Chapter 1

Regulation of road transport in Mexico

Transport by road is the most important mode of transport in Mexico in terms of production, volume and employment. More than half of Mexico's international trade by value is carried by road, most of it across the border with the United States. The most important regulatory instruments for road transport refer to a safety, weight and size dimensions, import of used vehicles and emissions. Road transport faces important challenges: the resources available for enforcement should be increased; the regulation in preparation to regulate hours of service should be completed and adopted as a matter of priority; emissions standards should be introduced in the regulation for imported second hand vehicles; and any change on the limits of weigh and dimension should be based on empirical evidence that should allow for a cost-benefit analysis of the proposed changes.

Overview of road transport in Mexico

Market organisation

Road transport in Mexico is extensively used by freighters and passengers, in contrast with air transport that focus on passengers, or rail that concentrates on freight. SME firms account for the majority of the business in road transport, but larger firms, however, own most of the units operating in the market. This segmentation impacts the competitiveness of the sector, because most of the SME firms have old trucks and in consequence old technology in their vehicles. In contrast, big firms have more new generation transport trucks. The difference between SME and big firms has made these groups of interest struggle to make regulation less harmful to them. An example of this is the modification of the NOM-012 of weights and dimensions of trucks. During the recent public consultancy process to modify it, there were arguments to increase the limits on weight and dimensions, as well as calls to introduce technology devices to increase efficiency. At the same time, there were arguments to limit dimensions and weight to avoid accidents. In any case, any regulation or standards such as the NOM-012 should be modified based on hard evidence.

Freight

The market of freight road transportation consists of SMEs and larger firms. In 2015, SMEs, which comprise owners with a fleet from one to one hundred trucks, accounted for 99.4% of the total firms in the sector and 72.4% of the total fleet. This implies that less than 0.6% of firms have 27.6% of the fleet—265 trucks by firm on average. In contrast, the micro firms, which comprises owners with a fleet from one to five trucks, also called *truck man* (*hombre camion*), accounted for 25.6% of the total fleet in Mexico (109.8 thousand firms with 206.4 thousand vehicles, so 1.8 trucks on average per firm, see Table 1.1.

Table 1.1. **National freight fleet by type of owner**

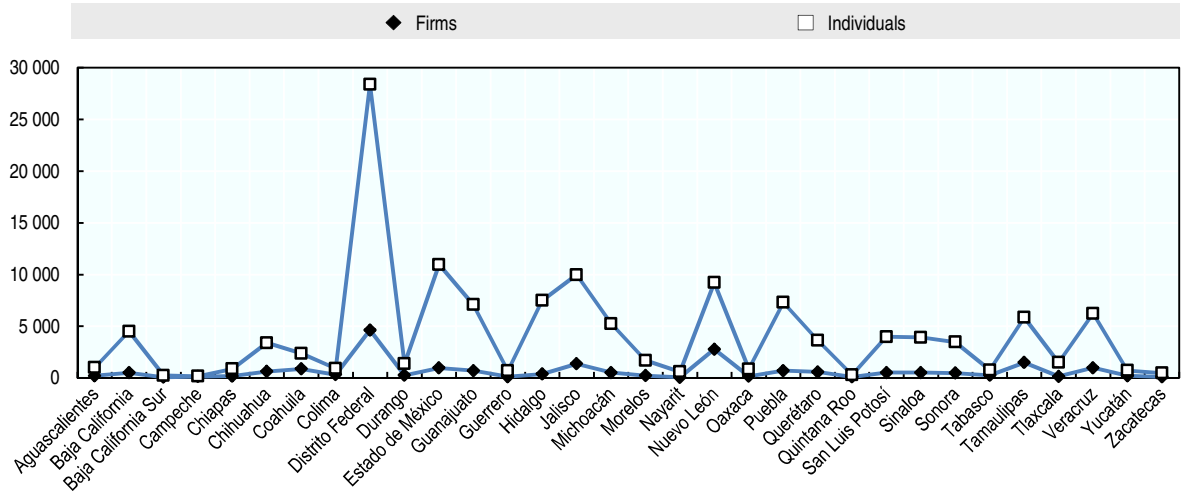
Type of firm	Units	Number of firms	%	Number of vehicles	%
Micro (*hombre camion*)	1 to 5	109 890	81.6	206 416	25.6
Small	6 to 30	21 389	15.9	245 066	30.4
Medium	31 to 100	2 610	1.9	132 571	16.4
Large	> 100	837	0.6	222 352	27.6
Total		**134 726**	**100**	**806 405**	**100**

Source: SCT (2015a), "Estadística Básica del Autotransporte Federal" (Basics Statistics of Federal Road Transport 2015), www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016).

The total fleet in Mexico in 2015 was about 806 405 vehicles, 85% of which are used for transporting general freight and the remaining 15% for specialised freight, such as dangerous materials, cars without rolling, funds and values, cranes, and large vehicles. However, 91% of the firms involved in transport focus on specialised freight and 9% on general freight. Around 51% of the total fleet in Mexico is categorised as driving units with an average age of 17.5 years; and 48% of the fleet is categorised as drag units with an average age of 17.1 years.

The state with the most freight operators (individuals and firms)[1] is Mexico City with 21% of the individuals and 22% of total firms, see Figure 1.1. The states with most individuals in road transport are Mexico City, Nuevo León, Jalisco, Estado de Mexico and Guanajuato, which account for 48.5% during 2015. In contrast, the states with a majority of firms are Nuevo Leon, Jalisco and Tamaulipas, which together with the Mexico City hold 48.2%. Firms have a larger participation in specialised transportation[2] compared to individuals; for instance 24.5% of the firms transported products under special conditions (5 228 of 21 337 versus 7% of the individual's share (9 299 of 135 377).

Figure 1.1. **Firms and individuals operating road transport freight by entity in 2015**



Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basics Statistics of Federal Road Transport 2015), www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016).

Passengers

As in the case of air transport, road transport share infrastructure with passenger transportation. Thus, the road congestion and the quality of the infrastructure are affected by freight and passenger vehicles. The road transportation of passengers in Mexico meets a demand of around 3 million people with 48 287 registered vehicles in 2015—56% owned by 97 large firms which represented 3.6% of the total number of firms. On average, large firms owned 276 vehicles, see Table 1.2. In contrast, 44% of the fleet was owned by SMEs which represented 96.4% of the firms. The *truck man* had 6.4% of the fleet with an average of 1.5 vehicles *per head* and the small firms owned 14% with an average of 14 vehicles.

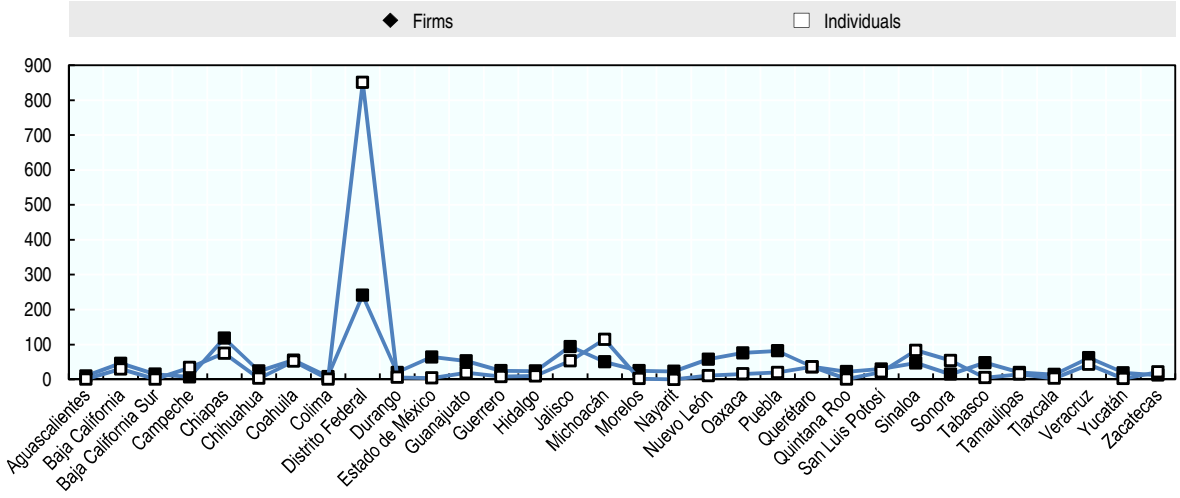
Approximately 61% of the total fleet is concentrated in six states: Distrito Federal, Jalisco, Guanajuato, Estado de México, Nuevo Leon and Veracruz. The most important of these is the Distrito Federal that concentrates 33% of the total, see Figure 1.2. The thirteen states with lower participation have less than 10% of the fleet— Morelos, Sonora, Aguascalientes, Quintana Roo, Baja California Sur, Yucatán, Chihuahua, Guerrero, Nayarit, Durango, Campeche, Zacatecas and Colima. Only 5% of the fleet is owned by individuals and 95% by firms and both are concentrated at 36% in the Distrito Federal, followed by Chiapas with 6%, Michoacán and Jalisco with 5% and Sinaloa and Coahuila with 4%.

Table 1.2. **National passenger fleet by type of owner**

Type	Units	Number of firms	%	Number of vehicles	%
Micro (*truck man*)	1 to 5	1 933	71.3	3 079	6.4
Small	6 to 30	475	17.5	6 765	14.0
Medium	31 to 100	207	7.6	11 614	24.1
Big	> 100	97	3.6	26 829	55.6
Total	2 712	2 712	100	48 287	100

Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basics Statistics of Federal Road Transport 2015)., www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016).

Figure 1.2. **Firms and individuals in road transport for passengers by entity in 2015**



Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basics Statistics of Federal Road Transport 2015), www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016).

Economic performance

Transport by road is the most important mode of transport in Mexico in terms of production, volume and employment – it generates approximately 2 million direct jobs.[3] In fact, it has had a steady economic growth since its deregulation, except in times of economic crises, for instance in early 2000's and 2008.

The average growth of the GDP of road transport in the period of 1995-2015 is 6.1%, the highest of all the transport modes as shown in Table 1.3. This growth pace has meant that road transported accounted for between 4.4 and 5.0% as a proportion of the GDP, in spite of the strong growth of the other modes of transport. This is possible because of the central role of the road transport for the Mexican economy.

Table 1.3. **GDP by mode of transport in Mexico, 2015**

Concept	GDP (MXN)	Share of total GDP	Average growth 1995-2015	Total growth 1995-2015
Total GDP	14 664 491.85		2.8%	78.6%
Tertiary sector	8 962 800.11	61.1%	3.1%	90.7%
Transport, mail and storage	852 321.87	5.8%	3.1%	84.0%
Air transport	30 391.34	0.2%	5.2%	189.4%
Rail transport	17 134.60	0.1%	3.9%	99.4%
Maritime transport	8 480.08	0.06%	2.1%	11.7%
Road transport	689 057.05	4.7%	6.1%	83.6%
Freight	420 099.12	2.9%	4.4%	128.1%
Passengers	268 957.93	1.8%	1.6%	40.8%

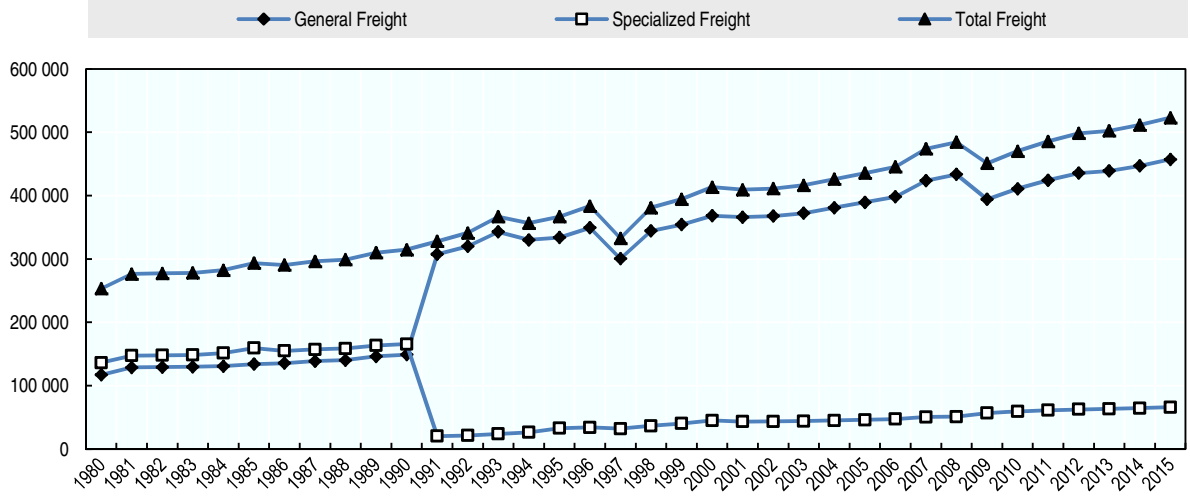
Source: National Institute of Statistics and Geography (INEGI), www.inegi.gob.mx (accessed 9 November 2016).

Freight

Freight road transport represents an important share of the value of the services sector, and the GDP as a whole, as shown in Table 1.3. While each the rest of the modes of transport represented less than 1% of the GDP of the country, freight transport by road accounted for 2.9% of the GDP of 2015. Its average growth rate from 1995 to 2015 was 4.4%, which is 1.6% higher than the total GDP of Mexico in the same year. Finally, the accumulated growth in the period studied was the fastest, with an increase of 128.1%, only after air transport.

In 2015, the total freight transported by road was 522 990 tonnes and 245.13 million of tonnes by kilometre. The average growth rate of tonnes transported by this mode was 2.2% from 1980 to 2015 (Figure 1.3). The total growth of road transport of freight measured in tonnes from 1995 to 2015 was 42.6% while the GDP growth was 128% for the same period. During that period of time, the increase in tonnes on this mode was slower than any other mode.

Figure 1.3. **Road transport freight in thousand tonnes in Mexico**



Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basics Statistics of Federal Road Transport 2015), www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016).

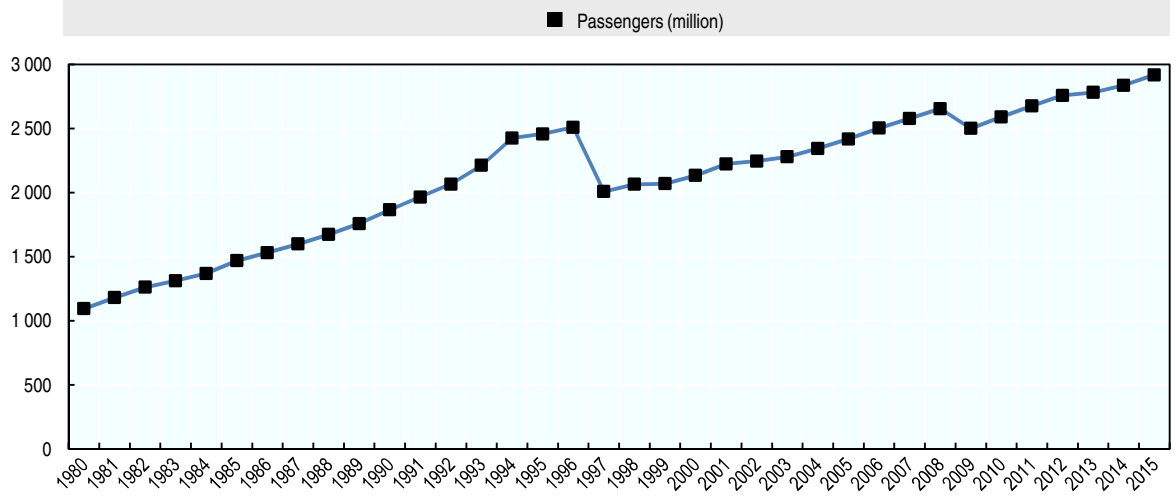
Freight transport by road had two mayor falls, one in 1997 and the other in 2009 in which the tonnes transported decreased 13% and 7% respectively; in both cases after severe macroeconomic crises. Figure 1.3 also shows that road specialised freight transport dropped heavily in 1990, while the general freight service increased more or less in the same amount. This was the result of deregulation during the 90s, which eliminated some restrictions which differentiated specialised cargo from general service.[4]

Passengers

The economic value of road transport of passengers accounts for 31.6% of the sector's GDP, and 1.8% of the total of Mexican economy (Figure 1.4). The average growth of its GDP during the period of 1995-2015 was the lowest among the other modes of transport at 1.6%. Similarly, the total growth in the same period was slower than any other mode exempt maritime by 30%, with, a total growth of 40.8%.

Transport of passengers increased 1.67 times from 1980 to 2015 (Figure 1.4). Taking as a reference the period of 1995 and 2015, the average growth of passengers was approximately 1.0%. This rate however, is lower than the rate of the general and the transport subsector value added for the same period. Road transportation is the most frequent mode for passengers with almost 96.5% of the market in 2015. As in other cases the falls in growth of road transport were in 1997 and 2009 coinciding with national crisis.

Figure 1.4. **Evolution of passenger transportation in Mexico**



Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basics Statistics of Federal Road Transport 2015), www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016).

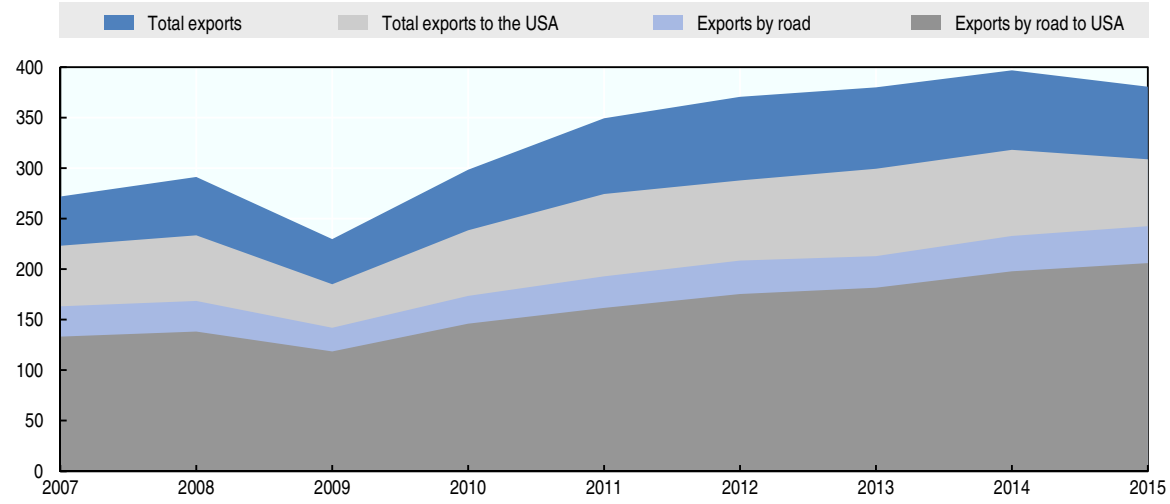
International road freight transport

More than half of Mexico's international trade by value is carried by road (67% in 2015), most of it across the border with the United States. Figure 1.5 illustrates that the value of Mexican exports to the United States represent a big share of the total Mexican exports, which were 82% in 2015. In addition, over 85% of the exports to United States take place through roads, which makes this mode of transports vital for Mexican international trade. Figure 1.5 also shows the growth that international freight transport

has had, reaching 48.7% during the period 2007-2015 and 54.7% specifically to the United States over the same period.

Figure 1.5. **Mexican total exports, exports to the United States, exports by road, and exports to the United States by road**

USD billion

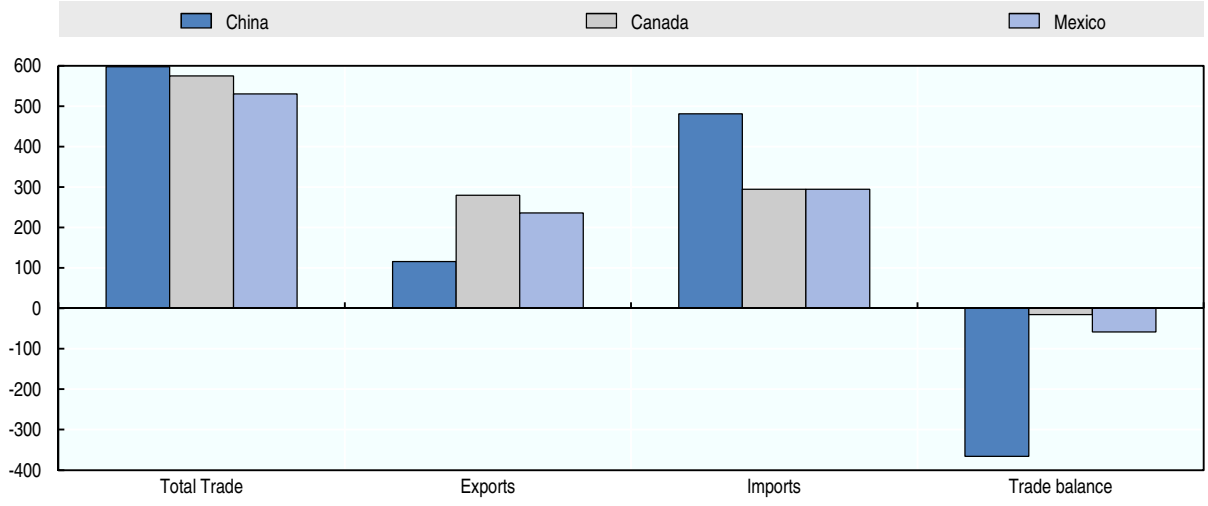


Source: Data extracted from the Economic Information Database of INEGI: www.inegi.org.mx/sistemas/bie/ (accessed 9 November 2016).

The United States is Mexico's largest trading partner, and the relationship is mutual as Mexico has been the United States' third largest trading partner from 2006 to date (Figure 1.6) and cross border traffic accounts for a large share of total road freight transport (Figure 1.7).

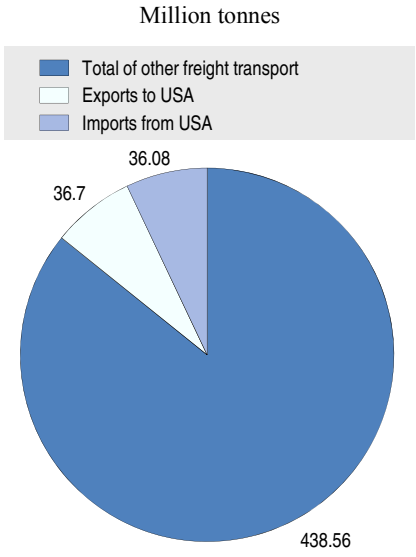
Figure 1.6. **Top three US trade partners**

USD billion 2015



Source: U.S. Census Bureau, Foreign Trade, https://www.census.gov/foreign-trade/statistics/highlights/top/top1512yr.html (accessed 9 November 2016).

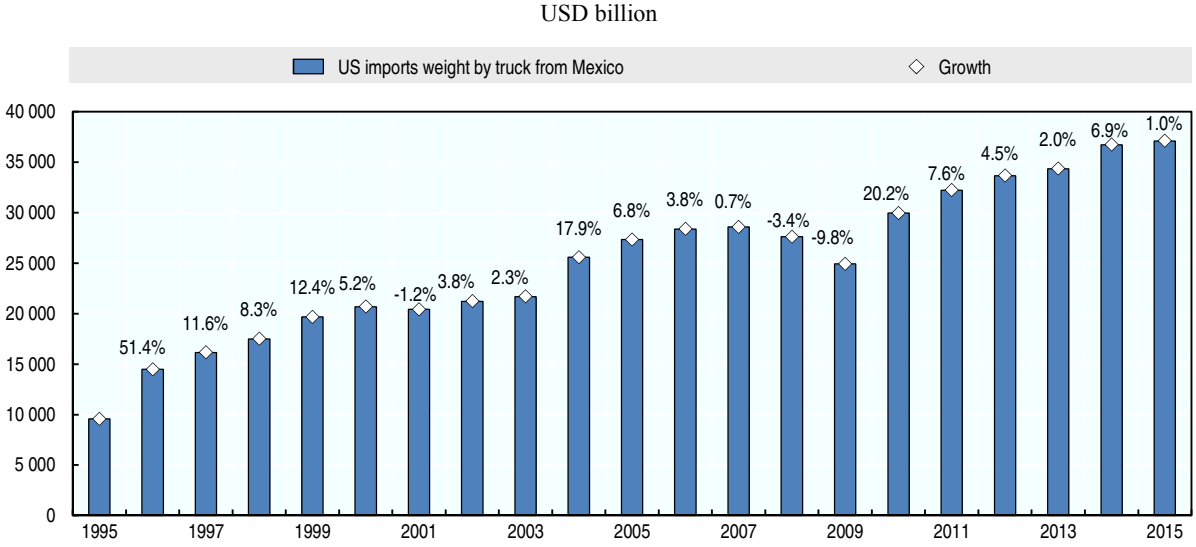
Figure 1.7. **Share of Mexico/US trade in total road freight haulage 2014**



Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basics Statistics of Federal Road Transport 2015), www.sct.gob.mx/transporte-y-medicina-preventiva/autotransporte-federal/estadistica/2015/ (accessed 9 November 2016). Statistics from IMT.

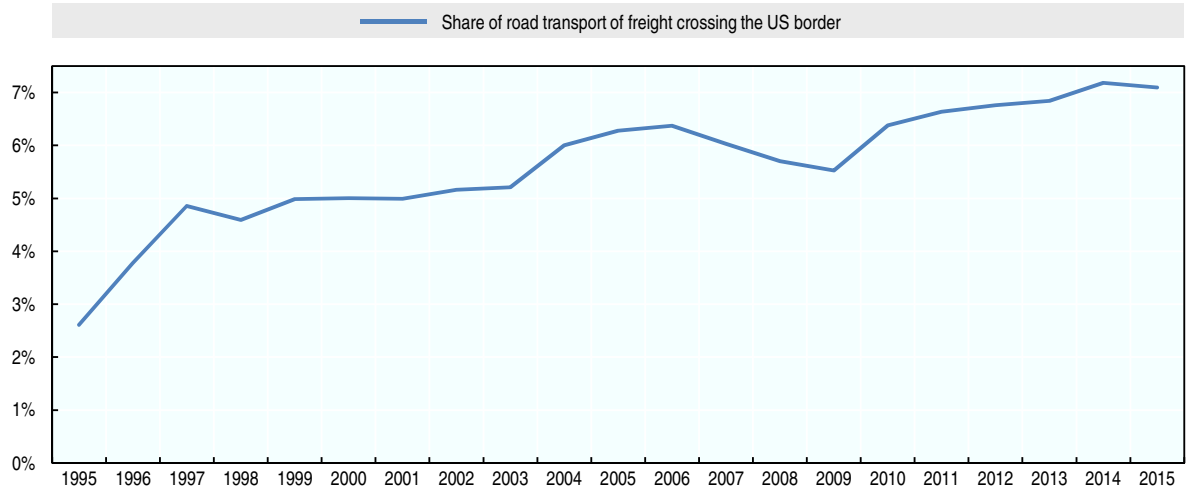
In terms of volume, the US imported from Mexico 37 106 thousand tonnes by road in 2015 (Figure 1.8). The volume of US imports from Mexico has had an average growth in the period 1996-2015 of 7.6% and a total growth of 287.8% in the same period. Moreover, US imports from Mexico (or Mexico's exports) accounted for 7.1% of the total freight volume transported by road in Mexico in 2015. Figure 1.9 shows a positive tendency, and there is still further opportunity to grow in terms of value and volume.

Figure 1.8. **US imports from Mexico and growth**



Source: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, TransBorder Freight Data.

Figure 1.9. **Share of the road transport of freight exported to the United States through trucks**

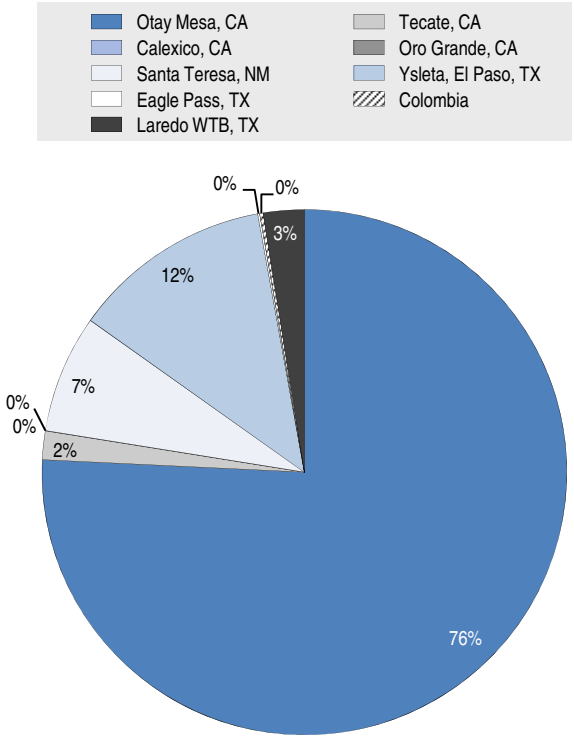


Source: US Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Trans-border Freight Data and Road statistics of the Ministry of Communications and Transport 2015 (SCT).

Until the US Bus Regulatory Reform Act of 1982, Mexican[5] and Canadian trucks could operate freely in the United States, provided they complied with US safety laws. The Act imposed a two-year moratorium on new authorisations for trucks registered in Canada and Mexico[6] and while the moratorium was soon lifted for Canada, the issue was not addressed with Mexico until the NAFTA negotiations in 1994. Under the Act, some Mexican trucks could receive OP-2 type registration[7] and were permitted to operate within specified commercial zones in the four U.S.-Mexico border states—Texas, California, New Mexico, and Arizona. These commercial zones generally extend from 3 to 20 miles from the border, reaching up to 75 miles. For haulage beyond a commercial zone, Mexican carriers were required to transfer loads to a U.S. truck for delivery to the final destination. Delays in delivery and added costs are associated with the transfer of goods. The Department of Transportation estimates that the requirement to off-load cargo adds USD 400 million in transportation and warehousing costs annually (Alexander and Soukup, 2010).

In 1995, the U.S. Congress passed the Interstate Commerce Commission Termination Act, which authorised the President to lift the moratorium on Mexican carrier movements beyond the commercial zones if removal was deemed consistent with the obligations of the United States under a trade agreement or with United States transportation policy. This gave the President flexibility to implement the trucking provisions under NAFTA, which entered into force on January 1, 1994. Discussions about the conditions and requirements to be imposed on Mexican trucks took several years. In 2002, rules for Mexican carries that operate in the US were published.[8] Mexican carriers must carry a certificate issued by the US transport authority (without such authorisation, Mexican trucks are limited to making deliveries to the designated commercial areas along the border); they are subject to intensive supervision in Mexico and the United States during the first 18 months after authorisation has been granted; they can only cross the border when a safety inspector is on duty; drivers have to go through alcohol and drug tests and are controlled for compliance with maximum working hours, and must be able to manage required data reporting and safety management systems; vehicles must be insured with a US registered company. Despite the restrictions, Mexico-U.S. border crossings now almost equal those between Canada and the United States (see Figure 1.10).

Figure 1.10. **NAFTA pilot programme: distribution of crossings by location as of 10 October 2014**



Source: US-Mexico Cross-Border Long-Haul Trucking Pilot Program Report FINAL January 2015, https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/US-Mexico%20Cross-Border%20Long-Haul%20Trucking%20Pilot%20Program%20Report%20FINAL%20January%202015.pdf (accessed 10 November 2016).

A long-haul authorisation pilot programme began in September 2007 but was de-funded (effectively ended) by the US Congress in March 2009. Mexico continued to admit US companies registered in the trial to enter the country but imposed retaliatory tariffs (permitted under NAFTA and costing an estimated USD 2.4 billion to US exporters) on certain U.S. goods in response to the programme's termination.

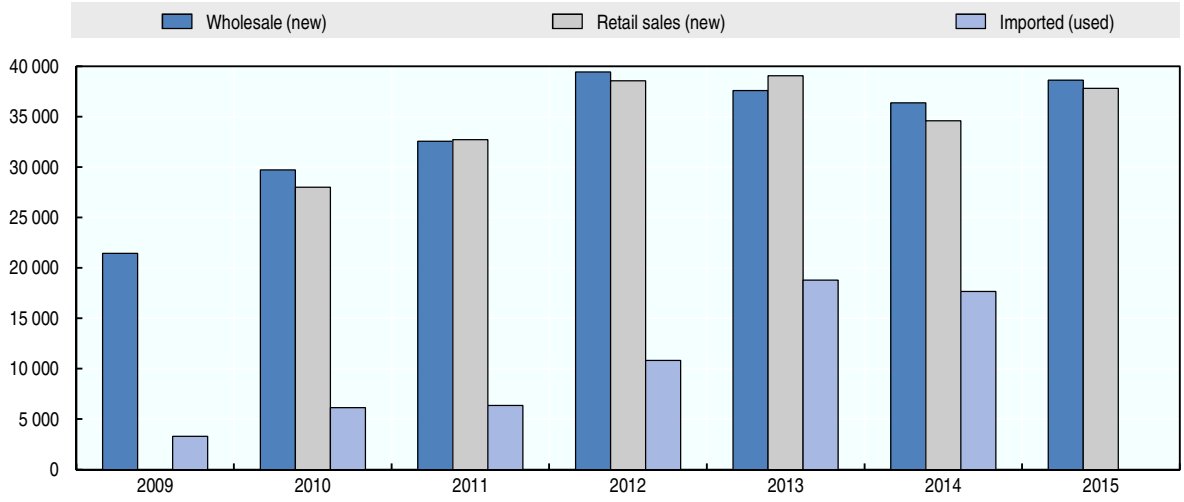
A new three-year pilot programme to allow long-haul Mexican trucks into the United States began in April 2011 with the first Mexican truck crossing the border in October 2011. The Mexico-domiciled motor carriers that participated in the pilot programme were required to complete a pre-authorisation safety audit before being granted operating authorisation and were required to complete a compliance review.[9]

As of October 2014 when the pilot programme ended there were thirteen Mexico-domiciled carriers with long-haul operating authority,[10] two of these accounting for 90% of crossings, with three quarters of the crossings at Otay Mesa, the main border-crossing point near San Diego in California. Over 80% of the mileage of the Mexican trucks crossing the border is on roads in the border states, as shown in Figure 1.11. Despite fears of trucking unions in the United States that Mexican hauliers would undercut local carriers, few Mexican truck make longer journeys. Almost 90% of trips terminated in commercial zones along the border, only 4% reached non-border States. Joint ventures and sunk costs in logistics centres determine that many loads are passed to U.S. hauliers at points near the border; a pattern that might change over time with a fully open border, albeit gradually.

At the beginning of 2015 the pilot programme was replaced by an identical permanent system. The distribution of traffic and operators is evolving gradually and is currently similar to the situation in 2014.

FMCSA monitors the safety of Mexican trucks through road-side inspections. Twenty per cent of the border crossings were inspected in the three years of the pilot. The key safety indicator is "out-of-service" rates, which is the frequency of violations of standards severe enough to prevent a truck or driver from being allowed to continue a journey until the deficiency is addressed. In the United States, 20% of trucks that undergo a roadside inspection are taken out of service and about 5% of truck drivers have committed violations that prevent them from continuing their journeys. Based on 2013 data,[11] four of the Mexican carriers in the pilot had vehicle-out-of-service rates similar to that of US trucks, the remainder had much lower rates. The two Mexican carriers that accounted for most of the crossings (and 85% of the inspections) have *vehicle-out-of-service* rates of 10% and 13%.

Figure 1.11. **Sales of heavy vehicles 2009-2015 in Mexico**



Note: No data was available for 2015 imports and 2009 retail sales at the time of writing.

Source: ANPACT (2015), "Boletín Estadístico Mensual" (Monthly Statistical Bulletin), www.anpact.com.mx/ (accessed 9 November 2016).

The *US Federal Motor Carrier Safety Administration* completed an assessment of the pilot programme for the *House and Senate Appropriations Committees* in January 2015.[12] The assessment was positive, as the statistics taken from the pilot programme confirmed that Mexican carriers have safety levels that were at least as good as US and Canadian carriers.[13] The FMCSA opened a register to receive requests from Mexican carriers for licences to operate on routes across borders on 15 January.[14] Carriers would be asked to go through an audit of their safety programmes in order to be granted this authorisation.

To facilitate cross-border transport, Mexico's DGAF and the US FMCSA are updating their 1991 *Memorandum of Understanding* on the equivalency of the Mexican Federal Driver´s License (*Licencia Federal de Conductor*) and the US Commercial Driver's License, to mutually recognise procedures and results regarding issuance of licenses (Federal Register, 2011).

At present, the US Department of Transportation (DOT) is accepting applications from Mexico-domiciled motor carriers interested in conducting long-haul operations. The current process to get a long-haul operating authority and be able to transport international trade beyond the US-Mexico commercial zones the carrier consist in four phases:

1. In phase one, the applicant must submit a non-refundable fee of 300 USD and send to FMCSA the filled forms: the application for a *US DOT number*; the application for *Long-Haul Operating Authority* and the *Designation of Agents for Service of Process* and pay.
2. In phase two the FMCSA confirms that the application is complete, and conducts a Pre-Authorisation Safety Audit (PASA) to confirm that the applicant has safety management systems in place to be able to comply with Federal Motor Carrier Safety Regulations, for instance the Controlled Substances and Alcohol testing.
3. Phase three begins after complying with the PASA, when the carrier must file a proof of financial responsibility.
4. In phase four, the FMCSA publishes the application in its register to give notice to the public, which can oppose the application. If no one opposes it, then it becomes effective.

Mexican carriers (same as Canadian ones) have to comply with all U.S. laws and regulations, including regular border and random roadside inspections and meet English language proficiency requirements. Additionally, vehicles must undergo regular inspections every 90 days for at least four years.

As noted in the previous section, mutual recognition of physical and mechanical standards for heavy-duty vehicles is under preparation between SCT and the US FMCSA, based on the January 2015 revision of NOM-068 on the physical and mechanical conditions of vehicles providing transport services on federal roads. The new NOM is consistent with the equivalent DOT regulation and published in the Official Gazette on 15 June 2015 providing the basis for mutual recognition (CFR, 2011).

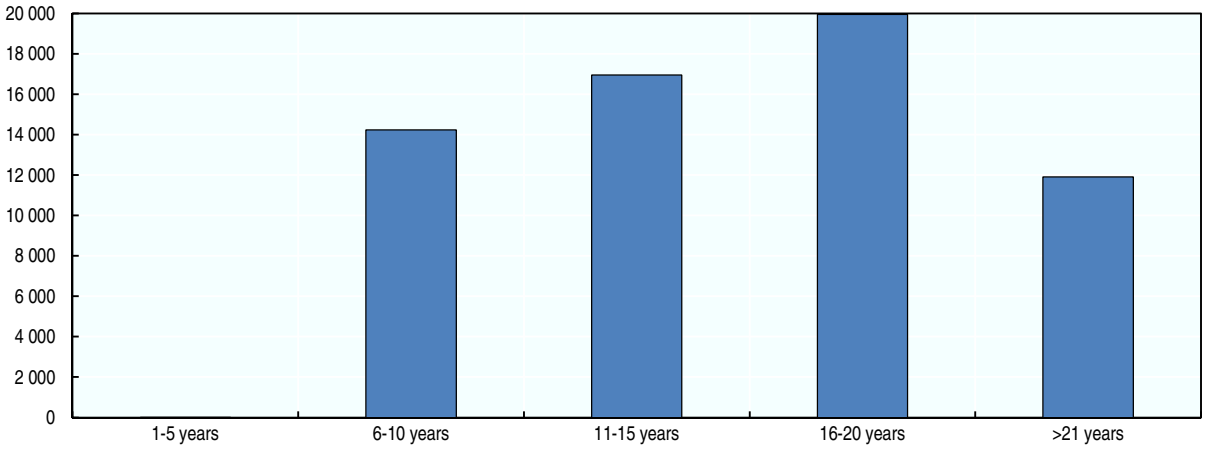
Production and imports of heavy vehicles

Eleven commercial vehicle manufacturers had production facilities in Mexico in 2014,[15] placing it as the 7th producer of heavy vehicles worldwide. These firms manufactured 190 978 heavy vehicles in 2015, nearly 157 000 of which were exported—87% —to the United States (INEGI, 2015). However, nationally heavy vehicle sales were just over 76 000 in the same year, which represents a 6.2% growth of wholesales and 9.3% in retail sales (Figure 1.12).

Much of the sales of heavy vehicles in Mexico are in the form of used imported vehicles, particularly from the US, due to Mexico's regulatory framework allowing the import of heavy vehicles through the NAFTA agreement. Figure 1.11 illustrates the imports of used heavy vehicles, where 63 076 units entered the Mexican territory during the period from 2009 to 2014.

The main characteristic of heavy the vehicles entering the Mexican market is their age. The vehicles imported during this timeframe have an average age of 16.1 years, and 77% of them are more than 10 years old. Only 12 vehicles imported were less than 5 years old. Figure 1.13 highlights the range of age of these units. This has a significant impact from a safety and environmental perspectives, which will be discussed in the next sections.

Figure 1.12. **Age of imported used heavy vehicles for the period 2009-2014 in Mexico**



Source: ANPACT (2015), "Boletín Estadístico Mensual" (Monthly Statistical Bulletin), www.anpact.com.mx/ (accessed 9 November 2016).

In the import of used heavy vehicles from the United States, the units should comply with the physical-mechanical conditions and safety and environmental regulations that any other national vehicle does. To achieve this, the entry of units to the territory should be conditional to the minimum standards stated in the NOMs, and to a maximum age of 6 years, which is the age that the scrappage and renewal programme allows.

General regulatory framework

National context

Commercial freight transport was deregulated between 1989 and 1993,[16] when a market-oriented approach replaced the restrictive system of licencing operators as providers of public services. The deregulation was supplemented with restrictions on market entry to ensure safety standards and financial security.

Many firms entered the market after 1990 and within five years, road transport prices had dropped by 23% in real terms (see Box 1.1). Vigorous intervention by the competition authority (COFECO) following deregulation has largely eliminated behaviour which tended to be anticompetitive (Dutz, Hayri and Ibarra, 2000).

Box 1.1. **The Mexican road freight industry: the World Bank case study on competition and prices**

"Prices fall overall, but fastest in lower quality-of-service segments". Rate analysts in SCT found that between 1987 and 1994 trucking rates nationwide declined 23% in real terms. One official in SCT estimated that general cargo trucking cargo rates in 1994 on the major route between Laredo and Mexico City were about 30% lower in real terms than the prevailing rates in 1987. Another study concluded that while there is only incidental and anecdotal evidence on changes in truck tariffs, all the evidence points to reduction of the order of 25% in real terms. The substantial reduction in overall tariff levels documented in available nationwide studies is corroborated by survey results. Almost all downstream users of trucking services interviewed reported that the cost of hiring a truck had fallen in real terms since 1989.

Box 1.1. **The Mexican road freight industry: the World Bank case study on competition and prices** (*cont.*)

Estimates of the size of the decline generally ranged between 5 and 15%. More careful probing of additional exogenous factors confirms that there have been significant declines in real prices of a given service delivered, though the magnitude of the price change is difficult to quantify given the variations in the actual service provided. For instance, one shipper estimated that an additional 20% price fall for the originally available service should be attributed to the higher quality levels now available, including newer trucks, faster delivery, and more reliable shipping facilitated by more sophisticated tracking systems. Another shipper estimated that the price fall would have been even more substantial if it did not incorporate the effect of new toll roads, which he estimated added 6% to the cost of a typical trip.

Regarding rate structure, there appears to have been an important differentiation of prices to reflect differentiation of services provided to distinct classes of users. Customers who ship high value-to-weight components where timeliness and reliability of delivery are critical are willing to pay substantially more for higher quality service. For such shippers, the logistics cost generally represents less than 10% of the product price. These services are generally provided by the larger, more sophisticated carriers. These prices do not appear to have come down as much, no doubt reflecting the increased quality elements embedded in the price and the relatively less intensive competition prevalent between the larger, technologically most sophisticated trucking fleets. On the other hand, customers who ship high volume, high weight products where the logistics cost is substantial generally seek to minimise transportation costs. These lower quality services tend to be provided relatively more by the small owner-operators. These are the prices that have come down most substantially.

Source: Dutz, M., A. Hayri and P. Ibarra (2000), "Regulatory Reform, Competition, and Innovation: A Case Study of the Mexican national competition agency Road Freight Industry", *World Bank Policy Research Paper 2318*, www-wds.worldbank.org/external/default/wdscontentserver/iw3p/ib/2000/05/25/000094946_00050505302442/rendered/pdf/multi_page.pdf, p. 21.

The regulator of road transportation is the SCT, through the General Direction of Federal Road Transport (DGAF). The legal framework consists mainly of the following regulations:

- Federal Law on Roads, Bridges and Motorized Transport (*Ley Federal de Caminos, Puentes y Autotransporte Federal*, LCPAF)
- Law of General Communication Routes (*Ley General de Vías de Comunicación*, LGVC)
- Law of Public-Private Associations (*Ley de Asociaciones Público Privadas*, LAPP)
- Federal Law to Control Chemicals Precursors, Essential Chemical Products and Machines to Elaborate Capsules, Pills and Tablets (*Ley Federal para el Control de Precursores Químicos, Productos Químicos Escenciales y Máquinas para Elaborar Capsulas, Tabletas y Comprimidos*, LGCPQ).

Some of these laws are supported by specific by-laws (*reglamentos*) and NOMs. The most important NOMs are related to road transport and auxiliary services, safety, dangerous materials, package and weight and dimensions. The NOM-012-SCT-2 for instance, sets limits in dimensions and weights for freight trucks allowed to circulate in Mexican roads. A draft to amend this technical regulation was published in the official federal gazette of Mexico (DOF) on June 11, 2014 and it replaced the NOM-012-SCT-2-2008 of 13 January 2014. The modification of this NOM was prompted by allegations by

some stakeholders that double-articulated trucks increase road accidents and impose more damage to the road. The most important changes of the amendment were:

1. Articulated trailers must include devices to increase safety
2. Elimination of the obligation for buses, trucks (type "C") and articulated trucks (type "R") to comply with technical requirements to be allowed to use national roads, such as security devices and pneumatic suspension
3. Reduction from 150 to 50 kilometres of the limit to connect between high-specific roads and B type roads (low-specific roads) with permission
4. Reduction of the maximum weight from 80 to 75.5 tons.

One of the most important changes in the NOM-012-SCT-2-2014 was the reduction in the connectivity permission from 150 to 50 kilometres for low specification roads. This change should be evaluated *ex post* in terms of the effects on economic performance of the transport industry, as it should be assessed whether these changes made the transport of goods by road more expensive vis-à-vis.

Supporting the NOM, the Article 8 of the by-law on Weight, Dimension, and Capacity of the Road Transport Vehicles that can circulate in Roads and Bridges with Federal Jurisdiction (RPDC) states that the SCT will monitor, verify and control that road transport vehicles, auxiliary services and private transport comply with the regulation. The verification and inspection of weight and dimensions is done in fixed verification centres or through verification units approved by the Federal Law of Measurements and Technical Standards (*Ley Federal de Metrología y Normalización*, LFMN). While the SCT has the faculty to conduct measurements in the verifications centres the Federal Police may conduct them while the trucks are circulating federal highways.

Prior to the preparation of the draft amendment of the NOM-012-SCT-2-2008 the SCT set up a panel of eight independent experts to review and assess the impact of regulation on measurement and weight in road transportation. This panel was formed by transport experts, academics and researchers, amongst others. Some of main findings and recommendations are shown in Table 1.4.

Similarly, the NOM-068 "establishes the physical and mechanical specifications of vehicles to ensure safe transit on roads and of other users of these (…)". The standard also explains the process of verification of the vehicles, and the aspects that they need to comply with in order to acquire the authorisation to circulate in federal roads. Enforcement inspections are also considered in the standard. NOM-068 was revised in 2014 and the new NOM-068-2-SCT-2014 is now consistent with the equivalent U.S. Department of Transport regulation. It entered into force on 18 May 2015 providing the basis for mutual recognition between Mexico and the United States.

Another important feature of the regulatory framework of road transport is the formality to import used trucks from the United States under the North America Free Trade Agreement (NAFTA)—which has the objective to regulate the import of used vehicles. In July 1st, 2011 the Ministry of Economy published in the official gazette, the Decree in which the import of used vehicles in Mexico is regulated (Import used Vehicles Decree (DOF, 2011). In Article 6, the decree states that vehicles cannot be imported when their circulation in the origin country is restricted or prohibited due to its characteristics or technical conditions or when the vehicle does not comply with the physical-mechanical or environment protection conditions established in relevant regulations, such as the NOM-068 and the Agreement in which the environmental conditions to import heavy

vehicles are established[17]—which allows the importation of heavy vehicles with engines produced from 2004 onwards, among others.

Table 1.4. **Main expert panel findings and recommendations about NOM-012 on weight and dimensions**

Findings	Recommendations
There is no evidence that accidents in road transport are related to the double trailers.	• Maintain the limits of 66.5 tonnes for fulles (double trailers) and exceptionally allow 75.5 tonnes under the condition of compliance with technical requirements and speed limits • Develop statistics about the sector for at least three years. • Driver's permits should be valid for two years except in the cases of fulles that transport dangerous material, in which case it should last for one year. • Promote the use of new technology in trailers to guarantee safety. • The SCT should promote rail transport, mainly for dangerous materials and prohibit transport via road. • The truck fleet has to be renewed in order to improve performance, but financial help should be provided.
There is no specific regulation concerning workdays in road transport. There is a draft NOM regarding fatigue for drivers but it is still in draft form.	• Explore with the Ministry of Labour and Social Prevision (STPS) the possibility to establish regulation on maximum working hours for drivers. • Regulate time schedules.
The general Direction of Road Transport is not a strong regulator.	• Enhance the regulator and make it more independent from the federal government.
There is a lack of information about the vehicle fleet in the country. The SCT is about to change the license plates of all trucks.	• Link the license plate with the truck.
Training of drivers is not a standard practice.	• Set up training programmes.
Connectivity is not adequate.	• Roads have to be reclassified in order to develop a current map of truck permission through roads and establish schedule circulations flows.

Source: Responses by the Ministry of Communications and Transport (SCT) to the OECD questionnaire.

The Decree has been updated four times, and is in force until December 2016. The National Association of Producers of Motor Coaches and Trucks (ANPACT) has raised concerns on this decree, arguing that it results in older trucks on the road, with a reduced mechanical quality, thus decreasing safety in roads.

There are gaps in the regulation of heavy road freight transport, most notably in the absence of driving and rest time regulation to avoid fatigue. A number of regulations are currently under amendment providing opportunities to improve the regulation and efficiency of the sector. This opportunity area will be explained further in the *Safety* section.

Federal regulations apply to federal highways and vehicles using federal highways. State regulations apply on state roads and to vehicles using only state roads. Regulations vary between states although Federal regulations generally function as a model for State laws. A deep revision of state regulation would be object of a specific study due to its size and variation among the country.

International framework: recognition of technical inspections

Standardised requirements to which the components of road vehicles should conform are established by the UNECE "Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts…"[18] issued on 20 March 1958. Over the years the agreement has had 134 regulations annexed to it, with two additional regulations entering into force in the middle of 2015. The agreement provides equal safety and environmental requirements in the 51 Contracting Parties to the 1958 Agreement, including 41 UNECE countries, as well as the European Union, Japan, Australia, South Africa, New Zealand, the Republic of Korea, Malaysia, Thailand, Tunisia and Egypt.

The UNECE "Agreement concerning the Establishing of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts…",[19] issued on 13 November 1998, and the Agreement concerning the Adoption of Uniform Conditions for Periodical Technical Inspections of Wheeled Vehicles and the Reciprocal Recognition of such Inspections, issued on 13 November 1997, provide governments with a legal framework for adoption of global technical regulations and for carrying out technical inspections of vehicles in use, and for the reciprocal recognition of the certificates of such inspections.

European Union

In the European Union the minimum common rules for periodical technical inspections of vehicles are set out in Directive 2014/45/EU (previously 2009/40/EC) on periodic roadworthiness tests for motor vehicles and their trailers. The rules for the technical roadside inspection of the roadworthiness of commercial vehicles are established in the Directive 2014/47/EU (repeals 2000/30/EC). At the time of writing the previous directives are in force because the directives of the EU have to be transposed in the national law and this takes time. The new directives came into force on 20 May 2014 and transposition has to happen before 20 June 2018.

The directives require that passenger cars and light commercial vehicles (M1 and N1 type vehicles) will be tested four years after their first registration date, and every two years thereafter. M1-category vehicles used as taxis or ambulances; buses and coaches (M2, M3); heavier commercial vehicles (N2, N3); and heavy trailers (O3, O4) must be checked one year after their first registration date and subsequently each year. Member states may choose to conduct additional roadworthiness tests, and in practice many member countries apply more stringent schedules. Additionally, between periodic inspections, roadside checks can be carried out for commercial vehicles.

Directive 2014/45/EU also sets the minimum technical requirements for testing centres equipment and skill levels for the inspectors who carry out the tests. The testing itself is required to consider impact on the environment as well as safety aspects of the vehicles. Defects are assessed in accordance with common rules and severity ratings.

United States and Canada

The United States and Canada are countries that do not recognise the standards of the 1958 UNECE Agreement. This means that the agreement-compliant vehicles are not authorised for import, sale or use on the territories of those countries. In order for a vehicle to be compliant for use in the US and Canada, it has to be tested to prove it meets domestic regulation. The United States and Canada have signed the 1998 Agreement, but there are no provisions in place for mutual recognition or approvals.

Federal Motor Vehicle Safety Standards (FMVSS) regulate technical characteristics of road vehicles in the United States. Currently the US does not recognise UNECE standards for vehicles on its territory. Ways to narrow the regulatory differences between US and EU are being sought as part of the Transatlantic Trade and Investment Partnership (TTIP) negotiations.

In Canada the Motor Vehicle Safety Standards (MVSS) are similar to the standards of the United States. Canada works closely with the US to align its standards. Contrary to the US, Canada also accepts parts of the UNECE main standards as allowable alternatives (14 articles of 17). It is expected that Canada could recognise all UNECE standards under the Comprehensive Economic and Trade Agreement (CETA) in negotiation between Canada and the European Union. This would come into effect in 2016 at the earliest.

Also to facilitate cross-border transport, mutual recognition of physical and mechanical standards for heavy-duty vehicles is under preparation between SCT and the US FMCSA. This will be based on the new NOM-068-STC-2-2014 on physical and mechanical conditions of vehicles providing transport services on federal roads, published in January 2015.

Safety

Working hours and conditions: regulation of driving time

Fatigue is a factor in a significant proportion of road crashes. Almost all OECD countries therefore regulate driving hours and rest times for commercial drivers with specific legislation. The exceptions are Mexico and Korea, where only general labour regulations apply. In Mexico, drivers are required to keep a log of driving times, but there are no legal national limits on continuous driving times. Under the Federal Law of Labour, Article 257, drivers can be hired by the hour, by kilometre or by trip. Guidelines have been issued (for instance, by the Mexican Institute of Transport) recommending drive-time is kept to 8 hours a day (or night) as is the case for standard labour conditions, but this is not an enforceable limit. The National Advisory Committee for Surface Transport Norms (*Comite Consultivo Nacional de Normalización del Transporte Terrestre*) established a sub-committee in December 2014 to analyse the issue with a view to issuing a NOM on driving and rest times. In this context, Mexico should complete this effort and set it as priority next regulatory step.

Therefore, it is strongly recommended that regulation of fatigue and hours of service be given priority in the regulatory agenda. It will make control of driving times possible, with assured benefits for road safety, although it will not solve all problems related to fatigue, or drug abuse to cope with fatigue. Long waiting times at borders and ports, for example, contribute to fatigue but may escape regulation through legislation on services hours. Issues with the effectiveness of hours of service regulations are common to all jurisdictions, but regulations are the essential starting point for managing fatigue. Regulations usually distinguish between non-driving working time, for example completing paper work and waiting at depots, terminals and borders and true rest time.

European Union regulations

In the European Union the maximum daily and fortnightly driving times and minimum rest periods for drivers of road haulage and passenger transport vehicles is set out in regulation (EC) No 561/2006. The regulation applies to national and international passenger transport and road haulage operations. The aim of the regulation is to establish

common conditions for competition in road haulage and passenger carriage markets to avoid distortion of competition, whilst safeguarding road safety and reasonable working conditions for drivers.

Regulation (EC) No 561/2006 establishes a maximum daily driving time of 9 hours, which can be extended twice per week to 10 hours, a daily rest period of at least 11 hours, and breaks of at least 45 minutes after 4.5 hours of driving.

Table 1.5. **List of national exceptions in regulation on safety in transport in the European Union**

	Austria	Belgium	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	[illegible]a	Lithuania	Luxembourg	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	United Kingdom
13.1 a: non-competing public authorities	x	x		x	x	x	x			x	x		x	x		x	x			x	x		x	x	x	x		xg
13.1 b: agricultural etc. own activity < 100 km	x	x	x	x	x	x	x	xj		xp	x		x	x		x	x			x	x	x	x	x	xm	xa	x	xh
13.1 c: agricultural/forestry tractors < 100 km	x	x	x	x	x	x	x	x		x	x		x	x		x	x	x			x	x	x	x	xm	x	x	x
13.1 d: <7.5 tons universal services < 50 km		x	x	x	x	x	x			x	x		x	x	x	x	x	x		x	x	x	x	x	x	x		xi
13.1 d: <7.5 tons for driver's use for work < 50 km	xz	x		x	x	x	x	x		x	x		x	x		x	x	x		x	x	x	x	x	x	x	x	x
13.1 e: operating on islands < 2300 square km				x	x	x	x			xq	x			x					x		x	x				xb	x	x
13.1 f: <7.5 t< 50 km gas/electricity				x	x	x	x	x		x	x		x	x			x	x			x	x		x	x	x		x
13.1 g: instruction/examination dr.license/CPC		x		x		x	x	x			x			x	xw	x	x	xy		x	x	x		x	x	x	x	x
13.1 h: sewerage/flood protection/water etc	xu	x	x	x	x	x	x	x		xr	x		x	x	x	x	x	xk		x	x	x	x	x	x		x	x
13.1 i: non-comm.pass.transp. Betw. 10-17 seats	x	x		x	x	x	x	xc		xs	x		x	x		x	x				x	x		x			x	x
13.1 j: circus/funfair	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x	x		x	x	x		x	x	xd	x	x
13.1 k: mobile projects for education	x	x		x	x	x	x			x	x		x	x		x	x			x	x	x	x	x	x	x		x
13.1 l: milk/animal feed from/to farms	xn	x		x	x	x	x	xk		xt	x		x	x	x	xk	xk	x		x	x	x		x	x	xe	x	x
13.1 m: trasnporting money/valuables	xn	x	x	x	x	x	x			x	x		x	xv		x	x			x	x	x	x	x	x	x		
13.1 n: animal waste or carcasses		x		x	x	x	x	x		x	xo		x	x		x	x			x	x	x	x	x	x		x	x
13.1 o: hub facilities	x	x	x	x	x	x	x			x	x		x	x		x	x			x	x	x		x	x	x		x
13.1 p: live animals farms -> markets v.v. < 50 km	x	x		x	x	x	x	x		x	x		x	x		x	x			x	x	x	x	x	x	x	x	x

Table 1.5. **List of national exceptions in regulation on safety in transport in the European Union** (*cont.*)

Note: "x" states an exception. The letter besides the x refers to the following:

a: additional restriction: agriculture etc. own activity within a range < 50 km.
b: additional restriction: operating on islands < 1500 square km
h: A vehicle which is being used by a fishery undertaking does not fall within the description specified unless the vehicle is being used: (a) to carry live fish, or (b) to carry a catch of fish from the place of landing to a place where it is to be processed
j: within a radius of 50 km of the place where the vehicle is usually based, including towns within this area
k: as of 1/01/2008 Estonia, Latvia and Lithuania will mutually apply the exception from Articles 5 to 9 to vehicles used for milk collection from farms etc., only in cases where the service radius does not exceed 100 km
m: within a radius of up to 50 km
n: derogation concerns only obligatory breaks (Article 7 of the Regulation); Articles 5,6,8 and 9 remain applicable for these two types of vehicles
u: vehicles used by municipal highways departments and driven by regional or municipal employees are fully exempt; vehicles used by highways departments for winter maintenance purposes are exempt from Article 7 on breaks, unless the vehicle is covered by the previous exception; drivers of vehicles used by competent authorities for the disposal of domestic waste are exempt only from Article 7 on breaks; drivers of other vehicles under this para are exempt provided that driving is not their main activity
r: for door-to-door household refuse collection and disposal, only within a radius of 100 km
s: not for the transport of children
t: within a radius of up to 150 km of the base of the undertaking
q: additional restriction: operating on islands < 400 square km
w: it refers only to the obligation of equipping and using tachograph
y: exception only for the (learning) driver, instructor must respect Regulation (EC) No 561/20006
z: drivers of vehicles under this para are exempt provided that driving is not their main activity

Source: European Commission (2014), "Report from the Commission to the European Parliament and the Council on the implementation in 2011-2012 of Regulation (EC) No 561/2006 on the harmonisation of certain social legislation relating to road transport and of Directive 2002/15/EC on the organisation of the working time of persons performing mobile road transport activities", Brussels, http://eur-lex.europa.eu/legal-content/en/txt/pdf/?uri=celex:52014sc0342&from=en (accessed 21 November 2016).

Article 13 (1) of the regulation provides exceptions from application of provisions on driving times, breaks and rest periods based on differences between existing national regulations, when the European rules were first introduced. The member states are free to choose which exceptions apply on their territory. A summary of the national exceptions is provided in Table 1.5 above. These exceptions are covered by national legislation, for example, in the UK in the Transport Act 1968, in Germany in the crew Regulation (*Fahrpersonalverordnung*), and in Latvia Cabinet Regulation No.279.

Box 1.2. **AETR Agreement**

Nineteen European countries outside the EU are signatories to the AETR (European Agreement concerning the Work of Crews of Vehicles engaged in International Road Transport, 1970). For transport journeys to or through their territories the AETR rules apply. The AETR rules apply to the whole journey, including the parts of the journey that are done in any EU country. The AETR agreement has been amended to recognise the digital tachograph, in line with European Union regulation (EC) No 561/2006 from 2010 that makes digital tachographs standard in the Union. Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Kazakhstan, Liechtenstein, Macedonia, Monaco, Montenegro, Moldova, Russia, San Marino, Serbia, Turkey, Turkmenistan, Ukraine and Uzbekistan

Source: United Nations (2006), "European Agreement concerning the Work of Crews of Vehicles Engaged in International Road Transport "(AETR).

Article 14 of regulation (EC) No. 561/2006 allows the European Union member states to grant exceptions in urgent cases to the application of driving times. These are granted on *per-case* basis by the countries and usually relate to extreme weather conditions. The enforcement of the driving time regulation is based on the records of tachographs fitted to every vehicle.

Some countries outside of the EU have aligned at least part of their regulation signing the AETR Agreement. Box 1.2. further explains the agreement.

United States Hours of Service Regulations

In the United States, *Hours of Service Regulations* regulate the driving time for the drivers, differentiated for the goods-carrying and passenger-carrying services (see Box 1.3). The maximum driving times are limited to 11 or 14 hours for goods-carrying drivers, and 10 or 15 hours for passenger-carrying drivers, depending on the length of the rest period. Drivers are required to record driving time in a logbook or using an electronic on-board recorder, which is similar to the digital tachograph in Europe. The driver is obliged to retain on board a log for the previous seven consecutive days for roadside inspection.

Box 1.3. **US DoT driving time requirements**

FMCSA regulations on Hours of Service require drivers of heavy vehicles to maintain a DoT log book, which is a daily calendar divided into half-hour increments for logging the point-to-point driving record of the driver. The Hours of Service Rules include the following stipulations:

- Drivers may drive 11 hours, following 10 hours off-duty.
- Drivers may not drive beyond the 14th hour after coming-on duty, following 10 hours off-duty.
- Drivers may not drive after 60/70 hours on-duty in 7/8 consecutive days.
- A driver may restart a 7/8 consecutive day period after taking 34 or more consecutive hours off-duty.

Source: FMCSA Regulations, Part 395, "Maximum driving time for property-carrying vehicles", www.fmcsa.dot.gov/regulations/title49/section/395.3 (accessed 21 November 2016).

The regulations adopted in North America, Europe and elsewhere have been able to provide the necessary flexibility to account for the constraints of *just-in-time* delivery and routine disruption to service schedules. Adopting regulations that correspond or are aligned in many respects to US FMCSA *Hours of Service Regulations* might be considered because of the benefits in simplifying compliance for drivers crossing the border and to fuel international road transport. Whatever system is preferred, regulatory priority should be given to putting hours of service regulations into practice.

New vehicles and imported used vehicles

Standards applicable to road vehicles with first registration in Mexico are provided under the Federal Law on Standards and Measurement (DOF, 2012a), with SCT responsible of the issued standards for vehicles under the Law on Roads, Bridges and

Motor Transport.[20] Mechanical and safety standards for motor vehicles are set under NOM-068 last revised in 2014. Safety standards for trailers and methods of testing are set by NOM-035.[21] However, environmental standards are set in the NOM-045-SEMARNAT-2016 (DOF, 2012b) and the Agreement to disclose the environmental conditions to import used vehicles equipped with a diesel engine and gross vehicular weight greater than 3 857 kg.[22]

The Law on Roads, Bridges and Motor Transport, revised on 2014, regulates the "construction, operation, exploitation, conservation and maintenance of roads and bridges (...)" and the federal transport services that operate within them. According to the law, SCT can issue standards for roads, bridges and vehicles and monitor, verify and inspect their compliance.

NOM-068 establishes the physical and mechanical conditions of the vehicles to guarantee their safe transit in federal roads, and the safety of others circulating in them. It represent the baseline of the tools and systems (and their conditions), required for the vehicles, to circulate. Similarly, NOM-035 states the minimum safety and operational measures for new or used trailers, semi-trailers and converters. Both standards apply both to manufacturers and importers, and to all the vehicles and trailers, semi-trailers and converters used inside of the Mexican territory.

A large number of imported second hand vehicles enter the Mexican fleet each year. In August 2014 ANPACT reported a figure of 5 imported used vehicles for every new truck sold.[23] This makes the enforcement of regulation on environmental and safety standards for these vehicles paramount. Imported second hand vehicles are likely to be equipped to lower standards than new domestic vehicles in terms of safety and emissions control technology.

Trade in second hand vehicles is subject to provisions of NAFTA but trade agreements generally follow the GATTs rules and allow for controls to be imposed achieving non-economic objectives through:

- Taxes, including "green tariffs" or "eco-tariffs"
- Minimum mechanical and technical standards
- Minimum environmental standards.

Some countries require emissions inspections with second-hand vehicles that fail tests not allowed into the country. Another option is for imported second hand vehicles to be required to meet specified environmental standards (e.g. Euro III or US EPA, 2004). A bill to this effect has been prepared by the Transport Committee of the Senate IN Mexico and is awaiting passage.[24] This is a positive development.

Safety standards for trailers, NOM-035

As well as the large number of old vehicles on the road there are a large number of old, used and reconditioned trailers, some that clearly do not meet the standards set out in NOM-035. In the case of Mexico, non-standard and unsafe dollies (tow bars) are a particular problem. NOM-035 requires trailers to be fitted with an identification plate confirming compliance with the norm. In the United States and many other countries a second plate with a serial or VIN number has to be attached to the dolly.

In this context, Mexico should consider amending NOM-035 to include the obligation to attach a plate confirming conformity with safety standards to dollies (tow bars) in order to facilitate inspections and enforcement of the regulation.

It is vital that the physical-mechanical, environmental and safety regulations in force, and the ones yet to come, apply to both imported and national vehicles through the Mexican territory, and this can only be implemented with a wide enforcement programme of compliance.

Enforcement

Enforcement of compliance with heavy-duty vehicle licensing and operating regulations is undertaken by the police and a team of 400 SCT inspectors. They undertake road-side checks and visits to company premises. Companies are sampled according to size and date of last visit. Supervisions to companies that register accidents are conducted as well.

Commercial vehicles present a significant risk to other road users because of their size and weight. They typically travel long distances with heavy cargo. Without well-established maintenance programmes, these vehicles can quickly develop safety faults. The quality of vehicle fleet maintenance varies with operators in Mexico, ranging from among the best in the OECD to among the worst. Compulsory road-side inspections are essential to maintaining standards and the safety of the road environment. The system implemented in the European Union is explained in Box 1.4. Countries with enhanced road safety policy-making have dedicated teams of police officers for inspecting commercial vehicles. In New Zealand, for example, the police's *Commercial Vehicle Investigation Unit* has 110 dedicated staff, including vehicle mechanics (Cliff, 2014). In Mexico this would translate into a dedicated force of between 750 and 3 000 officers depending on whether relative GDP or population is employed as basis for comparison—a measure based on the number of vehicles on the road would be also valid. It is acknowledged that Mexico's police forces are short of resources in all areas. The *Federal Police* force is better resourced and more effective than state and municipal forces but relatively small—municipal forces however, cannot inspect federal duties. Nevertheless, road safety enforcement should be among the priority areas for reinforcement.

Box 1.4. **Roadworthiness testing in the European Union**

Each Member State tests for the roadworthiness of vehicles circulating on its roads. The European Union has agreed minimum standards of testing for all vehicles to meet, and vehicles passing these tests are allowed to circulate on any Member State's roads. Tests are administered annually in garages registered for carrying out inspections, reinforced by roadside testing. Heavy vehicles over 3.5 tons gross laden weight are tested from the first year onwards, smaller vehicles from the fourth year onward. The standards are set out in Directive 2009/40/EC on roadworthiness tests for motor vehicles and their trailers.

Brakes are checked on 88 specific points, most of them concerning signs of excessive wear and including testing of performance/efficiency against design specifications. Seven other categories of equipment are tested including: steering; lights; axles, wheels, tyres and suspension; chassis and chassis attachments; seat belts; speedometers, tachographs and speed limiters; and noise. Vehicles failing tests must be repaired before they can resume duty.

Source: Directive 2009/40/EC, http://eur-lex.europa.eu/legal-content/en/txt/html/?uri=celex:32009l0040&from=en.

Elevated levels of cargo theft and carriage of illegal drugs make road-side checks more hazardous for the enforcement services. Shifting responsibility for inspections of vehicles, loads and drivers from the police to a dedicated unit with powers limited to enforcement of road safety might facilitate enforcement by insulating inspectors from responsibility for controlling contraband.

When road-side inspections are organised as a targeted campaign and a sufficient rate of checking is in place, coupled with sufficient penalties, inspections can be effective in deterring most infractions, including drink-driving offences, poor vehicle maintenance, overloading, driving without a license or insurance.

In Mexico, seventy road-side weighing stations have been installed nationally to control for overloading of heavy goods vehicles. This is about the same as the number of inspection weigh-stations as in the US state of California[25] (a state with a third of Mexico's population). Budget constraints mean they are not able to operate 24 hours a day, 7 days a week. A pilot automated weighing station is being tested in Queretaro, equipped with automatic number plate recognition. And 14 corridors have been designated to be equipped with automatic stations over time.

In the United States, many states now use electronic bypass systems with automatic vehicle identification (PrePass, NORPASS, Drivewyze etc.). The system stores safety and compliance records for each registered vehicle. Roadside transponders monitor equipped vehicles on the approach to weigh-stations. Safety and compliance records determine how often trucks from the same company are pulled in. Compliant vehicles will be permitted to pass by without a check 95% of the time. It is recommended that this kind of compliant operator system is incorporated in Mexico's automatic weigh-station programme.

It should be noted that weigh stations need to be maintained in good working order to be effective. Past investments in control technologies – weighing stations, speed control cameras – have sometimes been ineffective because of poor maintenance.

Enforcement is most effective when the haulage company, as well as the driver, consignors and all relevant parties are subject to sanctions. Mexico has enacted chain of responsibility legislation in 2016 to sanction that everyone in the supply chain has an obligation to ensure that breaches of road transport laws do not occur, and if a party's actions, inactions or demands contribute to an offence, they can be held legally accountable.[26] Chain of responsibility legislation in other OECD countries covers mandatory driving time and rest limits, respect of speed limits, safe operation and loading of vehicles, vehicle maintenance and driver fitness for work.[27] Some jurisdictions have provided powers for inspection of the accounts of companies shipping and receiving freight to verify compliance with loading limits. For example, in New South Wales the Roads and Maritime Services Authority levies multimillion dollar fines on companies found to have shipped or received tonnages (for example of grain) that significantly exceed the legal capacity of the haulage services contracted. Within limits, Roads and Maritime Authorised Officers can enter premises without consent and without a warrant for both monitoring, and investigation purposes. This has proved highly cost effective in enforcing maximum loading limits. Such extensions of powers under chain of responsibility legislation should be considered in Mexico. Currently Mexican tax authorities can investigate company accounts after SCT notifies them of a non-compliant operator, more proactive powers might be awarded to SCT inspectors.

Complex behavioural infractions such as speeding will require specific deterrence efforts, with fixed automatic speed cameras and mobile speed enforcement units. Although automatic speed cameras have been installed along federal highways it is

understood that most are currently not used. This should be reversed, and be complemented with mobile speed control patrols dosed at sufficient intensity to bring compliance with speed limits to acceptable levels (targeting all road users as a priority for overall road safety policy). The enforcement of federal traffic regulations, however, is an exclusive faculty of the Federal Police. In many jurisdictions (France for example) police are equipped to take payment of fines at the roadside, with IT systems linked to a central database.

Road safety policy co-ordination

Mexico has one of the poorest road safety records in OECD countries in terms of killed and seriously injured per head of population and per vehicle (light duty vehicles included). Heavy goods vehicles are involved in a relatively small proportion of crashes but the mass of heavy vehicles means that the consequences of crashes involving them are disproportionately serious. International experience underlines that co-ordinated leadership is required to make major improvements in road safety outcomes (ITF, 2008). A range of institutions are responsible for managing road safety in Mexico, many showing strong performance in specific areas, given the resources available, but co-ordination appears inadequate. For example, detailed statistics on deaths and injuries are collected by IMT for federal roads but data is not collated centrally for crashes on state roads.

In most areas (speed, alcohol, infrastructure, etc.) increased funding for road safety investment and management appears needed. In the area of crash reporting, for example, investment in addressing under-reporting and improving crash reports in the police service would be warranted (starting with crashes involving heavy vehicles) as a basis for developing more effective interventions and enforcement strategies.

Designation of a lead co-ordinating agency in the higher levels of government to develop strategy for reducing the number of killed and seriously injured on the roads is likely to be needed to achieve significant improvement. The role of such a lead agency is not to replace existing agencies and centres of expertise, but to focus attention in government, and consult with stakeholders and the public on the introduction of new safety interventions, to achieve support and understanding of the value of enhanced enforcement. A lead agency is also important for co-ordinating interventions between stakeholders to achieve a systematic approach to safety, and for working at the highest levels of government to ensure the resources available are commensurate with the targets set. Parallels exist in the area of security, where in the late 1990s the Ministry of the Interior led a ‘National Security Protocol’ that resulted in the rate of crimes affecting the sector falling. New initiatives of this sort for security and for road safety would be beneficial.

Environmental protection

In Mexico, Heavy-duty diesel vehicle emissions standard (NOM-044 of SEMARNAT), establishes the maximum permissible limits of emissions of hydrocarbons, non-methane hydrocarbons, carbon monoxide, nitrogen oxides, non-methane hydrocarbons plus oxides of nitrogen, particulate matter and smoke opacity from the exhaust of new engines that use diesel as fuel and that will be used for the propulsion of motor vehicles with a gross vehicle weight greater than 3 857 kilograms; and from the exhaust of new units with a gross vehicle weight of more than 3 857 kilograms equipped with this type of engines. The Ministry of Environment and Natural Resources

(SEMARNAT) through the Federal Procurement of Environment Protection (PROFEPA) is the authority competent for the enforcement of NOM-044. This standard is of mandatory observance for manufacturers, importers and assemblers of new diesel engines. In order to import or commercialize the mentioned engines and units in the Mexican territory, they have to obtain a Certificate of compliance with the NOM, issued by PROFEPA.

NOM-044 is currently under revision (see Box 1.5). Coupled with increasing availability of ultra-low sulphur diesel, there is an opportunity for early adoption of cleaner vehicles and accelerated turnover of the existing fleet. The new regulation would significantly lower limits on emissions of particulate matter (PM) and nitrogen oxides (NOx) from trucks and buses, and requires that new heavy-duty diesel vehicles sold in Mexico be equipped with advanced emissions control devices and on-board diagnostic systems. These additions to NOM-044 would bring Mexico's regulatory framework into alignment with the international heavy-duty vehicle market, matching the most progressive standards worldwide. The *International Council for Clean Transportation* estimates that over the period 2018 to 2037, the tighter standards would result in a net benefit to Mexico of USD 123 billion (MXN 1.6 trillion), taking into account the value to society of 55 000 avoided early deaths from air pollution, and the reduced climate impact from lower emissions of black carbon.[28]

Box 1.5. **Mexican, United States and European Union air pollutant emissions standards**

Mexico is updating its heavy-duty diesel vehicle emissions standards in 2015 to be equivalent to the latest standards in force in the United States at the Federal level and in the European Union. On 1 December 2014, COMARNAT, the national regulatory committee of the Ministry for Environment and Natural Resources (SEMARNAT) approved the update to existing emissions standards regulating particulate matter (PM), nitrogen oxides (NOx), hydrocarbons (HC) and carbon monoxide (CO) from heavy-duty diesel engines and vehicles, including trucks, buses and large pickups and vans. The modification to NOM-044-SEMARNAT-2006 was published on 17 December 2014 for a 60 day consultation period. Following this COMARNAT is to approve the regulation.

The new standards will require new heavy-duty diesel vehicles sold after 1 January 2018 to meet emissions standards equivalent to those in the United States (EPA, 2010) and European Union (Euro VI). The proposal to fully align with the prevailing US and European standards in 2018 will require new vehicles to be equipped with diesel particulate filters, advanced NOx after treatment, full on-board diagnostic systems and fail safe devices which ensure correct operation of emissions control systems (see Annex A1.1).

Source: Elaboration by the OECD Secretariat with information from www.cofemermir.gob.mx, www.semarnat.gob.mx, and www.dof.gob.mx

The current regulation in Mexico provides manufacturers with two compliance pathways, modelled on the US Environmental Protection Agency and the European Union standards, incorporating outdated versions of those standards that imply different compliance costs. The current proposal would update NOM 044 to EPA 2010 and Euro VI standards with full on-board diagnostics systems by January 2018. The options are functionally equivalent, require the same emissions-control and diagnostics technologies, and will result in the same compliance costs. Manufacturers will have little problem meeting the new standards, which they meet already in other North American markets. Vehicle owners should benefit despite any (moderate) increase in price as engines

designed to meet the more stringent PM and NOx limits are also more fuel-efficient than those on the Mexican market at present. Harmonisation of standards across North America also removes a potential barrier to cross-border long-haul freight transport (see Box 1.5).

The emissions-control technologies required to meet the updated standards depend on ultra-low-sulphur diesel fuel (ULSD). More than 30% of the diesel fuel sold in Mexico already meets ultra-low sulphur limits, including fuel supplied to Mexico City, Monterrey, and Guadalajara, and the share of ULSD will continue to grow. Nevertheless, to promote adoption of the new limits, there may be a case for introducing temporary fiscal incentives and there may be opportunities to introduce incentives for early adoption or phase-in of the vehicle standards.

The fuel quality standard enacted by the Energy Regulatory Commission (NOM-EM-005-CRE-2015) establishes the specification of quality to be met by petroleum fuels in each stage of the production and supply chain in the Mexican territory. NOM-EM-005 requires nation-wide availability of ultra-low sulphur diesel by 1 Jul 2018. At the same time, energy sector reform will open Mexico to new retail gas stations in January 2016 and new importers of gasoline and diesel (starting January 2017 or before). The standard requires nation-wide availability of ultralow sulphur diesel, with an accelerated phase for the three largest cities and identified major freight routes and low sulphur gasoline (average 30 ppm / maximum 80 ppm) from December 2015. More than half of the current diesel supply is ultra-low sulphur. There thus appears to be no reason to delay implementation of the new vehicle standards.

Heavy duty standards on fuel economy have begun to be developed by the Commission for the Efficient Use of Energy (*Comisión Nacional para el Uso Eficiente de la Energía*, CONUEE) to mitigate emissions of CO_2 and cut fuel bills, with interest from U.S.—based manufacturers for harmonisation with U.S. fuel economy standards. It is recommended that work on these standards resumes once NOM-044 is finally issued.[29]

Scrappage and renewal incentives

The average age of heavy goods vehicles in Mexico was 17.5 years in 2015 (see Table 1.6 and Figure 1.13). This compares to 7 years in Canada,[30] 12 years in the EU (see Figure 1.14) and 15 years for heavy rigid trucks and 11 years for articulated trucks in Australia.[31] In Mexico, whilst an age limit exists for public buses, there is no limit for trucks. For heavy trucks, 36% of the fleet is over 21 years old and 23 228 units are over 40 years old. These old vehicles are technically poorly equipped in terms of safety and emissions, compounded by the deterioration in performance that inevitably affects old vehicles. Removing the oldest vehicles from circulation and replacing them with new or recent second hand vehicles could improve safety and pollution significantly, although older vehicles tend to be driven far fewer kilometres than newer vehicles.

The government has introduced incentives to scrap old vehicles since 2003, which was updated in March 2015,[32] raising the levels of offering up to MXN 250 000, which is thought to be the critical level for the subsidy (see Table 1.7). This was the result of a negotiation between the Ministry of Economy, SCT, SEMARNAT and the Ministry of Finance. The specific incentives consist of a credit equivalent to the smallest quantity between the price in which the old vehicle is being purchased, the 15% of the price of the new vehicle, or the following prices:

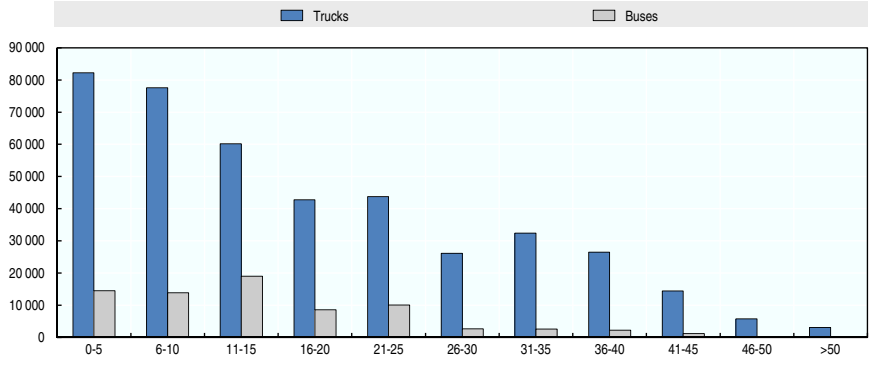
- Truck-tractors of five-wheel type: MXN 250 000
- Single-unit trucks of three axis with gross vehicle weight of at least 14 500 kg: MXN 160 000
- Single-unit trucks of two axis with gross vehicle weight of at least 11 794 kg: MXN 107 000
- Integral buses with capacity of more than thirty installed seats; MXN 250 000
- Conventional buses with capacity of more than thirty installed seats: MXN 145 000
- Comprehensive platform or chassis for integral buses with more than thirty installed seats: MXN 150 000
- Comprehensive platform or chassis for conventional buses with more than thirty installed seats: MXN 87 000.

Table 1.6. **Heavy vehicle fleet in Mexico in 2015**

Age (years)	Trucks	Busses
0-5	82 276	14 455
6-10	77 580	13 846
11-15	60 195	18 982
16-20	42 736	8 578
21-25	43 765	10 060
26-30	26 151	2 632
31-35	32 372	2 551
36-40	26 487	2 232
41-45	14 428	1 161
46-50	5 737	121
> 50	3 063	0
Fleet	414 790	74 618
Average age	17.5	14.5
Vehicles over 21 years old	152 003	18 757

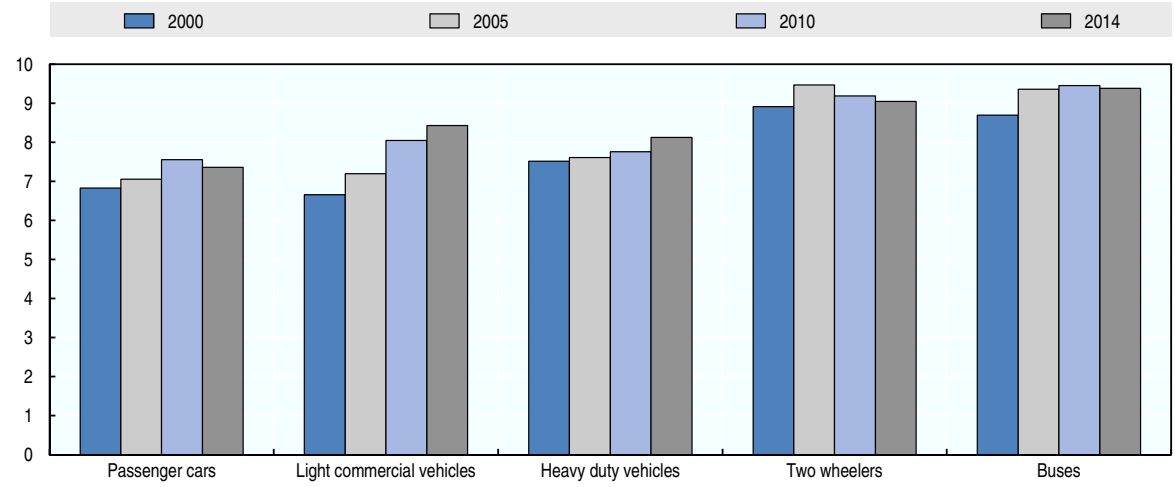
Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basic Statistics of Federal Road Transport 2015), www.sct.gob.mx/fileadmin/direccionesgrales/dgaf/est_basica/est_basica_2015/estadistica_basica_del_autotransporte_federal_2015.pdf (accessed 9 November 2016).

Figure 1.13. **Heavy vehicle fleet in Mexico in 2015**



Source: SCT (2015a), "Estadística Básica del Autotransporte Federal 2015" (Basic Statistics of Federal Road Transport 2015), www.sct.gob.mx/fileadmin/direccionesgrales/dgaf/est_basica/est_basica_2015/estadistica_basica_del_autotransporte_federal_2015.pdf (accessed 9 November 2016).

Figure 1.14. **Average age of vehicles in the European Union**



Source: Elaborated by the OECD Secretariat with data from the European Environment Agency using EU TREMOVE data, www.eea.europa.eu/data-and-maps/indicators/average-age-of-the-vehicle-fleet/average-age-of-the-vehicle.

Table 1.7. **HDV scrapping programmes in Mexico and in other countries**

Country	Programme name	No. of subsidised vehicles	Conditions / eligibility of vehicles	Time frame for application	Premium per vehicle (EUR)	Further information	Source
Chile	Change your truck (Cambia tu camion)	500	Trade in vehicles: Older than 24 years. New purchased vehicles: Better fuel efficiency than the old vehicle.	07.09.2009 – 07.10.2009	7 400 – 18 500	Total programme expense: 6.2 M Euros. CO2 mitigation 120 000 T/year	Zarchy, 2009
China	Old-Swap-New		Vehicles traded in: 10 to 15 years old.	01.06.2009 – 31.05.2010	1 200 – 2 000		Scrapmonster2011; Pengfei, 2011
Colombia	Vehicle renovation (Renovación Vehicular)	4 000			20 500 (average)	Total programme expense: 82 Mio. Euros	Ministro de Transporte, 2011
	PND 2010-14	5 000 /year		2010-14		Participation via reverse auctions Higher premiums if HDV emit less emissions	Ministro de Transporte, 2011
Japan	Vehicle replacement programme	Up to 690 000 vehicles in total	Trade in vehicles: older than 12 years New purchased vehicles: comply with new 2005 standards	01.04.2009 – 31.03.2010	7 300 (up to 8t) 16 440 (<12t)	Total programme expenses: 3.4 billion)	JAMA, Kim, 2009
	Non replacement programme		New purchased vehicles: Comply with 2015 fuel efficiency Standards 10% Nox and PM emissions compared to 2005 standards		3 650 (up to 8t) 8 220 (<12t)		

Table 1.7. **HDV scrapping programmes in Mexico and in other countries** (*cont.*)

Country	Programme name	No. of subsidised vehicles	Conditions / eligibility of vehicles	Time frame for application	Premium per vehicle (EUR)	Further information	Source
Mexico	Programme to replace and renovate vehicles (Esquema de Sustitución y Renovación Vehicular)	21 214 (between 2004 and 2012)	Vehicles traded in: Older than 10 years. New vehicles purchased: Maximum age 6 years.	2003-2015	15% of the value of the "new" HDV		SCT, 2012
	Renovation programme (Programa de renovación)	46 800 (between 2004 and Feb. 2012)				Total programme expense 1.4 billion pesos	NAFIN, 2012

Source: GIZ Mexico based on data from ITDP 2012, SEPSA 2014 and TSTES 2013, for GIZ, SCT and SEMARNAT http://transport-namas.org/projects/t-nama-countries-iki/mexico/.

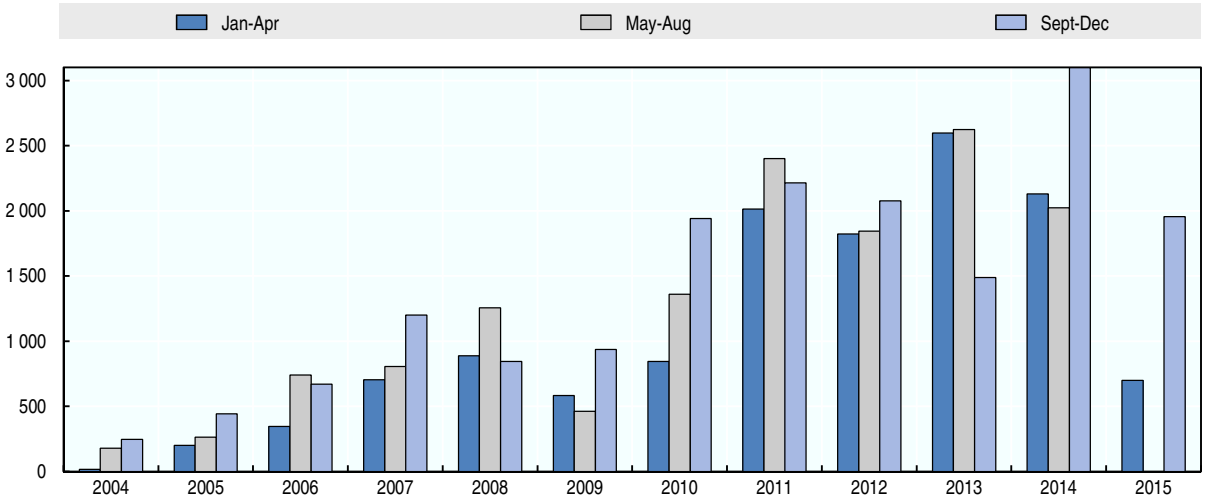
The keys to ensuring such schemes are cost effective is to target the worst vehicles, guarantee they are taken out of service and destroyed, avoid creating opportunities for abandoned vehicles being repaired to be eligible for a scrapping bonus and, where incentives are provided for renewal rather than just scrapping, ensuring replacement of only vehicles that meet high safety and environmental standards qualify.[33] The current programme complies with some of these good practices, as it requires the old vehicle (older than 10 years) to be destroyed as part of the payment for the new unit; the owner must provide proof of ownership of the destroyable unit, proof of its operation on transport services, permit, car plates and physical-mechanical and environmental verifications, at least from 1 January 2014 to the scrapping date.[34]

Additional features of the programme are the possibility to provide two vehicles for scrapping and acquire a new one, with the focus of the benefit on the sector of the *truck man*, from whom half of the destroyed vehicles must come from. The unit to be acquired must be new or up to 6 years old.

Cost-effectiveness tends to decline as the size of the programme increases but in Mexico the large number of very old vehicles suggests the public resources available for such a scheme is more likely to be the limiting factor. In this line, the programme is to be in force for the period of 2015-17 and it has a ceiling of up to 6 thousand vehicles to destroy for each calendar year, which according to STC[35] is 83% higher than in the last 10 years.

More generally a government sponsored scheme provides credit for heavy-duty vehicle renewals for qualifying owners. A financial plan is underway to be launched by the National Development Banking Institution[36] to provide liquidity for the *truck man* to have access to the programme. An Investment Plan for Mexico was requested to complement the facility with loans from the World Bank. Clean Technology Funds, administered by the World Bank, which carry a zero interest rate in principle, and offer a way of expanding the scheme tied explicitly to high standard vehicles.[37] However, if disbursement is channelled through commercial banks that take fees, the attractiveness of this source of finance might be limited.

Figure 1.15. **Vehicles destroyed 2004-2015**



1. Figures from July to December 2015 are under the new decree.

Source: ANPACT.

Weights and dimensions

All OECD countries set maximum weights and dimensions for heavy goods vehicles in order to ensure compatibility with the design of bridges, tunnels, road carriageways and junction layouts. Most jurisdictions provide for a standard articulated vehicle of around 16 to 21 metres in length and 36 to 48 tons gross laden vehicle weight authorised for use on the primary road network, be it state or federal roads. In Europe this has been extended to an international standard for 16.5 metre 40 tonne trucks guaranteed access to primary roads in all of the countries of the European Union. Standard truck-trailer combinations are similarly authorised for use across the network in most jurisdictions.

Longer, heavier vehicles are authorised for use on specified parts of the road network in most countries. In some federal systems standards for these vehicles are set at state level. In such cases there is often a degree of harmonisation nationally, as for example in Australia (see Table 1.8), which has nationally accepted standards for vehicles pulling two or three trailers on designated parts of the road network. Even longer and heavier road trains are authorised for use on parts of the road network, including unsurfaced roads. "B-doubles", 68.5 tonne vehicles with two trailers, have become a standard workhorse vehicle and are authorised for use on parts of the urban road networks in many cities.

Table 1.8. **Harmonised Australian standards for long, heavy vehicles**

Vehicle configuration	Axles	Maximum gross vehicle weight (t)	Maximum length (m)
B-double (tractor and two 'B-coupled' trailers)	9	68.5	26
B-double (tractor and two 'B-coupled' trailers)	12	91	36.5
Double road train (tractor and two "A-coupled" trailers)	11	85.5	36.5
Triple road train (tractor and three "A-coupled" trailers)	16	125	53.5

Source: ITF (2011), "Car Fleet Renewal Schemes: Environmental and Safety Impacts and Sustainability", International Transport Forum, OECD, www.itf-oecd.org/sites/default/files/docs/11fleet.pdf.

Table 1.9. **Mexican standards for heavy vehicles**

Vehicle configuration	Axles	Maximum gross vehicle weight (t)
Single trailer articulated (T2-S1)	3	30
Single trailer articulated (T3-S3	6	54
Double trailer articulated (T2-S1-R2)	5	53
Double trailer articulated (T3-S2-R4)	9	76

Source: NOM-012-SCT-2-2014.

Table 1.10. **Standard configurations for standard and higher capacity heavy vehicles in selected countries**

Jurisdiction	Vehicle category	Vehicle configuration	Axles	Maximum gross vehicle weight (t)	Length (m)
USA national road network	Standard	Articulated tractor-trailer	5	36.3	19
	Standard	B double	5	36.3	22
	Standard	Articulated tractor-trailer	6	41.9	19
US Western States	Higher capacity (standard in some states)	"Rocky Mountain" Double	9	57	31
Canada national road network	Standard	Articulated tractor-trailer	5	39.5	22
	Standard	Articulated tractor-trailer	6	46.5	22
Canadian Western Provinces	Higher capacity (standard in some states)	B double	8	62.5	20
	Higher capacity (standard in some states)	B double	9	62.5	38
South Africa	Standard	Articulated tractor-trailer	5	43.5	15
	Standard	Articulated tractor-trailer	6	49.3	18
	Higher capacity	B double	8	56	22
Brazil	Standard	B double	7	57	20
EU trunk road network	Standard	Articulated tractor-trailer	5	40	16.5
	Standard	B double	5	40	18.75
Netherlands motorways	Higher capacity	B double "European Modular Vehicle"	7	60	25.2
Denmark	Standard	Articulated tractor-trailer	6	48	16.5
	Higher capacity	B double "European Modular Vehicle"	8	60	25.2
Sweden	Standard	B double	8	60	25.2

Source: ITF (2008), Aurell, J., T. Wadman and V. Trucks, "Vehicle combinations based on the modular concept", Report No. 1/2007, Committee 54: Vehicles and Transports, Sweden, www.modularsystem.eu/download/facts_and_figures/20080522att02.pdf.

The United States has national standards for use of a designated national road network (about four times the length of the interstate highway system) defined in maximum weights per axle (9.1t for a single axle, 14.5t for a tandem axle), maximum trailer lengths and a maximum gross vehicle weight of 36.3 tonnes. Typical vehicles are 19 to 22 metres long. Longer, heavier vehicles are permitted on the trunk roads of some western States. These limits and typical vehicles configurations are summarised in Table 1.10 for the United States and a selection of other countries. Maximum vehicle standards for Central American countries estimated by the Inter-American Development Bank are summarised in Table 1.11.

Mexico's limits for the weight and dimensions of commercial vehicles (Table 1.9) are set out in NOM-012 that applies to vehicles using federal roads.[38] Revisions published on 14 November 2014 came into force in mid-January 2015. Maximum weights are determined according to axle and wheel configurations. The largest single trailer articulated truck weight is 54t. The largest double trailer vehicle (known as a 'full' in Mexico) is limited to 75.5 tons (66.5t plus an allowance of 1.5t per drive axle and 1.0t per standard axle). The 2014 revision to the standard reduced this maximum limit for double articulated truck from 80 tons, by cutting the allowance per standard axle from 1.5 to 1.0t.

Table 1.11. **Maximum permitted weights for heavy trucks in Central America**

Vehicle type	Element	Regional	CR	SV	GT	HN	NI	PA	DO
C2	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	4.0	9.0
	Tractor axle	10.0	10.0	10.0	10.0	8.0	9.0	10.0	9.0
	Total	15.0	16.0	15.0	15.5	-	-	-	-
C3	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	16.5	15.0	16.5	16.5	16.0	16.0	16.4	14.5
	Total	21.5	21.0	21.5	22.0	-	-	-	-
C4	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	20.0	23.0	20.0	20.0	20.0	20.0	22.0	-
	Total	25.0	29.0	25.0	25.0	-	-	-	-
T2-S1	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	9.0	10.0	9.0	9.0	8.0	9.0	10.0	9.0
	Trailing axle	9.0	10.0	9.0	9.0	8.0	9.0	10.0	9.0
	Total	23.0	26.0	23.0	23.0	-	-	-	19.5
T2-S2	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	9.0	10.0	9.0	9.0	8.0	9.0	10.0	9.0
	Trailing axle	16.0	16.5	16.0	16.0	16.0	16.0	16.4	14.5
	Total	30.0	32.5	30.0	30.0	-	-	-	27.3
T2-S3	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	9.0	10.0	9.0	9.0	8.0	9.0	10.0	9.0
	Trailing axle	20.0	23.0	20.0	20.0	20.0	20.0	22.0	
	Total	34.0	39.0	34.0	34.0	-	-	-	30.1
T3-S1	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	16.0	16.5	16.0	16.0	16.0	16.0	16.4	14.5
	Trailing axle	9.0	10.0	9.0	9.0	8.0	9.0	10.0	14.5
	Total	30.0	32.5	30.0	30.0	-	-	-	30.1
T3-S2	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	16.0	16.5	16.0	16.0	16.0	16.0	16.4	14.5
	Trailing axle	16.0	16.5	16.0	16.0	16.0	16.0	16.4	14.5
	Total	37.0	39.0	37.0	37.0	-	-	-	30.1
T3-S3	Front axle	5.0	5.0	5.0	5.0	5.0	5.0	5.5	9.0
	Tractor axle	16.0	16.5	16.0	16.0	16.0	1.0	16.4	14.5
	Trailing axle	20.0	23.0	20.0	20.0	20.0	20.0	22.0	-
	Total	41.0	45.5	41.0	41.0	-	-	-	-
B-double		No	Yes	No	Yes	-	-	Yes	No

CR: Costa Rica; SV: El Salvador; GT; Guatemala; HN: Honduras: NI: Nicaragua; PA; Paraguay; DO: Dominican Republic.

Source: Elaborated by the OECD Secretariat with data from IDB (2013), "Trucking Services in Belize, Central America, and the Dominican Republic: Performance Analysis and Policy Recommendations".

NOM-012 was recently updated in Mexico (see section *General Regulatory Framework*) and the SCT indicated that it foresees the inclusion of the NOM-012-SCT-2-2014 in the National Normalization Program of 2017 to review its contents. Changes to truck weight and dimension limits tend to be controversial in all jurisdictions. Similar arguments over the advantages and disadvantages of raising limits for standard vehicles arise in the US, Europe and Australia even though the limits currently in force in these jurisdictions range from 36 to 91 tonnes.

At stake with higher limits, on the positive side, are improved productivity and potentially fewer vehicles on the road. Higher productivity translates into lower logistics costs, which drives economic growth and translates directly into higher profitability for own-account operators. In the case of general hauliers, the benefit of higher productivity will be passed on to customers through competition. Larger loads in principle result in fewer journeys and a contribution to containing emissions and road congestion (ITF, 2011).

Those opposing higher limits note there will be a rebound effect. Larger loads mean lower unit costs, and lower prices which will stimulate more trade and transport. This effect is, however, only expected to offset 10% of the reduction in truck-kilometres driven achieved with higher productivity vehicles. Operators of smaller trucks may see larger vehicles as a threat to business. Rail companies also generally see higher weight limits as a threat to business, but the impact depends very much on the nature of the rail market nationally. In Europe, for example, the impact of moving from a 40t to a 60t limit might have little effect on rail freight in Germany but could wipe-out the deep sea container business in the UK railways because of the relatively short haul lengths in the UK. In Sweden introduction of 60 tonne trucks was beneficial to the competitiveness of the railways, providing for enhanced feeder services in the timber hauling business (ITF, 2011).

Heavier vehicles require adequate safety regulation. In general, higher capacity vehicles behave as well or better than standard vehicles in tests of braking, stability and manoeuvrability as they are designed to high standards (ITF, 2011). Heavier vehicles also need to be configured to respect design standards for the strength of roadways and bridges. As with safety, heavier vehicles can perform as well as or better than standard vehicles when well designed (ITF, 2011). *Pneumatic suspension* is for example superior to *leaf suspension* in terms of road wear, other things being equal (see next subsection on EU standards). Axle lengths determine the dynamic impact on bridges, but gross vehicle weight is ultimately a limiting factor in relation to bridge design.

Weights and dimensions regulation in the European Union

European Union Directive 96/53/EC of 25 July 1996 (with amendments in Directive 2002/7/EC) sets standard maximum dimensions for vehicles in national and international road traffic and weights for vehicles used in international traffic within the EU. The EU member states are free to set different maximum authorised weights for domestic journeys. The aim of Directive 96/53/EC is to ensure that there are no obstacles to international use of standard commercial road freight and passenger vehicles in the European Union. The requirements of the directive are transposed into the national legislation of member states. A list of maximum permissible weights and dimensions for European countries is available from the ITF website www.internationaltransportforum.org/IntOrg/road/dimensions.html.

In the European Union air suspension is defined as a suspension system in which at least 75 % of the spring effect is carried by a pneumatic device. Regulation No 1230/2012 defines the characteristics of an air suspension system and sets conditions of equivalence between mechanical and air suspension. According to Directive 96/53/EC, maximum allowed weights depend on a list of factors, including spacing between the axles, the number of tyres on each axle and the type of suspension fitted. Vehicles equipped with air suspension are permitted higher weights than those without. For example, for a vehicle with 4 axles the maximum allowed weight of a truck with a semi-trailer is 36 tonnes; but under certain conditions if the driving axle is fitted with twin tyres and air suspension or equivalent the limit is raised to 38 tonnes.

Elements to consider when assessing changes in regulation in weight and dimensions for road transport

Determining the benefits and costs of higher (or lower) weight limits with any precision requires testing of the specific vehicles in question and modelling of their impacts on infrastructure under prevailing national conditions. The Mexican Transport Institute is well equipped to undertake the physical testing, with state-of-the-art road-wear testing machinery and facilities for testing braking, stability and handling performance of trucks. SCT is establishing a group of experts to report on the compatibility of higher maximum weight limits with the Mexican road environment with a view to guiding future changes to standards. Such a study is, however, unlikely to be able to arbitrate between different sections of the trucking industry over the perceived advantages and disadvantages of higher weight limits. After receiving the recommendations from the Experts' Panel, a Follow-up and Evaluation Group was formed with experts, business chambers, industry organisations and government officials.

SCT is required to undertake two evaluations of the 2014 amendments to NOM-012. The implementing arrangements specified in Article 13 of the norm require SCT to undertake studies to evaluate the effectiveness of the norm within three years of it entering into force, in preparation for the next programmed 5-yearly revision. In the immediate term, the Federal Commission for Better Regulation (COFEMER) has asked SCT to undertake an *ex post* assessment of the amendments.

COFEMER's *ex post* regulatory impact assessment is a "voluntary" regulatory quality tool that aims to improve regulation (Comisión Federal de Mejora Regulatoria, 2013). Under the process COFEMER selects which norms should be reviewed and issues a request to the ministry responsible requiring an *ex post* assessment, within 30 working days of the date of entry into force of the norm. For NOM-012, the assessment must be submitted at the end of February 2016. After submission, COFEMER either accepts and publishes the assessment or reverts to the Ministry requesting more information. On 27 May 2016, the Mexican Institute of Transport submitted a report of accidents by request of the General Direction of Federal Transport so as to be integrated to the *ex post* impact evaluation of the NOM-012. Afterwards on 19 July 2016, COFEMER sent to the SCT a report of *ex post* evaluation. COFEMER outlines the objectives of *ex post* assessment as:

- To check achievement of the objectives
- To verify improvements brought about
- To identify opportunities for further improvement.

The procedure requires collection of data to verify theoretical assumptions on the basis of experience but allows for a broad range of modelling techniques to be used to assess impacts. It starts with identification of the problem addressed by the regulation and identification of the objectives of the norm and includes identification of potential alternative measures.

The introduction to NOM-012-2-2014 specifies the following criteria for setting new weight limits:

- Preservation of infrastructure
- Environmental protection
- Promoting productivity
- Promoting the safety of all road users.

It stresses the objective of the 2013-18 National Development Plan to accelerate economic growth and the duty placed on SCT to reduce the costs of economic activity through the way in which it develops and manages infrastructure. It also stresses the 2013-18 Transport and Communications Sector Program and its focus on delivering an effective logistics and transport services that are efficient, safe and increase the competitiveness and productivity of economic activities. The introduction to the norm notes that "attention to diverse themes" is required, hinting that trade-offs may need to be made between productivity and the other criteria but not making this explicit.

The objectives are thus clearly stated and the problem addressed is identified as follows: To improve levels of safety and reduce damage to infrastructure it is necessary to set maximum limits to weights and dimensions for commercial vehicles in accordance with the physical and technical characteristics of the infrastructure.

Impact assessment of the amendments to NOM-012 can be undertaken in two respects: overall achievement – objective 1 and 3 of the COFEMER *ex post* assessment procedure; improvement brought about by the amendments made – objective 2.

Starting with this narrower, second task, the main change to the norm in the 2014 amendment is removal of the weight allowance for pneumatic suspension. This reduced the maximum capacity for the largest trucks from 80 to 75.5 tons. Assessment of the impacts will require both empirical data and modelling. Such exercises have been undertaken in a number of countries for weight increases. Mexico may be unique in reducing statutory weight limits but the same methodology applies. Three relevant examples from other OECD countries of assessment of the impact of changes in regulations on maximum truck weights and dimensions are:

- McKinnon (2004) The Economic and Environmental Benefits of Increasing the Maximum Truck Weight: the British Experience, a research paper reviewing basement of increasing the limit from 41 to 44 tonnes
- Rijksaterstaat (2011) Longer and Heavier Vehicles in Practice: Economic, Logistical and Social Effects, the Ministry of Infrastructure and Environment's evaluation of the impact of licensing 60 tonne combination vehicles in a system where the standard maximum weight is 40 tonnes
- Risksolutions (2014) Evaluation of the Longer Semi-Trailer Trial: Annual Report 2013, a report for the UK Department for Transport reviewing the impact of using trailers up to 2.05m longer than the standard 13.6m units.

Box 1.6. **Procedure used to forecast the impact of weight increase in the United Kingdom**

1. Estimates were obtained from the UK Department for Transport's Continuing Survey of Road Goods Transport (CSRGT)[1] of the distances travelled by 38, 40 and 41 tonne vehicles with weight-constrained loads and the total tonne-kms moved over these distances.
2. Maximum payload weight (MPW) ratios were calculated. These were expressed as the ratios of the MPWs that could be carried on 38 tonne 5 axle vehicles (24 tonnes), 40 tonne 5 axle vehicles and 41 tonne 6 axle vehicles (26 tonnes) to the maximum carrying capacity of the 44 tonne 6 axle vehicle (29 tonnes).
3. The vehicle-kms travelled with weight-constrained loads were multiplied by the MPW ratios to estimate the potential gross saving in laden vehicle-kms.
4. The gross saving in laden vehicle-kms was converted into a gross saving in total vehicle-kms by allowing for empty running. It was assumed that the average empty running figure for 38, 40 and 41tonne vehicles (28%) would also apply to the new 44 tonne vehicles.
5. High, medium and low migration factors were applied to the gross savings in vehicle-kms in recognition of the fact that some loads would reach volume, scheduling or other constraints at a MPW of less than 29 tonnes. Separate migration factors were used for 38 and 40/41 tonne vehicles. These factors were chosen subjectively though in consultation with a group of industry specialists and road freight operators.
6. Allowance was made for traffic generation by applying the Government's National Road Traffic Forecast elasticity value of 0.1 to the estimated saving in road haulage costs per tonne-km from increasing MPWs from 24 to 29 tonnes (for 38 tonne vehicles) and 26 to 29 tonnes (for 40/41 tonne vehicles). The traffic generation factors were applied to road freight tonne-kms carried by vehicles carrying weight-constrained loads.
7. Allowance was made for three levels of modal diversion: high—19% of tonne-kms transfer to road, medium—10% transfer and low 5% shift (based on a studies for the Department of Transport).
8. The average load factor for new 44tonne vehicles (on laden trips) was estimated with reference to the current load factors of the 38, 40 and 41tonne vehicles derived from CSRGT data. These were, respectively, 63%, 72% and 82%. On this basis, it was assumed that the 44 tonne truck would have an average load factor of 70%.
9. The net savings in vehicle-kms were calculated for each of the levels of load migration and modal diversion.
10. The net savings in vehicle-kms were translated into transport cost savings. This was done using an average vehicle operation cost value of GBP 0.65 per vehicle-km obtained from the Motor Transport cost tables.
11. Environmental cost savings were derived using monetary valuations of air pollution, climate change, noise disturbance and traffic accidents provided by AEA Technology. The environmental estimates for rail freight were based on the use of the new, cleaner Class 66 locomotives. Average environmental externalities were valued at 0.87 pence per tonne-km for road and 0.28 pence per tonne-km for rail.

1. https://www.gov.uk/government/statistics/continuing-survey-of-road-goods-transport-gb-respondents-section; https://www.gov.uk/government/collections/road-freight-domestic-and-international-statistics.

Source: McKinnon (2004), "The economic and environmental benefits of increasing the maximum track weight: the British experience", *Transport Research*, Part D, Elsivier; Department for Transport, UK (2012), "Road freight: domestic and international statistics", retrieved from: https://www.gov.uk/government/collections/road-freight-domestic-and-international-statistics.

The impact on productivity, despite being a complicated enough process (see Box 1.6), is the simplest part of the overall assessment. Productivity will be reduced for the users of the largest double articulated trailers and their clients. These vehicles are operated typically by large retail companies, who either hired them from haulage firms or have their own-account transport operators. Data on how many vehicles this concerns and average load factors for them are not readily publicly available. It should be possible to obtain such data from industry sources and through surveys, but as the analysis described in McKinnon illustrates, a full assessment requires separate identification of the proportions of loads subject to a weight or volume constraint. To be accurate, assessment should also aim to sample overloading under the 80 and 76 tonne limits as well as the impact on average load factors.

For hauls where trucks are typically fully loaded, the impact of a reduction in weight on the number of extra vehicles that need to be used is simply proportionate. Where loads vary, the calculation is not so straightforward and there may be no substitute for interviews and sampling by survey. Back-haul load factors need also to be taken into account. Data on load factors is again not currently publicly available. The National Observatory for Transport and Logistics to be established by SCT and in preparation by the Mexican Transport Institute could be charged with assembling the necessary data for impact assessments under NOM-012.

Generally truck fleets can be expected to adapt to a change in weight limit, but in Mexico's current case there may be little impact in this respect as the configuration of the large double articulated truck remains unchanged in terms of axles, wheels and dimensions. Manufacturers are unlikely to begin to market customised 76 tonne designs, not least because of the possibility that the 80 tonne limit is reinstated after the next five-year review.

Environmental impacts depend in large part on the number of vehicle-kilometres driven, as calculated in relation to productivity. The maximum weight limit reduction will therefore probably have a negative effect on the environment. Emissions may also be affected by the change in effort required to accelerate with a fully loaded vehicle, 5% lighter under the amended regulation. This will depend on the motor used in each truck configuration. On-road emissions testing is probably the only way to establish if there is a significant difference; test-bed emissions and on-road emissions in real driving condition can differ greatly. CO_2 emissions can be readily calculated from fuel purchase records but there is no substitute for on-road sampling of NOx and particulate emissions.

Safety impacts are likely to be too small to model or monitor. The trucks affected by the weight change were designed to operate safely at the higher weight limit. A reduction in mass carried reduces the kinetic energy involved in any crash, but a 5% change to a heavy load will be of only marginal relevance to the damage done in terms of life lost or injury. Other factors are much more important: overloading; condition of the vehicle in terms of maintenance of breaks, lights, etc.; conformity with design standards, especially trailers; age of vehicle; use of advance safety technologies. Behavioural factors are also much more important than the change in maximum authorised weight: speeding; fatigue; driving under the influence of drugs and alcohol. Monitoring might be able to reveal changes over time but standard of monitoring and reporting of crash causation are currently poor, inconsistent and far from systematic in Mexico. It is difficult to foresee advances in crash reporting sufficient to provide a basis for monitoring the impact of a maximum weight change in the time frame, even for a five-year review of the norm.

Pavement wear may benefit from a reduction in maximum loads. The incidence of overloading and poor maintenance of suspension may be more important, however, and data collected to date is probably insufficient to provide a baseline. An approximation of the impact on road wear can be modelled, with the results of accelerated road wear testing machines. Such tests have been carried out in Mexico by IMT and could be repeated and improved to assess the change to NOM-012. It should be kept in mind that the largest vehicles are not necessarily the most aggressive towards infrastructure, but the reduction in weight can be expected to have a small benefit for road wear – albeit offset by the increase in truck-kilometres driven. Evaluation for the 1 year *ex post* assessment will have to rely on modelling as the time-scale needed for detecting marginal infrastructure wear through direct monitoring is much longer.

Removal of the incentive to fit pneumatic suspension is potentially problematic. Pneumatic suspension reduces road wear, as reflected in the European Union's regulations and in the revised NOM-012 itself in relation to commercial passenger vehicles (Article 6.1.1.1.1). It would be unwanted if manufacturers phased out pneumatic suspension in trucks for the Mexican market, not least because pneumatic systems make it much easier to install automatic weigh-in-motion equipment, part of the package for advanced compliance monitoring systems of the sort already deployed in Australia, to improve enforcement of safety and operating regulations and reduce the cost of enforcement. The value of pneumatic suspension to preserving infrastructure is questioned by the Mexican authorities, and would merit a testing programme to validate suppression of the incentive in NOM-012, or provide the basis for design of a new incentive element in the norm at whatever overall weight limit is retained.

Bridge integrity is unlikely to be affected by the change in NOM-012 as 80 tonne double articulated trucks were found to be acceptable under the bridge formula applied for infrastructure compliance in Mexico. The assessment will be verified by the expert group for the 3-year review of the NOM. Compliance with operation on designated routes – federal highways – is little affected as 76 and 80 tonne trucks are similarly incompatible with surfaces and bridges on roads under State jurisdiction built to lower design standards.

It should be stressed that in undertaking impact assessments, specific costs will have to be established for Mexican conditions. Whilst the methodologies developed elsewhere, for example as described by McKinnon (2004) can be applied to the extent that data available in Mexico permits, cost factors should be transferred with care. McKinnon provides the example of infrastructure costs developed in the US where strengthening the design of roadways to carry larger vehicles produces large unit costs for the assessments undertaken in the US. These figures were not transferable to the United Kingdom as no strengthening of roadways was needed to accommodate the change from 41 to 44 tonnes. Similarly in Mexico, switching between 80 and 76 tons will not require design changes.

Professional qualifications

Conditions for entry to the profession of truck driving are regulated in all OECD countries. Regulations usually impose tests of financial capacity and familiarity with safety and operating regulations for the sector, as a condition for awarding of a licence to operate haulage services. Markets have developed to provide insurance bonds to provide the necessary financial guarantees at low cost for owner-drivers in most countries. Certification requirements in Mexico are minimal. The National Chamber for Road Freight Transport, CANACAR (*Cámara Nacional del Autotransporte de Carga*),

provides training on tax and regulatory issues for members, focusing on assisting small enterprises and the National Confederation of Mexican Carriers, CONATRAM (*Confederación Nacional de Transportistas Mexicanos*) also provides guidance. Government may wish to support these efforts and work with organisations representing owner-operators such as the Mexican Alliance Carriers Organization (*Alianza Mexicana de Organización de Transportistas*) to improve standards and prepare for the introduction of stricter professional standards. The NOM-012-SCT-2-2014 establishes a specific licence for double articulated vehicles, since March 2016 the SCT is granting these licences. They include specific training, and additional requirements.

Recommendations

Enforcement of safety regulations

The resources available for enforcement should be increased. The number of SCT inspectors for roadside checking of heavy goods vehicles needs to be substantially increased. A modernisation of the equipment must be carried out, as well as an improvement of the organisation for the inspectors. Police resources for vehicle inspections also need to be increased and consideration given to establishing a dedicated unit charged only with enforcement of heavy vehicle regulations.

Driving and rest time regulation

The regulation in preparation to regulate hours of service should be completed and adopted as a matter of priority. Until now, there is only a project proposal of a NOM regarding the risks associated to fatigue, whose process to be released has not finished.

In the European Union there is a maximum driving time of 9 hours that can be extended to 10 hours twice a week. In the United States, driving times vary between 10 and 15 hours, depending on whether the driver is carrying passengers of freight and on the length of the resting period.

Safety and security

Resources should be allocated to ensuring existing weigh-stations are maintained in operating condition and operated 24/7. Many of the 70 existing stations are reportedly out of commission or manned only intermittently. In fact, according to the dynamics of the sector (cargo transported, fleet, kilometres of road, etc.) the checking points should be increased substantially to enforce regulation based on risk assessments.

A pilot programme introducing automatic weighing stations is welcome. It is recommended that a compliant operator system is incorporated in this programme.

It is recommended to establish a lead agency with focus on road safety at the highest levels of government.

Standards for vehicles at first registration

Regulations for the design and testing of trailers, NOM-035, should be amended to include the obligation to attach a plate confirming conformity with safety standards to dollies (tow bars) as is the requirement in the United States in order to facilitate inspections and enforcement of the regulation.

Environment

Emissions standards should be introduced in the regulation for imported second hand vehicles. For instance, the proposed heavy-duty vehicle emissions standards, adopting EPA 2010 and Euro VI limits, are welcome and should be adopted as a matter of priority and the implementation of NOM-EM-005 for fuel quality, requiring nationwide availability of ultra-low sulphur diesel by 2018 should be prioritised.

Weights and dimensions

The maintenance of the expert group to examine optimal weight and dimension limits for trucks in relation to infrastructure and safety is welcome. It should be supported with the resources necessary to deliver its report by 2018 as provided for by NOM-012-SCT and as a basis for revision of the limits in 2020. The evaluation of the expert team must be based on evidence, and statistics production has to be enhanced.

The value of pneumatic suspension to preserving infrastructure merits a testing programme to establish the potential value of reintroducing an incentive element under NOM-012, whatever maximum overall weight limit applies. This could be part of the *ex ante* assessment of the norm required in 2016.

Notes

1. Mexican law distinguishes at least two types of legal entities to undertake economic activities: individuals and firms, both with different legal and fiscal obligations.
2. Dangerous materials, cars without rolling, funds and values, drag cranes, rescue and drag cranes and large vehicles.
3. Basics Statistics of the Road Transport (*Estadística Básica del Autotransporte Federa*)l. 2015, SCT, www.sct.gob.mx/transporte-y-medicina-preventiva/transporte-ferroviario-y-multimodal/anuarios-dgtfm-edicion-digital/ (accessed 9 November 2016).
4. IMT-SCT (1992), Assessment of the status of freight in Mexico 1990-1991: Movements road, IMT and SCT (*Evaluación de la situación del transporte de carga en México 1990-1991: Movimientos por carretera*).
5. Freight trucks residing in Mexico would request authorization to operate in the US to the former US Interstate Commerce Commission (Mendoza and Diaz, 2003)
6. Authorisations granted before 1982 were respected (Mendoza and Diaz, 2003).
7. Freight trucks residing in Mexico but owned by US registered companies, Mexican trucks carrying goods exempt from tariffs, and Mexican trucks and pick-ups that cross the United States territory for delivery in Canada (Mendoza and Diaz, 2003).
8. See U.S.-Mexico Cross-Border Trucking Pilot Program, US FMCSA, www.fmcsa.dot.gov/international-programs/mexico-cross-border-trucking-pilot-programme and Status of Mexican Trucks in the US, John Fritelli, Congressional Research Service, January.
9. http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=2230&context=key_workplace.
10. FMCSA, www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/MX-Trucking-Pilot-Program-Report.pdf.
11. Status of Mexican Trucks in the United States, John Fritelli, Congressional Research Service, January 2014, http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=2230&context=key_workplace.
12. United States-Mexico Cross-Border Long-Haul Trucking Pilot Program Report to Congress, www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/MX-Trucking-Pilot-Program-Report.pdf.
13. http://eleconomista.com.mx/industrias/2015/01/09/eu-abre-su-frontera-camioneros-mexicanos.
14. Federal Register /Vol. 80, No. 10 /Thursday, January 15, 2015 /Notices, Acceptance of Applications for Mexican-Domiciled Long-Haul Operations, www.gpo.gov/fdsys/pkg/FR-2015-01-15/pdf/2015-00555.pdf.
15. Secretaría de Economía (2014), Monografía de la Industria Automotriz.

16. Law of Roads, Bridges and Federal Motor Carrier, 1993 (*Ley de Caminos, Puentes y Autotransporte Federal*).

17. Agreement to disclose the environmental conditions to import used vehicles equipped with a diesel engine and gross vehicular weight greater than 3 857 kgs., 2011 (*Acuerdo por el que se dan a conocer las condiciones ambientales a que se sujetará la importación de vehículos usados equipados con motor a diésel y con peso bruto vehicular mayor a 3 857 kilogramos*).

18. Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions.

19. Agreement concerning the Establishing of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles.

20. *Ley de Caminos, Puentes y Autotransporte Federal*, 1993, revised June 2014.

21. www.sct.gob.mx/fileadmin/_migrated/content_uploads/64_nom-035-sct-2-2010.pdf.

22. Agreement that notifies the environmental conditions that the imports of used vehicles with diesel motor and weight higher than 3 857 kg will be subjected to, 2011 (*Acuerdo por el que se dan a conocer las condiciones ambientales a que se sujetará la importación de vehículos usado equipados con motor a diésel y con peso bruto vehicular mayor a 3 857 kilogramos, 2011*).

23. http://mexicoautomotivesummit.com/highlights.html.

24. www.senado.gob.mx/sgsp/gaceta/63/1/2016-04-28-1/assets/documentos/dict_com_y_transp_35_39_y_50_lcpaf.pdf.

25. There are 65 weigh-stations for road-side inspections in California, www.coopsareopen.com/california-weigh-stations.html. The law requires trucks passing open stations to pull in and check loads. Stations close access ramps when they are fully occupied to prevent long delays.

26. Criteria of the Shared Responsibility in the provision of the service protected by the Waybill or Proof that Protects the Transport of Goods, 2016 (*Criterios de Aplicación de la Corresponsabilidad en la prestación del servicio que ampara la Carta de Porte o Comprobante que Ampara el Transporte de Mercancías*), http://dof.gob.mx/nota_detalle.php?codigo=5439315&fecha=31/05/2016.

27. A useful checklist of responsibilities under Australia's National Heavy Vehicle Law is provided here: https://www.nhvr.gov.au/law-policies/heavy-vehicle-national-law-and-regulations.

28. ICCT, www.theicct.org/revising-mexicos-nom-044-standards-considerations-decision-making.

29. NOM-EM-005 is an emergency standard. The Energy Regulatory Commission is yet to publish a final standard.

30. Canadian Vehicle Survey 2005, Resources Canada, http://oee.nrcan.gc.ca/Publications/statistics/cvs05/pdf/cvs05.pdf.

31. Annual vehicle census, Australian Bureau of Statistics, www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/f19b5d476fa8a3a6ca257d240011e088/$file/93090_31%20jan%202014.pdf.

32. Decree that promotes the renovation of the vehicular park of motor road, 2015 (*decreto por el que se fomenta la renovación del parque vehicular del autotransporte*), www.dof.gob.mx/nota_detalle.php?codigo=5386771&fecha=26/03/2015.

33. Car Fleet Renewal Schemes: Environmental and Safety Impacts and Sustainability, International Transport Forum, OECD 2011.

34. www.sct.gob.mx/despliega-noticias/article/conferencia-de-prensa-programa-del-gobierno-federal-para-la-renovacion-de-vehiculos-de-carga-y-1/.

35. Official press statement, www.sct.gob.mx/uploads/media/se_actualiza_el_programa_de_renovaci%c3%93n_de_veh%c3%8dculos_de_carga_y_de_pasaje.pdf.

36. Nacional Financiera.

37. More information on Clean Technology Funds for Mexico can be found on: https://www-cif.climateinvestmentfunds.org/country/mexico/mexico-ctf-programming.

38. NOM-012-SCT-2-2014, "About the maximum weight and dimensions that the motor vehicles are authorised to circulate in the general communication roads of federal jurisdiction" (*Sobre el peso y dimensiones máximas con los que pueden circular los vehículos de autotransporte que transitan en las vías generales de comunicación de jurisdicción federal*).

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Annex A1.1

US, EU and Mexican standards and their progressive tightening over time

Table 1.A1. **US EPA and California emission standards for heavy-duty CI engines (g/bhp hr)**

Year	CO	HCa	HCa+NOx	NOx	PM	
					General	Urban bus
1974	40	-	16	-	-	
1979	25	1.5	10	-	-	
1985	15.5	1.3	-	10.7	-	
1987	15.5	1.3	-	10.7d	0.60f	
1988	15.5	1.3b	-	10.7d	0.60	
1990	15.5	1.3b	-	6.0	0.60	
1991	15.5	1.3c	-	5.0	0.25	0.25g
1993	15.5	1.3c	-	5.0	0.25	0.10
1994	15.5	1.3c	-	5.0	0.10	0.07
1996	15.5	1.3c	-	5.0e	0.10	0.05h
1998	15.5	1.3	-	4.0	0.10	0.05h
2004j	15.5	-	2.4i	-	0.10	0.05h
2007	15.5	0.14k	-	0.20k	0.01	
2010	15.5	0.14	-	0.20	0.01	
2015	15.5	0.14	-	0.02l	0.01	

Non-methane hydrocarbons (NMHC) for 2004 and later standards.

For methanol-fuelled engines, the standard is for total hydrocarbon equivalent (THCE).

California: NMHC = 1.2 g/bhp·hr, in addition to the THC limit.

California: NOx = 6.0 g/bhp·hr.

California: Urban bus NOx = 4.0 g/bhp·hr.

California only, no federal PM limit.

California standard 0.10 g/bhp·hr.

In-use PM standard 0.07 g/bhp·hr.

Alternative standard: NMHC+NOx = 2.5 g/bhp·hr and NMHC = 0.5 g/bhp·hr.

Under the 1998 Consent Decrees, several manufacturers supplied 2004 compliant engines from October 2002.

NOx and NMHC standards were phased-in on a percent-of-sales basis: 50% in 2007-2009 and 100% in 2010. Most manufacturers certified their 2007-2009 engines to a NOx limit of about 1.2 g/bhp·hr, based on a fleet average calculation.

Optional. Manufacturers may choose to certify engines to the California Optional Low NOx Standards of 0.10, 0.05 or 0.02 g/bhp·hr.

Source: ICCT.

Table 1.A2. **EU emission standards for heavy-duty diesel engines: steady state testing**

Stage	Date	Test	CO	HC	NOx	PM	PN	Smoke
			g/kWh				1/kWh	1/m
Euro I	1992, ≤ 85 kW	ECE R-49	4.5	1.1	8.0	0.612		
	1992, > 85 kW		4.5	1.1	8.0	0.36		
Euro II	1996.10		4.0	1.1	7.0	0.25		
	1998.10		4.0	1.1	7.0	0.15		
Euro III	1999.10 EEV only	ESC & ELR	1.5	0.25	2.0	0.02		0.15
	2000.10		2.1	0.66	5.0	0.10a		0.8
Euro IV	2005.10		1.5	0.46	3.5	0.02		0.5
Euro V	2008.10		1.5	0.46	2.0	0.02		0.5
Euro VI	2013.01	WHSC	1.5	0.13	0.40	0.01	8.0×1 011	

a - PM = 0.13 g/kWh for engines < 0.75 dm^3 swept volume per cylinder and a rated power speed > 3000 min^{-1}.

PN = Particulate number (note, US EPA regulations do not include a value for number of particulates emitted).

Source: Dieselnet, https://www.dieselnet.com/standards/eu/hd.php.

Table 1.A3. **EU emission standards for heavy-duty diesel and gas engines: transient testing**

Stage	Date	Test	CO	NMHC	CH4a	NOx	PMb	PNe
			g/kWh					1/kWh
Euro III	1999.10 EEV only	ETC	3.0	0.40	0.65	2.0	0.02	
	2000.10		5.45	0.78	1.6	5.0	0.16c	
Euro IV	2005.10		4.0	0.55	1.1	3.5	0.03	
Euro V	2008.10		4.0	0.55	1.1	2.0	0.03	
Euro VI	2013.01	WHTC	4.0	0.16d	0.5	0.46	0.01	6.0×1011

a - For gas engines only (Euro III-V: NG only; Euro VI: NG + LPG)

b - Not applicable for gas fuelled engines at the Euro III-IV stages

c - PM = 0.21 g/kWh for engines < 0.75 dm^3 swept volume per cylinder and a rated power speed > 3000 min^{-1}

d - THC for diesel engines

e - For diesel engines; PN limit for positive ignition engines TBD

Source: Dieselnet, https://www.dieselnet.com/standards/us/hd.php.

Table 1.A4. **Mexican maximum permissible emissions standards for new heavy-duty vehicles**

Year	Compliance equivalent
1993	US EPA 1991
1994	US EPA 1994
1998	US EPA 1998
2006-08	US EPA 1998 or Euro III
2008-2015	US EPA 2004 or Euro IV
2015-17 (Proposal)	US EPA 2004 or Euro IV
Beginning 1 January 2018 (Proposal)	US EPA 2010 or Euro VI

Source: TransportPolicynet, http://transportpolicy.net/index.php?title=mexico:_heavy-duty:_emissions.