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

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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 enormous potential to increase efficiency and, eventually, to reduce prices.

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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.

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 about 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 enormous 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 broad and deep political connections at all levels of government.

Mexican gasoline stations are dealer-owned, dealer-operated (DODOs) franchises. The franchisees own the stations and pumps, and manage the stations, but sell 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

¹Pemex franchise agreements are generally confidential, but we have obtained and reviewed

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

2.2 Price Regulation

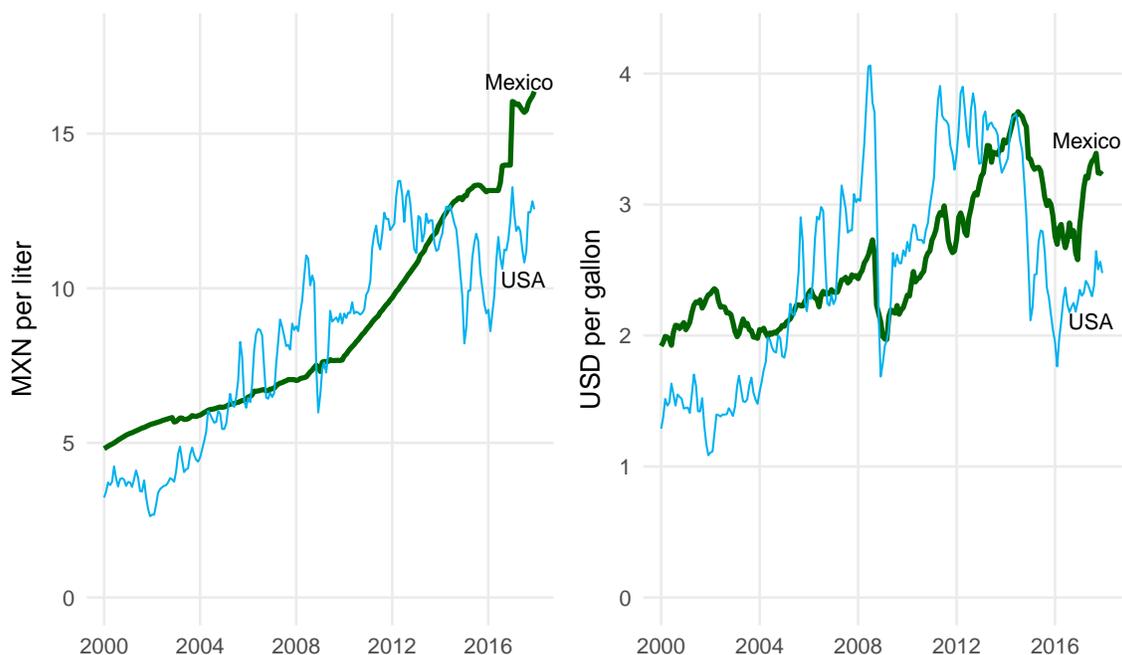
Until very recently, gasoline and diesel prices in Mexico were not market determined. Instead, retail fuel prices were set nationally by the Mexican finance ministry. Not only was there no variation from station to station, but there was also no variation across Mexican states. In July 2016, for example, all stations nationwide sold regular unleaded gasoline for \$2.84 per gallon (13.2 pesos per liter), premium gasoline for \$3.02 per gallon (14.0 pesos per liter), and diesel for \$2.98 per gallon (13.8 pesos per liter).²

Figure 1 plots prices for regular unleaded gasoline in Mexico with average U.S. retail gasoline prices for comparison. 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. For most of the period, Mexican retail prices were below average U.S. prices, and thus reflected an implicit subsidy. This has not always been the case, however. Most recently, since crude oil prices fell sharply in 2014, Mexican gasoline and diesel prices have been above U.S. retail

selected contracts through the “Federal Law of Transparency and Access to Information” *Ley Federal de Transparencia y Acceso a la Información Pública Gubernamental*. 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%.

²Petroleum prices are from Mexico’s *Sistema de Información Energética* with information from *Diario Oficial de la Federación* (SHCP), accessed November 2017.

Figure 1: Mexico and U.S. Retail Gasoline Prices, Regular Grade, 2000–2017



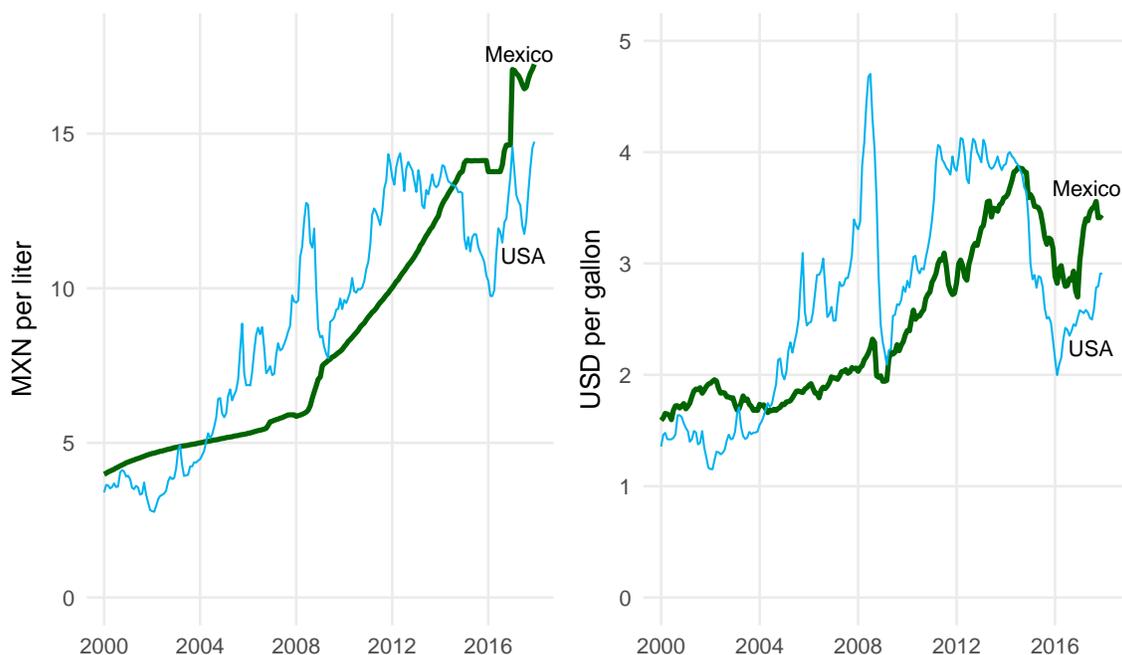
Notes: Prices are the national monthly mean retail prices, including tax, for regular gasoline (both conventional and reformulated). Sources for Mexican prices: Energy Information System (before 2017) and Energy Regulatory Commission (2017). Source for U.S. prices: Energy Information Administration.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

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.

Figure 2 plots diesel prices for 2000-2017. Overall, the pattern is very similar. As with gasoline prices, Mexican diesel prices are set administratively and follow a slow

³During 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 III and Lee, 1987).

Figure 2: Mexico and U.S. Retail Diesel Prices, 2000–2017



Notes: Prices are the national monthly mean retail prices, including tax, for diesel. See Figure 1 for sources.

and steady increase throughout almost the entire period. Moreover, by 2017 Mexican diesel prices are well above U.S. diesel prices, albeit with a somewhat smaller gap compared to the differences for unleaded gasoline in Figure 1.

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.

2.3 Mexico's Energy Reforms

It was against this backdrop that Mexico starting in the 2010s 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 bloated, inefficient markets that could be improved through exposure to competition.

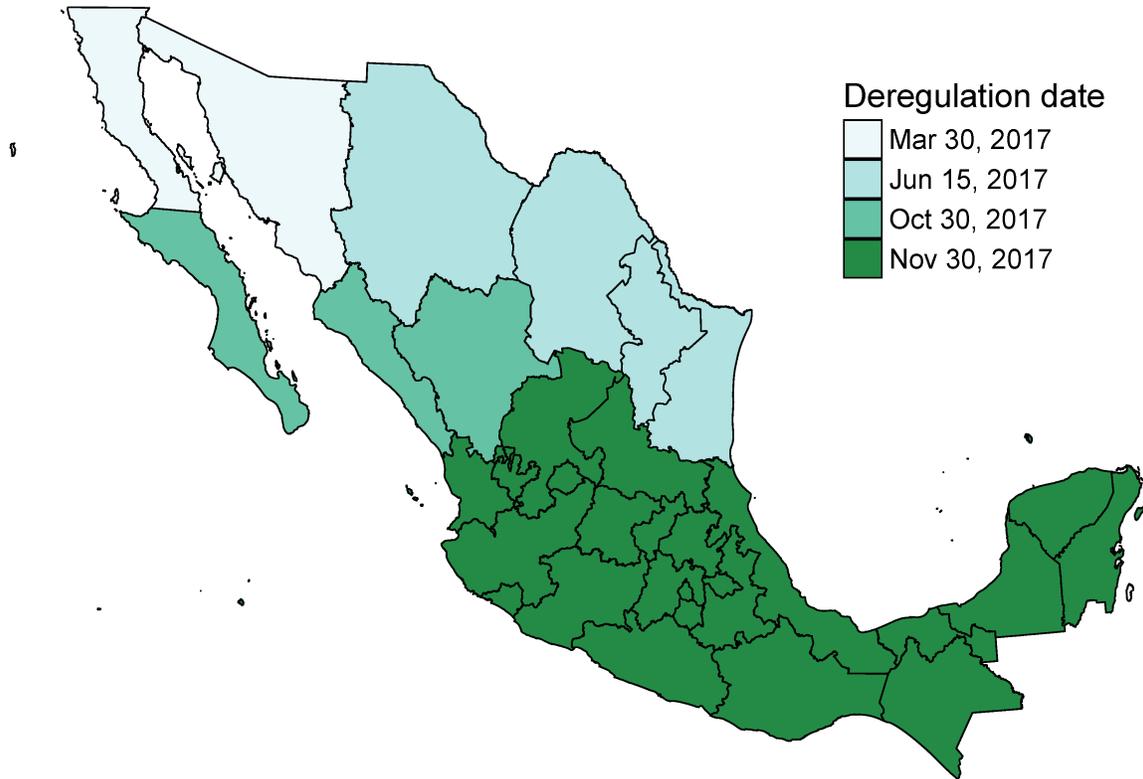
Starting April 1, 2016, independent companies were granted the right to import, transport, store, distribute, and sell petroleum products in Mexico. Companies remain subject to Mexico's environmental regulations (e.g., low-sulfur gasoline), but there are no restrictions on entry or operations, and, after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

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 April 2018, BP operates 197 gasoline stations in Mexico. Shell has also announced that it will be making a significant investment in the sector.

Price controls for retail gasoline and diesel began to be removed starting March 30, 2017. As Figure 3 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.

Figure 3: Gasoline and Diesel Price Deregulation Schedule



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. The ex-refinery price charged by Pemex is set by a regulated formula that uses an average of international crude oil prices in the previous two months. Regulation of

wholesale prices will continue until the wholesale market share of Pemex falls below 70%.⁴

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. We focused on Mexico City as the high-density of gasoline stations allowed us to survey a large number of stations at relatively low cost. The results provide information about product availability, retail offerings, as well as various measures of service quality.

Table 1 presents mean characteristics for the 332 Pemex stations operating in Mexico City as of July 2017. 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. The average store size is 160 square meters.

⁴CRE Resolution 2508/2017: <http://drive.cre.gob.mx/Drive/ObtenerResolucion/?id=14246>.

- 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.
- Stations have an average of 5.8 men working and 1.5 women working.

Without an identical survey, it is impossible to make strong statements about 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.

These results 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.

3 Economic Predictions

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.

3.1 Price Competition

We expect prices to be the single most-studied outcome during deregulation. Fuel prices are of intense public interest. In fact, 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, 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 markups, 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 are allowed only a modest retail markup, leaving little scope for 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.

Moreover, 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 about 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, 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. Although all stations are full-service, station employees often work for tips, and it is even common for employees to pay their employers for the right to work.⁵ 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 very little “fat to cut” when it comes to cost-minimization.

⁵In 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.

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. And unlike retail distribution which uses franchise agreements, these facilities are Pemex-owned and Pemex-operated. In this paper, we are focused 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. In particular, geographical variation in retail and wholesale prices will now provide price signals to investors for profitable locations to build new transportation infrastructure.

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 firms 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. Most studies have found that demand for gasoline and other fuels is relatively inelastic, particularly in the short-run (Hughes et al., 2008; Li et al., 2014; Coglianesi et al., 2017; Levin et al., 2017). On the surface, this evidence would appear to imply a considerable potential for market power in Mexico's retail petroleum markets. However, there are a couple of important issues.

First, most existing studies of gasoline and diesel demand have focused on the United States and other high-income countries. We would expect demand for fuels in a middle-income country to be more elastic. In high-income countries, the cost of travel is dominated by the value of time, so the elasticity with respect to fuel prices is relatively low. In middle-income countries, however, the value of time is lower, so fuel prices themselves are a larger component of the total cost of travel, and thus more important for travel demand. If demand is indeed more elastic in Mexico than in the United States, this will reduce the scope for market power.

Second, and probably more importantly, what matters for market power is the elasticity of demand faced by an *individual* gas station. In contrast, the vast majority of existing studies attempt to estimate the overall demand elasticity with respect to market-wide price variations. The responsiveness of sales at an individual gasoline

station depends on how willing customers are to shop around for prices and on the number and type of nearby stations (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 dispersed, we should expect franchise owners to engage in price competition.

It has long been recognized that market power increases with search costs (Stahl, 1989). Again, however, 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 (2017b) find that Australian consumers search both across stations and over time. In a middle-income country with a lower value of time, willingness to search may be higher, reducing the scope for market power.

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 every gasoline station on its website and through a smartphone app (“Gasapp”). 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 (2017a) 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 and brand of non-Pemex stations that are opened.

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.

There may 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. In the short-run, retailers may attempt to differentiate their product 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.

3.6 Entry and Exit

One of the reasons economists like markets is that they encourage firms to make efficient long-run 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),

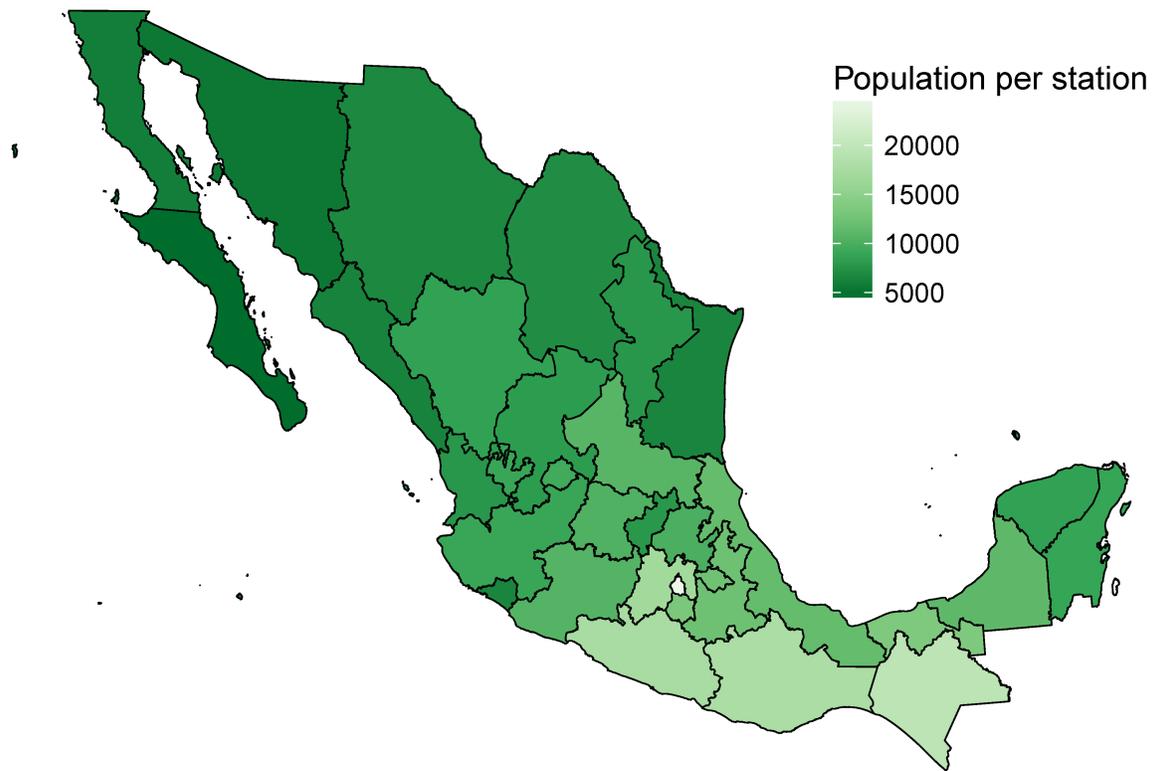
and Mexico's reform represents a unique opportunity to test these models in a new environment.

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.

Figure 4 shows the density of gasoline stations in Mexico before the start of the price liberalization in 2017, expressed as the population in each state divided by the number of stations. The state with the highest density of gasoline stations is Baja California Sur, with one gasoline station for every 4620 residents. At the opposite extreme is Mexico City, with one gasoline station for every 24700 residents. This substantial variation in the baseline level of station density could be due to demand factors (e.g., number of vehicles) or supply factors (e.g., local political constraints).

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,

Figure 4: Density of Gasoline Stations



Notes: The map shows the population 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).

each operating at larger scale with more pumps per station.

3.7 Vertical Integration

Historically, the pattern of vertical integration in Mexico's petroleum sector has not been particularly interesting. In particular, state-owned Pemex has done everything, controlling the entire petroleum supply chain, and then selling refined products to franchised Pemex stations. All gasoline stations in Mexico were required to buy their

gasoline and other refined products from Pemex.

In the short-term, Pemex will continue to dominate these upstream markets. 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 is going to become less necessary as private 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 a couple of serious concerns related to competition. Most importantly, there could be input foreclosure, that is, Pemex may 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.

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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%
Average Size of Store For Stations with Stores, Square Meters	160
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.