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The gasoline shortage crisis in Mexico: A Big Data analysis

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Summary

The strategy of the new government in Mexico to combat the theft of gasoline led to a temporary shortage, which was exacerbated by panic among the general public over the shortage of this resource, leading to the "gasoline shortage crisis" in January 2019. This study analyzes Big Data on the behavior of the general public based on gas stations transactions, per day and per hour, within the BBVA business network in the Valle de México metropolitan area. The study found that: a) the shortage became a crisis at 12:00 pm on January 8, it lasted 13 days and ended on January 20; b) during the crisis, consumers purchased on average 16% more gasoline per transaction and fuel purchases late at night and early in the morning increased up to 400%; c) after the crisis was over, the fuel stockpiled by consumers lasted for a week, in which gas stations reported a 21% decline in transactions. It was also found that digital media and social networks contributed to rapidly spreading news, and probably also panic, during the onset and development of the crisis. The conclusions stress that different levels of government and society in general must be prepared and develop protocols to deal with collective episodes of panic: In high-density cities, crises due to the shortage of goods or services can have serious consequences.

Key words: big data, shortage crisis, incomplete markets, gasoline, digital media.

JEL classification: C55, D45, D52, H44, Q31.

1. Background

Although the country has experienced several periods of fuel scarcity at gas stations, the events at the end of December 2018 and during January 2019 were probably the most serious in Mexico in recent decades.

The drilling of pipelines to steal fuel, or *huachicol*¹ as it is known in Mexico, is not a recent problem, but it has grown exponentially in recent years. During the final year of President Vicente Fox's term in office, in 2006, 213 illegal taps were recorded; this figure grew to 1,635 in 2012, at the end of President Felipe Calderón's term in office. There was a sudden surge in illegal tapping in 2017, under President Enrique Peña Nieto, when figures reached 10,363 (Aroche, 2018).

Faced with this severe problem, on December 27, 2018, a few weeks after the change of government in Mexico and the arrival of President Andrés Manuel López Obrador, the federal government officially presented its plan to combat fuel theft, a strategy that had been in operation since December 20. Under this plan, 15 government agencies, including the Ministry of National Defense (Secretaría de la Defensa Nacional – Sedena), the Navy, the Ministry of Finance (Secretaría de Hacienda y Crédito Público – SHCP) and the Federal Agency for Consumer Protection (Procuraduría Federal del Consumidor – Profeco), would work together to fight this crime. The government strategy envisaged a change in fuel distribution logistics where tanker trucks were given priority over pipelines and the armed forces were used to safeguard Pemex's strategic facilities (Casasola, 2018). Also, it was revealed that officials from Petróleos Mexicanos (Mexico's state-owned petroleum company, known as Pemex) had been complicit in the theft of hydrocarbons.

Soon, this change in logistics resulted in a temporary fuel supply shortage in several parts of the country, with the Bajío region being the most affected. On December 29, Pemex's storage depot in Tarímbaro ran out of fuel, causing the gas sector in Michoacán State to fear a potential shortage of product, as the last fuel supplies were received on December 27 (Hernández González, 2018).

By Monday, December 31, with the New Year celebrations in full swing, about 320 gas stations closed in Michoacán due to a lack of gasoline, which led to panic buying at stations where gas was still available (Arrieta, 2018). In Morelia, the state capital, it was estimated that only five gas stations still had fuel (Celaya, 2018).

At the start of January 2019, the Salamanca-León pipeline was closed due to illegal tapping. This cut off supplies to gas stations in the state of Jalisco, causing a state-wide shortage of fuel. The city of Zapopan was hardest hit, where gas stations were closed due to a lack of fuel (Gallegos, 2019). Several cities in Bajío were already feeling the effects of the shortage. In the city of León, there were reports of hundreds of cars and dozens of people waiting in line and using up, in just under eight hours, the 20,000 liters of gasoline delivered that same morning (Sun, 2019a).

Faced with these events, on several occasions the federal government called on areas with sufficient supplies to help meet the demand and insisted that the delays in distribution were being addressed (Notimex, 2019). However, by Sunday, January 6, it was clear that panic had already set in. In the metropolitan area of Jalisco, several gas stations began rationing the sale of fuel in response to an increased number of motorists (Romo, 2019). In León, only around 32 of the city's 200 gas stations were still selling fuel (Álvarez, 2019). It was announced that the Salamanca-León pipeline, which supplies the Guanajuato gas stations, had reopened but had to be closed again within a few hours (Negrete, 2019).

1: Term used in Mexico to refer to the action of drilling underground to extract fuel illegally from pipelines. Also, it is used as a general term to refer to fuel theft.

In the states of Querétaro, México, Tamaulipas and Michoacán, the situation was not much different. News of fuel shortages had already reached the Valle de Toluca area and some municipal areas around Mexico City (Sun, 2019b; Velasco, 2018). Panic buying resulted in long lines of motorists and people with fuel cans, rationing, gas stations closing or running out of certain types of fuel and in some areas, the police were called in to maintain order (El Universal, 2019).

As part of the government strategy, as of January 6, military units from the Ministry of National Defense (Secretaría de la Defensa Nacional – Sedena) and the Navy were deployed to protect the country's six refineries, located in Salamanca, Guanajuato; Ciudad Madero, Tamaulipas; Salina Cruz, Oaxaca; Minatitlán, Veracruz; Cadereyta, Nuevo León; and Tula, Hidalgo (Milenio, 2019). On the one hand, this led to the discovery of a facility for stealing fuel at the Ingeniero Antonio M. Amor refinery (RIAMA) in Salamanca, (Flores, 2019); but on the other hand, strict control over the entry and exit of fuel and staff made it difficult for the refineries to operate as normal (Durán, 2019).

Mexico City would soon join the federal states with fuel supply problems. On Tuesday, January 8, the media and social networks reported that several gas stations in the boroughs of Cuajimalpa, Iztapalapa, Venustiano Carranza, Azcapotzalco, Coyoacán and Cuauhtémoc had closed due to a lack of fuel. This created panic and a surge in extraordinary gas purchases (Velázquez, Ortega, Castro, & López, 2019).

This is the context in which the "gasoline shortage crisis" began in the Valle de México metropolitan area (Zona Metropolitana del Valle de México – ZMVM), which is the subject of this study. A comparative static analysis is presented below to understand the problem of a product shortage, then the geographic coverage of the analysis and the sources of information are defined. The scope and limitations of the study are specified in the following section. The results and findings of the Big Data analysis are then presented followed by the final considerations. At the end of the paper, there is an annex with relevant data from the study.

2. Comparative static analysis of gasoline supply and demand

In a market of an "ordinary good or service"² with plentiful supply and demand, there would be no reason for "long lines" to buy the good or service, nor would there be any perception of scarcity. If there was a sudden decline in the supply of a good or service, the price and quantity would be adjusted: the price would go up and a smaller quantity would be consumed on the market (Varian, 2010). Figure 1 shows a market with an ordinary good and plentiful supply and demand, which would be in equilibrium at point E_1 , where the amount Q_1 of the good is sold at a price of P_1 per unit. If there was a decline in supply, the market would be adjusted by increasing the price to P_2 and the quantity Q_2 of this good would be sold. Supply and demand would be in equilibrium at the new point E_2 .

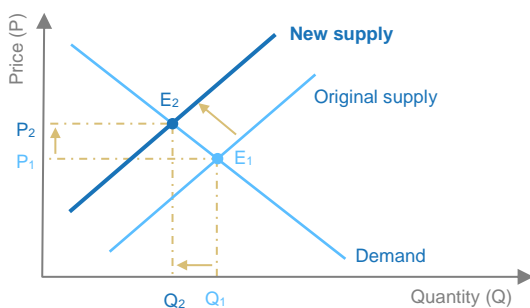
The gasoline market in Mexico is special. On the demand side, it behaves like a *basic or first-need good*; that is, it has low price elasticity. On the supply side, almost all the country's gasoline (94%) is imported and marketed by a single state-owned company called Petróleos Mexicanos (Pemex); that is, there is a *monopsony* in the wholesale link of fuel sales (Ávila, 2019). Given this market structure, the retail price of gasoline is regulated and monitored by

2: An "ordinary good or service" is a product or service where consumption goes up when the price goes down, and consumption goes down when the price goes up, considering that all other conditions remain unchanged.

the government. The Mexican market has a perfectly elastic gasoline supply curve: all quantities of this good are sold in the price range defined by the wholesale supplier.

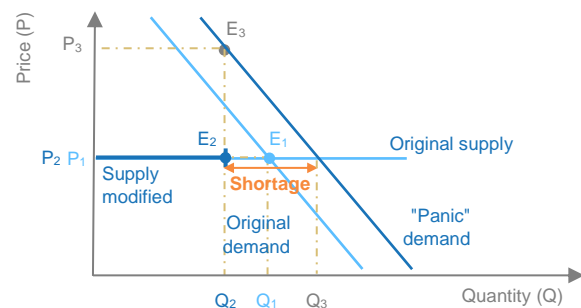
Given that an adjustment in the price of gasoline is not possible, shortages in this market occur when suppliers do not supply the quantity demanded at the established price on time or in form; we are faced with a case of *incomplete markets*. The term *shortage* that is used in this study, refers to when buyers cannot obtain a sufficient amount of a product or service at the market price, either because it is rationed or there are significant indirect costs.

Figure 1. **Model of supply and demand for an ordinary good with plentiful supply and demand**



Source: BBVA Research

Figure 2. **Simplified model of the gasoline supply and demand market in Mexico**



Source: BBVA Research

The shortage gap during the gasoline shortage crisis in January 2019 can be explained by two linked events:

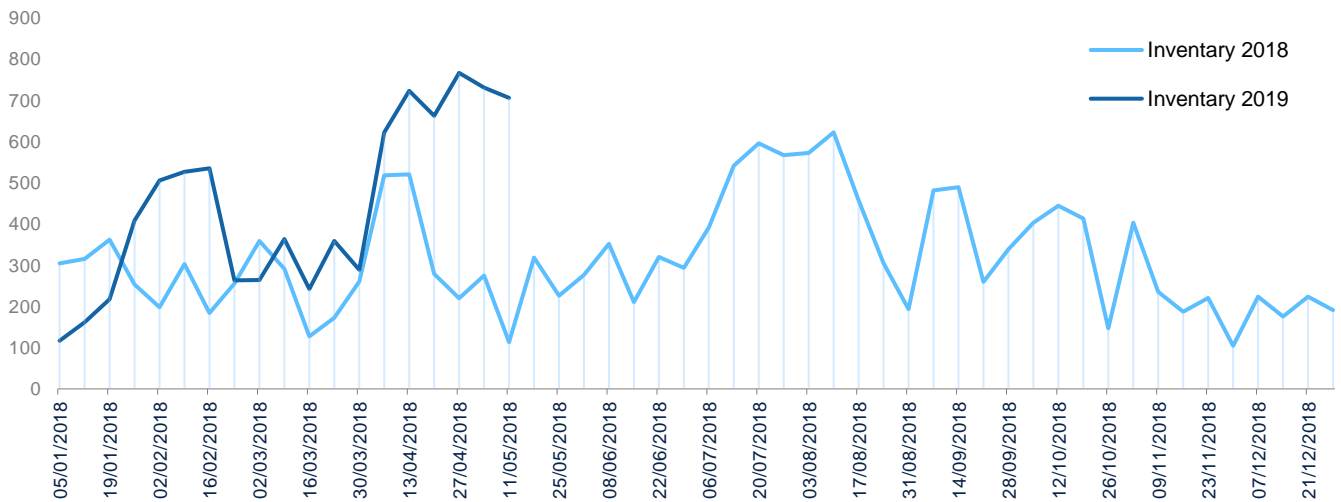
1. As part of the strategy of the new government of Mexico to combat the theft of fuel from pipelines, the amount of gasoline transported by pipeline was reduced and transportation by tanker trucks was increased. This strategy created temporary shortages and a decline in gasoline inventories in some parts of Mexico (Reforma, 2019). Data from the Ministry of Energy (Secretaría de Energía – Sener, 2019) show that gasoline inventories in Mexico City and the State of Mexico were reduced by 44% during the first weeks of January 2019, compared to those same weeks in 2018. The situation continued until the last week of January.
2. In response to this temporary shortage, a sense of panic began to gradually set in among the general public, leading the most prudent or risk-averse people to prepare for a potentially longer-term fuel shortage. Some simply kept their cars topped up with fuel, while others resorted to using containers and cans to transport and store fuel. This shifted the demand curve to the right and further exacerbated the shortage of gasoline.

Figure 2 presents a simplified model of the gasoline market in Mexico, with a perfectly elastic supply curve. It shows how the shortage was exacerbated by panic, moving demand outward. Given the price P_1 established by the supplier, the original supply and demand curve would be in equilibrium at point E_1 consuming the quantity Q_1 . The decreased supply of fuel from the supplier limits the supply curve to quantity Q_2 , which is the maximum amount of gasoline that can be sold. Additionally, due to the panic over the shortage of this product, demand is shifted outward. With these new supply and demand curves, if the price could be adjusted it would lead to the new equilibrium at point E_3 ; in this case there would be no shortage problem since at price P_3 the demand would only be quantity Q_2 , which is the exact quantity the supplier can supply.

However, as there is no price adjustment, the price remains at P_1 . The supplier only sells quantity Q_2 of this product, but market demand at this price would be quantity Q_3 with the new demand curve, creating a shortage of this good in the magnitude of $Q_3 - Q_2$. These imbalances in supply and demand lead consumers to use alternate means of transport (substitution effect) and to incur indirect costs to buy gasoline: opportunity costs through waiting in long lines or buying at atypical times of day; or monetary costs through alternate markets.

These events resulted, among other causes, in the onset of a "gasoline shortage crisis" in Mexico City and in other metropolitan municipalities in the State of Mexico during January 2019. While the problem arose in other states at the same time and started several weeks earlier in the Bajío region, this study focuses on the ZMVM.

Figure 3. **Gasoline inventory in Mexico City and the State of Mexico per week, 2018–2019**
(Thousands of barrels)



Source: BBVA Research with information from the Energy Ministry (Secretaría de Energía – Sener, 2019). Retrieved 2019/05/16

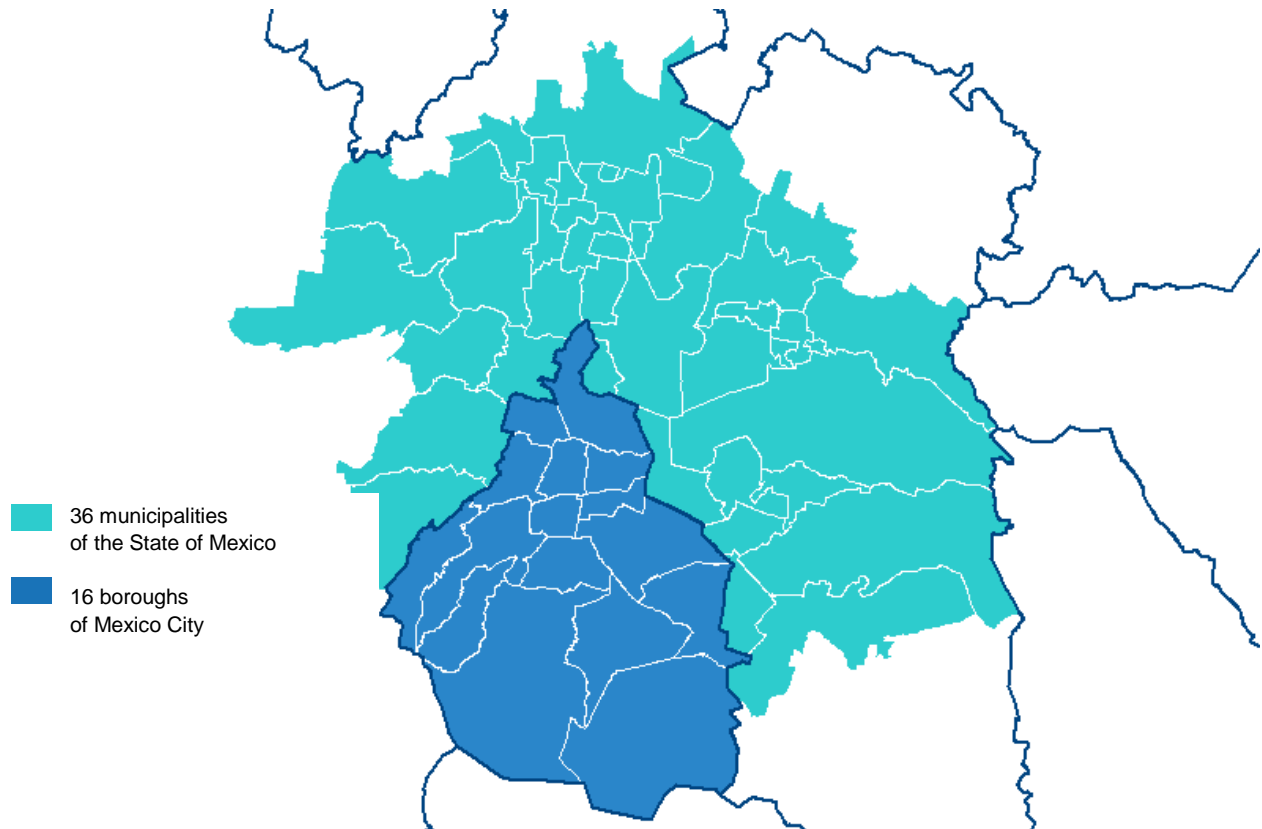
3. Geographic coverage and sources of information

The geographical borders of the Valle de México metropolitan area (ZMVM) vary according to different authors, institutions or reasons for which they are defined. In 2018, the Ministry of Agrarian, Land and Urban Development (Secretaría de Desarrollo Agrario, Territorial y Urbano – Sedatu), the National Population Council (Consejo Nacional de Población – Conapo) and the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía – Inegi) published the latest review of metropolitan areas in Mexico based on data from the 2015 intercensal survey. Under the established criteria, the ZMVM has a total of 76 municipalities, of which 52 are classified as central and 24 as external (Sedatu, Conapo & Inegi, 2018).

To analyze the gasoline shortage crisis in Mexico City and the main metropolitan municipalities, this study uses the official geographical delimitation of the ZMVM consisting of the 52 central boroughs or municipalities formed by:

1. Mexico City, consisting of its 16 boroughs; and
2. the metropolitan municipalities of the State of Mexico, defined as the 36 central municipalities of the ZMVM located in the State of Mexico.

Map 1.. **Central municipalities of the Valle de México metropolitan area (Zona Metropolitana del Valle de México – ZMVM), 2015**



Source: BBVA Research based on information from Sedatu, Conapo & Inegi (2018). Delimitación de las zonas metropolitanas de México 2015

The primary source of information for this study is the database of transactions at businesses within the BBVA network, through their Point of Sale (POS) terminals. Programming and estimates were made on BBVA platform for Big Data analysis based on data inputted into its "Data Lake". In 2018, BBVA payment methods network recorded about 1.9 billion transactions throughout Mexico, made by clients and non-clients of the bank, which equates to about 5 million transactions on average per day.

Among these transactions, transactions at businesses classified as "gasoline stations" were identified, which accounted for 9.5 million transactions in 2018, about 26,000 daily transactions on average on a national level. Transactions at gas stations, officially known as "service stations", accounted for 0.5% of all transactions at BBVA POS terminals.

The main period of study is from December 1, 2018 to February 15, 2019, when information was analyzed per day and per hour, allowing for a more detailed analysis of the specific patterns of behavior before, during and after the gasoline shortage crisis. The data for the ZMVM come from almost 500 affiliated businesses; although, on average, in December 2018, at least one transaction per day was recorded at about 460 gas stations. In addition, all of 2018 data was analyzed to provide a framework for comparing fuel purchasing patterns.

The study seeks to focus on the behavior of individual users or natural persons, so the analysis is restricted to transactions lower than or equal to 1,500 Mexican pesos per transaction (USD 78³). Transactions of up to 1,500 Mexican pesos account for about 99% of gas station purchases. As such, we aim to exclude some of the purchases by corporations, big businesses, semi-trailer trucks, cargo trucks, etc.

The data are presented daily for January 2019 and hourly for the days 6 to 12 January (see annex). In both cases, four statistics are presented:

- Number of transactions. Total number of transactions, up to 1,500 Mexican pesos, carried out on POS terminals within the BBVA business network per day or hour.
- Average transaction. Average amount of the transactions per day or hour.
- Operational businesses. Number of businesses that, within a set time interval (one day or one hour) had at least one transaction on POS terminals.
- Average business transaction. Average number of transactions among operational businesses per day or hour.

3: With data from Banco de México, the average exchange rate for one US dollar was 19.2154 pesos in January 2019.

4. Scope and limitations

Given the number of gas stations within the BBVA business network, we were able to study patterns of behavior across the whole ZMVM. In January 2019, there were around 366 gas stations operating in Mexico City (Excelsior, 2019), while gas stations with business contracts with BBVA totaled 197 (54% of the total) in December 2018, of which 181 recorded regular transactions (49%) on a daily basis. It should be noted that a gas station may have POS terminal contracts with more than one financial institution; and signing a contract with a bank does not mean the business must carry out transactions every day.

We believe that during the gasoline shortage crisis, the number of customers who paid by bank card at gas stations in the BBVA business network remained relatively similar to the number of customers who used other types of payment (e.g. cash), or that any changes in this respect were insignificant. In addition, estimates do not consider potential rightward shifts in demand due to an increase in motor vehicle users between the average figures for 2018 and those recorded in January 2019.

To counter the component of changes in the price of gas between the data presented in January 2019 and the average in 2018, the adjustment factor is 1.025733. This figure was calculated as the simple average of the price of Magna and Premium gasoline⁴ for Mexico City and the State of Mexico in January 2019, compared to the monthly average of these prices recorded in 2018. This adjustment factor is not a measure of inflation and it is only intended to compare the data in this study. It is worth noting that in both Mexico City and the State of Mexico, at least in the last 3 months of 2018, the average price of Magna and Premium gasoline was higher than in January, 2019 (CRE, 2019). For simplicity, all data presented in this study are in current values and were not adjusted.

4: Two types of gasoline, both lead-free, are sold to motorists throughout Mexico: Magna (87 octanes, identified by the color green) and Premium (92 octanes, identified by the color red). In this study, the term "gasoline" is used to refer, in general, to both types.

5. The gasoline shortage crisis through Big Data

5.1. Calm before the storm

During the first days of January, more specifically from January 1–7, 2019, the general public in the ZMVM was already learning of gasoline shortages in some areas of the country through news reports and social media. Faced with this information, the most risk-averse or prudent people could go and fill up their car(s) and/or store some amounts of fuel in containers, at no significant extraordinary cost or loss of time. To a certain degree, this diffused the fear of a shortage of gas and stopped panic from spreading.

It should be noted that from January 1 to 6, the ZMVM saw a slowdown in activity due to the school break and because people are often away on vacation the start of the year. Those who feared there would be a gasoline shortage in the ZMVM could simply fill up with fuel before their return. The data suggest that during this period, there were 22% fewer transactions recorded on average at gas stations in the ZMVM compared to the average in 2018, due to this vacation period.

On Monday, January 7, the day many people on vacation returned to their jobs and elementary school students officially returned to school, social networks and the media continued to broadcast news of fuel shortages. In general, there was a sense of uncertainty but the mood in the ZMVM remained calm. Compared to an average day in 2018, records of hourly transactions at gas stations suggest that:

- On Monday, January 7, from very early in the morning (04:00) there was a sustained increase of 9% in the average transaction for buying gas; and from 06:00 to 08:59 and 17:00 to 20:59 hours, there was an increase of 20% and 14%, respectively, in the total volume of transactions.
- During the morning of Tuesday, January 8, there was an increased number of gas station transactions, especially from 07:00 to 08:59, when transactions were up 19%. This could be explained by the relative shortage of gas in the city of Toluca, which caused users to seek supplies in the ZMVM (Miranda & Valenzuela, 2019). Between 09:00 and 11:59, there was a higher number of transactions than the hourly average in 2018, but the figures did follow a downward trend.

From this data, we can draw no strong conclusion of a shortage of fuel, since it could be attributed to normal economic activity in the ZMVM.

5.2. "Zero hour" 12:00 on January 8, 2019: Onset of the gasoline shortage crisis

It is difficult to determine the precise moment at which the fear of a gasoline shortage in the ZMVM began or became widespread. But it is clear that at 12:00 on Tuesday, January 8, 2019, there was a sudden and sustained surge in the number of transactions at gas stations in the ZMVM. From 12:00 to 12:59, there was a 13% increase in gas station operations compared to an average day; over the next hour, this increased to 24% and an hour later to 42%.

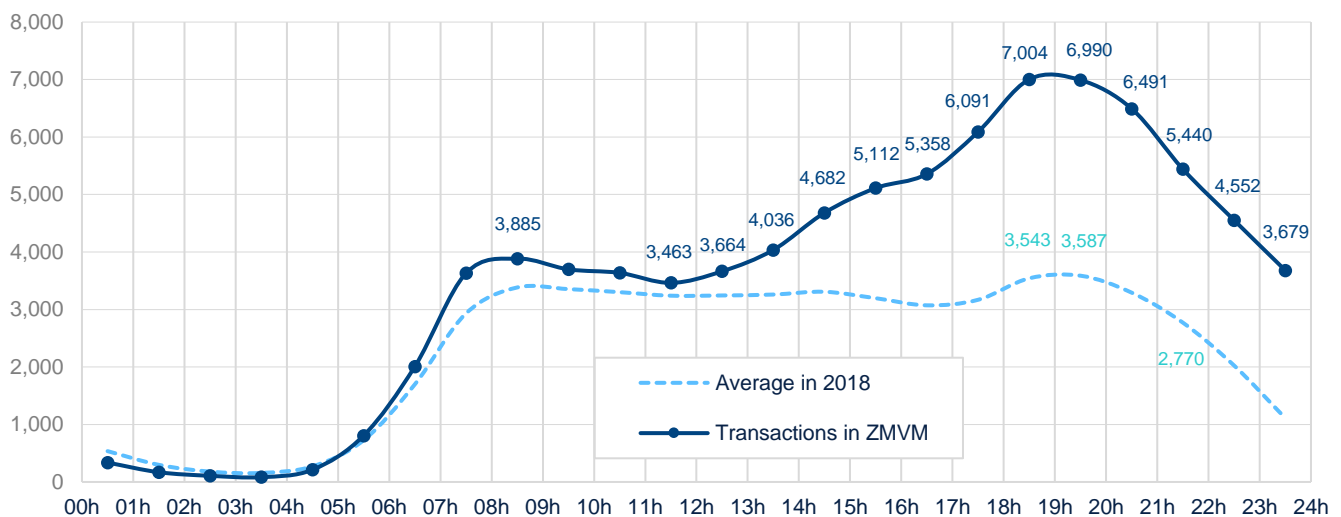
From 15:00 to 16:59, the increase in transactions rose to 60% and the following hour to 74%. Between 17:00 and 22:00, gas stations recorded hourly increases of 92% to 98%, compared to the average seen in the previous year. During the time when people usually fill up with gas, between 18:00 and 19:59, about 7,000 transactions per hour were recorded, almost double the usual average.

Faced with this sudden surge in demand, gas stations had no time to adjust their operational capabilities. With the same installed capacity and the same number of fuel dispatchers, the ZMVM gas station network was able to handle up to double the number of transactions at the "peak" time for gas sales.

In the ZMVM, long lines of cars were seen at gas stations where fuel was still available and there were even vehicles waiting at empty stations, where customers were ensured supplies would be arriving shortly. A side effect of this problem, which could hardly have been anticipated, was the increase in heavy traffic on the avenues and streets surrounding gas stations. The long lines of cars waiting to fill up hindered the flow of traffic with rows of stationary vehicles blocking the streets and intersections.

The next day, the Mexican president reported an incident on the Tuxpan-Azacapatzalco pipeline (in Hidalgo state), saying that the repairs had caused the gasoline shortage in Mexico City. In addition, he urged the general public to remain calm and avoid panic buying of gasoline (Zavala & Morales, 2019); however, some members of the public ignored his words.

Figure 4. **Number of transactions at affiliated gas stations per hour in the ZMVM, January 8, 2019**



Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

5.3. In response to the crisis, people filled up with gas late at night and early in the morning

Some people opted to substitute private vehicles with public transport, so they stopped buying fuel during the gasoline shortage crisis. But for others, there is no substitute for gasoline and the use of a car, as they form a basic asset that is vital for their daily activities.

Faced with the need for gasoline, many drivers waited in long lines and filled up with gas late at night and early in the morning. During the first day of the crisis, on the night of Tuesday 8 from 22:00 to 22:59, 4,552 transactions were recorded at gas stations and 3,679 transactions were recorded an hour later. This represents increases of

125% and 232%, respectively, compared to an average day. In each of these one-hour intervals, more transactions were recorded at gas stations than during the peak hour on an average day (19:00 to 19:59, with 3,587 transactions).

At the start of the following day, Wednesday, January 9, people were still waiting at gas stations to buy fuel. At 00:00, 2,328 gas station transactions were recorded, which is equivalent to 334% more than the usual figures for that time on an average day, an hour later the increase was 305%.

During the early hours of the morning, gas stations began to close as either workers were exhausted from covering unexpected overtime or the supply of fuel ran out. Since the price of gasoline is regulated and there is a shortage of this product, suppliers have no incentive to pay overtime, so it is likely that many gas dispatchers only worked overtime in exchange for income from tips.

Gas stations that still had fuel had to adjust their schedules to be open late into the night in response to demand from the general public. The days with the highest recorded number of transactions during the first four hours of the day (from 00:00 to 03:59) were: Thursday, January 10 (+204%, compared to an average day), Saturday, January 12 (+314%) and Sunday, January 13 (+391%). Data suggest that these early-morning sales of gas continued until Sunday, January 20.

5.4. Mexicans bought 16% more gasoline per transaction during the crisis

Like in many parts of the world, in Mexico the extensive network of retail gasoline suppliers means that most of the population only buys fuel to fill up their car. That is, many retail gasoline buyers have neither the means to transport nor store this product beyond the predefined capacity of their car(s).

Between January 8 and 16, the average amount of transactions at gas stations was 565 pesos, which is 19% higher than the average recorded in 2018, which was 476 pesos. During this period, the highest average amount per hour was 635 pesos, which was recorded from 03:00 to 03:59 in the morning of January 11 (only transactions of up to 1,500 pesos were analyzed).

At first glance, this could be explained by inflation and/or price adjustment by suppliers, but the sale price of this product is regulated and monitored by the government. During the crisis, the Federal Agency for Consumer Protection (Procuraduría Federal del Consumidor – Profeco) announced there had been no price increase due to the delays in distribution and commented on the operations carried out to verify that closed gas stations were not storing up supplies (Sun, 2019c). As noted previously, the price in January only increased by 2.5733% compared to the average in 2018. As such, discounting this effect, we can calculate that close to 16% more fuel was purchased on average in each transaction.

This increase in the average amount of fuel per transaction can largely be explained by changes in the buyers' behavior:

- Some people usually buy fuel without filling up the tank of their car: They buy gas in a round number of pesos (e.g. 200 or 300 pesos). Due to the long lines and the cost in time required to buy fuel, this practice ceased to be viable. As such, during the gasoline shortage, it is highly likely that everyone preferred to fill up their tank.
- As panic set in, it is possible that the most prudent or risk-averse people, in addition to filling up their cars, may have carried containers or "cans" to store gasoline.

5.5. Some gas stations closed for full days and others were open intermittently

Given the surge in demand caused by panic and considering the logistical constraints of refueling gas stations, it was inevitable that inventories would run out and that gas stations would have to close. Since the first day of this crisis, on Tuesday January 8, from 19:00 onwards it became clear that several gas stations in the ZMVM had stopped recording transactions. From 20:00 to 20:59, 14% fewer gas stations were recording transactions compared to an average day, 18% the next hour and 16% one hour later.

During the gasoline shortage crisis, some gas stations had to close completely for a few days, while others were open intermittently. When they had fuel, they worked tirelessly to dispatch it at full speed and, when supplies ran out, bored workers were seen with nothing to do. Meanwhile, motorists continued waiting in line even at gas stations without fuel, hoping that trucks would arrive to replenish supplies.

On Friday, January 11, data suggest that 26% of gas stations did not record a single transaction all day, while many gas stations operated intermittently. Probably one of the most critical moments of this crisis occurred in the afternoon/evening of January 11, when transactions were recorded at around just 100 gas stations; that is, a quarter of the gas stations that usually operate in the area.

5.6. How long did the crisis last and when did it end?

While there are different criteria for determining the duration and end date of the crisis, results from the Big Data analysis suggest that the gasoline shortage crisis had already ended on Monday, January 21. On that day, 98% of the gas stations analyzed in the ZMVM recorded transactions. Based on this criterion, the gasoline shortage crisis in the ZMVM started on Tuesday 8 and ended on Sunday 20 January, lasting 13 days.

However, the fuel shortage panic that shifted the demand curve outward may have ended days earlier. If the workload per gas station is considered, measured using the variable of average transactions per day at operating businesses and the average amount per transaction, the data suggest that the panic about obtaining fuel ended on Friday, January 18. On January 19 and 20, there were noticeable decreases in the workload per gas station and the average amount per transaction. That weekend, there were already gas stations with available fuel, but with very few customers.

5.7. Fuel stockpiled by consumers lasted for at least a week

The panic about gasoline shortages caused some people to devise ways to transport and store fuel, predicting there would be future shortages. But as of Monday, January 21, it was widely felt in the ZMVM that there was no longer a shortage: supply covered demand at market price.

Data indicate that, from January 21 to 26, there was a 21% drop in transactions at ZMVM gas stations, despite the fact that fuel supply was already guaranteed. This was not only due to the decline in panic buying: The most convincing explanation of this drop in gas sales could be that end consumers started using their own stocks instead of buying fuel.

As of January 27, the gas market in the ZMVM had returned to "normal". Meanwhile, during the last week of January, in the worst-affected states of the Bajío region, news of long lines and fuel shortages became increasingly less frequent.

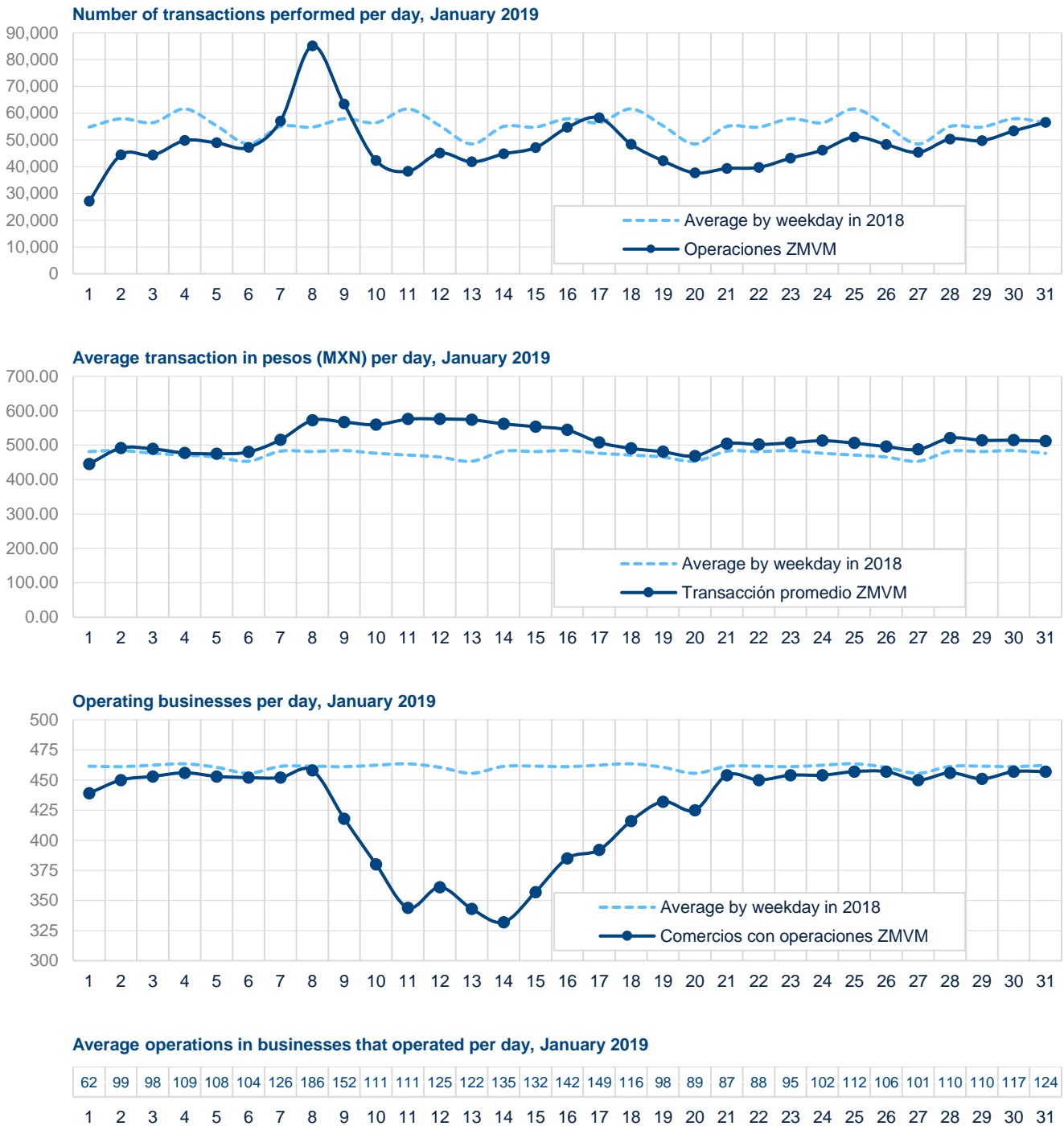
5.8. Some strategies implemented by governments during the crisis

The gasoline shortage crisis caused panic in several parts of the country. This widespread angst caused the different levels of government to take action and seek alternatives to the delays in fuel distribution. The governor of Guanajuato published a set of rules to maintain order at gas stations and sought to import fuel directly from Texas (Sun, 2019d). The government of Mexico City assigned police officers to each of the gas stations in the state to reduce potential fights among motorists and it deployed public security units to escort tanker trucks (Capital, 2019; Mosso, 2019). In the ZMVM, police cars, ambulances and emergency-response vehicles (e.g. fire trucks) were given priority at gas stations (Gutiérrez, 2019; Ríos, 2019).

On Tuesday, January 15, Mexico's president announced that the Tuxpan-Azcapotzalco pipeline, which supplies fuel to Mexico City and the State of Mexico, had been sabotaged for the fourth time, which continued creating supply problems in the ZMVM (Jiménez, 2019). He also reported that 500 tanker trucks would be purchased to address the fuel shortage in the country. Three days later, a call was put out to hire 2,000 drivers to mobilize the tanker trucks (Expansión, 2019); and on Friday, January 24, the SHCP confirmed the purchase of 671 trucks, with the capacity to transport the equivalent of 144,000 barrels of fuel per day, at a cost of 92 million dollars (Rodríguez, 2019).

During the first weeks of January 2019, the logistical problem of transporting gasoline caused a temporary decline of almost 25% in gasoline imports from the United States to Mexico. As a result, several ships carrying fuel were anchored outside the docks waiting to unload their cargo (Whelan & Elliott, 2019).

Figure 5. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 2019**



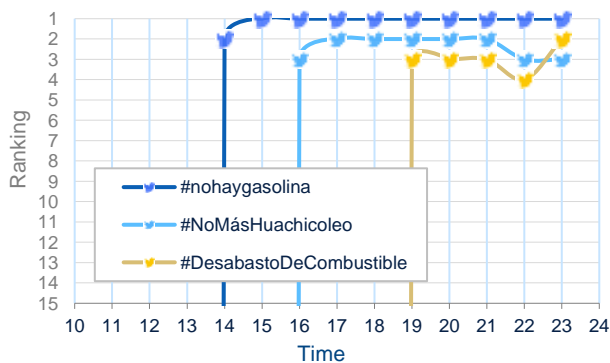
Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

6. Social networks and digital media in the gasoline shortage crisis

Social networks and the digital media played a very important role in sharing information almost in real time about what was happening during the onset and development of the gasoline shortage crisis. In the ZMVM, Twitter, Google, Facebook and WhatsApp, among others, were some of the main social networks or news search engines that gave the digitized population almost instant knowledge about events during the gasoline shortage and, at the same time, about the magnitude of the problem. In this section, we will analyze the relevance of the event through the Big Data of the digital media Twitter and Google.

News about the shortage of gasoline in Mexico spread quickly through Twitter. Before 14:00 on Tuesday, 8 January, the shortage was not among the 15 trending topics. Suddenly, at 14:00, the hashtag #nohaygasolina (there is no gasoline) ranked as the second most discussed topic in Mexico and an hour later it moved to first place, where it remained throughout the rest of the day. As of 16:00, the hashtag #NoMásHuachicoleo (no more fuel theft) appeared as a trending topic in Mexico, occupying second place for several hours in the afternoon/evening. Then, from 19:00 onward, the hashtag #DesabastoDeCombustible (fuel shortage) ranked among the main topics discussed on the social network. These three hashtags were the trending topics during the afternoon/evening of the first day of the gasoline shortage crisis.

Figure 6. The top 15 trending topics per hour on Twitter in Mexico, January 8, 2019



Source: BBVA Research based on hourly information from trendingtopics.mx

Figure 7. Word map of the 25 fastest-growing Google searches in Mexico City, Jan. 8–12, 2019



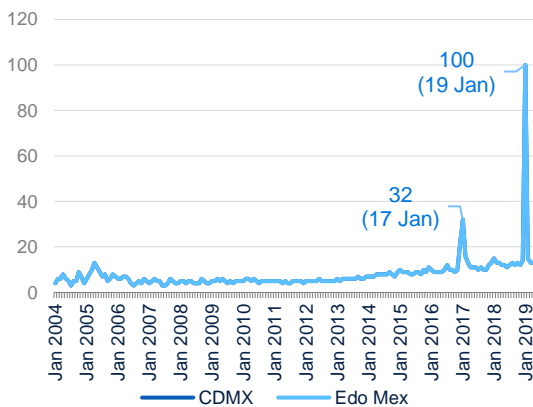
Source: BBVA Research with Google Trends information, in all categories and web search

On the Google platform, the 25 fastest-growing searches were analyzed from January 8–12, 2019 in Mexico City. The word map shows that "gas," "gas stations," "open," "where is there," "shortage" and "huachicol," among others, stand out among the fastest-growing searches in this period. In addition, a historical analysis of searches for words related to gasoline (gasolinera, gasolinera, gasolina or combustible) was carried out from 2014 to 2019. The results showed two periods with popular searches: January 2017 and January 2019. The first period is due to the fact that in December 2016, the SHCP announced that in January 2017 there would be increases in the maximum prices for Magna, Premium and Diesel fuel of 14.2%, 20.1% and 16.5%, respectively, compared to the maximum price recorded in December 2016 (SHCP, 2016). This news caused popular protests and the closure of some gas stations.

This event had a 65% lower search popularity than the second, which occurred in January 2019 due to the gasoline shortage crisis. Analysis of search trends over this last period show that the search trend first began in the State of Mexico, on January 6, 2019 and in Mexico City on January 8, reaching maximum popularity on January 12.

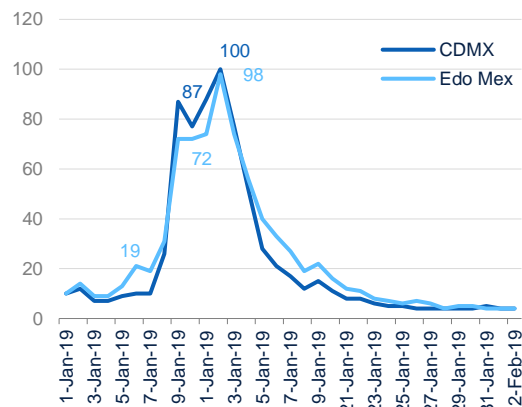
In comparative terms, the gasoline shortage crisis produced 63% less traffic in Google searches than the earthquakes in September 2017⁵ and a similar level of traffic as the earthquake on December 25, 2017⁶.

Figure 8. **Monthly rate of search interest on Google for "gasolinería + gasolinera + gasolina + combustible" in Mexico City and the State of Mexico, January 2004 to April 2019**



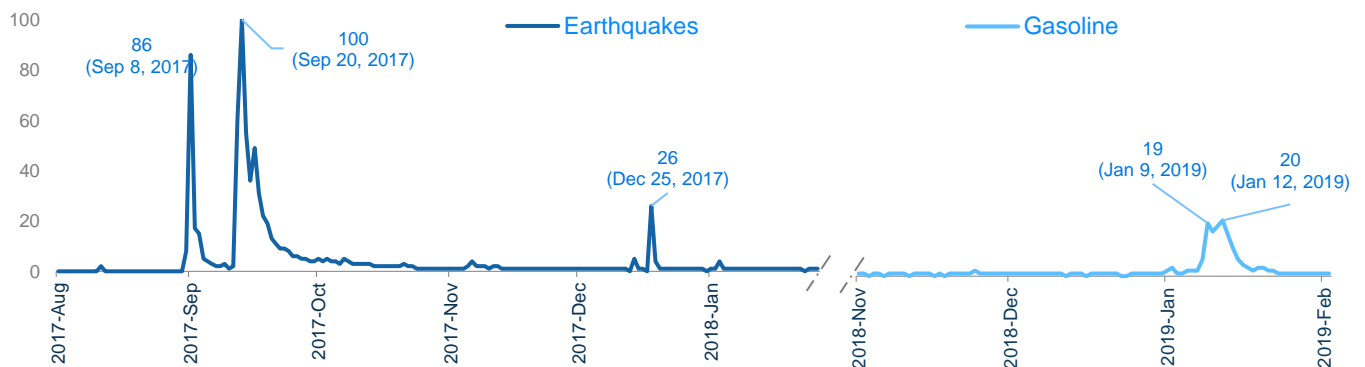
Source: BBVA Research with Google Trends information, in all categories and web search

Figure 9. **Daily rate of search interest on Google for "gasolinería + gasolinera + gasolina + combustible" in Mexico City and the State of Mexico, January 2019**



Source: BBVA Research with Google Trends information, in all categories and web search

Figure 10. **Rate of search interest on Google for "gas station + filling station + gas + fuel" compared to "earthquake + tremor + quake" in Mexico City, August 2017 to February 2019**



Source: BBVA Research with Google Trends information, in all categories and web search

5: The magnitude 8.2 earthquake on September 7, 2017 at 23:49 was the most intense in 100 years (Excelsior, 2017; SSN, 2017b); and the magnitude 7.1 earthquake on September 19, 2017 at 13:14 caused more than 200 deaths, the collapse of several buildings and structural damage in Mexico City (SSN, 2017a).
6: Magnitude 5 on the Richter scale at 14:23 (CNN, 2017).

7. Final considerations

In this study, through an analysis of Big Data from the information repository at businesses within the BBVA network, we analyzed per day and per hour the volume and amounts of transactions at gas stations in the Valle de México metropolitan area (Zona Metropolitana del Valle de México – ZMVM). The main findings include the following:

- The "Zero hour" that marks the onset of the gasoline shortage crisis was 12:00 pm on Tuesday, January 8, 2019, when there were sudden and sustained increases in the number of transactions at gas stations in the ZMVM. The crisis lasted 13 days and ended on Sunday, January 20.
- During the crisis, Mexicans purchased an average of 16% more gasoline per transaction and created strategies to fill up with gas late at night and early in the morning. The days with the biggest increase in transactions from 00:00 to 03:59 were: Thursday, January 10 (+204%, compared to an average day), Saturday, January 12 (+314%) and Sunday, January 13 (+391%).
- Some gas stations were closed for full days and others were open intermittently during the crisis period. When they had fuel, they worked tirelessly to dispatch it at full speed and, when supplies ran out, workers had nothing to do, which is a flawed operating system. One of the most critical moments occurred in the afternoon/evening of Friday, January 11, when only a quarter of the gas stations recorded transactions.
- After the end of the crisis, the fuel stockpiled by end consumers in the ZMVM lasted for at least one week, a period that saw a 21% drop in transactions at gas stations. The situation returned to normal as of Monday, January 27.
- Social networks and the media played a very important role: They helped to rapidly spread news of events during the onset and development of the crisis and probably also panic. In Mexico, the hashtags #nohaygasolina, #NoMásHuachicoleo and #DesabastoDeCombustible were the three trending topics on Twitter that dominated the afternoon/evening of the first day of the crisis. On Google, the terms "gas," "gas stations," "open," "where is there," "shortage" and "huachicol" stood out among the fastest-growing searches in the first week of the crisis; however, in relative terms the gasoline shortage crisis produced 63% less search traffic compared to the earthquakes in September 2017.

After reflecting on the series of events that led to the gasoline shortage crisis in Mexico and the strategies that consumers had to devise to deal with this problem, we believe that some of the final considerations are of particular note.

There should be greater competition in Mexico in the import and distribution of gasoline. Despite the 2013 Energy Reform in Mexico and the entry into force of the Oil and Gas Law (Official Gazette of the Federation, DOF, 2013, 2014), in early 2019, Pemex continued to import and sell 94% of all gasoline in the country (Ávila, 2019). To prevent the problems of a single supplier affecting the entire gasoline market, we need to see greater competition in the wholesale distribution chain and the diversification of risks among a higher number of suppliers with a greater market share. In general, this reflection applies to any market where there is a high concentration in the supply of a product or service.

The different levels of government and society in general must be prepared and develop measures to deal with collective episodes of panic: In densely populated cities, crises due to the shortage of goods or services can have serious consequences. The different levels of government and society in general must be prepared and develop measures to deal with collective episodes of panic: In densely populated cities, crises due to the shortage of goods or services can have serious consequences.

There have been several recent events in Mexico that have led to a relative shortage of certain goods or services. For example, during the 2009 breakout of AH1N1 influenza, panic caused a rapid depletion of products such as mouth covers, antibacterial gel, cough and flu medicines and similar products.

A relatively successful case of managing a large collective problem was during the cut-off of the water supply to Mexico City and some metropolitan municipalities in early November 2018. Given the scope of the works, the water supply needed to be cut off for a prolonged period, which would affect up to 7 million inhabitants (Aldaz & González, 2018). Authorities gave warning several weeks in advance. Before the cut-off, the general public filled cisterns, tanks and tubs with water. Some people chose to buy containers to store water, increasing the price of these products during the last weeks of October (Silva & Pérez, 2018). During the cut-off, some people decided to go on vacation and those who stayed in the city adapted their lifestyle as much as possible to consume less water. In addition, local governments planned a water distribution system using tanker trucks and water tanks in public places (Bolaños Sánchez, 2018; Campos Suárez, 2018; Chilango, 2018).

The explosion in Tlahuelilpan: A tragedy that could have been avoided? For many years, the inhabitants of different communities located near gasoline pipelines would make a living from "milking fuel," influenced by local leaders and, in some cases, by organized crime. This activity, in addition to being illegal, is extremely dangerous.

In the context of the gasoline shortage crisis, on Friday, January 18, 2019, one of the greatest tragedies occurred in Mexico's history. In Hidalgo State in the municipality of Tlahuelilpan, there was an explosion on the Tuxpan-Tula pipeline, resulting from manipulation due to illegal tapping. At the time of the explosion, adults, young people and children from the surrounding community were collecting fuel. Soldiers and federal police arrived to address the problem, but as they were seriously outnumbered, they resorted to shouting people to get away, given the serious danger they were in. At about 18:50, an explosion occurred on the pipeline that killed 135 people and left dozens wounded (Animal Político, 2019; Zavala, 2019).

This tragedy shocked Mexico and reaffirmed among the general public the need to combat fuel theft and prevent further tragedies from occurring. The federal government and local governments accelerated the launch of social programs in municipalities with Pemex pipelines running through them. The aim of these programs was to prevent inhabitants from having to steal fuel due to economic need and they were accompanied by campaigns to raise awareness of the risks involved in this activity (Álvarez Maury, 2019).

8. References

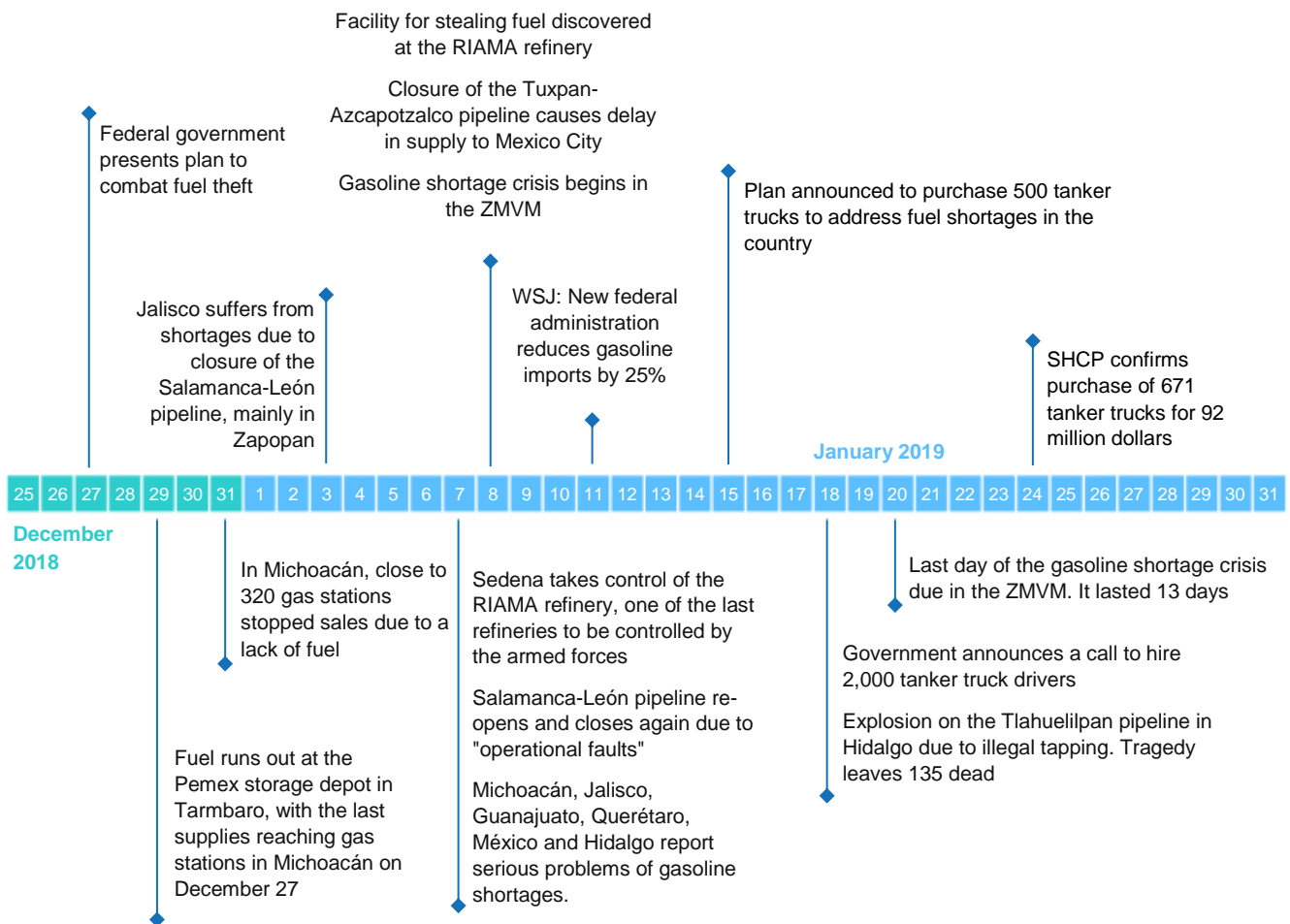
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9. Annexes

Figure 11. **Timeline of the main events during and around the gasoline shortage crisis in Mexico**



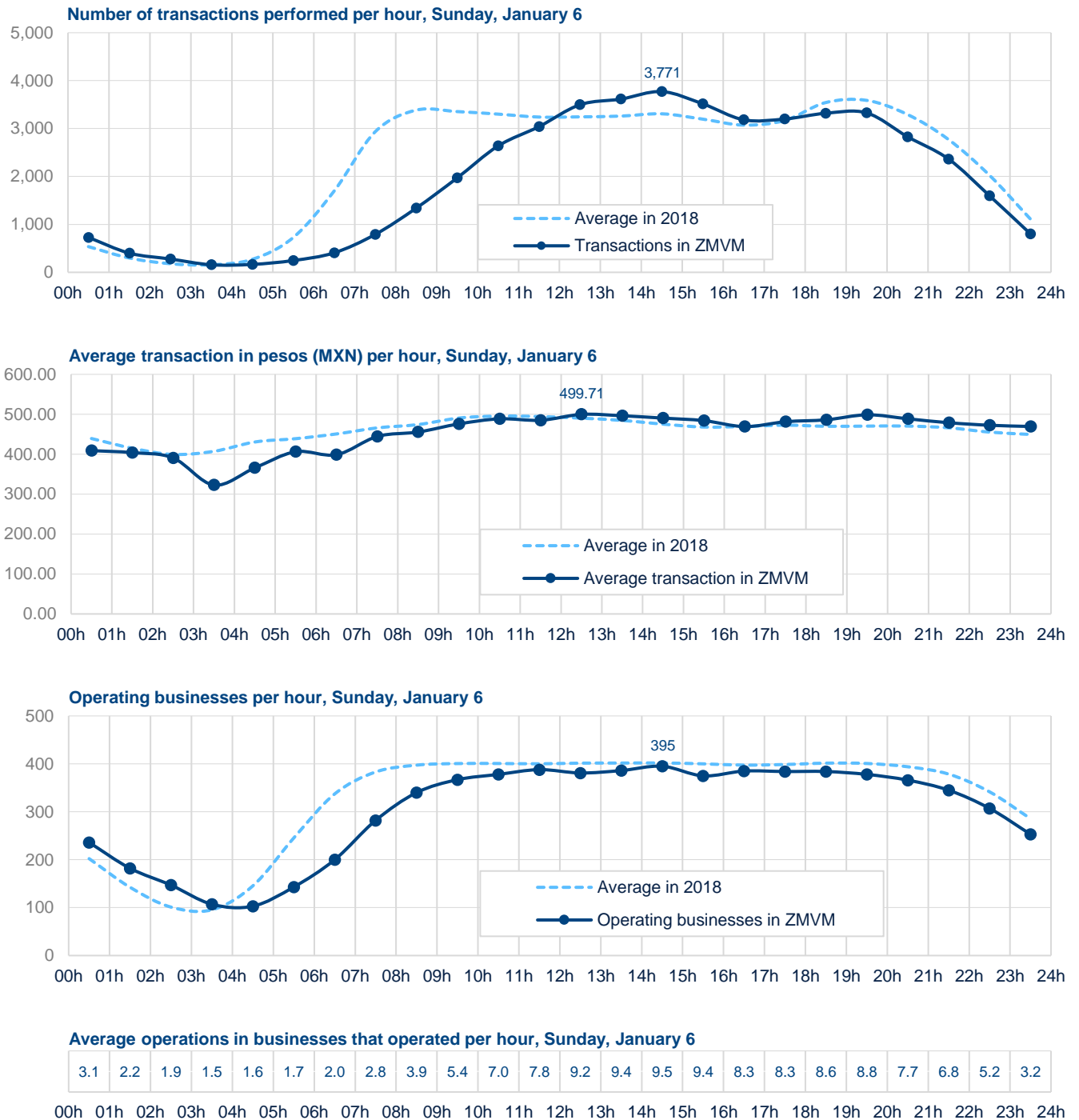
Source: BBVA Research with information from various journalistic sources

Table 1. **Central boroughs and municipalities that make up the Valle de México metropolitan area (Zona Metropolitana del Valle de México – ZMVM)**

| Mexico City (16) | State of Mexico (36) | |
|-----------------------------|-------------------------------|-----------------------------------|
| 9002 Azcapotzalco | 15002 Acolman | 15059 Nextlalpan |
| 9003 Coyoacán | 15011 Atenco | 15060 Nicolás Romero |
| 9004 Cuajimalpa de Morelos | 15013 Atizapán de Zaragoza | 15069 Papalotla |
| 9005 Gustavo A. Madero | 15020 Coacalco de Berriozábal | 15070 La Paz |
| 9006 Iztacalco | 15023 Coyotepec | 15081 Tecámac |
| 9007 Iztapalapa | 15024 Cuautitlán | 15091 Teoloyucan |
| 9008 La Magdalena Contreras | 15025 Chalco | 15092 Teotihuacán |
| 9009 Milpa Alta | 15028 Chiautla | 15093 Tepetlaoxtoc |
| 9010 Álvaro Obregón | 15029 Chicoloapan | 15095 Tepotzotlán |
| 9011 Tláhuac | 15030 Chiconcuac | 15099 Texcoco |
| 9012 Tlalpan | 15031 Chimalhuacán | 15100 Tezoyuca |
| 9013 Xochimilco | 15033 Ecatepec de Morelos | 15104 Tlalnepantla de Baz |
| 9014 Benito Juárez | 15037 Huixquilucan | 15108 Tultepec |
| 9015 Cuauhtémoc | 15039 Ixtapaluca | 15109 Tultitlán |
| 9016 Miguel Hidalgo | 15044 Jaltenco | 15120 Zumpango |
| 9017 Venustiano Carranza | 15053 Melchor Ocampo | 15121 Cuautitlán Izcalli |
| | 15057 Naucalpan de Juárez | 15122 Valle de Chalco Solidaridad |
| | 15058 Nezahualcóyotl | 15125 Tonanitla |

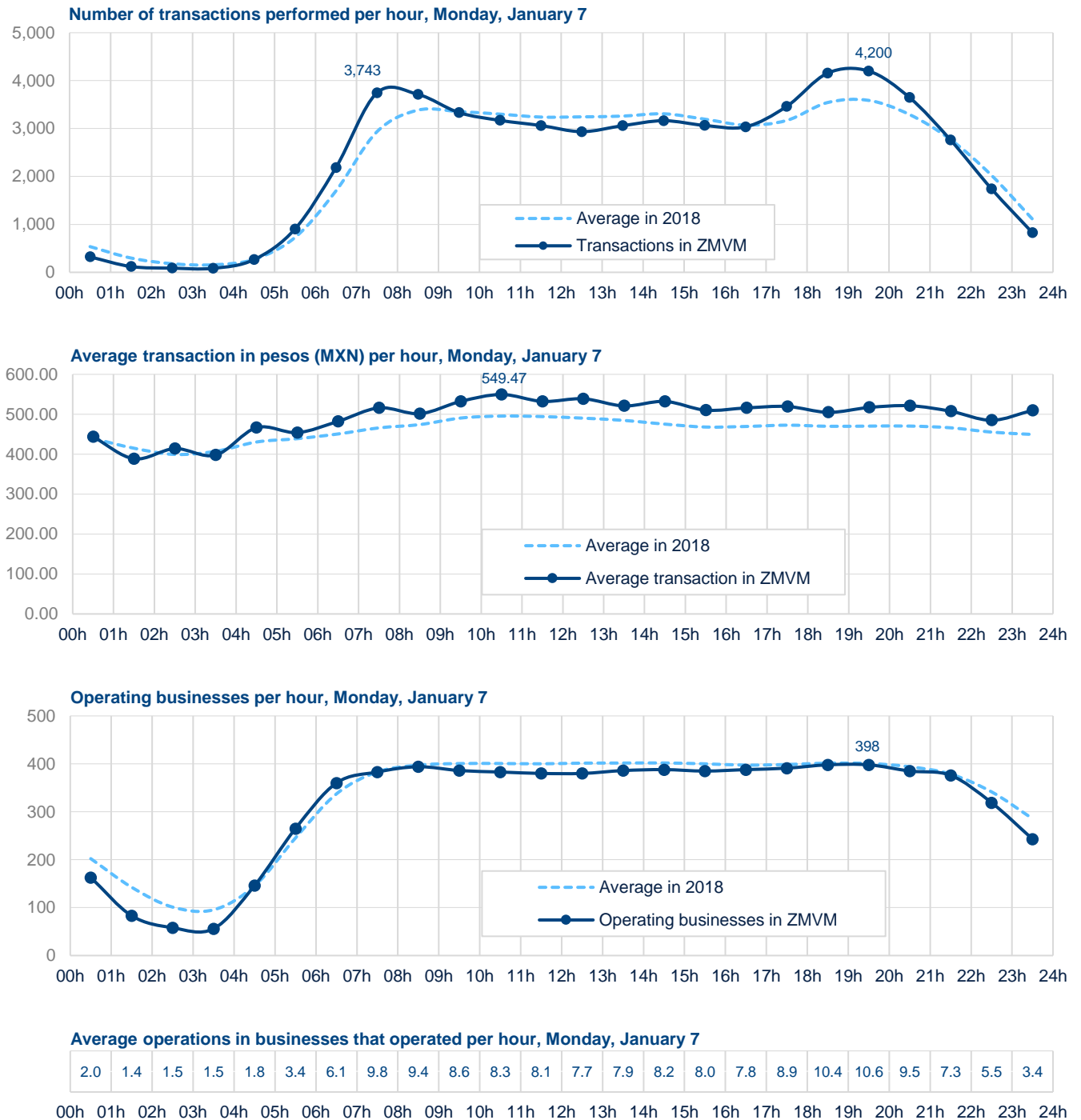
Source: BBVA Research based on Sedatu, Conapo & Inegi (2018). Delimitación de las zonas metropolitanas de México 2015

Figure 12. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 6, 2019**



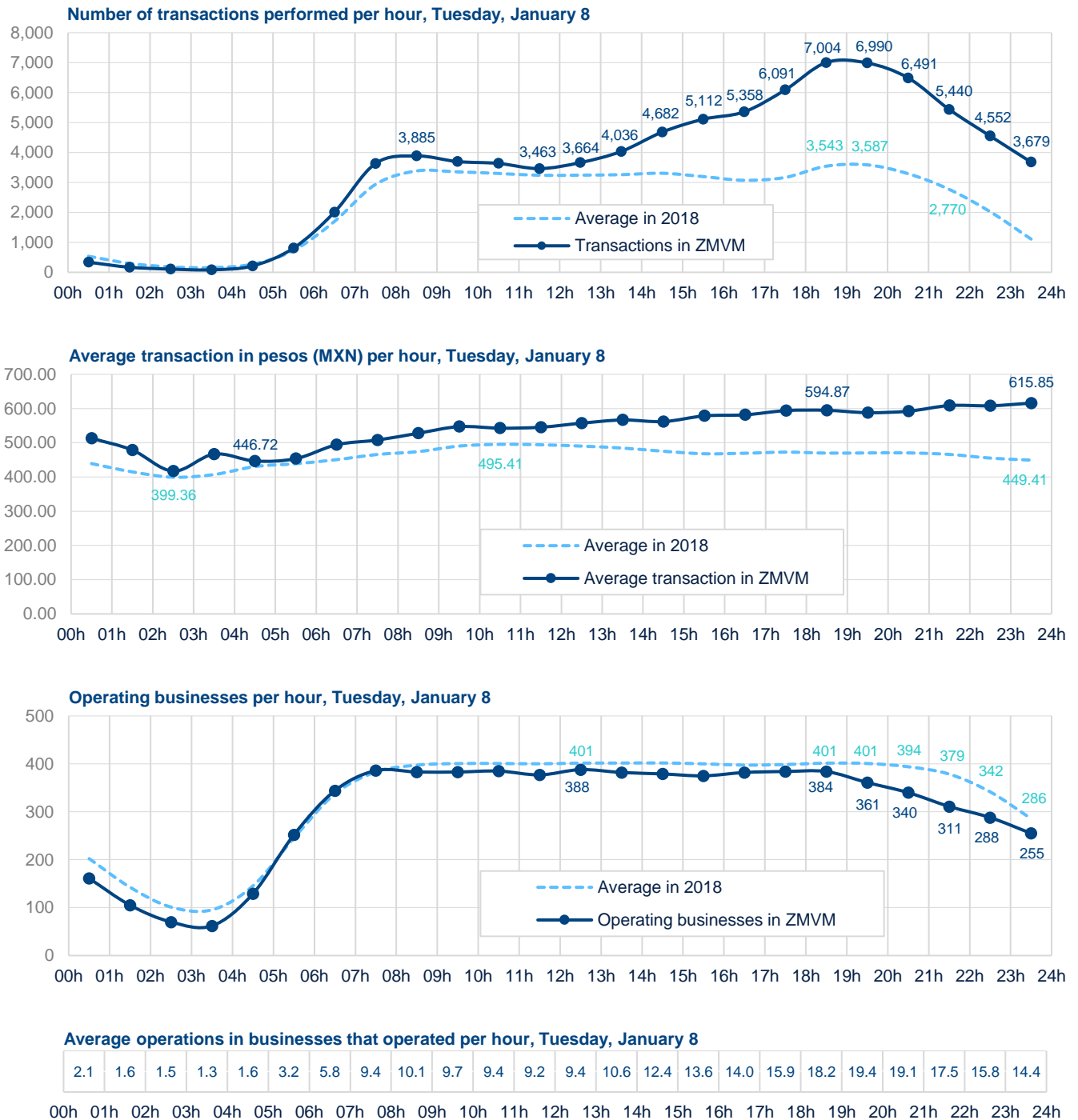
Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

Figure 13. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 7, 2019**



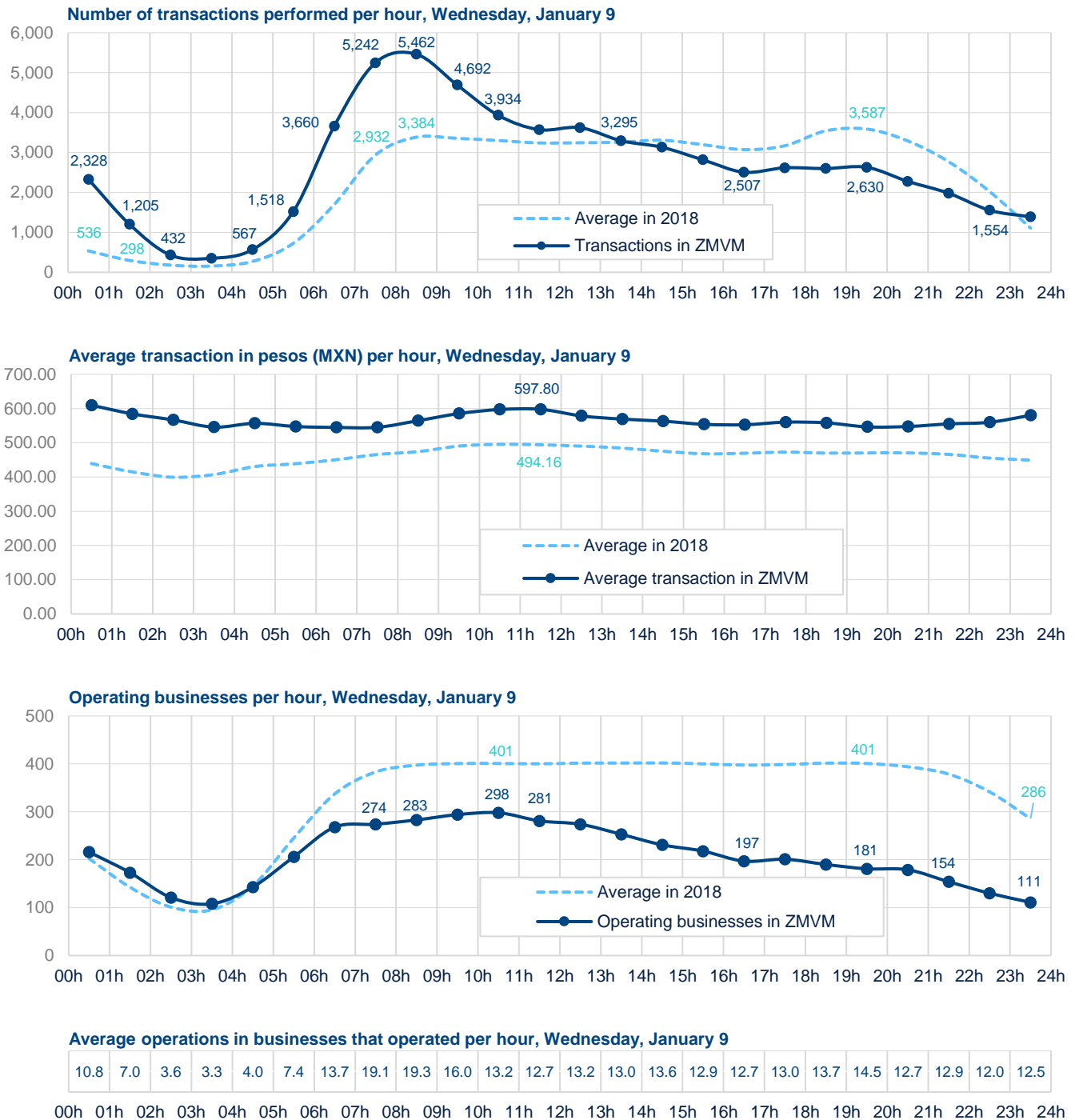
Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

Figure 14. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 8, 2019**



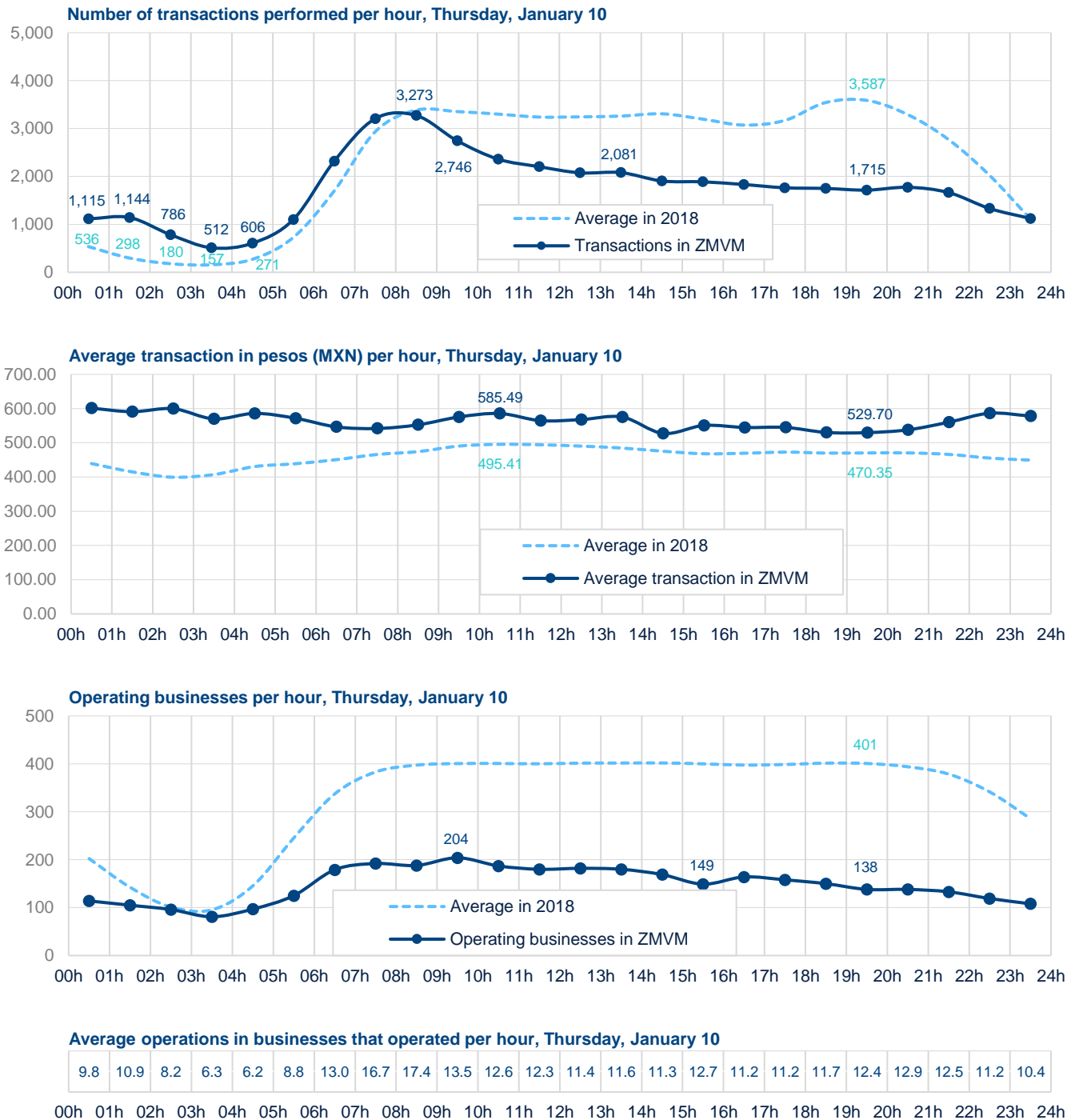
Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

Figure 15. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 9, 2019**



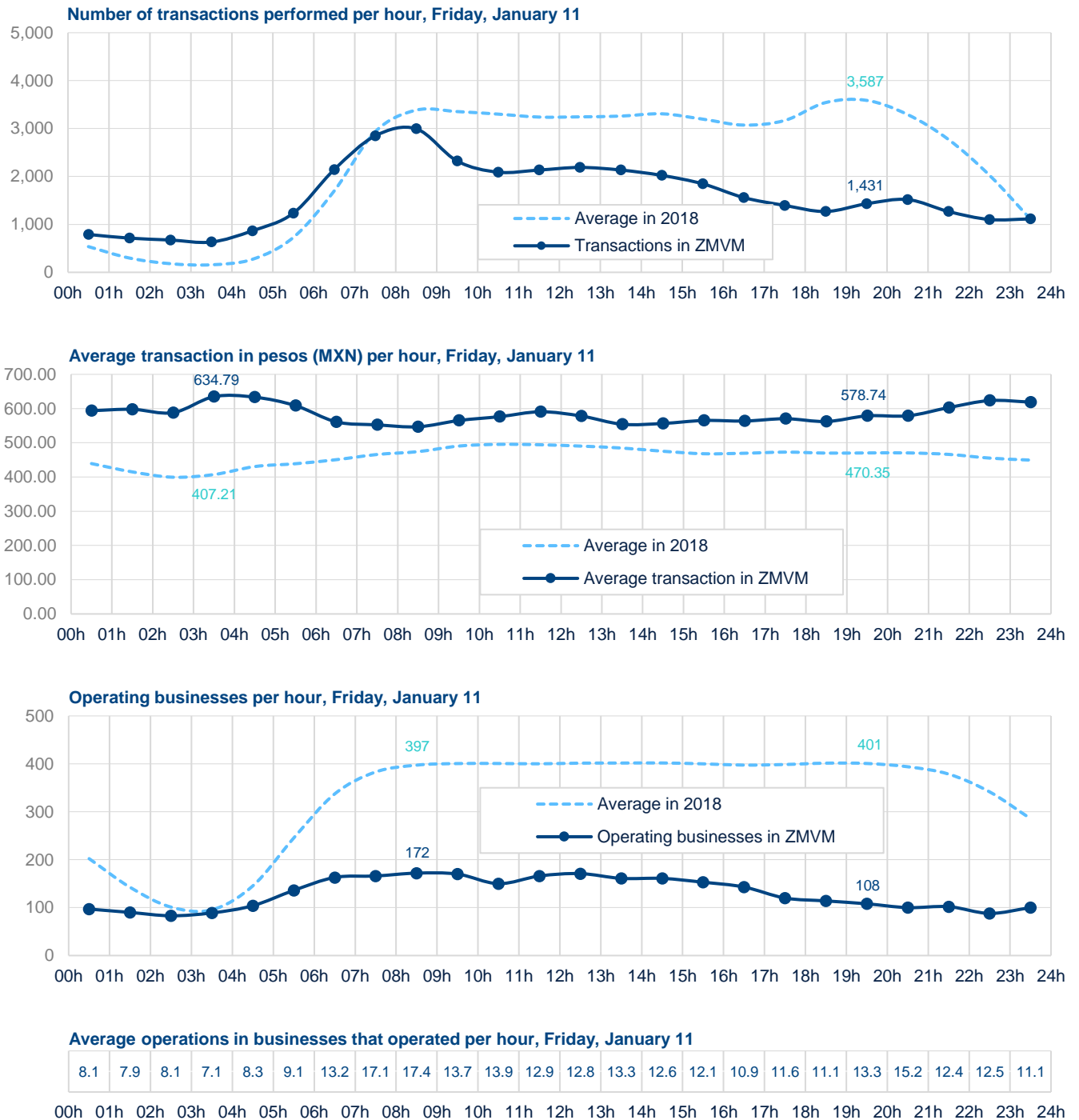
Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

Figure 16. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 10, 2019**



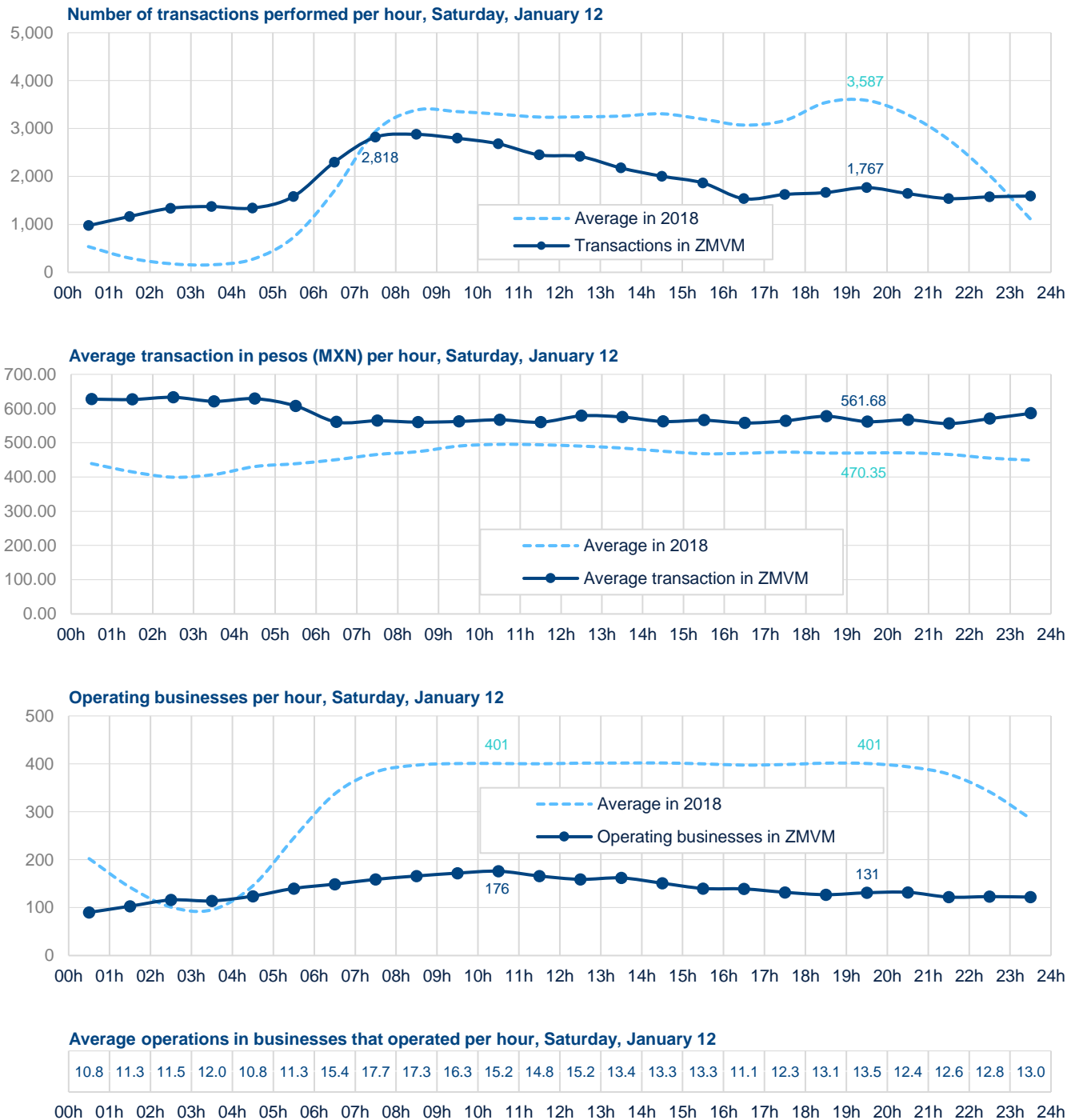
Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

Figure 17. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 11, 2019**



Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

Figure 18. **Number of transactions, average transaction and operating businesses per hour at affiliated gas stations in the ZMVM, January 12, 2019**



Source: BBVA Research based on BBVA Big Data, data on transactions of affiliated businesses 2018–2019

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