

An Economic Perspective on Mexico's Nascent Deregulation of Retail Petroleum Markets

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ABSTRACT

Retail petroleum markets in Mexico are on the cusp of a historic deregulation. For decades, all 11,000 gasoline stations nationwide have carried the brand of the state-owned petroleum company Pemex and sold Pemex gasoline at federally regulated retail prices. This industry structure is changing, however, as part of Mexico's broader energy reforms aimed at increasing private investment. Since April 2016, independent companies can import, transport, store, distribute, and sell gasoline and diesel. In this paper, we provide an economic perspective on Mexico's nascent deregulation. Although in many ways the reforms are unprecedented, we argue that past experiences in other markets give important clues about what to expect, as well as about potential pitfalls. Turning Mexico's retail petroleum sector into a competitive market will not be easy, but the deregulation has the potential to increase efficiency and, eventually, to reduce prices.

Keywords: Market Deregulation, Gasoline Stations, Price Competition, Product Differentiation, Vertical Integration

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✎ 1. INTRODUCTION ✎

Economists have long studied the impact of government regulation on economic outcomes. Over the last several decades the trend has been toward deregulation (Joskow, 2005; Peltzman and Winston, 2011) and a substantial literature in economics has developed aimed at understanding these market changes. Many industries have been analyzed including airlines (Borenstein, 1992), telecommunications (Olley and Pakes, 1996), trucking (Rose, 1987), natural gas (Davis and Kilian, 2011), and electricity (Wolfram, 1999). These studies have provided important lessons about regulation, while also shedding light on broader issues in economics including price competition, productivity, market entry, and vertical integration.

We use this rich existing economic literature as a lens through which to view Mexico's nascent deregulation of retail petroleum markets. For decades all 11,000 gasoline stations in Mexico have carried the brand of the state-owned petroleum company Pemex and sold Pemex gasoline at federally regulated retail prices. This industry structure is now changing. Since April 2016, independent companies can now import, transport, store, distribute, and sell gasoline and diesel. The deregulation is part of Mexico's broader energy reforms aimed at increasing private investment. For Mexican consumers, no other piece of the energy reforms is as visible as what is beginning to happen with gasoline stations.

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We revisit many of the themes in the existing literature including price competition, cost-minimization, market power, product differentiation, entry and exit, and vertical integration, and discuss what we can expect and not expect based on historical experience and academic literature. Although in many ways the reforms are unprecedented, we argue that past experiences in other markets give important clues about what to expect, as well as about potential pitfalls.

The market we study has been mostly unexamined in previous research, so we also provide novel descriptive information about what the market looks like on the eve of deregulation. We describe the former system by which retail gasoline prices were set and discuss how this is changing under deregulation. We also present descriptive information on the retail gasoline sector in Mexico and contrast these results with relevant statistics from the United States.

In addition, a novel feature of our analysis is that we performed original data collection, designing and conducting a survey of all gasoline stations in Mexico City. The results provide insight into the service quality at gasoline stations, for example, documenting the availability of different products and services. This information provides baseline information about starting conditions as well as some guidance on what we think are important metrics for measuring the success or failure of the transformation moving forward.

The paper proceeds as follows. Section 2 provides background about Mexico's retail petroleum market, describes the pending reforms including price deregulation, and presents descriptive information about the current market. Section 3 discusses economic predictions for price competition, cost-minimization, market power, collusion, product differentiation, entry and exit, and vertical integration. We describe the relevant economic literature on these topics as they relate to the Mexican context, and make tentative predictions about which themes are likely to be most important. Finally, Section 4 concludes with a summary and call for patience on all sides. Turning this sector into a competitive market will not be quick or easy, but deregulation has the potential to increase efficiency and reduce prices. Policymakers need to be prepared to give the market a chance to work.

✎ 2. BACKGROUND ✎

2.1 The Status Quo

Between 1938 and 2016 every gasoline station in Mexico was branded Pemex, selling Pemex gasoline and diesel, and at regulated retail prices. By any measure, this is an extremely long time with little change in market structure: almost 80 years with a single brand, no price competition, and limited scope or incentive for product differentiation. The incumbent government-owned firm in this market is deeply entrenched, with deep political connections at all levels of government.

Mexican gasoline stations are dealer-owned, dealer-operated franchises. The franchisees own the stations and pumps, and manage the stations, but historically have sold gasoline and diesel purchased exclusively from Pemex. The most commonly sold product is regular unleaded gasoline (known as "Magna"), although most stations also sell premium unleaded gasoline, and some stations sell diesel. Franchisees receive a fixed, guaranteed markup for each liter sold.¹ Franchisees can also make money from

1. Pemex franchise agreements are generally confidential, but we have obtained and reviewed selected contracts through the "Federal Law of Transparency and Access to Information" *Ley Federal de Transparencia y Acceso a la Información Pública Gubernamental*.

having a store or offering other services, though as we show later, most stations provide only minimal services.

2.2 Price Regulation

Before January 2015, gasoline and diesel prices in Mexico were fixed nationally by the Mexican finance ministry. During 2015 and 2016, the ministry set a national maximum price each month, although very few stations charged a price below the maximum. There was no meaningful variation in prices between stations or even across Mexican states. In July 2016, for example, nearly all stations nationwide sold regular unleaded gasoline for \$2.73 per gallon (13.40 pesos per liter), premium gasoline for \$2.92 per gallon (14.37 pesos per liter), and diesel for \$2.80 per gallon (13.77 pesos per liter).² During 2017, in the final months before price deregulation, the ministry set maximum prices each day that varied across 83 regions in Mexico.

Before 2017, the areas close to Mexico's border with the United States provided the one exception to the uniform national price. Gasoline prices at stations within 20 kilometers of the border were set approximately equal to the price in the neighboring city in the United States. This goal of this policy was to reduce the potential for cross-border arbitrage. A sharp discontinuity was avoided by interpolating the U.S. and Mexican prices, in five-kilometer steps, for stations between 20 and 45 kilometers from the border.

Figure 1 plots pre-deregulation prices for regular unleaded gasoline in non-border regions of Mexico with average U.S. retail gasoline prices for comparison. Although not plotted here, the pattern for diesel prices is almost identical. The panel on the left shows prices in Mexican pesos, whereas the panel on the right shows prices in U.S. dollars. Whereas U.S. prices vary monthly with crude oil prices, local currency Mexican retail prices are much less volatile, following a slow and steady increase. Between 2006 and 2014, Mexican retail prices were below average U.S. prices and thus incorporated a subsidy to gasoline consumers. However, prices have not always been subsidized. Most recently, since crude oil prices fell sharply in 2014, Mexican gasoline prices have been above U.S. retail prices.³ In part, this decision to maintain higher retail prices was a reaction to fiscal challenges both at Pemex and in the Mexican Federal government.

Before the reforms, Pemex controlled the entire upstream petroleum market. Pemex produces or imports crude oil and refined products, operates refineries, pipelines, wholesale terminals, and a network of trucks. Franchisees typically call and order refined products from Pemex and receive truck deliveries every day or two. Wholesale prices for these deliveries were the same everywhere in Mexico, regardless of how far away a station was from the nearest wholesale terminal.

tal. For example, a 2010 contract for a station located in Toluca, State of Mexico, (Folio Number 1857600005715), shows that the retail markup for "Magna" ranges from 5.2% to 6.0%.

2. Petroleum prices are from Mexico's *Sistema de Información Energética* with information from *Diario Oficial de la Federación* (SHCP), accessed November 2018.

3. During this period there was no gasoline price regulation in the United States. This has not always been the case, however. In particular, the U.S. imposed gasoline price controls during the 1970s, resulting in long queues at gasoline stations during the OPEC oil embargo in 1973-1974 and again during the Iranian revolution in 1979. Economists have documented large welfare losses from U.S. gasoline price controls, with scarce fuel supplies "rationed by waiting" rather than to buyers with the highest willingness-to-pay (Deacon and Sonstelie, 1985; Frech and Lee, 1987).

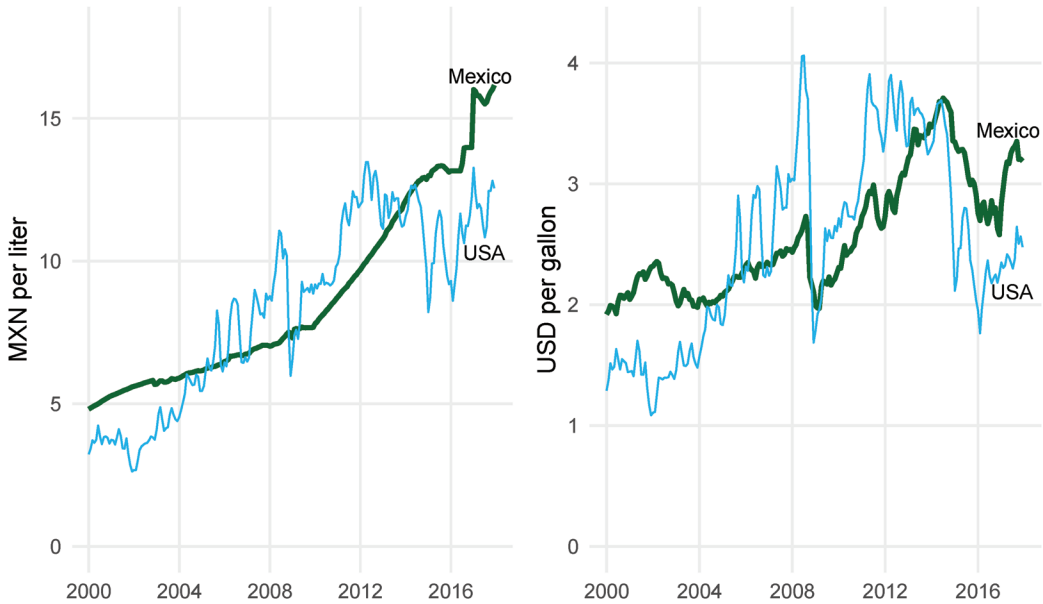


FIGURE 1

Mexico and U.S. retail gasoline prices, Regular Grade, 2000–2017.

Note: Prices are the national monthly mean retail prices, including tax, for regular gasoline (both conventional and reformulated). Sources for Mexican prices: Energy Information System (before 2017) and Energy Regulatory Commission (2017). Source for U.S. prices: Energy Information Administration. Exchange rate data from Bank of Mexico.

2.3 Mexico's Energy Reforms

It was against this backdrop that Mexico embarked on a campaign of market deregulation. These reforms included telecommunications, banking, health, and education. But in no sector was deregulation undertaken with as much fervor as in energy markets, driven by a widely held view that years of monopoly had led to inefficient markets that could be improved through exposure to competition.

Starting April 1, 2016, independent companies were granted the right to import, transport, store, distribute, and sell petroleum products in Mexico. Companies remain subject to Mexico's environmental regulations (e.g., low-sulfur gasoline), but starting April 1, 2016, there were no restrictions on entry or operations.

The first non-Pemex gasoline station opened in Mexico in July 2016. One of the most significant groups of franchisees in Mexico is known as Hidrosina, and the first non-Pemex station to open in Mexico was one of these stations, rebranded from Pemex to Hidrosina. Another early entrant was "La Gas". Then, in March 2017, BP opened the first station with a major international petroleum brand. As of December 2018, BP operates 400 gasoline stations in Mexico. Many other major international brands have also entered the market, including Shell, Chevron, Mobil, Arco, Repsol, and Total.

Price controls for retail gasoline and diesel began to be removed starting March 30, 2017. As Figure 2 illustrates, the price liberalization started in Baja California and Sonora, and then continued to other border states, followed by states farther south. By November 30, 2017, prices were liberalized nationwide.

The staggered rollout could form the basis for future empirical analyses. In particular, during the summer of 2017, gasoline stations in Northern Mexico had already experienced



FIGURE 2

Gasoline and diesel price deregulation schedule.

price liberalization while gasoline stations in the rest of Mexico had not. Comparing pricing behavior across states thus could provide a measure of the short-run impact of price liberalization.

Even in the liberalized gasoline market, Mexico still uses a price stabilization mechanism. The finance ministry varies the excise tax on gasoline each week. Changes in the excise tax absorb approximately 90 percent of the weekly change in international gasoline prices. The excise tax applies to gasoline sold by both Pemex and independent importers. This smoothing mechanism means that wholesale and retail gasoline prices in Mexico are much less volatile than in the United States.

In addition, the liberalized market retains the subsidy for gasoline stations within 45 kilometers of the U.S. border. The subsidy is highest in the Mexican state of Coahuila, near the Texas city of Del Rio: 4.55 pesos/liter (US\$0.85/gallon) for regular gasoline for stations within 20 kilometers of the border.⁴ The subsidy is zero in the border city of Tijuana in Baja California. As of December 2018, the subsidies had not changed since April 2017, and their geographical variation coincides with differences in U.S. gasoline prices in March 2017. For example, the average price for regular gasoline in Texas at the end of March 2017 was US\$0.91/gallon lower than in California.⁵

The wholesale terminal prices charged by Pemex, including excise taxes, are set each day by the energy regulator. The daily price formula further smoothes the week-to-week changes

4. https://dof.gob.mx/nota_detalle.php?codigo=5544569 fecha=23/11/2018.

5. United States gasoline prices are from the Weekly Retail Gasoline and Diesel Prices report published by the Energy Information Administration. https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_sca_w.htm.

in the excise tax. Regulation of the Pemex wholesale price will continue until the wholesale market share of Pemex falls below 70%.⁶

Investment in the upstream petroleum markets is proceeding more slowly. Although legally open to entry since April 2016, there have thus far been limited investments by independent companies in wholesale fuels terminals, rail facilities, pipelines, storage, and other infrastructure necessary to deliver gasoline and other refined products to gasoline stations. These infrastructure limitations mean that in the short- and medium-term most gasoline stations in Mexico will continue to sell Pemex fuels.

In December 2018, the new administration of Andrés Manuel López Obrador came to power in Mexico. López Obrador has criticized the energy reform, calling it a “failure” and a “disaster”, but has said that he will not seek to overturn the law (Monroy, 2018). We note that the price stabilization mechanism described above provides flexibility to decrease (or increase) retail gasoline prices by varying the excise tax formula, without reverting to administrative price controls. At the time of writing, the new government has not announced any changes to the regulatory framework for the retail gasoline sector.

2.4 Gasoline Station Quality on the Eve of Deregulation

To understand the state of the Mexican market on the eve of deregulation we designed and conducted a survey of all gasoline stations in Mexico City as of July 2017. The advantage of focusing our survey on Mexico City is that the concentration of gasoline stations allowed us to survey a large number of stations at relatively low cost. The disadvantage is that our survey is not nationally representative. Mexico City is a highly-urban environment. The composition of vehicles, demographics of drivers, types of trips, density of services, and other features differ significantly from the rest of Mexico. The results of the survey are nonetheless interesting and provide a starting point for thinking about the different dimensions of gasoline station quality.

Table 1 presents mean characteristics for the 332 Pemex stations operating in Mexico City as of July 2017. The survey collected general information about product availability, retail offerings, as well as various measures of service quality. Our surveyors visited all 332 stations and recorded information, but did not interview customers or gasoline station employees. We highlight the most pertinent facts below and then use this as motivation for the economic predictions that follow in Section 3. Our objective is to both describe a set of forecasts for the market and also begin to think about how these could be tested.

- 100% of stations sell regular gasoline, and 97% sell premium, but only 42% of stations sell diesel.
- Stations have an average of 5.7 pumps.
- Two-thirds of stations (68%) do not have a store attached. Most stores sell coffee, beer, and soda.
- 98% of stations have bathrooms, but only 21% of stations have a free bathroom. Despite most stations charging customers to use the bathroom, less than half of stations have basic services (toilet paper 47% and soap 45%).
- Only 5% of stations offer a car wash, and most have trash (53%) or oil/gasoline (71%) on the ground.

6. CRE Resolution 2508/2017: <http://drive.cre.gob.mx/Drive/ObtenerResolucion/?id=14246>.

TABLE 1

Characteristics of Pemex stations in Mexico City on the eve of deregulation.

Petroleum Products	
Percentage of Stations that Sell Regular Unleaded	100%
Percentage of Stations that Sell Premium Unleaded	97%
Percentage of Stations that Sell Diesel	42%
Price Regular Unleaded, Pesos Per Liter	15.9
Price Premium Unleaded, Pesos Per Liter	18.1
Price Diesel, Pesos Per Liter	16.5
Average Number of Pumps	5.7
Percentage of Pumps that are Working	97%
Retail Offerings	
Percentage of Stations that Have a Store	32%
Percentage of Stations that Have a Store that Sells Coffee	28%
Percentage of Stations that Have a Store that Sells Beer	31%
Percentage of Stations that Have a Store that Sells Soda	31%
Percentage of Stations that Have a Store that Has Wifi	1%
Bathrooms	
Percentage of Stations With Bathroom	98%
Percentage of Stations With Free Bathroom	21%
Percentage of Stations With Bathroom with Toilet Paper	47%
Percentage of Stations With Bathroom with Soap	45%
Restrooms Clean, (1 to 5, 1 very dirty, 5 very clean)	3.6
Other	
Percentage of Stations With Car Wash	5%
Percentage of Stations With Trash on Ground	53%
Percentage of Stations With Oil or Gasoline on Ground	71%
Average Number of Men Working	5.8
Average Number of Women Working	1.5

Note: This table reports descriptive statistics from a survey of 332 Pemex stations in Mexico City. The survey was designed by Lucas Davis, Shaun McRae, and Enrique Seira Bejarano, and conducted by a professional survey firm in July 2017.

- Stations had at the time the survey was conducted an average of 5.8 male and 1.5 female employees on duty.

As discussed below in Section 3.6, the density of gasoline stations in Mexico City is very low, with only one station for every 24,700 residents. The low density means that drivers often have to wait in line until a pump is available. At the time of our survey observation, slightly less than a third (31%) of the Pemex stations had a queue of cars waiting for a pump. On average, the stations with a queue had 3.4 cars waiting, with 12 cars being the longest line observed. Lines were most common during the morning commute (54% of stations had waiting cars before 11:00 AM) and least common after lunch and before the evening commute (15% of stations had waiting cars between 4:00 PM and 6:00 PM).⁷

Another somewhat peculiar aspect of the Mexican gasoline market related to reputation and quality is the practice of selling “chiquilitros”. For many years it has been common in Mexico for gasoline station operators to manipulate the electronic and mechanical gasoline pump equipment to dispense incomplete liters to customers (Guerrero, 2012; Liu et al., 2018). Al-

7. These results are only suggestive because each station was only visited once and we did not randomize the timing of the visit.

though this practice is illegal, the monetary and legal sanctions have not always been significant enough to deter this behavior.

Although we could not directly observe the sale of incomplete liters in our survey, we merged our data with the inspection records of the consumer protection agency PROFECO.⁸ This agency undertakes surprise audits of gasoline stations in Mexico, during which they measure the quantity and quality of gasoline dispensed at each pump. Of the Pemex stations in our survey, 84% had received such an inspection in the twelve months before the survey. Five of these stations (1.7%) had at least one pump that was immobilized by PROFECO for dispensing inaccurate quantities. For the two stations with data available, customers received 0.92 or 0.93 liters per liter purchased. Many more stations in our survey (18%) had at least one pump that was immobilized for another reason, most commonly for lack of repeatability of the measurements or electronic faults with the pump equipment.⁹ The stations that failed the PROFECO inspections tended to perform worse on our survey measures of quality. Only 20% of them have a store attached. Compared to the overall sample, a higher percentage have oil/gasoline on the ground, and a lower percentage have soap and toilet paper in their bathrooms.

Without an identical survey, it is difficult to say how these characteristics compare to the United States, for example. As far as the measures of service quality, it would appear that the average Mexican station offers a level of service quality that is low compared to stations in the United States. It is surprising, for example, that only about one-third of stations have a store attached, whereas in the United States most gasoline stations have stores. Also, the average bathroom quality seems well below typical U.S. levels, with most Mexican stations charging a fee for even basic bathroom services. Finally, the queues to purchase gasoline and the fraudulent manipulation of pump equipment are much more common features of the gasoline market in Mexico than in the United States.

The results of our survey provide baseline data about starting conditions against which we will be able to compare future outcomes. The information also provides guidance about what could be relevant metrics for measuring the success or failure of the industry reform. Fuel prices will likely be the most studied economic outcome from the deregulation, but our survey highlights that there are other significant dimensions of product differentiation that affect consumer welfare. Previous studies have also found a correlation between prices and service quality, for example, Bello and Cavero (2008) find higher prices at gasoline stations that are perceived to be of higher quality.

✎ 3. ECONOMIC ANALYSIS OF THE DEREGULATION ✎

In this section we review the economic literature relevant to understanding the retail petroleum market in Mexico and its prospects under market reform. We discuss the following topics: price competition (Section 3.1), cost-minimization (Section 3.2), market power (Section 3.3), collusion (Section 3.4), product differentiation (Section 3.5), entry and exit (Section 3.6), and vertical structure (Section 3.7). Where possible we incorporate evidence from deregulation in other markets, and attempt to point out key similarities and differences.

8. The station-level inspection reports are available at <https://combustibles.profeco.gob.mx/qqg/>.

9. The inspection data suggests that the sale of incomplete liters is more common in other parts of Mexico than in Mexico City. Of all the stations inspected by PROFECO during 2017, 27.5% had at least one pump immobilized as a result of the inspection. 3.4% of stations had a pump immobilized because of inaccurate quantities. However, because the PROFECO audits are not random, these results cannot be interpreted directly as estimates of the prevalence of incomplete liters in the Mexican gasoline market.

Spain provides perhaps the best comparative case study of gasoline deregulation (Contín et al., 1999; Bello and Cavero, 2008). As in Mexico, before 1984 Spain had a government monopoly operating in all stages of gasoline production, distribution and retailing. Between 1984 and 1992, all segments of the gasoline industry were opened up to competition. In 1990, the system of administrative pricing was replaced by ceiling price regulation, with the maximum price that gasoline stations could charge updated weekly based on a formula. Prices were not completely deregulated until 1998. Other policies were designed to encourage competition, including the elimination of the mandated minimum distances between gasoline stations in 1995. Bello and Cavero (2008) show that the reforms led to a decline in market concentration and substantial growth in the number of gasoline stations, from 4,800 in 1992 to 8,600 in 2005. There was an increase in product differentiation, either by investment in advertising and branding by the larger companies (Repsol and Cepsa) or by the building of complementary infrastructure. Most gas stations now have a convenience store, about half have automated or hand carwashing, and more than a quarter have cafeterias or restaurants. Bello and Cavero (2008) argue that this product differentiation has enabled the major branded gasoline stations to charge higher prices. Perhaps the most interesting aspect of the Spanish reforms was that it took more than a decade for a competitive market to develop. This suggests that considerable patience will be required to see the results of the deregulation process in Mexico.

3.1 Price Competition

We expect prices to be the single most-studied outcome during deregulation. Fuel prices are of intense public interest. There is perhaps no price in an economy as salient as the price of gasoline. In the United States, for example, gasoline prices are advertised ubiquitously with large, highly-visible signs. Also, consumers buy gasoline frequently, often with cash, receiving regular feedback about price levels. Thus consumers know and understand fuel prices, and the public perception about market reforms will be formed by how these prices evolve.

In addition to being of considerable public interest, economists are interested in prices because they shed light on firm behavior. Deregulation can be expected to have two effects on prices, of opposite sign. We first discuss price competition and cost-minimization (Section 3.2), and then later turn to market power (Section 3.3). The net effect of deregulation on retail fuel prices is ambiguous and will depend on the relative size of these effects. Thus in studying the market reforms, it will be essential to use measures and predictive approaches that distinguish between these different mechanisms.

Deregulation will make it possible for firms to compete using price. Whereas for decades price competition was not allowed, firms will now have an incentive to lower prices to gain market share. Economists have documented price declines from deregulation in many markets. For example, Morrison and Winston (1986) find that U.S. airline deregulation yielded significantly lower fares, resulting in \$23 billion (USD 2015) annually in increased consumer surplus. With airlines, the fare decreases resulted from both price competition shrinking mark-ups, as well as from cost-cutting.

In Mexico's retail petroleum markets there is a reason to believe that there will be limited price competition, particularly in the short-run. Pemex stations have historically been allowed only a modest retail markup, so there may not be much scope for immediate price decreases. That is, even if an aggressive entrant wanted to cut prices to gain market share, there is not much room to maneuver without pricing at a loss, which firms will be reluctant to do for more than a limited period.

It may also take time for firms to learn how to engage in price competition. In related work, Doraszelski et al. (2018) study a new UK electricity market, and find that when the market first opened there was a period of experimentation during which firms tried different pricing strategies. After three years, however, firms eventually stabilized on behavior that closely approximates Nash equilibrium. We might expect a similar convergence in behavior in our setting. After all, market prices have been regulated for decades in this market, so it may take time for firms to learn how to compete.

3.2 Cost-Minimization

Costs are another important outcome which we expect to be widely studied. Cost-minimization is one of the primary rationales for deregulation in many markets. However, in Mexico's retail petroleum sector the scope for cost reductions is likely to be more limited, particularly in the short-run. The existing Pemex stations already have a relatively low cost of operation. Under price regulation, stations were not able to compete based on price, but there was an incentive for franchisees to lower costs. As is usually the case with franchise relationships (Lafontaine, 1992; Lafontaine and Shaw, 1999), Pemex franchisees were the residual claimant on any cost reductions, so if a station owner could reduce costs, they could keep those savings.

In practice, these incentives have resulted in stations making choices to keep operation costs very low. For example, most stations pay relatively little in labor costs. Although all stations are full-service, station employees often receive no wages and instead work for tips. There are even some stations where employees pay their employers for the right to work.¹⁰ Moreover, most stations invest little in their bathrooms or other services, as we showed before using evidence from the survey we conducted in Mexico City. Thus, there may well be little "fat to cut" when it comes to cost-minimization.

In contrast, most previous studies of deregulation have examined other contexts in which there was more scope for cost-minimization. For example, several studies have documented that U.S. electricity market deregulation resulted in substantial cost decreases (Rose and Wolfram, 2007; Davis and Wolfram, 2012). However, in these studies, the firms were transitioning away from rate-of-return regulation which provides only limited incentives for cost-minimization. With Mexican retail petroleum markets, the starting point is franchising, not rate-of-return regulation.

Upstream petroleum supply has considerably more scope for cost-minimization. State-owned Pemex is involved all along the supply chain including production, transportation, refining, and storage of petroleum. Unlike retail distribution which uses franchise agreements, these facilities are Pemex-owned and Pemex-operated. In this paper, we are focused primarily on the retail part of the market, but as competition intensifies, we expect significant cost reductions could occur at these other points along the chain. For example, geographical variation in retail and wholesale prices will now provide price signals to investors for profitable locations to build new transportation infrastructure.

It is worth noting again that on the eve of deregulation, Mexican retail gasoline prices were *higher* than U.S. retail gasoline prices (see Figure 1). This difference reflects a combination of higher wholesale prices, higher transportation costs, and higher excise taxes. After years

10. In 1972, 92% of gasoline stations in the United States were full-service, meaning that customers did not pump their gasoline. Basker et al. (2017) study the transition from full-service to self-service stations in the United States. They show that this change did not lead to a decline in employment, because stations became larger, stayed open longer, and added convenience stores.

of gasoline subsidies, the decision to set higher excise taxes was a reaction to fiscal challenges at Pemex and in the Mexican government. It is possible that upstream investments, either by Pemex or its competitors, could reduce costs and lead to convergence of wholesale prices with the U.S. However, for consumers, it is likely that the reform will be judged by whether prices fall back to their regulated, subsidized levels. Whether this occurs will mostly depend on future changes in oil prices, exchange rates, and excise taxes. Compared to these three factors, the scope for price reductions from cost minimization is limited.

3.3 Market Power

Deregulation also makes it possible for firms to exercise market power. When firms face a residual demand curve that is relatively inelastic, they have an incentive to price above marginal cost. A stark example is California's initial experience with electricity deregulation. During the Californian electricity crisis, electricity producers were able to push prices many times higher than marginal cost (Borenstein et al., 2002; Joskow and Kahn, 2002). This exercise of market power was possible, in part, because demand for electricity is highly inelastic.

The degree to which gasoline stations will be able to exercise market power in Mexico's deregulated petroleum markets thus depends on the price elasticity of demand for gasoline and diesel. Galindo (2005) and Crotte et al. (2010) estimate price elasticities of demand for gasoline in Mexico of between -0.05 and -0.20 in the short-run and between -0.20 and -0.40 in the long-run. Both papers use national or state-level gasoline consumption data at an annual frequency.¹¹ The challenge for estimating gasoline demand using historical data from Mexico is the absence of cross-sectional price variation and the uniformity of price changes over time, as shown in Figure 1. Nonetheless, the results are consistent with studies using U.S. data that also find relatively inelastic demand for gasoline and other fuels, particularly in the short-run (Hughes et al., 2008; Li et al., 2014; Coglianesi et al., 2017; Levin et al., 2017).

Nearly all of the existing studies of gasoline demand, in both the U.S. and Mexico, estimate the overall demand elasticity with respect to market-wide price variations. However, what matters for market power is the elasticity of demand faced by an *individual* gas station. This depends on how willing customers are to shop around for prices and on the number and type of nearby stations (Houde, 2012; Langer and McRae, 2015).

Market competition depends both on the number of nearby stations, as well as on the ownership structure. Even after price competition begins, the majority of stations will still be branded Pemex. This is where the franchising becomes important, however. In locations where there is a single owner that owns a large number of stations, we would expect this owner to act as a quasi-monopolist, setting price such that marginal revenue is equal to marginal cost. In other cases, where ownership is more disperse, we should expect franchise owners to engage in price competition.

It has long been recognized that market power increases with search costs (Stahl, 1989). The empirical evidence on consumer search behavior in gasoline markets comes mostly from the U.S. and other high-income countries. For example, Lewis and Marvel (2011) and Lewis (2011) find that U.S. gasoline consumers search more when prices rise than when prices fall, and Byrne and de Roos (2017) find that Australian consumers search both across stations and over time.

11. Crotte et al. (2010) also estimate gasoline demand at a borough-level in Mexico City. They impute gasoline consumption by combining vehicle fuel economy ratings with odometer readings from vehicle inspection stations.

There is also related literature that shows, perhaps because of this search behavior, that retail gasoline prices tend to respond more quickly to crude oil price increases than decreases (Borenstein et al., 1997; Chesnes, 2016). It will be interesting to see whether Mexican markets follow this “rockets and feathers” pattern, as this would shed light both on consumer search behavior, as well as on firms’ pricing behavior.

Learning is again potentially interesting. Emerging from almost 80 years of uniform national pricing, Mexican consumers have no experience of searching for low gasoline prices. Thus it is not clear how much Mexican gasoline consumers will search, or how this behavior will change over time. To help consumers search, the regulator publishes prices for all Mexican gasoline stations on its website and through a smartphone app (“Gasoaapp”). Understanding consumer search in this new market is a priority for future research and will be interesting both from a consumer behavior perspective and because of its implications for market power.

3.4 Collusion

The gasoline retailing industry is particularly susceptible to collusion between firms. In many local markets, ownership of gasoline stations is highly concentrated, and wholesale costs are common across firms. These factors mean that the initial transaction costs of forming a cartel are low (Levenstein and Suslow, 2006). Moreover, gasoline price changes are publicly observable, making it impossible to secretly deviate from a coordinated price, thus eliminating the principal threat to cartel stability. It is interesting that policies to improve price transparency for consumers also make it easier for cartels to detect cheating behavior by members.

Antitrust authorities in many countries have discovered and punished gasoline cartels. In spite of the public visibility of gasoline prices, these cases have shown that explicit communication between cartel members is often still required. In Australia and Canada, gasoline stations phoned other cartel members to coordinate their price increases (Wang, 2008; Clark and Houde, 2013). Even a delay of a few hours in matching the price increase of a fellow conspirator can create large transfers between firms.

The availability of real-time price information could be used by Mexican regulators to screen for possible collusive behavior. Empirical screens have been valuable for the detection of price conspiracies, including the manipulation of LIBOR (Abrantes-Metz, 2013). In Brazil, screens based on the level and correlation of retail margins and price dispersion measures were used to prioritize complaints about collusive behavior in retail gasoline markets (Ragazzo, 2012). Screens were used in Mexico to detect bid-rigging in the public procurement of medicines (Mena-Labarthe, 2012). However, it is almost impossible to prove the existence of collusion based on observed price changes alone, so these measures work best in combination with other antitrust enforcement mechanisms, such as leniency or whistleblower programs.

The possibility of entry by new competitors is one of the principal challenges faced by cartels (Levenstein and Suslow, 2006). Mexican authorities should be especially mindful of attempts by existing stations to restrict the entry of competitors (see Section 3.6). Of particular concern would be cooperation between local authorities and existing firms to block entry using municipal zoning restrictions.

Economists have also studied tacit collusion in gasoline markets. This phenomenon is the apparent coordination by firms of their pricing decisions, without any explicit cartel agreement or secret communication. Byrne and De Roos (2019) show how BP used price experiments in Perth, Australia, to communicate pricing intentions to its competitors and to eventually coordinate on a focal point pricing strategy. Lewis (2015) shows that U.S. stations tend to charge

prices ending in “5” or “9”, and that fuel prices change less frequently in markets with a higher prevalence of these last digits. He argues that these odd numbers provide focal points, subtly encouraging firms to maintain these prices rather than trying to undercut other stations by a cent or two per gallon.

3.5 Product Differentiation

Another significant economic outcome that will be used to evaluate the success of Mexico's market reforms will be the number of non-Pemex gasoline stations. It will be interesting to see the number, location, and characteristics of non-Pemex stations that open.

Firm reputation will now matter. For decades, there has been free riding by franchisees. That is, all stations were branded Pemex, reducing the incentive for any individual station owner to provide memorable service. Exerting effort to improve service quality was, in part, a “public good” contribution, benefiting the owners of other stations. This calculation changes under brand differentiation. If BP, for example, can establish a reputation for better service quality they can reap benefits throughout their station network.

Another important form of product differentiation is location. As we discuss in Section 3.6, perhaps the most consequential decisions taken by firms will be where to enter and exit. We expect firms to strategically target under-served markets, and, ultimately achieve a more efficient long-run equilibrium with a more efficient number of stations in different locations.

Beyond brand and location, another form of product differentiation is service quality. There is scope, for example, for a firm to gain market share by offering higher-quality service. This could mean stations that are more illuminated, cleaner, with better bathrooms, and faster service. There could also be overlap between service quality and locations, with a high-end brand offering a “premium” product in “privileged” areas. Higher-service stations cost more to operate and would command higher markups.

One possible outcome would be a bifurcation of the market in which a set of entrants offer high-service, high-price stations, while the traditional Pemex stations continue to offer low-service, low-price stations. Alternatively, this bottom part of the market could be filled with the rise of “low-cost” competitors as occurred, for example, in U.S. airline deregulation with the rise of Southwest and other low-price providers (Bailey et al., 1985; Morrison and Winston, 1986).

There could also be innovation in the number and types of products offered. In the short- and medium-term most stations will be continuing to source refined products from Pemex, so stations will have little choice about the type of products they sell. Retailers may, however, attempt to differentiate their products by selling fuels with proprietary additives. This practice has long been a strategy used by U.S. gasoline retailers, although in practice the performance benefits of these additives are negligible. Over the longer-run, it may be possible for retailers to offer completely new products.

Although there are parallels between this market and U.S. airline deregulation, service quality in the airline industry fell rather than rose after deregulation (Bailey et al., 1985; Morrison and Winston, 1986; Borenstein, 1992). When they were regulated, the major airlines competed on quality, offering frequent flights, low load factors, expensive meals, and other services. The difference between the two industries was reputation. United Airlines was able to benefit from reputation investments, in a way the current Pemex franchisees cannot.

A final aspect of the Mexican gasoline market related to reputation and quality is the sale of incomplete liters to customers, as discussed in Section 2.4. Just as brand differentiation

creates better incentives for investing in service quality, it also creates better incentives for investing in *avoiding* bad service quality. BP, for example, wants to have a good reputation in the Mexican market so has an incentive to closely monitor their own stations, and avoid selling chiquilitros and the potential negative media attention that would go along with that. Overall, we expect deregulation to decrease this practice of stations selling incomplete liters.

3.6 Entry and Exit

One of the reasons economists like markets is that they encourage firms to make efficient long-run entry and exit decisions. If there are too many firms in a market, prices will fall, and firms will exit. If there are not enough firms, prices will rise, and firms will enter. Firms are forward-looking and thus will use potential future rents in any market to guide entry and exit decisions.

These patterns of entry and exit will be some of the most consequential decisions taken by firms after Mexico's deregulation of petroleum markets. Future research will examine the number of stations that enter and exit, how this impacts the spatial distribution of stations, and how this distribution, in turn, affects short-run pricing and other behaviors. Economists have estimated spatial competition models of gasoline markets (Netz and Taylor, 2002; Chandra and Tappata, 2011; Houde, 2012), and Mexico's reform represents a unique opportunity to test these models in a new environment.

We anticipate some of the most significant efficiency gains from deregulation to come from better entry and exit decisions. In particular, we expect stations to close in low-demand locations, and open in high-demand locations. For example, consider a relatively isolated area with a relatively small number of high willingness-to-pay buyers. We would expect more entry in such locations. Symmetrically, we would expect less entry in more competitive regions as price competition pushes down equilibrium prices.

It is not clear whether the total number of stations in Mexico will increase or decrease. Just as the price impacts will not be uniform nationwide, nor will entry and exit patterns, so predicting *ex ante* the net effect is challenging. Another complicating factor is station size. In the United States, labor costs and other factors have led to continued consolidation in retail petroleum, with fewer and fewer gasoline stations, each operating at a larger scale with more pumps per station.

Figure 3 shows the density of gasoline stations in Mexico before the start of the price liberalization in 2017. We use two different measures of density: population per station and vehicles per station. The state with the highest density of gasoline stations (i.e. least population per station) is Baja California Sur, with one gasoline station for every 4,620 residents. At the opposite extreme is Mexico City, with one gasoline station for every 24,700 residents. This substantial variation in the baseline level of station density could be due to demand factors (e.g., number and type of trips) or supply factors (e.g., local political constraints).

3.7 Vertical Integration

In the short-term, Pemex will continue to dominate the upstream petroleum market. Pemex has long controlled petroleum production, refining, imports, transport, and storage, and it will take time for entrants to make the large-scale investments necessary to participate in these markets. Accordingly, price regulation will be essential for wholesale petroleum products for some time. Eventually, however, this price regulation will become less necessary as pri-

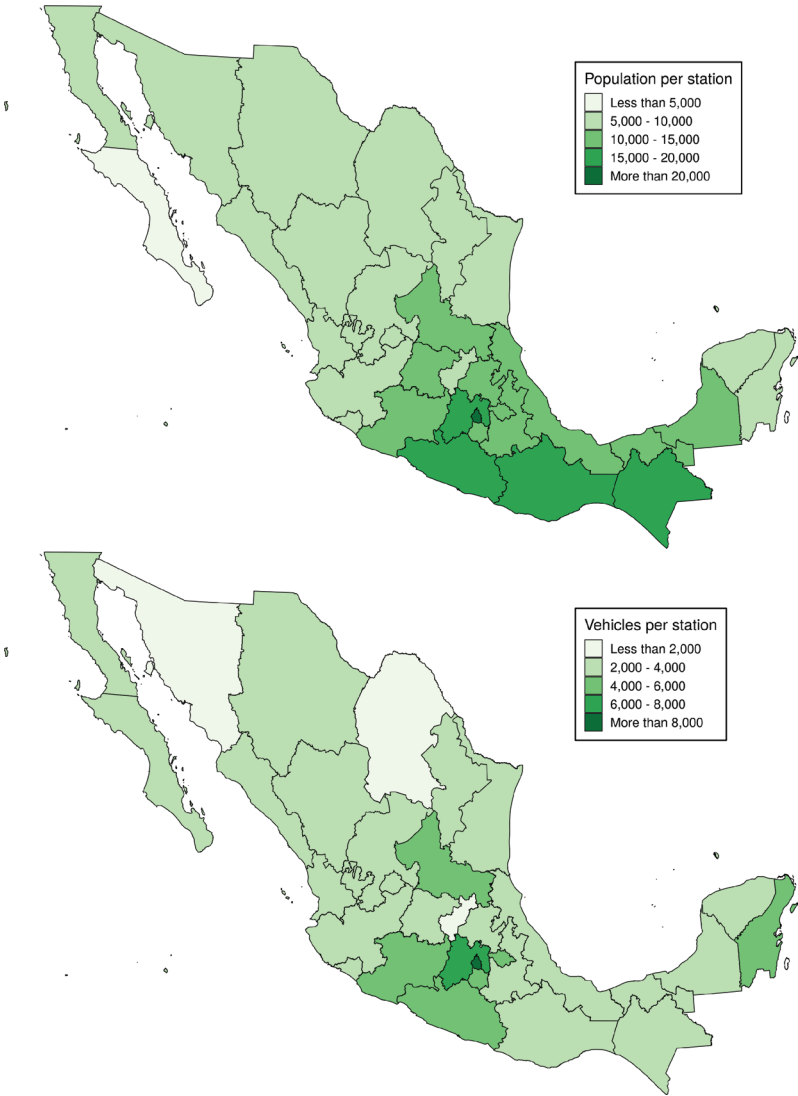


FIGURE 3
Density of gasoline stations.

Note: The two panels of this figure show the population per gas station and number of vehicles per gas station for each of the 32 Mexican states, as of the start of 2017. Sources: INEGI Intercensal Survey 2015 (population data) and the Energy Regulatory Commission (gas station data).

vate investment expands. And moving forward, these investment decisions will be increasingly driven by market factors, leading to more efficient choices.

In the short- and medium-term, this vertical structure raises concerns related to competition. Most importantly, there could be input foreclosure, that is, Pemex could somehow attempt to favor Pemex-branded stations. Pemex could try to charge lower prices to Pemex stations or refuse to sell products to non-Pemex stations. These are mostly franchisee-owned stations, so the incentives here are not completely clear, but it will be critical for the Mexican regulator to keep a close watch on this type of non-competitive behavior.

In the long-term, stations will be able to choose alternative suppliers, and the entire vertical structure may change. In the United States, for example, many gasoline stations are independently owned, while others are vertically integrated with petroleum refineries. A broad existing literature in economics on vertical integration examines the determinants and consequences of various market structures. Previous studies have looked at gasoline markets (Hastings, 2004; Hastings and Gilbert, 2005) as well as other markets such as cement (Hortacsu and Syverson, 2007) and electricity (Bushnell et al., 2008). With Mexico's petroleum sector the starting point is very different from these other markets, but these studies nonetheless provide valuable points of comparison.

✎ 4. CONCLUDING COMMENTS ✎

Milton Friedman in his book *Free to Choose* writes about the power of market competition to increase efficiency. He gives the example of U.S. agriculture, which experienced a 100+ fold increase in labor efficiency during the 19th and 20th centuries. Market competition has the potential to unleash not only productivity improvements but also to spur innovation and to reduce prices. At the same time, economists also continue to be acutely concerned about market power, and the idea that excessive concentration in a market can lead to prices above their efficient level and large transfers from consumers to producers.

Thus it is with great excitement but also real trepidation that we await the continued evolution of Mexico's retail petroleum market. In this paper, we have argued that the rich existing economic literature is a valuable lens through which to view this historic transformation. Mexico's reforms are different from other deregulation processes, given the degree of entrenchment by the incumbent firm and the likely continued dominance of Pemex in upstream markets. Nonetheless, there are many similarities, which we have attempted to highlight in this paper.

However, this paper is a prospective study, and we emphasize that there continues to be a great deal of uncertainty about how this market will unfold. From the government side, there will be more course corrections and perhaps even temporary reversals. From the industry side, there will be periods of growth and optimism, but also periods of challenge and retrenchment. Whichever direction the market goes, we expect the transformation to be of considerable interest to economists and policy analysts interested in market design and optimal regulation.

We urge patience on all sides. Deregulation takes time. With U.S. airline deregulation, for example, even twenty years after deregulation started, the industry continued to become more efficient. Thus it will take time for firms to find new ways to compete, to differentiate, and to increase productivity. We should not try to judge the success of deregulation based on the performance over the first few years. Nor should policymakers be tempted to "re-regulate" at the first sign of trouble. Previous experience shows that benefits continue to accrue over many decades, so deregulation is best viewed through a long time horizon, and it is critical that the market be given an opportunity to work.

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