0	36.6	45.3	0.0	0.0	18.0
Share in national exports (%)	0.6	8.3	15.5	0.0	3.5	5.6
Mexico City						
Share in state's exports (%)	0.0	50.6	37.3	0.0	0.0	12.1
Share in national exports (%)	0.2	6.2	6.9	1.0	0.5	2.0
State of México						
Share in state's exports (%)	0.5	42.7	41.4	0.0	0.0	15.4
Share in national exports (%)	92.8	16.5	24.1	6.7	1.0	8.2
Puebla						
Share in state's exports (%)	0.0	78.4	5.4	0.0	0.2	16.1
Share in national exports (%)	0.1	21.6	2.2	0.0	16.8	6.1
Sonora						
Share in state's exports (%)	0.0	78.6	6.5	0.0	0.8	14.1
Share in national exports (%)	0.5	10.6	1.3	0.0	44.3	2.6
Chiapas						
Share in state's exports (%)	0.0	1.2	0.5	0.0	0.0	98.4
Share in national exports (%)	0.0	0.0	0.0	0.0	0.0	0.4

Source: Calculations based on Mexico Atlas of Economic Complexity.

FIGURE H.9

Mexico's Main Automotive Import Partners, 2021



Source: Based on data from UN Comtrade.

TABLE H.6

Main Automotive Imports in Chiapas

HS code	Description	Import value, 2014 (US$, thousands)	Share in auto industry imports, 2014 (%)	CAGR, 2004–14 (%)
8708	Parts and accessories of the motor vehicles of headings 8701 to 8705	816.1	82.2	7.0
8703	Motor cars and other motor vehicles principally designed for the transport of persons (other than those of heading 8702), including station wagons and racing cars	106.5	10.7	−7.1
8704	Motor vehicles for the transport of goods	56.3	5.7	4.6
8707	Bodies (including cabs) for the motor vehicles of headings 8701 to 8705	13.7	1.4	−6.2
	Total	992.6		3.6

Source: Based on data from Mexico Atlas of Economic Complexity.
Note: CAGR = compound annual growth rate; HS = Harmonized System. The table shows the share of the product in the total automotive industry imports of Chiapas.

TABLE H.7

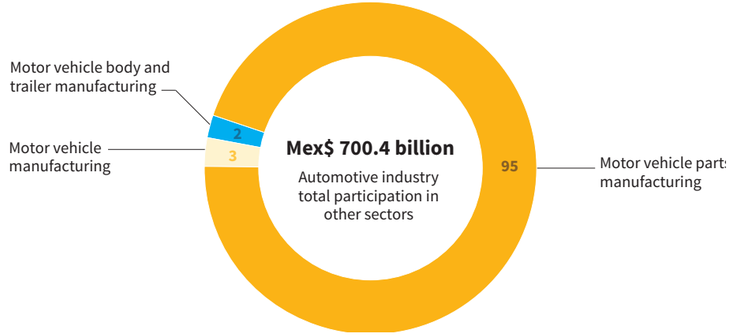
Main Automotive Imports in the North and Bajío Regions, 2014

HS code	Product	Import value (US$, millions)	Share in auto industry imports, 2014 (%)	CAGR, 2004–14
8708	Parts and accessories of the motor vehicles of headings 8701 to 8705	13,403.9	82.5	6.9
8703	Motor cars and other motor vehicles principally designed for the transport of persons (other than those of heading 8702), including station wagons and racing cars	2,216.1	13.6	−7.6
8704	Motor vehicles for the transport of goods	436.9	2.7	−6.7
8702	Motor vehicles for the transport of ten or more persons, including the driver	100.0	0.6	7.6
8706	Chassis fitted with engines for the motor vehicles of headings 8701 to 8705	60.5	0.4	15.4
8707	Bodies (including cabs) for the motor vehicles of headings 8701 to 8705	31.5	0.2	−9.9
	Total	16,248.9	100.0	2.4

Source: Based on data from Mexico Atlas of Economic Complexity.
Note: CAGR = compound annual growth rate; HS = Harmonized System. The table shows the share of the product in the combined total automotive industry imports of the North and Bajío regions.

FIGURE H.10

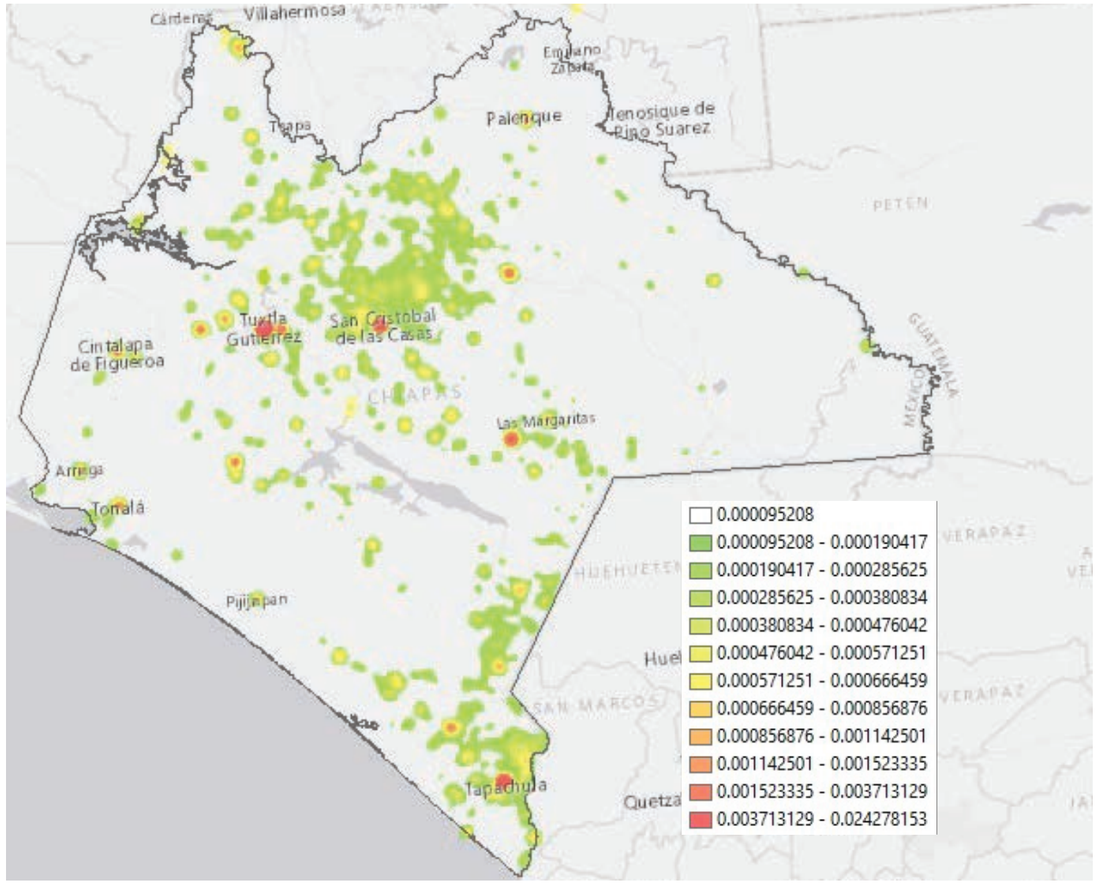
Automotive Industry's Participation in Other Sectors in Mexico, 2013 (%)



Source: Based on INEGI's Input-Output Matrix.
Note: The input-output matrix does not disaggregate beyond four digits in the NAICS classification. Consequently, vehicle parts from the rubber and plastics industries are not included in this figure. The corresponding North American Industry Classification System codes for these sectors are as follows: motor vehicle parts manufacturing (3363), motor vehicle body and trailer manufacturing (3362), and motor vehicle manufacturing (3361).

MAP H.4

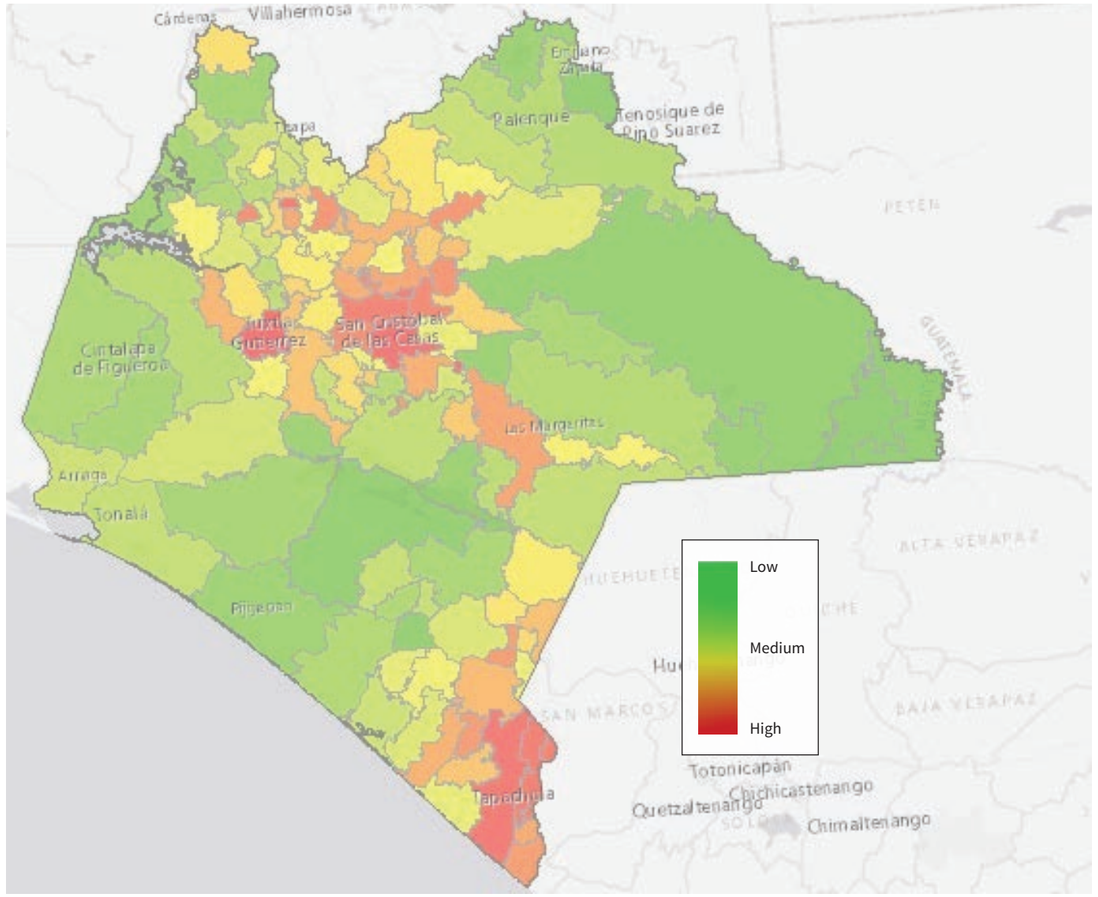
Population Density in Chiapas



Source: Calculations based on data from INEGI 2010 and elaborated using Arcgis.
Note: The population density is calculated using the kernel density model with the population by village in the state. Colors are calculated by quartile. Those villages with the lowest density are not shown to have a better visualization.

MAP H.5

Urban Density in Chiapas



Source: Calculations based on data from INEGI 2010 and elaborated using Arcgis.
Note: Density is the population divided by the area in square kilometers of the municipalities.

Notes

1. In the automotive industry, Tier 1 firms supply original equipment manufacturers, Tier 2 firms supply Tier 1 firms with moderate-complexity parts, and Tier 3 firms supply Tier 2 firms with less-sophisticated components.

2. The South-Southeast region of Mexico covers nine states: Campeche, Chiapas, Guerrero, Oaxaca, Puebla, Quintana Roo, Tabasco, Veracruz, and Yucatán. Given the differences in economic structure, social development, and institutional capacities of each state, and potential flaws of having a "one-size-fits-all" approach, this Deep Dive by the International Finance Corporation focused on the three poorest states in Mexico: Chiapas, Guerrero, and Oaxaca—all located in the southern part of the country, and Yucatan, one of the more dynamic and developed states in the southeast ("the selected states" from here on).

3. Data for the automotive industry in Chiapas is grouped with other sectors in INEGI's National Accounts. NAICS three-digit codes 333 to 336 include the automotive industry and the manufacturing of machinery, computers and electronics, electrical equipment, appliances, components, and transportation equipment. However, the automotive industry concentrates all medium and large firms under these categories in the state, while the rest of manufacturing sectors is 90 percent composed of micro firms, so it is reasonable to assume that most of the value added reported comes from automotive.

4. World Bank and MMK Consulting (2016).

5. AMIA and INEGI (2018).

6. Kallstrom (2015).

7. Based on estimations using INEGI's Monthly Survey of the Manufacturing Industry during 2013–21.

8. AMIA and INEGI (2018).

9. Customary law or "*usos y costumbres*" is used by indigenous population and communities. The Inter-American Court of Human Rights describes it as legal norms and rules that arise from repeated events over time in a specific territory. They have binding force as long as they respect human rights and basic legal frameworks. This means that conditions, practices, traditions, and customs are accepted as obligatory rules of conduct by a community. In many indigenous communities authorities are selected through assemblies, which can vary in terms of inclusiveness. Political parties may not play a role in this process. See the Corte Interamericana de Derechos Humanos' and the World Intellectual Property Organization's websites for more details

10. SHCP (2016); Hausmann, Cheston, and Santos (2015).

11. Financial access points refer to banks, *sociedades cooperativas de ahorro y crédito popular* (savings and credit cooperative societies) and *sociedades financieras populares* (popular financial companies) branches, as well as bank agents, and automated teller machines.

12. Although there are no disaggregated data for the global automotive industry, one way to estimate the size of the sector internationally is by aggregating data for motor vehicles, trailers, semitrailers (ISIC Rev. 3 code 34) and other transport equipment (ISIC Rev. 3 code 35) categories using UNIDO's INDSTAT at the two-digit level 2020 of ISIC Rev. 3 database. Data for 98 countries were used to calculate the global manufacturing growth estimate.

13. Based on UNIDO's INDSTAT at the two-digit level 2022 of ISIC Rev. 3 database, which do not include an aggregated estimate for global GDP (or value added) aggregated estimate. Based on available data, approximately 88 countries were considered to calculate the global GDP estimate for this purpose.

14. According to AlixPartners estimates, these shortages resulted in a revenue loss of more than US$200 billion for the global automotive industry and a production decrease of around 8.2 million vehicles in 2021. AutoForecast Solutions estimates the production decrease to be even higher, more than 11 million. Despite a 1.3 percent increase in light vehicles production to 79.1 million compared to 2020, this figure is more than 10 percent below prepandemic levels, as reported by Oxford Analytica. These effects can be explained by the semiconductor shortages and logistics disruptions.

15. Refers to motor vehicle manufacturing (NAICS sector code 3361), motor vehicle body and trailer manufacturing (3362), and motor vehicle parts manufacturing (3363). The disaggregation level of INEGI's National Accounts data is limited to NAICS four-digit codes, therefore, activities such as tire manufacturing (except retreading) (326211), tire retreading (326212), and motor vehicle plastic parts (326192) are excluded.

16. Based on GDP data from INEGI's National Accounts and data on firms (economic units) and workers (personal ocupado) from INEGI's 2019 Economic Census.

17. INEGI (2019).

18. Other related activities include the manufacturing of machinery, computers and electronics, electrical equipment, appliances, components, and transportation equipment. However, the automotive industry concentrates all medium and large firms under these categories in the state. In contrast, the remaining manufacturing sectors are primarily composed of micro firms, making up 90 percent of the total. Given this significant disparity in firm size, it is reasonable to assume that the automotive industry is the primary contributor to most of the production, value added, and jobs reported within these categories.

19. Refers to motor vehicle parts manufacturing (NAICS sector code 3363) and FDI inflows data between 2016 and 2021 are confidential. Most FDI inflows data for motor vehicle manufacturing (3361) between 2016 and 2021 are confidential. The SE's FDI database does not show FDI for motor vehicle body and trailer manufacturing (3362). Further, the disaggregation of the database is limited to NAICS four-digit codes, activities such as tire manufacturing (except retreading) (326211), tire retreading (326212), and motor vehicle plastic parts (326192) are excluded.

20. The calculation excludes motor vehicle plastic parts (NAICS 326192) because INEGI's 2019 Economic Census does not include data on gross fixed capital formation.

21. Import substitution is particularly challenging for components where scale and/or technology is key to carry out tasks to produce them (for example, casting parts, microchips, among others). Indeed, import substitution opportunities should be assessed for each components subsegments Mexico currently imports.

22. AMIA and INEGI (2018).

23. In 2021, the United States filed its first labor complaints with Mexico under the USMCA, alleging acts that undermined union freedoms at the General Motors plant in Silao, Guanajuato and at the Tridonex auto parts factory in Matamoros, Tamaulipas, a subsidiary of Philadelphia-based Cardone Industries. Potential complaints could arise if the sector's production in Chiapas is stimulated without complying the minimum hourly wage established in the trade agreement.

24. Saberi (2018).

25. AMIA and INEGI (2018).

26. AMIA and INEGI (2018).

27. Kallstrom (2018).

28. Based on INEGI's Input-Output Matrix, https://en.www.inegi.org.mx/programas/mip/2013/.

29. Pavlínek and Ženka (2016).

30. Silver (2006).

31. Pavlínek and Ženka (2016).

32. Veloso and Kumar (2002).

33. Criscuolo (2015).

34. For further details on Mexico's free trade agreements, see appendix H.

35. For further details on Mexico's official standards, see appendix H.

36. For further details on financial programs and products offered at the federal and state level, see appendix F.

37. In most cases, INEGI's TFP calculations are limited to NAICS three-digit codes. Transportation equipment manufacturing (NAICS 336) includes motor vehicle manufacturing, motor vehicle body and trailer manufacturing, motor vehicle parts manufacturing, aerospace product and parts manufacturing, railroad rolling stock manufacturing, ship and boat building, and other transportation equipment manufacturing.

38. Estimates based on INEGI's monthly survey of the manufacturing industry. The industry's wage was calculated as a weighted average using the shares of employment in motor vehicle, motor vehicle body and trailer, and motor vehicle parts manufacturing, which averaged 10.1, 2.2, and 87.6 percent, respectively, during 2013–21.

39. For international comparisons, see World Bank and MMK Consulting (2016). For the analysis of main locations in Mexico, see World Bank and MMK Consulting (2016).

40. Manufacturing sectors include: aerospace, agroindustry, automotive, chemicals, electronics, green energy, medical devices, metal components, pharmaceuticals, plastics, precision manufacturing, and telecommunications. Services sectors include: digital entertainment, software design, biotechnology, clinical trial administration, product testing, professional services, and support services. The analysis was conducted at the city level, with Tapachula for Chiapas.

41. SHCP (2017b).

42. MGI (2005).

43. See CSI Market's total market profitability, https://csimarket.com/Industry/industry_Profitability_Ratios.php.

44. OICA (2017).

45. For maps illustrating the location of the main automotive plants in Mexico, see appendix H.

46. Based on 2014 data from Mexico Atlas of Economic Complexity of Mexico.

47. NAICS sector code 336 includes: motor vehicle manufacturing, motor vehicle body and trailer manufacturing, motor vehicle parts manufacturing, aerospace product and parts manufacturing, railroad rolling stock manufacturing, ship and boat building, and other transportation equipment manufacturing.

48. A product is said to have a comparative advantage if its revealed comparative advantage (RCA) is greater than one. The RCA is determined by calculating as the ratio of the value added or export of an industry or product to the total value added or export in a state, over the average contribution of that industry or product in Mexico's total value added or exports.

49. These include the following products (using HS four-digit codes, disaggregated to six-digit level): buses (HS 8702), cars (8703), motor vehicles for transporting goods (8704), vehicle chassis fitted with engines (8706), vehicle bodies (8707), and motor vehicle parts (8708).

50. IFC–World Bank (2019).

51. Criscuolo (2016).

52. Travel time estimates were obtained using Google Maps.

53. As part of a presidential decree in December 2020, companies are granted, between January 2021 and December 2024, income tax breaks and value-added taxes (a reduction of 30 to 20 percent and 16 to 8 percent, respectively) in 22 municipalities from the states of Chiapas (17), Campeche (2), Tabasco (2) and Quintana Roo (1) along Mexico's southern border with Guatemala and Belize.

54. Notably, La Sepultura, a protected natural area in northern Arriaga, is excluded.

55. A major project of the current federal administration aims to enhance the economic and social infrastructure around the Isthmus of Tehuantepec, which represents the shortest distance between the Pacific and Atlantic Oceans in Mexico (approximately 300 km, from the Port of Salina Cruz, Oaxaca to the Port of Coatzacoalcos, Veracruz), and consolidate up to 10 industrial parks along it. Benefits of the project would cover 79 municipalities including from Oaxaca (46) and Veracruz (33) and a population of 2.4 million inhabitants.

56. The distance between Arriaga and the Port of Salina Cruz is 221 km, less than three hours by road.

57. That is, instead of focusing on country- or state-level economic growth, the focus is on investment and growth for the specific industry in the state.

58. The analysis is carried out following a methodology implemented by Barrios and others (2018a; 2918b) using data from the *Encuesta Nacional de Ocupación y Empleo* (National Survey of Occupation and Employment) and information from the *Sistema Nacional de Clasificación de Ocupaciones* (National Classification System for Occupations). The deviation between the share of occupations existing at the national and state levels were calculated using the symmetric mean absolute percentage error to measure the availability of workers performing the occupations required. In addition, the labor cost for each state is calculated and compared to the national level to measure the relative availability or scarcity of qualified human capital. This involves a weighted average of the hourly wage, using the occupation proportions at national level as the weights. In cases where a state has no workers in a particular occupation, the highest salary among the states for that occupation is assigned (reflecting the scarcity of workers in that activity).

59. SHCP (2016a, 2016b); Hausman, Cheston, and Santos (2016).

60. To identify infrastructure-related constraints hindering the development of the sector, the assessment of coverage and quality of infrastructure services are combined with measures of usage intensity of key inputs. For a detailed analysis of coverage and quality of infrastructure services and their usage intensity, see appendices C and D.

61. This section draws on the methodology implemented by Barrios and others (2018a; 2018b) and includes all industry groups NAICS sectors 31–33 (manufacturing) at the four-digit level, except classified ones, according to INEGI's Economic Census for 2014 and 2019.

62. Hausmann, Cheston, and Santos (2016).

63. SHCP (2016a, 2016b); Hausman, Cheston, and Santos (2016).

64. The centers carry out design and engineering activities for vehicle and auto parts, virtual design, laboratory testing, emissions analysis, as well as testing under hot or cold weather conditions and rugged road simulations. The activities conducted encompass the development, review, and testing of processes and products, ranging from simple change or modification to auto parts to partial or total changes in body, chassis,

engine or transmission.

65. Financial access points refer to bank, *sociedades cooperativas de ahorro y crédito popular* (savings and credit cooperative societies) and *sociedades financieras populares* (popular financial companies) branches, as well as bank agents, and automated teller machines. The data is from CNBV's *Bases de Datos de Inclusión Financiera* (Financial Inclusion Dataset) for December 2021.

66. INEGI (2019).

67. For the analysis, see appendix E.

68. According to World Bank estimates, the share of world's population living cities rose from 2 percent in 1800 to 50 percent in 2015.

69. IPCC (2022); U.S. EPA (2018).

70. Countries such as China, France, Germany, India, the Netherlands, Norway, and the United Kingdom intend to ban the production and sale of fossil-fuel-powered cars. While cities such as Athens, Madrid, Mexico City, Paris, and Stuttgart plan to ban diesel cars by 2030 or earlier.

71. Deloitte (2017).

72. Arnecom-Yazaki is already in this market. Its products are in almost half of the world's top ten hybrid and electric vehicles in the market and almost three-fifths of the world's top five electric vehicles.

73. Hallward-Driemeier and Nayyar (2017).

74. For more details, see appendix A.

75. This assessment identified some auto parts in table 3.1. In the medium and long term, the goal would be attracting at least one relevant assembly plant with its main suppliers.

76. This involves a weighted average of the hourly wage is using the occupation proportions at the national level as weights. In cases where a state has no workers in a particular occupation, the highest salary among the states for that occupation is assigned (reflecting the scarcity of workers in that activity).

77. According to Hausmann, Cheston, and Santos (2015), to work on Yazaki's production lines, a worker only has to have a basic education, know how to read, differentiate colors, and conclude a six-day training.

78. The approach and assumptions are similar to that used by Barrios and others (2018a; 2018b).

79. The analysis approach and assumptions are similar to that used by Barrios and others (2018a; 2018b) and includes all industry groups NAICS sectors 31–33 (manufacturing) at the four-digit level, except classified ones, according to INEGI's Economic Census for 2014 and 2019.

80. Financial access points refer to bank, *sociedades cooperativas de ahorro y crédito popular* (savings and credit cooperative societies) and *sociedades financieras populares* (popular financial companies) branches, as well as bank agents, and automated teller machines. The data is from CNBV's *Bases de Datos de Inclusión Financiera* (Financial Inclusion Dataset) for December 2021.

81. Those firms were identified in a Mexican special economic zones survey by the World Bank Group in 2016.

82. The plant in Huixtla is the only one that has between 101 and 250 workers (inclusive); the other plants have at least 251 workers. Based on information from INEGI's *Directorio Estadístico Nacional de Unidades Económicas* database.

References

AMIA (Asociación Mexicana de la Industria Automotriz). 2018. "Dialogo con la Industria Automotriz 2018–2024." AMIA, Mexico City.

AMIA and INEGI (Asociación Mexicana de la Industria Automotriz and Instituto Nacional de Estadística y Geografía). 2018. "Colección de Estudios Sectoriales y Regionales: Conociendo la Industria Automotriz." AMIA and INEGI, Aguascalientes.

ARTF (Agencia Reguladora del Transporte Ferroviario). 2022. "Anuario Estadístico Ferroviario 2018." ARTF, Mexico City. https://www.gob.mx/artf/documentos/anuario-estadistico-ferroviario-2021-parte-i#:~:text=El%20PIB%20del%20transporte%20por,0.9%25%20con%20respecto%20al%202020.

Automotive News. 2019. "2019 Top Suppliers." Crain Communications Inc.

Barrios, Douglas, Johanna Ramos, Jorge Tapia, and Ana Grisanti. 2018a. "Tabasco: Diagnóstico Industrial." CID Working Paper 105, Harvard University, Cambridge, MA. https://growthlab.cid.harvard.edu/sites/projects.iq.harvard.edu/files/growthlab/files/tabasco_diagnosticoindustrial_cidrfwp105.pdf.

——. 2018b. "Baja California: Insumos Para el Desarrollo de Recomendaciones." CID Working Paper 100, Harvard University, Cambridge, MA. https://growthlab.cid.harvard.edu/sites/projects.iq.harvard.edu/files/growthlab/files/baja_iinsumosrecomendaciones_cidrfwp100.pdf.

Bank of America Merrill Lynch Global Research. 2014. "Global Automotive Supplier Review—Who Makes the Car?" Bank of America Merrill Lynch, New York.

Carbajal Suárez, Yolanda, Berenice Carrillo Macario, and Leobardo De Jesús Almonte. 2018. "Dinámica Productiva del Sector Automotriz y la Manufactura en la Frontera Norte de México: Un Análisis con Datos de Panel, 1980–2014." *Frontera Norte* 30 (59): 29–56. https://www.redalyc.org/jatsRepo/136/13655099002/html/index.html.

CENACE (Centro Nacional de Control de Energía). 2018. "Programa de Ampliación y Modernización de la Red Nacional de Transmisión y Redes Generales de Distribución del Mercado Electrico Mayorista PRODESEN 2018–2032." Secretaría de Energía, Mexico City.

CEPAL (Comisión Económica para América Latina). 2017. "La Inversión Extranjera Directa en América Latina y el Caribe 2017."

CGPMM (Coordinación General de Puertos y Marina Mercante). 2018. "Anuario Estadístico de los Puertos de México." Dirección General de Puertos, Secretaría de Comunicaciones y Transportes (website). https://www.sct.gob.mx/fileadmin/CGPMM/U_DGP/estadisticas/2016/Anuario/Anuario2018.html.

Criscuolo, Alberto. 2015. "FYR Macedonia and the European Periphery Automotive Regional Value Chain: Industry-Specific Global Value Chain Analytics Project." World Bank, Washington, D.C.

Criscuolo, Alberto. 2016. "Chiapas: Industry Identification and Analysis." Presentation presented at the Taller de Cadenas de Valor y Zonas Económicas Especiales, Tuxtla Gutiérrez, April 14. https://www.ceieg.chiapas.gob.mx/productos/files/ECOBANCOMUNDIAL/Chiapas_industry_analysis-Criscuolo-April-14-2016-FULL_DRAFT.pdf.

Daville Landero, Selva L. 2014. "Relocalización de la Industria Automotriz en la Frontera Norte de México, TLCAN e Integración Regional, 1993–2008." *Aldea Mundo* 38 (19): 35–51. http://erevistas.saber.ula.ve/index.php/aldeamundo/article/view/8549/8511.

Deloitte. 2017. "México y el Futuro de la Tecnología Automotriz." Deloitte, London. https://www2.deloitte.com/content/dam/Deloitte/mx/Documents/consumer-business/Futuro-Tecnologia-Automotriz-en-Mexico.pdf.

El Financiero. 2018. "Viene Inversión Automotriz a México." *El Financiero*, July 18, 2018. https://www.elfinanciero.com.mx/opinion/de-jefes/viene-inversion-automotriz-a-mexico.

Global Business Reports. 2016. "Mexico's Regional Automotive Report." Industry Explorations. Global Business Reports, Singapore. https://www.gbreports.com/wp-content/uploads/2016/09/Mexico-Automotive-2016-web-v2.pdf.

Guanajuato Puerto Interior. n.d. "GTO Puerto Interior Smart Port 4.0." Secretaría de Desarrollo Económico Sustentable, Gobierno del Estado de Guanajuato (website). https://puertointerior.guanajuato.gob.mx/.

Hallward-Driemeier, Mary, and Gaurav Nayyar. 2017. *Trouble in the Making? The Future of Manufacturing-Led Development*. Washington, D.C.: World Bank.

Hausmann, Ricardo, Bailey Klinger, and Rodrigo Wagner. 2008. "Doing Growth Diagnostics in Practice: A 'Mindbook.'" CID Working Papers 177, Harvard University, Cambridge, MA.

Hausmann, Ricardo, Timothy Cheston, and Miguel Angel Santos. 2015. "La Complejidad Económica de Chiapas: Análisis de Capacidades y Posibilidades de Diversificación Productiva." CID Working Paper 302, Harvard University, Cambridge, MA. https://growthlab.cid.harvard.edu/files/growthlab/files/cid_wp_302.pdf.

Hausmann, Ricardo, Timothy Cheston, Miguel Angel Santos, and Carlo Pietrobelli. 2016. "Towards a Prosperous and Productive Chiapas: Institutions, Policies, and Public-Private Dialog to Promote Inclusive Growth." CID Working Paper No. 317, Harvard University, Cambridge, MA. https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/towards-prosperous-and-productive-chiapas.

IFC (International Finance Corporation)–World Bank. 2019. "Creating Markets in Morocco: Country Private Sector Diagnostic - A Second Generation of Reforms: Boosting Private Sector Growth, Job Creation and Skills Upgrading." IFC and World Bank, Washington, D.C.

INEGI (Instituto Nacional de Estadística y Geografía [National Institute of Statistics and Geography]). 2010. "Household and Population Census 2010." INEGI, Aguascalientes.

——. 2019a. "Biblioteca Digital de Mapas." INEGI, Aguascalientes. https://www.inegi.org.mx/app/mapas/.

——. 2019b. "Economic Censuses." INEGI, Aguascalientes.

——. 2020. "Household and Population Census 2020." INEGI, Aguascalientes.

IPCC (Intergovernmental Panel on Climate Change). 2022. *Climate Change 2022: Mitigation of Climate Change*. Edited by Priyadarshi R. Shukla, Jim Skea, Raphael Slade, Alaa Al Khourdajie, Apoorva Hasija, Juliette Malley, Roger Fradera, Malek Belkacemi, Géninha Lisboa, David McCollum, Purvi Vyas, Minal Pathak, Renée van Diemen, Sigourney Luz, and Shreya Some. Cambridge University Press, Cambridge and New York.

Kallstrom, Henry. 2015. "Why the Automotive Industry Generates Employment." Market Realist, February10, 2015. https://marketrealist.com/2015/02/automotive-industry-generates-employment/.

KMPG. 2016. "Competitive Alternatives." KPMG, Amstelveen, the Netherlands.

Levy, Dan, Ricardo Hausmann, Miguel Angel Santos, Luis Espinoza, and Miguel Flores. 2016. "¿Por qué Chiapas es Pobre?" CID Working Paper 300, Harvard University, Cambridge, MA. https://projθects.iq.harvard.edu/files/growthlab/files/cid_wp_300_spanish.pdf.

MGI (McKinsey Global Institute). 2005. Increasing Global Competition and Labor Productivity: Lessons from the US Automotive Industry." MGI, New York. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/increasing-global-competition-and-labor-productivity.

——. 2015. "Strategic Plan to Develop the Tehuantepec Isthmus (Plan Estratégico para el Desarrollo Económico del Corredor Interoceánico del Istmo de Tehuantepec)." MGI, New York.

Miranda, Arturo Vicencio. 2007. "La Industria Automotriz en México: Antecedentes, Situación Actual y Perspectivas." *Ciencia y Administración Journal* 221: 213–248. http://www.cya.unam.mx/index.php/cya/article/view/726.

Pemex (Petróleos Mexicanos). 2019. "Anuario Estadístico 2018." Pemex, Mexico City.

OECD (Organisation for Economic Co-operation and Development). 2016. "Upgrading Pathways in the Automotive Value Chain." Background paper at the Round Table on the Future of the Automotive Industry, 7th plenary meeting, "OECD Initiative for Policy Dialogue on Global Value Chains, Production Transformation, and Development," Mexico City, November 10–11.

OICA (International Organization of Motor Vehicle Manufacturers). 2017. "World Motor Vehicle Production: OICA Correspondents Survey - World Ranking of Manufacturers." OICA, Paris. https://www.oica.net/world-ranking-of-manufacturers/.

Pavlínek, Petr, and Jan Ženka. 2016. "Value Creation and Value Capture in the Automotive Industry: Empirical Evidence from Czechia." *Environment and Planning A* 48 (5): 937–959.

Porter, M. E. 2008. *On Competition*. Cambridge: Harvard Business School Publishing.

Proméxico. 2016. "The Mexican Automotive Industry: Current Situation, Challenges and Opportunities." Secretaría de Economía, Mexico City.

Ramírez, José Carlos, and Kurt Unger. 1997. "Las Grandes Industrias Ante la Restructuración: Una Evaluación de las Estrategias Competitivas de las Empresas Líderes en México." *Foro Internacional* 37 (2): 293–318. https://forointernacional.colmex.mx/index.php/fi/article/view/1472.

Ruiz Durán, Clemente. 2016. "Desarrollo y Estructura de la Industria Automotriz en México." Análisis No. 6/2016, Friedrich-Ebert-Stiftung México, Mexico City. https://library.fes.de/pdf-files/bueros/mexiko/13016.pdf.

Saberi, Behzad. 2018. "The Role of The Automobile Industry in the Economy of Developed Countries." *International Robotics & Automation Journal* 4 (3): 179–180. (2018).

SCT (Secretaría de Comunicaciones y Transportes). 2019. "Red Nacional de Caminos." SCT and Instituto Mexicano del Transporte. Mexico City, Mexico.

——. 2022. "Anuario Estadístico del Sector Infraestructura, Comunicaciones y Transportes 2021." SCT, Mexico City.

SE (Secretaría de Economía). 2020. "Sistema Integrado de Normas y Evaluación de la Conformidad." SE, Mexico City.

SENER (Secretaría de Energía). 2018. "Tercera Revisión del Plan Quinquenal de Expansión del Sistema de Transporte de Almacenamiento Nacional Integrado de Gas Natural 2015–2019." SENER, Mexico City.

SHCP (Secretaría de Hacienda y Crédito Público). 2016a. "Estudio Especial de Chiapas Tomo I." SHCP, Mexico City.

——. 2016b. "Estudio Especial de Chiapas Tomo II." SHCP, Mexico City.

——. 2017a. "Análisis de Mercado y Demanda Potencial, Dictámenes de las Zonas Económicas Especiales." SHCP, Mexico City.

——. 2017b. "Dictámenes de las Zonas Económicas Especiales." SHCP, Mexico City.

Silver, D. 2006. "The Automotive Supply Chain, Explained." *Self-Driving Cars* (blog), May 30, 2016. https://medium.com/self-driving-cars/the-automotive-supply-chain-explained-d4e74250106f.

Trujillo Sanchez, Josue. 2015. "La Política Económica y la Situación Actual de la Industria Automotriz Mexicana." Master thesis, Universidad Veracruzana. https://cdigital.uv.mx/bitstream/handle/123456789/42079/TrujilloSanchezJosue.pdf?sequence=1andisAllowed=y.

Unger Rubín, Kurt, and Roberto Chico Pérez. 2004. "La Industria Automotriz en Tres Regiones de México: Un Análisis de Clusters." *El Trimestre Económico* 71 (284): 909–941.

U.S. EPA (Environmental Protection Agency). 2018. 2018."Sources of Greenouse Gas Emissions." U.S. EPA. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

Veloso, Francisco, and Rajiv Kumar. 2002. "The Automotive Supply Chain: Global Trends and Asian Perspectives." ERD Working Paper Series No. 3, Economics and Research Department, Asian Development Bank, Manila.

Vieyra, Raquel. 2001. "El Desarrollo de la Industria Textil en México en el Siglo XX." PhD thesis, Universidad Nacional Autónoma de México. https://www.aehe.es/wp-content/uploads/2001/10/vieyra.pdf.

World Bank and MMK Consulting. 2016. "Cost Competitiveness of Mexican SEZ Cities." World Bank Group and MMK Consulting, Washington, D.C. and Vancouver, British Columbia.

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