

When Institutions Don't Matter:

The Rise and Decline of the Mexican Oil Industry

Stephen Haber, Noel Maurer, and Armando Razo

Abstract: This paper argues that there are circumstances under which institutions do not matter for economic outcomes. This can be the case if an industry has specific technological features that limit the ability of a government to raise taxes or expropriate the industry. It can also be the case if the industry is able to call on a foreign government to enforce its property rights. When both factors come into play, economic agents can easily mitigate attempts to reduce their property rights. We explore the implications of this framework by focusing on what is often assumed to be a canonical case of institutional change having a negative economic outcome: the Mexican oil industry during the period 1910-1929. We demonstrate that attempts by the Mexican government to reduce property rights were easily thwarted by the oil companies. In doing so, we challenge much of the existing historical literature on Mexican petroleum, which tends to argue (implicitly) that institutional change drove the oil companies out of Mexico. We demonstrate, instead, that Mexico simply ran out of oil deposits that could be extracted at a competitive cost, given prices, technology, and competing sources. This argument is sustained by a systematic analysis of quantitative data on oil company investment flows, drilling and exploration programs, leaseholds, rates of return, stock prices, and taxes.

Haber is Peter and Helen Bing Senior Fellow of the Hoover Institution, Professor of Political Science and History, and Director of the Social Science History Institute at Stanford. Maurer is Assistant Professor of Economics at the Instituto Tecnológico Autónomo de México. Razo is a Ph.D. Candidate in Political Science at Stanford.

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In 1921 Mexico accounted for 25 percent of the world's output of petroleum, making it the second most important producer after the United States. Over the next nine years Mexican output declined continuously and precipitously. By 1930, output was only 20 percent of what it had been in 1921, and Mexico accounted for only 3 percent of world production. Mexico would not again reach its 1921 levels of output until 1974. It never regained its 1921 market share.

One can advance either of two hypotheses regarding the dramatic decline of Mexico's petroleum industry. One hypothesis would focus on the role of institutions, particularly those that governed the property rights of the oil companies. In this view, the industry's decline came on the heels of a long and violent revolution (the Mexican Revolution of 1910). One result of that revolution was a new Constitution, written in 1917, that ended a 33-year tradition of fee-simple property rights over petroleum and instead vested property rights with the federal government. Another result of that revolution was continually rising taxes on petroleum production and exportation. A third result of that revolution was endemic political instability—which endured until 1929 (when the forerunner to the PRI was founded). This meant that no commitments made by Mexican governments toward the oil companies were credible: new governments, desperate for funds, had every incentive to renege on earlier agreements.

A second, competing hypothesis would focus on the specific geologic features of Mexico. In this view, Mexico simply ran out of oil deposits that could be extracted at a competitive cost, given prices, technology, and competing sources. The decline of Mexico's oil industry in the 1920s is analogous to the history of Pennsylvania oil in the late nineteenth century. At one time, Pennsylvania was the largest producer of oil in the United States.

Pennsylvania has not been a consequential producer of petroleum for decades, but no one thinks that this is the result of political instability, high taxes, or Pennsylvania's institutions.¹

Some historians of Mexico have favored the first hypothesis.² Others have favored the second hypothesis.³ Some have even argued that both hypotheses are true.⁴ Regardless of the substance of their arguments, all sides in this debate have two things in common. First, they tend not to specify hypothesis in a falsifiable manner. Second, they do not bring to bear much in the way of systematically retrieved and analyzed data.⁵

We argue, based on the retrieval and analysis of systematic data, that the weight of the evidence supports the hypothesis that Mexico's petroleum industry went into decline because of factors specific to Mexico's geology. Every single measure of new investment that we develop points to the same conclusion: the foreign oil companies that dominated Mexico's petroleum industry continued to explore and invest well after output began to fall. They simply could not find sources of petroleum that could be extracted at a reasonable

¹ Mexico had more oil, of course, and these deposits were tapped in the 1970s. The problem was that it was not possible to either discover or tap those sources with 1920s technology. In fact, most of Mexico's current oil wells are offshore and have to be accessed at depths an order of magnitude beyond the technological abilities of 1920s producers.

² See, for example, Hall, *Oil, Banks, and Politics*, especially p. 35.

³ See, for example, Meyer, *Mexico and the United States*, p. 9.

⁴ Jonathan Brown, for example, takes this approach. "For eleven years, from the promulgation of the 1917 constitution to the 1928 Calles-Morrow agreement, the government sought to enforce public dominion over a resisting industry. The conflict retarded exploration and drilling programs. By the time that the companies and the government had settled the issue of public dominion sufficiently to permit new exploration in Mexico, cheaper production from Venezuela had captured world markets while prices reached a nadir." Brown, "Why Foreign Oil Companies," p. 385.

⁵ Thus, for example, historians chronicle changes in specific taxes on petroleum companies in great detail, implying that these had a significant effect on decisions by the oil companies to stay or leave Mexico, but do not calculate the effect of the taxes on revenues or profits. See, for example, Brown, *Oil and Revolution*, pp. 40, 179, and 236-37; Meyer, *Mexico and the United States*, p. 37, 62-63; Rippy, *Oil and the Mexican Revolution*, p. 29, 46, 119-120; Davis, "Mexican Petroleum Taxes," p. 406, 408-09, 414-16; Hall, *Oil, Banks, and Politics*, pp. 19, 67. Similarly, there are assertions in the literature that threats to property rights induced the oil companies to stop exploring or investing—but these assertions are not supported by systematic evidence about the stocks or flows of new investment. See, for example, Meyer, *Mexico and the United States*, pp. 11, 57.

price using existing technology. Moreover, increases in taxes had little impact on their investment decisions: movements in tax rates had only a minor impact on corporate rates of return. Finally, the oil companies were not concerned about changes in their de jure property rights. They believed—correctly, it turned out—that they could mitigate the impact of those reforms.

The Mexican petroleum industry is, in short, a case where the specific features of a country's political institutions (the rules, regulations, and their enforcement mechanisms) did not matter for economic outcomes. What mattered were the specific features of the broader political economy of the oil industry. In the first place, the industry was owned by powerful constituents of powerful countries. They could appeal to the U.S. government to apply diplomatic pressure or threaten military intervention when their property rights were threatened. The U.S. could not, of course, threaten to send in the Marines every time the Mexican government tinkered with the tax rate. U.S. intervention was only a credible threat in the case of expropriation or tax levels so high that they amounted to *de facto* expropriation.

The Mexican government could not, however, engage in “creeping expropriation” (by gradually raising taxes until it had extracted all of the quasi rents generated by the industry). The government was hamstrung by three specific features of the industry and its relationship to it. First, oil taxes were the single biggest source of government revenue, accounting, at their peak, for one-third of all government income. Second, in the short run, the government could not run the industry itself: it lacked the know-how to find, extract, and market the oil. Even had it been able to ignore the threat of U.S. intervention, any expropriation or reallocation of property rights would have produced at least a temporary fall in income. Third, the time horizon that mattered to governments was the short run. Every government from 1911 to 1929 faced the continual threat of armed factions and

internal coups. No government could therefore have survived even a short-run decline in oil tax revenues. The oil companies could therefore threaten to hold back production in order to deprive the government of crucial revenues. If timed correctly, such production cutbacks could undermine the government's ability to defend itself against opposing factions. The government, in short, found itself in the position of needing the oil companies more than the oil companies needed the government.

This paper is organized as follows. The first section overviews the history of the Mexican oil industry from its beginnings around 1900 to the 1930s. It specifically focuses on the effects of the Mexican Revolution of 1910, and the subsequent two decades institutional change and political instability. The second section presents data on output and investment by the oil companies. It shows that investment and exploration continued at high levels for several years *after* output began to decline. This pattern is not consistent with a story of falling investment caused by uncertainty over property rights. The third section quantifies the magnitude and impact of petroleum taxes on the industry. While tax rates rose, the industry remained profitable. In fact, the rise in oil taxes was more than compensated for by a rise in oil prices, and the after-tax price for a barrel of Mexican crude rose substantially. The fourth section gathers data on two groups of petroleum companies—six which operated within Mexico, and three which operated across the world—in order to test the hypothesis that investors were not unduly perturbed by the political instability and institutional changes which gripped Mexico in the 1910s and 1920s. The performance of stock prices indicates that they were not. The fifth section compares the Mexican oil industry to a simple counterfactual—Mexico's other extractive industries during the same time period. The silver, copper, and lead mining and refining industries faced a similar institutional

environment as the oil companies, but very different geological endowments. Output in these industries did not decline in the 1920s.

Historical overview

Mexico's oil industry began as a source of domestic energy. At the time that the first oil companies began to explore Mexico's lagoons, swamps, and coastal plains for petroleum, their vision—and that of the dictatorship of Porfirio Díaz (1876-1911)—was to produce for the national market.⁶ The Díaz government had strong incentives to develop this industry because the Mexican economy faced high energy costs.⁷ The problem for the Díaz government was that the costs of developing the oil industry were huge and the time horizon uncertain. Díaz therefore reformed Mexico's institutions to attract investment rapidly. In 1884 he allocated the rights to subsurface petroleum to the owner of the surface. In 1892 he refined this law, stating that the owners of surface rights could freely exploit subsoil wealth without any special concession or permission from the government. In 1901, Díaz obtained authorization from Congress to award drilling concessions on federal lands without Congressional consent. He also obtained the right to grant tax exemptions to firms willing to invest in oil exploration. Finally, in 1909 he reformed the law yet again, putting an end to any remaining ambiguities in the earlier laws, declaring that the fields or deposits of mineral fuels were the “exclusive property” of the surface landowner.⁸

⁶ Brown, *Oil and Revolution*, p.44-45; Meyer, *Mexico and the United States*, pp. 3 and 4.

⁷ These high costs were the product of the need to import coal and oil from the United States. The refining and distribution of this oil was monopolized by an affiliate of Standard Oil. See, Meyer, *Mexico and the United States* p. 4; Brown, *Oil and Revolution*, pp. 14-21.

⁸ For the most thorough history of the Porfirian oil laws, see Rippy, *Oil and the Mexican Revolution*, pp. 15-28. Also see, Meyer, *Mexico and the United States*, pp. 24-25; Brown, *Oil and Revolution*, p. 93.

Two firms in particular took advantage of these institutional reforms—particularly the tax holidays. Edward L. Doheny, a California oil man who arrived in Mexico at the invitation of the Mexican Central Railway to prospect for oil, received a ten-year exemption covering both import tariffs on the necessary machinery *and* taxes on the resulting output.⁹ Sir Weetman Pearson’s El Águila oil company (also known as the Mexican Eagle Oil Company) received a 50-year exemption from taxes.¹⁰ Both companies received protection from external competition by a tariff of 3 centavos per kilo of imported crude oil and 8 centavos per kilo on imports of refined oil.¹¹ It was nearly a decade before either Doheny or Pearson found enough oil to make their operations profitable. By 1911, however, Mexico had emerged as the world’s fourth most important oil producer, with Doheny and Pearson controlling 90 percent of the output.¹²

Unfortunately for the oil magnates, the political system than underpinned their property rights was coming to an end. Díaz was overthrown in 1911, and for the next 18 years Mexico found itself amidst turmoil as various factions attempted to control the government.

⁹ Doheny’s Mexican Petroleum Company and its numerous subsidiaries ultimately came to control 1.5 million acres of land, either through fee simple ownership or leasehold. The Mexican Petroleum Company of Delaware, Ltd. was a holding company for a network of firms that included the Mexican Petroleum Company of California, the Huasteca Petroleum Company, the Tuxpan Company, and the Tamihua Petroleum Company. In 1917 these firms were all brought together by Doheny under the aegis of another holding company, The Pan-American Petroleum and Transport Company. The structure of this interlocking group of companies is analyzed in *Moody’s Investment Manual*.

¹⁰ Pearson was one of the late nineteenth century’s master civil engineers and entrepreneurs. He built the Blackwall Tunnel under the River Thames, as well as four tunnels under New York’s East River. His financial empire eventually came to include the *Financial Times*, the *Economist*, and Penguin Books. Yergin, *The Prize*, p. 230. A detailed analysis of Pearson’s history as Mexico’s major public works contractor can be found in Connolly, *El contratista de don Porfirio*. For the details of his tax exemptions and special privileges, see Meyer, *Mexico and the United States*, pp 23-24. Brown, *Oil and Revolution*, p. 28, and *Moody’s Manual of Investments*, 1913, p. 1536. El Águila also received a zone of three kilometers surrounding each producing well, within which no other party would be allowed to drill. The purpose was to protect Pearson against offset drilling. Lewis, “An Analysis,” p. 41.

¹¹ Brown, *Oil and Revolution*, pp. 63-64.

The revolution that overthrew Díaz (1910-11) was followed by a counter-revolution (1913), a counter-counter revolution (1913-14), a civil war (1914-17) a successful coup against the first constitutional president (1920), two more bouts of civil war (1923-24 and 1926-29), multiple failed coups (1920, 1921, 1922, 1927), and a presidential assassination (1928). Mexico would not regain political stability until 1929.

This period of coups, revolutions, and civil wars produced a series of institutional reforms that attempted to reduce the property rights of the oil companies. First, every single government from 1911 to 1929 tried to find ways to increase oil taxes. Second, in 1917 Mexico wrote a new constitution which completely reformed the property rights system. Article 27 of the Constitution of 1917 made oil and other subsoil wealth the property of the nation. Third, Mexico's governments, beginning in 1917, tried to write and enforce enabling legislation to the constitution that severely reduced the property rights of the oil companies—even if those rights had been acquired before the constitution was written.

Every single government from 1911 to 1928 viewed the oil companies as a cash cow. Every single one of them also tried to redefine the oil companies' property rights. The escalation of taxes began under Mexico's first revolutionary President, Francisco Madero (1911-13). Madero increased the excise tax on oil from a negligible amount under Díaz to 20 centavos per ton of oil. He also tried to triple the bar tax from 10 centavos per ton to 30 centavos. The companies launched a campaign against the bar tax increase, and ultimately negotiated a tax increase of ten centavos instead of twenty.¹³ In the process, they formed a lobbying organization, the Association of Petroleum Producers in Mexico (APPM). Madero

¹² *Mexican Year Book*, p. 79. Even as late as 1918, after dozens of other companies had entered the market, El Águila and the Mexican Petroleum Company still controlled 65 percent of Mexican crude production. Calculated from data in Brown, *Oil and Revolution*, pp. 125.

¹³ Brown, *Oil and Revolution*, p. 179; Meyer, *Mexico and the United States*, p. 37; Rippy, *Oil and the Mexican Revolution*, p. 29. Davis, "Mexican Petroleum Taxes," p. 406.

also demanded that the oil companies register their holdings with the government, in order to be able to identify owners in case of expropriation. The oil companies simply refused to comply, and Madero, lacking the ability to win a showdown with the companies, dropped the demand.¹⁴

The overthrow and assassination of Madero in 1913 intensified the military conflict. Madero's successor (and assassin), General Victoriano Huerta, needed funds even more desperately than his predecessor. Huerta hiked taxes on the importation of oil equipment by 50 percent—ignoring the companies' Porfirian-era exemptions. He further raised the stamp tax, from 20 centavos to 75 centavos per ton of oil. Several months later, Huerta increased the bar duties to one peso per ton.¹⁵ We estimate that the tax burden rose from ten percent of the value of gross output under Madero to slightly more than 15 percent under Huerta. American oil companies refused to pay most of the tax increases. Huerta could not actually do anything about their recalcitrance, because his army did not control the oil zone—his opposition did.¹⁶

Huerta's regime collapsed in 1914, but his fall from power did not bring relief to the oil companies. The oil zone was in the hands of one of two anti-Huerta factions (the Carrancistas—the followers of Venustiano Carranza), and that faction needed revenues to win a civil war against its former allies, who had now become its mortal enemies (the

¹⁴ In 1913 the Chamber of Deputies actually received a proposal to nationalize the industry. Rippy, *Oil and the Mexican Revolution*, p. 29. Also see, Meyer, *Mexico and the United States*, pp. 31, 32.

¹⁵ Brown, *Oil and Revolution*, pp. 181, 184. There is some dispute in the historical literature about exact tax rates. Davis puts the bar tax at 50 centavos per ton. Davis, "Mexican Petroleum Taxes," p. 406.

¹⁶ Brown, *Oil and Revolution*, pp. 182-87.

Villastas and the Zapatistas). Carranza attempted to use new taxes, drilling permits, and the substitution of royalty-generating concessions for fee-simple titles to generate revenues.¹⁷

The oil companies successfully resisted Carranza's efforts. The mix of taxes changed, and government revenues increased (because of a dramatic rise in petroleum output) but the tax rate actually *fell* during Carranza's tenure in office. Within weeks of their retreat from Mexico City to Veracruz in 1914, Carranza's government began to try to squeeze the oil companies. Candido Aguilar, the Carrancista military commander in Veracruz, extracted small forced loans of 10,000 pesos from the El Águila and Huasteca oil companies.¹⁸ He also demanded that firms pay the bar duties in gold.¹⁹ When the oil companies refused, Aguilar threatened to shut down their pipelines. He simultaneously declared null and void all oil concessions given by the Huerta regime. A short time later, he forbade the sale or leasing of lands to the oil companies without federal authorization. The U.S. State Department protested to Carranza, who reversed all of Aguilar's decrees, save the rise in the bar tax. Carranza also agreed that the tax could be paid in paper pesos, rather than gold pesos or dollars. The companies paid under protest.²⁰

Carranza was not satisfied with these small gains, but he needed to know how far he could push the oil companies if he was to extract the maximum amount of taxes from them. Therefore, in January 1915 he demanded that they turn over their financial data. He also levied an assessment for back taxes. With the support of the State Department, the oil

¹⁷ Meyer, *Mexico and the United States*, p. 46.

¹⁸ Brown, *Oil and Revolution*, p. 259.

¹⁹ There is some confusion in the historical literature about the tax rate in the early years of the Carranza government. According to Davis, Carranza lowered the stamp tax from 75 centavos per ton to 60 centavos per ton. The bar tax was also lowered: from one peso per ton to 50 centavos per ton. Davis, "Mexican Petroleum Taxes," pp. 406. Brown, on the other hand, simply states that Carranza raised the bar duties.

companies refused to turn over the requested financial data and negotiated their way out of paying the back taxes.²¹ In fact, the companies managed to obtain a reduction in the bar tax from 50 centavos to 10 centavos per ton. Our estimate of the overall tax rate indicates that the tax burden from 16 percent to 14 percent between 1914 and 1916.

In 1917, Carranza raised taxes back to their 1914 level. On April 13th, he changed the excise tax on petroleum to an ad valorem production tax.²² Crude petroleum and fuel oil were assessed at ten percent of their value, based on the New York price. Specific duties were levied on refined products. Domestically consumed output was exempted.²³

The Carranza government also reformed the institutions governing property rights. Article 27 of the Constitution of 1917 made oil and other subsoil wealth the property of the nation. This meant that the oil companies no longer had a right to the oil beneath the ground. Instead, they had a revocable concession from the federal government to exploit a national resource. Worse yet, the Constitution declared the banks and beds of rivers, streams, lagoons, lakes, and other bodies of water federal property. The oil fields, of course, sat along Mexico's Gulf Coast and were crisscrossed by innumerable bodies of water.²⁴ The government therefore had the right to award drilling rights to third parties on those lands,

²⁰ Carranza also agreed to recognize the validity of the tax payments made by the companies to Huerta. Meyer, *Mexico and the United States*, p. 28, 47-48. Brown, *Oil and Revolution*, pp. 214-15.

²¹ Carranza agreed to credit their tax bills with past shipments of oil they had made to the government owned railroads. Meyer, *Mexico and the United States*, pp. 48-49.

²² This was formally called a production tax, but only oil that was exported actually paid it. The reason that the government engaged in this semantic game was because its export taxes were pledged to pay the government's bonded debt. Calling it a production tax allowed Carranza to deploy the revenues for domestic needs, such as paying the army. Rippey, *Oil and the Mexican Revolution*, p. 119. Davis, "Mexican Petroleum Taxes," pp. 408-09.

²³ Davis calculates that the conversion of the stamp tax to an ad valorem tax resulted in an increase in the tax rate on crude oil from 60 centavos to 1.16 to 1.40 pesos (the amount depending on the specific gravity) per barrel. Davis, "Mexican Petroleum Taxes," p. 408-10.

²⁴ Brown, *Oil and Revolution*, p. 226; Meyer, *Mexico and the United States*, p. 55.

allowing them to tap into the common pool of oil that the oil companies had already identified.²⁵

No one debated the right of the Mexican government to declare that the subsoil was national patrimony.²⁶ The real bone of contention between the oil companies and Carranza's government was whether Article 27 affected the millions of acres of land already owned or leased by the oil companies, or whether it only pertained to new lands. The oil men argued that Article 27 only affected properties acquired or leased after May 1, 1917 (the date the Constitution took effect) because Article 14 of the Constitution stated that laws cannot have retroactive effects. By extension, the companies did not have to obtain drilling permits to lands acquired prior to this date because they already had property rights to the oil. President Carranza, of course, did not agree with this analysis.²⁷

At first, Carranza took a strong position in regard to the retroactivity of Article 27. On February 19th, 1918, Carranza decreed a five percent royalty on all petroleum production and levied a tax of 10 to 50 percent on the value of royalties paid to lessors, the exact tax rate depending on the royalty rate per hectare. The decree also required that the oil companies register their properties with the government. If they failed to do so within three months,

²⁵ By 1922 the Mexican government had set up its own bureau to explore the 86 percent of the oil lands held as public lands. The company came to produce one percent of Mexican output, but according to Standard Oil of New Jersey, it obtained its production primarily by drilling in the federal zones of creek beds, lagoons, and ponds within the boundaries of established private oil fields. Rippy, *Oil and the Mexican Revolution*, p. 164. Also see Hall, *Oil, Banks, and Politics*, pp. 25-26; and Brown, *Oil and Revolution*, p. 227.

²⁶ In fact, the *only* country after 1917 where the owner of the surface land was also the owner of the subsoil rights was the United States of America.

²⁷ Brown (1993), p. 227. For a discussion of these views, as well as the legal theories that underpinned them, see Rippy (1972), p. 33-43.

third parties could “denounce” or lay claim to the land. The decree affected all contracts and property rights, regardless of whether they had been acquired before or after 1917.²⁸

Carranza’s attempt to increase oil taxes failed. All the oil companies refused to pay the royalty. Virtually all the companies refused to register their lands.²⁹ The government responded by giving out unregistered claims to Mexican citizens.³⁰ Carranza also ordered the army to occupy the oil fields and cap recently drilled wells. At this point, the U.S. State Department intervened. Carranza had no choice but to back down, because his regime could not survive even a temporary interruption in petroleum tax revenues. In fact, not only did Carranza fail to raise taxes—the weight of oil taxes collected actually fell from 16 percent of gross revenues in 1917 to 11 percent in 1919, Carranza’s last full year in power.³¹

When Alvaro Obregón came to power in 1920 he evidently believed that he enjoyed a stronger negotiating position against the oil companies than had Carranza. He therefore hiked oil taxes the following year.³² On June 7, 1921 Obregón imposed a new oil export tax. This was a specific duty of from 1.55 to 2.50 per cubic meter of petroleum (depending on

²⁸ Rippy, *Oil and the Mexican Revolution*, pp. 42-43; Meyer, *Mexico and the United States*, p. 62.

²⁹ El Águila and La Corona (a Royal Dutch/Shell subsidiary), however, agreed to register their lands. El Águila made it very difficult for the oil companies to maintain a united front against the government. In fact, in 1920 it negotiated a deal by which company was no longer free of export, capital, or production taxes. It also gave up the right to a protected zone three kilometers around its open wells. It agreed pay a royalty of 25 percent of production in specie or cash, at the option of the government. In return it received private lands in the states of Tabasco and Veracruz. Hall, *Oil, Banks, and Politics*, pp. 76-77.

³⁰ Meyer, *Mexico and the United States*, p. 62; Brown, *Oil and Revolution*, pp. 231-32, Rippy, *Oil and the Mexican Revolution*, pp. 43-45.

³¹ Revisions of the production tax changed the method of valuing the crude, but also raised the nominal rates. Davis, “Mexican Petroleum Taxes,” pp. 208-10; Meyer, *Mexico and the United States*, pp. 62-63. Rippy, *Oil and the Mexican Revolution*, p. 46; Hall, *Oil, Banks, and Politics*, pp. 19, 67, Brown, *Oil and Revolution*, pp. 236-37.

³² In 1920 Obregón decreed a tax on “infalsificables” (paper money printed during the Revolution). This was levied as a surcharge on taxes paid by oil and mining companies at a rate of one peso in paper infalsificables for every peso paid in gold. Davis (1932), p. 412. It is not clear if this tax amounted to more than a small surcharge on existing petroleum taxes, because infalsificables only traded at 10 centavos to the peso in 1920. (Infalsificables were quoted as merchandise in the *Boletín Financiero y Minero*.) The government’s apparent

the crude's specific gravity), that was assessed in addition to Carranza's export tax.³³ We calculate that by 1922 the combined incidence of these taxes reached 25 percent of the value of gross production.

Tax hikes of this magnitude provoked strong resistance by the oil companies. In protest against the increase, they curtailed output. Exports fell from over 14 million barrels per month to less than six million barrels per month in the summer of 1921.³⁴

Obregón was taking a calculated risk. He knew that a prolonged shutdown of the oil industry could bring down his government. The gamble was that the oil companies would compromise on a tax rate somewhere between the 1919 tax rate and Obregón's 1921 demands.

Obregón's gamble paid off. In order to break the deadlock, the oil companies sent a delegation—the so-called Committee of Five—to a secret conference in Mexico City.³⁵ The agreement reached by the oil companies and Obregón was not made public, but its terms were made clear by the subsequent actions of each party. The oil companies agreed to pay Obregón's export tax, in addition to all taxes instituted before 1920. The government, for its part, agreed that the oil companies could pay the export tax in Mexican bonds, which could be purchased for forty cents on the dollar. Shortly thereafter, the government declared that the export tax had to be paid in cash, but simultaneously lowered the nominal tax rate to

purpose was to enlist the oil and mining companies as its agents in collecting the outstanding emissions of paper money and removing them from circulation.

³³ There are approximately 6.5 barrels of petroleum per cubic meter. A barrel of petroleum is 42 gallons.

³⁴ Rippy, *Oil and the Mexican Revolution*, p. 119, Meyer, *Mexico and the United States*, p. 82. Davis, "Mexican Petroleum Taxes," pp. 413-15.

³⁵ The "Committee of Five," as they were called were: Walter Teagle of Standard Oil of New Jersey, E.L. Doheny, of Mexican Petroleum Company, J.W. Van Dyke of Atlantic Refining, Harry Sinclair of Sinclair Oil, and Amos Beaty of the Texas Company. Hall (1995), pp. 28-30.

forty percent of its former value.³⁶ In short, the oil companies managed to negotiate a 60 percent reduction in Obregón's new export tax. The overall tax rate therefore fell from 25 percent of the gross value of production in 1922, to 20 percent by 1924.³⁷

The question of the retroactivity of Article 27, however, remained unresolved. In 1922 the Mexican Supreme Court, in a case brought by the Texas Company, ruled in favor of the oil companies. Article 27 could not be retroactive as long as the companies had undertaken "positive acts." The problem was that the definition of "positive acts" was ambiguous. Did it mean that the companies had to be extracting oil, that they had drilled for oil, that they had mapped the area, or just that they had purchased or leased the land? Depending on what definition was applied to "positive act," between 80 and 90 percent of the oil companies' lands could still be affected by the Constitution.³⁸

The United States again intervened in order to resolve the dispute. The State Department wanted a treaty that explicitly recognized and protected American property rights. Obregón, however, refused to agree to a treaty that would limit Mexican sovereignty. The two sides therefore came to a gentlemen's agreement in which the property titles of the oil companies would be turned into "confirmatory concessions" (a de facto recognition of the oil companies' property rights) provided that the oil companies had made "positive acts" to the property. Positive acts were defined in the broadest way imaginable. Thus, leasing land before May 1st, 1917, even if the companies had not actively searched for oil, would be

³⁶ The government also dropped the infalsificables tax. Davis (1932), pp. 414-16; Rippy (1972), p. 120. The tax rates of different products, before and after the decree, can be found in Engineering and Mining Journal, Vol. 114, No. 10, p. 420.

³⁷ Due to the oil companies' resistance, taxes incurred in 1921 were not actually paid until 1922, after the negotiated agreement. This is why the tax rate spiked in 1922, despite the agreement.

³⁸ Meyer, *Mexico and the United States*, pp. 84-85; Hall, *Oil, Banks, and Politics*, pp. 115 and 137; Rippy, *Oil and the Mexican Revolution*, p. 80.

considered a positive act. Similarly, the purchase of land before May 1st, 1917 for a price that reflected the potential oil-bearing nature of the subsoil also would be a positive act.³⁹ In return, the United States agreed to recognize the Obregón government.

No sooner did Álvaro Obregón name his protégé, Plutarco Calles, to the presidency in 1924, than Calles (unsuccessfully) attempted to abrogate the agreement with the United States. President Calles hand-picked a congressional committee charged with writing enabling legislation to Article 27. The committee drafted a law that defined positive acts only as actual drilling prior to May 1st, 1917. In addition, property holders had to apply for confirmation of their rights.⁴⁰ In December 1925 the Mexican Congress approved the law. Predictably, the oil companies filed injunctions, citing the 1922 Supreme Court decisions. President Calles responded that his government was bound by neither the agreement with the U.S. government nor, astoundingly, by the decisions of the Mexican Supreme Court.⁴¹

Mexico's leading oil producers decided to openly defy the new law.⁴² President Calles responded by remanding the oil companies to the Attorney General, and canceling drilling permits. The oil companies drilled without permits. Calles upped the ante, imposing heavy fines and capping wells that lacked permits. The companies broke the seals on the wells. The government sent in troops and capped the wells again.⁴³

³⁹ Meyer, *Mexico and the United States*, p. 102; Rippey, *Oil and the Mexican Revolution*, pp. 89-91; Hall, *Oil, Banks, and Politics*, p. 149.

⁴⁰ The law also imposed a 50-year limit on the confirmations, counting from the time that operations began, and reaffirmed that subsoil rights were not recognized along coasts and national borders.

⁴¹ Meyer, *Mexico and the United States*, pp. 110-112, and 115; Hall, *Oil, Banks, and Politics*, p. 173; Rippey, *Oil and the Mexican Revolution*, pp. 57-58.

⁴² These firms controlled 90 percent of the oil producing lands in Mexico and 70 percent of current output. Rippey, *Oil and the Mexican Revolution*, p. 70.

⁴³ Meyer, *Mexico and the United States*, pp. 123-124; Rippey, *Oil and the Mexican Revolution*, pp. 58-59 and 167-168; Sterret and Davis, *The Fiscal and Economic Condition*, pp. 205-206.

Once again, the United States stepped into the breach. President Calles's government was fighting a vicious—and stalemated—civil war against rebels angry with his attacks on the Catholic Church.⁴⁴ President Coolidge took advantage of this fact, and announced that the United States was going to allow the transport of arms across the border. This was of obvious concern to a government fighting a civil war. Coolidge followed this up in April 1927 by issuing a corollary to the Monroe Doctrine. The corollary declared that the persons and property of American citizens, even abroad, enjoyed protection from the United States.⁴⁵

Armed with Coolidge's threat, Ambassador Dwight Morrow brokered a deal with Calles to break the deadlock. On November 17th, 1927 the Supreme Court, on Calles's instructions, granted an injunction against the 1925 oil law. Shortly thereafter, Congress formally amended the law. On March 27th, 1928, the State Department announced that the controversy beginning in 1917 was at a practical conclusion. Further discussions concerning the oil question would have to be handled through Mexico's executive departments.⁴⁶ The issue of the rights to the subsoil was settled. Properties acquired or leased prior to May 1st, 1917, were not affected by Article 27 of the Constitution of 1917.

The issue of property rights over Mexico's petroleum would only re-emerge in 1938, when the government of Lázaro Cárdenas nationalized the industry. This was possible precisely because the factors that limited the governments of the 1910s and 1920s were no longer operating. The industry was no longer a consequential contributor to the fisc, the polity was stable (hence the government had a longer time horizon), and the U.S.

⁴⁴ This civil war is commonly referred to as the Cristero War of 1926-29. The rebels were never defeated militarily. Rather, facing both the Cristeros and a military revolt, Calles backed down in the face of American pressure in 1929 and agreed to cease trying to enforce the Constitution of 1917's anticlerical provisions.

⁴⁵ Rippy, *Oil and the Mexican Revolution*, p. 170.

⁴⁶ Rippy, *Oil and the Mexican Revolution*, pp. 62-63; Meyer, *Mexico and the United States*, pp.133-134; Sterret and Davis, *The Fiscal and Economic Condition*, pp. 205-06.

government had publicly declared in the Good Neighbor Policy of 1934 that it was no longer going to enforce the property rights of U.S. companies abroad. The proximate causes of the nationalization were a dispute between oil workers and the foreign companies, but the larger point we would make is that the fundamental nature of the political economy of the industry had changed.

Output and Investment

Given this description of historical events, one could easily draw the conclusion that the oil companies perceived that they were in an environment where their property rights were indefensible. They therefore did what any rationale actor with lots of sunk costs would do. They pumped oil like mad, getting it out of the ground before the government could seize it. The implication is that we should observe a boom and then a bust in Mexican petroleum output—and this is in fact exactly what the data in Table 1 shows. Oil output increased every year to 1921, and then underwent a pronounced decline. By 1929, output was roughly 20 percent of its 1921 level.

TABLE 1 ABOUT HERE

There is only one problem with this hypothesis. It does not square with a further testable implication: If the hypothesis is true, we should not observe the oil companies undertaking new exploration or making new investments. The data we have assembled on oil exploration and investment do not, however, indicate, that the oil companies were cutting back on investment or exploration. Every measure we have developed of rates and levels of investment indicates a dramatic *increase* in productive assets in the oil industry until the mid-1920s. In fact, investment peaked *after* output peaked, indicating that the reason that oil output dropped was geological, not institutional. This result is not consistent with the hypothesis that the companies feared expropriation or tax increases that amounted to de

facto confiscation. It does, however, square with contemporary accounts of the invasion of Mexico's oil pools by salt water.⁴⁷ The deposits that had been tapped were not particularly large. It took only a few years for the sheets of salt water that lay beneath them to invade the petroleum.⁴⁸ The oil companies kept searching for petroleum.⁴⁹ They simply could not find enough to maintain their 1918-21 levels of production.

Data on the drilling of new wells indicates that firms were continuing to search for new oil deposits, long after production peaked, but were simply not able to find much new oil. The data are reported in Table 2. There are several striking features of the data about new drilling. The first is the strong upward trend in the number of new wells drilled. There were more wells drilled in 1921 than in the *combined* period 1917-20. In 1924, three years after production peaked, there were more than twice as many wells drilled as in 1921. By 1926, while production continued to decline, the number of wells drilled finally peaked at 2.5 times its 1921 level; and *twenty* times its 1919 level.

The second striking feature of the data is the decline in the number of these new wells that were productive. In 1919, 76 percent of new wells were productive. In 1921, the ratio was 64 percent. It then steadily declined to 28 percent in 1929. The falling ratio of productive to unproductive wells indicates that firms were trying hard to find new sources of oil, but where not succeeding.

⁴⁷ See, for example, Engineering and Mining Journal, Vol 110, No. 24, pp. 1136; Engineering and Mining Journal, Vol. 110, no 23, p. 1096; Engineering and Mining Journal, Vol. 110, No. 20, pp. 956; Engineering and Mining Journal, Vol. 111, No. 4, p. 185; Engineering and Mining Journal, Vol. 114, No. 20, p. 860.

⁴⁸ See, for example, Hall (1995), pp. 105, 109, 111; Brown (1993), p. 143, 164.

⁴⁹ In the early 1930's they found enough in the new Poza Rica field to cause a minor rise in total output. In short order, it too became played out.

TABLE 2 ABOUT HERE

Third, even when the oil companies sank successful wells, the initial output per well (the capacity of the well, measured in barrels per day) continuously fell. At its peak in 1921, the average initial capacity per new well was 24,800 barrels per day. By 1924, the average initial capacity of new wells had collapsed to only 3,400 barrels per day. It remained at that level throughout the 1920's. The combination of lower ratios of productive to unproductive wells and lower initial capacities was deadly in two senses. First, it meant that total new capacity was constantly declining. In 1921, the total capacity of new wells totaled 3.4 million barrels per day. By 1924, the total capacity of new wells had fallen to 1.0 million barrels per day. By 1927, total new capacity was only 384,000 barrels, and by 1929 it fell to 114,000 barrels. Thus, in the space of only eight years, new capacity collapsed by 97 percent. Second, the combination of falling ratios of productive to unproductive wells and lower initial capacities implied higher costs per unit of output. It meant, as one contemporary observer put it, "a very pronounced increase in the cost of obtaining a barrel of crude oil."⁵⁰ The oil companies cut back on drilling once it became clear that their exploration efforts were generating only new expenses, not new gushers.

Data on the amount of land owned or leased by the oil companies also supports the hypothesis that Mexico's oilmen continued to search for new petroleum in the 1920s. In 1920, according to the historian Merrill Rippy, the oil companies leased 2,012,604 hectares and owned an additional 677,553 hectares, for a total of 2,690,159 hectares. Five years later, the companies registered their claims under the 1925 petroleum law. Their total claims now covered 6,226,063 hectares, more than twice the amount claimed in 1920.⁵¹ Data gathered

⁵⁰ Sterret and Davis (1928), p. 204.

⁵¹ Rippy (1972), p. 162, 172.

by Lorenzo Meyer yields similar results. Meyer estimates that in 1917 the oil companies held rights to 2,151,025 hectares of oil lands.⁵² When the government granted confirmatory titles, during the period 1928-37 (as a result of the 1925 oil law) it granted titles to 6,940,568 hectares.⁵³

This evidence on the dramatic increase in oil lands is consistent with the observations of contemporaries regarding new exploration. As early as October 1920—well before the resolution of the property rights question—firms were exploring for oil well beyond their original claims in Veracruz and the Isthmus of Tehuantepec. These new exploratory operations were taking place in a large number of sites spread across Durango, Colima, Chihuahua, Coahuila, Chipas, San Luis Potosí, Jalisco, the Yucatán, Baja California, Sinaloa, Guerrero, Puebla, Sonora, and Oaxaca.. Contemporary observers also reported that these exploratory operations gave rise to a great many new leases outside of the traditional locus of the industry (the state of Tamaulipas and Northern Veracruz).⁵⁴

The entry of new firms into Mexico also supports the hypothesis that the oil companies were actively searching for new sources of oil, and not just intensively exploiting proven reserves. These new firms included many of the established international giants in the oil industry. The Texas Company (later Texaco), for example, entered the Mexican market in 1912 and established a subsidiary in 1917 with an initial capital of \$5.3 million. Gulf Oil arrived in 1912, and established a wholly owned subsidiary. Union Oil, Sinclair,

⁵² Meyer (1977), p. 57.

⁵³ Meyer (1977), p. 135. Meyer's claim, that any new investment after 1917 was designed solely to exploit already proven reserves, is therefore not supported by his own evidence. See Meyer (1977), p. 57.

⁵⁴ Engineering and Mining Journal, October 9, 1920, pp. 725-26. Later accounts from contemporary sources discuss other exploration and wildcatting operations. See, for example, Engineering and Mining Journal, Vol. 110, No. 22, p. 1050; Engineering and Mining Journal, January 8, 1921, p. 69; Engineering and Mining Journal, Vol. 111, No. 5, p. 232; Engineering and Mining Journal, Vol. 115, No. 24, p. 1074; Engineering and Mining Journal, January 22, 1921, p. 185.

and Standard Oil of California all soon followed, establishing subsidiaries by 1917.⁵⁵ These were all new operations, rather than purchases of already established oil companies. The world's two largest petroleum companies, Royal Dutch-Shell and Standard Oil of New Jersey, also entered Mexico. Shell began production in Mexico in 1912, through a small subsidiary operation, La Corona, SA. In 1919, Royal Dutch-Shell purchased a controlling interest in Mexico's second largest oil firm, El Águila.⁵⁶ Standard Oil of New Jersey entered the market in 1917 by purchasing the Transcontinental Petroleum Company for \$2.5 million. It had earlier tried to purchase El Águila, making unsuccessful offers in 1913 and 1916. By 1919, it had ten subsidiaries operating in Mexico. It is not clear how many of Standard's subsidiaries were entirely new ventures and how many were purchases of existing firms.⁵⁷ Nevertheless, Standard Oil of New Jersey believed that existing Mexican oil companies were a good bet—at least at the prices on offer—as late as 1932, when Standard acquired the Pan American Petroleum and Transport Corporation (the holding company that controlled Doheny's interlocking empire of Mexican oil companies, including Huasteca and the Mexican Petroleum Company), and became the largest producer of petroleum in Mexico.⁵⁸

Data on the value of new investment by the oil companies follow the same pattern as the data on new wells, and support the hypothesis that both new entrants and existing companies continued to invest well after production peaked. We have gathered the financial statements of major Mexican oil companies from *Moody's Manual of Investments*. Our sample includes the Mexican Petroleum Company, El Águila, Pan American Petroleum and

⁵⁵ Brown (1993), p. 141, Rippy (1972), p. 137.

⁵⁶ Rippy (1972), p. 154.

⁵⁷ Meyer (1977), p. 4; Rippy (1972), p. 160-61; Brown (1993), p. 152, 160-161.

⁵⁸ Pan American was first purchased by Standard Oil of Indiana in 1925, which then sold it to Standard Oil of New Jersey. Meyer (1977), p. 4; Brown (1993), p. 45.

Transport, the Mexico-Panuco Oil Company, the Mexico Seaboard Oil Company, and the Penn-Mex Fuel Company.⁵⁹ These firms accounted for 76 percent of total Mexican petroleum output in 1918, meaning that our sample captures that largest part of the industry.⁶⁰ We focus on the value of each firm's fixed assets, rather than total assets, which may include cash, securities, and other liquid investments. This allows us to know whether firms are investing in productive apparatus or were diverting profits into other activities.⁶¹ We convert the raw data into index numbers, so as to permit easy comparison in investment growth trends across companies, and report the results in Table 3.⁶²

TABLE 3 ABOUT HERE

Every company in the sample invested in new plant and equipment at a rapid rate well after output began to fall. The only variance is the year in which investment peaked. In the case of the Mexican Petroleum Company, investment levels peaked in 1924. For other firms it came later: 1925 in the case of Mexican Seaboard, 1930 in the cases of Mexico-Pánuco and Penn-Mex, and 1931 in the case of El Águila.

These results are consistent with estimates made by the Mexican government of total investment in the oil industry. We have taken these estimates and converted them to real

⁵⁹ This is not a random sample of Mexican oil companies, but is a sample of large, publicly traded firms that were followed by *Moody's Manual of Investments*.

⁶⁰ Market shares were calculated from data in *Engineering and Mining Journal*, May 1, 1920, p. 1030; *Engineering and Mining Journal*, July 1, 1922, p. 25.

⁶¹ We look at fixed assets (land, equipment, and buildings) not total assets. The reason is that total assets can increase through the purchase of securities or increases in cash balances, without these assets being invested in productive apparatus. In fact, total assets can increase even if a firm is selling its productive assets and holding the proceeds as cash.

⁶² Our figures are the book values of fixed assets, calculated at acquisition cost minus depreciation. Optimally, we would have converted these figures into replacement costs. This involves applying the same depreciation schedules across companies by asset type and adjusting the value of new acquisitions of productive apparatus for inflation. Unfortunately, many of our financial statements either lumped depreciation in with other expenses (making it difficult to back out) or failed to break down productive assets into sufficiently detailed sub-categories.

dollars, using the U.S. wholesale price index, with the base year reconverted from 1967 to 1928. The results indicate a rapid run-up of investment from 1912 to 1924—three years after production peaked—and then a gentle decline from 1924 to 1936. In 1912, the real (1928) dollar value of oil company investments in Mexico was \$246 million.⁶³ Ten years later, in 1922, the real value of investments had more than doubled to \$511 million. The total stock of investment grew an additional 11 percent by 1924, to \$569 million. The data indicate a drop in investment to mid-1926, when it hit \$393 million, followed by a slight recovery to 1928 when it rose to \$425 million.⁶⁴

A final method of estimating investment in the Mexican oil industry is to look at the real value of capital goods imported into Mexico from the United States. This method allows us to measure flows rather than stocks. It is also an extremely accurate measure of gross investment, because Mexico produced no oil drilling equipment, pipes, casings, or storage tanks. *All* of this machinery and equipment had to be imported from the United States. Our estimates, in 1928 U.S. dollars, are presented in Table 4. Prior to 1922, the U.S. Department of Commerce did not disaggregate petroleum machines from mining machines. Thus, the 1908-21 are estimates based on the reasonable assumption that the ratio of oil equipment expenditures to oil and mining equipment expenditures during 1908-21 was the same as it was in 1922 and 1923 (60 percent of total mining and petroleum spending). We note that partial data on mining and oil well equipment imports into Mexico in 1919 are consistent with this ratio.⁶⁵ We also note that the results are not sensitive to the ratio

⁶³ The nominal estimate, made by Carlos Díaz Dufoo, was 175 million. Díaz Dufoo (1921), p. 102.

⁶⁴ The nominal amounts, estimated by the Mexican government and reported by Rippy (1972) are as follows: 1922 equals 510 million dollars, 1924 equals 575 million, 1926 equals 406 million, 1928 equals 425 million, 1936 equals 306 million. Data from Rippy (1972), pp. 164, 166, 173, 181.

⁶⁵ In the month of August 1919 oil equipment accounted for 67 percent of total oil and mining equipment. Engineering and Mining Journal, October 11, 1919, p. 623.

chosen—even had 100 percent of mining and petroleum equipment imports during the 1908-21 period been destined for the oil industry, it would not affect our qualitative results.

TABLE 4 ABOUT HERE

The data are consistent with the hypothesis that investment was not affected by expectations about future institutional change. New investment dropped dramatically in 1914 and 1915, but then recovered rapidly. In 1920, gross investment in machinery was more than twice what it had been in 1910. The data also indicate that gross investment in the petroleum industry continued its high rates until 1924, when the flow of new machinery to Mexico was 56 percent higher than it had been just three years before. New investment flows only began to decline in 1925, four years after output peaked.⁶⁶ Even in the late 1920s, however, flows of new investment were, on average, higher than they had been during the period 1908-21.

Taken as a group, the various measures we have put together of exploration and investment indicated that the oil companies continued to invest even after output had begun to decline. Output peaked in 1921, but investment did not peak until sometime between 1924 and 1928, depending on how it is measured. The implication is that firms were not dissuaded from investing by changes in institutions, increases in taxes, or political instability. The data suggest, instead, that the oil companies believed that they could mitigate threats to their property rights and the returns from those property rights. They left Mexico when they could no longer find sources of petroleum that could be extracted at a reasonable price using existing technology.

⁶⁶ This is not the same thing as saying that the stock of investment declined. As long as new investment flows exceeded the depreciation of old equipment and the re-export of used equipment from Mexico to third countries, the stock of investment would have increased. Without estimates of re-exports of petroleum equipment and the rate at which equipment depreciated, it is not possible to estimate the stock of investment from these data. It is unlikely, however, that re-exports and depreciation would have exceeded the stock of new flows, at least through the late 1920s.

Taxes

If our interpretation is correct, then what are we to make of the fact that the petroleum companies endlessly haggled over tax rates? Historians have noted, quite correctly, that the oil companies fought the Mexican government's attempts to introduce new taxes or raise existing ones, and have surmised from this that the tax rate was a vital determinant of whether the oil companies continued to operate in Mexico. The problem with this interpretation is that all companies at all times in all places complain about taxes. Whether they complained and whether taxes really were a determinant of their level of operations are separate issues. What was germane to the oil companies was how badly taxes cut into profits.

In Table 5 we present estimates of Mexican government revenues, oil tax revenues, per barrel taxes, total oil industry revenues, and the tax rate (total taxes divided by total industry revenues). Our estimates of per barrel taxes indicate a steady increase from three centavos per barrel in 1912 to 47 centavos (gold pesos) per barrel in 1922. The tax then oscillated without trend through the rest of the 1920's.⁶⁷ In short, the data for the 1910's and 1920's indicates that the Mexican government did not know, ex ante, the point at which the oil companies would begin to push back, so it experimented by gradually increasing per barrel taxes until finding a threshold level at which the oil companies shut down. The government then negotiated a slightly lower tax rate.

From the point of view of the Mexican government, finding the threshold tax rate was difficult for two reasons. First, the threshold was not a constant value, but was a moving target that changed with exogenous factors. These factors included the world price

⁶⁷ The variation was driven by annual differences in the percentage of oil exported versus domestically consumed. The tax rate was considerably higher on exported oil.

of oil (which could be easily observed), and the extraction costs faced by companies in Mexico (which was extremely difficult to observe). Second, the government had to anticipate the response of the oil companies. This meant that the government had to take into account the perception that the companies had of the government's vulnerability to a dramatic decline in oil tax revenues. This would have been a particularly difficult factor to measure. The government could guess, but it could only know whether it guessed correctly *ex post*.

TABLE 5 ABOUT HERE

If the government guessed incorrectly, and the oil companies shut down production in protest of a tax increase, the results could have been deadly for the government. The basic fact of the matter was that petroleum taxes were a crucial component of the Mexican federal budget. In 1912 oil tax receipts made up less than one percent of total government revenue. This ratio climbed rapidly, reaching five percent by 1917, 20 percent by 1920, and 31 percent by 1922. It declined after 1922, but as late as 1926 oil taxes still accounted for 13 percent of government revenue.

Profits

How high were Mexican taxes from the point of view of the oil companies? That is, did increases in taxes lower the net revenues per barrel to the point that the oil companies could have more profitably deployed their capital elsewhere? We answer this question in three ways.

The first method we employ is to calculate the after-tax price for a barrel of Mexican crude oil received by the oil companies. The calculation from the data in Table 6 is straightforward. We simply subtracted the per barrel tax payments made by the companies

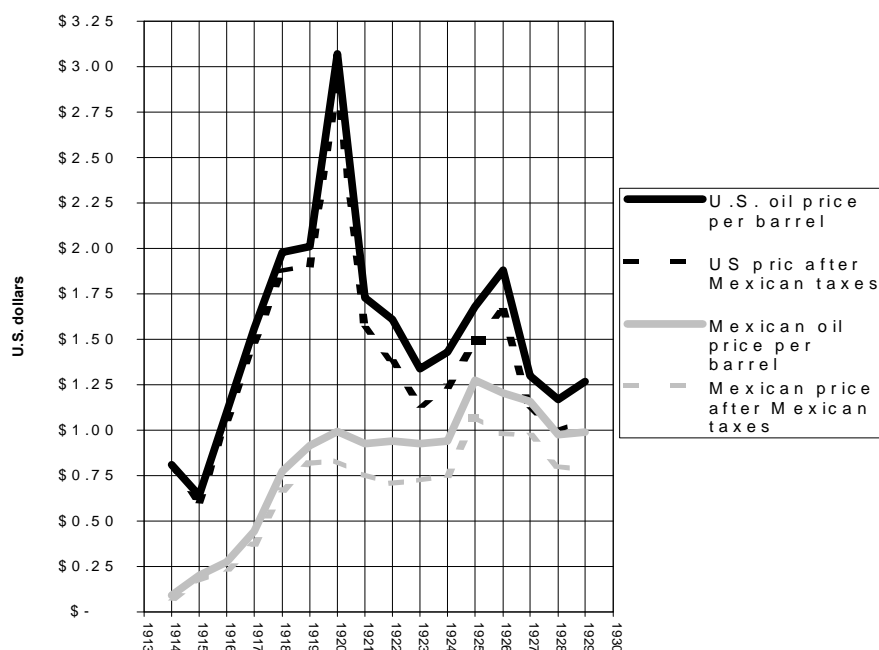
from the average pre-tax price of a barrel of Mexican oil in that year. We calculated the average pre-tax price of a barrel of oil by dividing the industry's total revenues by the total amount of production.

TABLE 6 ABOUT HERE

The result, presented in table 6 (and presented graphically in Figure 1), is clear. The run-up in oil prices during and after the First World War was so pronounced that the after-tax price per barrel received by the Mexican oil companies increased fourfold, despite the increase in petroleum taxes. The data support the argument that any decline in the companies' profits, therefore, was not induced by increases in Mexican oil taxes. Since the Mexican oil prices are imputed values, we performed the same exercise using the average U.S. price for crude oil.⁶⁸ We then subtracted the average total tax per barrel paid by the Mexican oil producers. Since the average American price was consistently higher than our imputed Mexican price—most Mexican crude was of rather low quality—the results are even more dramatic. Tax payments did not substantially reduce the revenues per barrel received by the oil companies.

⁶⁸ De la Fuente Piñeirua (2001), p. 98. We also make the reasonable assumption that Mexican oil prices did not determine world oil prices. Hence, U.S. oil prices are a good proxy for domestic oil prices in Mexico during that period.

Figure 1: Pre-tax and after-tax prices for crude oil faced by Mexican producers



Source: Mexican crude oil prices and the (actually paid) Mexican taxes per barrel, Table 1.

U.S. average crude oil prices from Neal Potter and Francis Christy, *Trends in Natural Resource Commodities: Statistics of Prices, Output, Consumption, Foreign Trade and Employment in the United States, 1870-1957*, Baltimore 1962: 318-19.

The second method we employ is to estimate rates of return on assets for six of Mexico's major oil companies from their financial statements.⁶⁹ We retrieved balance sheets

⁶⁹ Returns on assets are calculated by dividing total profits (gross revenues minus expenditures) by the total value of all assets (both fixed and liquid) of the company. Interest payments made by the company to bondholders and other creditors is added back to profits, because the value of the debts are included in the value of total assets. In short, they are the value of profits divided by the value of the investment that produced those profits. An alternative measure is the rate of return on owner's equity, which divides profits by the value of paid in capital, reserve accounts, and retained earnings. In this measure, the value of interest payments is

and profit and loss statements from *Moody's Manual of Investments* for: El Águila, the Mexican Petroleum Company, the Mexican Seaboard Oil Company, the Mexico Panuco Oil Company, the Mexican Investment Company, and the Penn-Mex Fuel Company.⁷⁰ These firms accounted for 74 percent of total Mexican petroleum output in 1918, and 40 percent in 1922.⁷¹ We then compare the financial performance of these Mexican firms to the performance of the world's major international oil companies. Our comparison set includes the Texas Company, Sinclair, Gulf Oil, and Standard Oil of New Jersey.⁷²

Our estimates of returns on assets for Mexican and international oil companies are presented in Tables 7 and Tables 8. There is some variance across companies, but the general pattern is for very strong rates of return in the period roughly 1916 to 1922 with some fall-off thereafter, but the decline experienced after 1922 is highly variable. For some companies, such as El Águila, Penn-Mex, Mexico-Pánuco, and the Mexican Investment Company the drop is quite pronounced. For others, such as the Mexican Seaboard Oil Company and the Mexican Petroleum Company, rates of return remained in the double digits until 1926 for the former and 1929 for the latter.

TABLES 7 AND 8 ABOUT HERE

subtracted from profits and the value of the debts is subtracted from assets. As a practical matter, the Mexican companies in our sample did not carry significant amounts of debt on their balance sheets. Thus, there would have been little difference in the rate of return on assets and the rate of return on owner's equity.

⁷⁰ These six companies were not chosen at random. Rather, we selected them because it was possible to retrieve their balance sheets and profit and loss statements from *Moody's Manual of Investments*.

⁷¹ Market shares were calculated from data in *Engineering and Mining Journal*, May 1, 1920, p. 1030, and July 1, 1922, p. 25.

⁷² We note that these firms all had Mexican investments. The value of those investments, however, were trivial compared to the value of their world-wide assets. Thus, their Mexican operations could not have driven their overall levels of profitability. The Texas Company, Standard Oil of New Jersey, and Gulf Oil, for example, earned less than one percent of their gross revenues from their Mexican operations. Revenue shares calculated from data on output in Brown (1993), p. 125, prices per barrel of output in table 6-1, and total revenues in the profit and loss statements of each company reported in *Moody's Manual of Investments*.

Did Mexican taxes cause rates of return to decline? The first way to answer this question is to compare Mexican oil company rates of return against those of the major international oil companies. (See Tables 7 and 8). The pattern for Sinclair, Gulf, Standard Oil of New Jersey, and the Texas Company is strikingly similar to that of the Mexico-only firms. Rates of return were highest in 1916 to 1922 and declined thereafter. As was the case with the Mexican companies, there is a high degree of variance in the amount and timing of this decline. The implication is that whatever was driving declines in rates of return after 1922 was not peculiar to Mexico.⁷³ Thus, Mexican taxes do not appear to be a likely candidate for explaining falling rates of return.

A second way to determine the impact of Mexican taxes on rates of return is to conduct a counterfactual exercise by estimating the rates of return for the same set of Mexican companies under the assumption that the Mexican tax rate was zero.⁷⁴ We backed out the value of Mexican taxes by first estimating the value of those taxes, using the tax rate estimates in Table 5 and information in the firms' balance sheets about the value of gross revenues. Because we could not separate out income from Mexican oil sales from income from other sources, we assumed that all income was generated in Mexico and was therefore subject to Mexican taxes. This maximized the impact of the tax rate on rates of return. We note that we were able to measure taxes directly for the Mexican Petroleum Company during

⁷³ The average American price of a barrel of crude oil declined rather precipitously from its peak in 1920. In 1920, a benchmark barrel of oil was valued at \$3.07. By 1923, that price had fallen to \$1.34. See Potter and Christy (1962), pp. 318-19.

⁷⁴ We took the estimated tax rate from our calculations in table 6-5. We then estimated the absolute value of taxes for each year by multiplying the tax rate by the value of each firm's gross revenues. We then subtracted these estimated taxes from the value of expenditures, to calculate zero-tax profits. We then divided these zero-tax profits by the value of assets. This is essentially an exercise in comparative statics. The calculations assume that short term output is entirely inelastic, holding fixed investment constant. Short term inelasticity is a reasonable assumption given the high sunk costs in the petroleum industry. Once a well is drilled and a pipeline built, it is almost impossible to redeploy them to other uses. As long as firms are covering their variable costs, they will continue to produce as much as their fixed investment will allow.

the period 1912-1917.⁷⁵ The results indicate that the method we employed in our counterfactual exercise overstates Mexican taxes by a factor of two. We further note that all of the companies in our sample had income earning assets outside of Mexico. In short, our assumptions create upper bound estimates for the impact of the tax on rates of return and bias our results against the hypothesis that taxes did not substantially affect profitability.

The results of our tax analysis are presented in Table 9. Two features of the data are obvious. First, even with a zero tax rate, rates of return still decline in the mid-1920's. Second, for most companies, a zero tax rate only pushed up rates of return by a few percentage points. Thus, for example, El Águila's rates of return moved from two percent in 1923-27 (with positive taxes) to an average of three percent (with a zero tax rate). We obtain roughly similar results for the Mexican Investment Company, Penn-Mex, and Mexico-Pánuco. For the Mexican Petroleum Company and the Mexican Seaboard Oil Company, the impact of zero taxes would have been significant in the early 1920's, when these firms already had double-digit rates of return. Once income began to fall for these firms in the late 1920's, however, cutting taxes to zero would have raised rates of return by only four percentage points in any given year. Even had taxes been zero, other expenses—those associated with discovering reserves and developing wells--would have continued rising. The end result would not have been dramatically different. The bottom line was that Mexican petroleum pools were becoming more difficult to find and more expensive (per barrel) to develop.

TABLE 9 ABOUT HERE

⁷⁵ The Mexican Petroleum Company paid taxes from 1912 to 1917 under protest. It therefore carried the value of the taxes on its balance sheets as an asset. We can therefore back out the yearly additions to this account, thereby imputing the actual amount of tax paid.

Investor Perceptions

If the view that we have advanced, that the Mexican oil industry went into decline for geological, not institutional, reasons is true, then it must also be true that investors were not perturbed by the political instability and institutional changes of the 1910's and early 1920's. One way to get at that question is to look at the real price of common stocks in Mexican oil companies relative to the real price of common stocks in big international oil companies. If investors were not concerned about political developments inside Mexico, then the price of Mexican oil stocks would move with the price of stocks in the big international oil companies. The price of stocks might rise or fall, depending on the international price of oil, but we would not expect share prices in the two classes of firms to consistently move in different directions.

We therefore gathered data on two groups of petroleum companies: a set of six companies that operated within Mexico; and a set of three oil companies that had worldwide sources of petroleum. The group of Mexican oil companies includes: the Mexican Petroleum Company, the Pan American Petroleum and Transport Company, the Penn-Mex Fuel Company, the Mexican Seaboard Petroleum Company, the Mexican Investment Company, and the Mexican Eagle Oil Company (El Águila). We note that most of the stock of Mexican Petroleum was held by Pan American Petroleum. Hence, we report the stock values of both companies. We also note that these six companies controlled roughly three-quarters of Mexican petroleum output circa 1918. The set of big international oil companies includes Standard Oil of New Jersey, Sinclair Consolidated Oil Company, and the Texas Company. Neither set of firms is a random sample. Rather, we chose them because it was

possible to find price quotes of their common shares.⁷⁶ We adjusted the nominal stock prices for stock dividends and stock splits, converted nominal values to real values using the U.S. Producer Price Index, and then converted the real values to index numbers (1921=100) in order to be able to compare the movement of prices across companies. The data are presented in Tables 10 and 11.

TABLES 10 AND 11 ABOUT HERE

What do the stock price indicate? To judge by the Mexican Petroleum Company, which is the only Mexican firm for which we can construct a series back to 1912, the counter-revolution against Madero (1912), the overthrow of Huerta (1914), and the civil war between Carranza, Villa, and Zapata (1914-1916) do not appear to have had a negative effect on investor confidence. The inflation-adjusted price of its stock more than doubled between 1912 to 1917. Investors in the Mexican Petroleum Company were so confident about the future of the firm, in fact, that its market value rose faster than the market values of the Texas Company and Standard Oil of New Jersey over the same period.

Starting in 1914, we have data for El Águila, Mexico's largest producer. From 1915 onwards we can add two additional companies: Pan-American Petroleum and Transport and Penn-Mex. The data show a sharp decline in stock prices for three of the four firms for which we have data between 1915 or 1916 to 1921. The index moves from 358 to 100 for Mexican Petroleum, from 182 to 100 for Pan-American, and from 525 to 100 for Penn-Mex. It is not possible to attribute this decline, however, to events in Mexico. First, stock prices of the three international giants in our sample also declined. The index for the Texas Company declined from 185 in 1915 to 100 in 1921. The index for Standard Oil declines

⁷⁶ Price data for all companies save El Águila came from either the *Wall Street Journal* or *Moody's Manual of Investments*. In the case of El Águila, price data (in pounds sterling) came from De la Fuente, *El desplazamiento*, p. 98, and was converted into dollars using the average dollar-pound exchange rate for the year.

from 106 to 100, and the index for Sinclair collapses from 217 to 100. The Mexican oil companies were not the only oil stocks making investors nervous during this period. Second, the stock price of one major Mexican producer, El Águila, which faced the same institutional environment as the other companies, rose from 44 to 100 between 1915 and 1921.⁷⁷

Beginning in 1921 we have observations for six Mexican companies. The data about the 1920s are mixed. Mexican Petroleum's index rose through the 1920s, reaching a level of 267 in 1928. Pan-American's index rose through 1926, and then dropped. Penn-Mex's index showed no clear pattern. It peaked at 224 in 1923, dropped to 89 in 1925, and then rose again to 177 in 1927. Conversely, stock indices for Mexican Seaboard, the Mexican Investment Company, and El Águila declined in a consistent manner throughout the 1920s.⁷⁸

Taken as a group, the six Mexican companies fared no better or worse than the big international oil companies in the 1920s. In 1928, for example, the real share price of Standard Oil common stock was less than one-third of what it had been in 1921. The real share price of Sinclair Consolidated in 1928 was virtually unchanged from 1921. The only one of the majors to see a sustained rise in its real share price was the Texas Company, whose real share price rose by slightly more than a third between 1921 and 1928.

In short, the analysis of stock prices supports the view that Mexican petroleum companies were impervious to threats of institutional change, expropriation, or higher taxes. Investors in Mexican firms were, on average, neither more nor less confident about the

⁷⁷ The run-up in El Águila's price coincides with the purchase of controlling share in the company by Royal Dutch-Shell. Evidently, Shell thought that Mexican oil was an excellent investment.

⁷⁸ The series indicates a value of 189 for Mexican Seaboard in 1927, which is not consistent with the observations for 1926 and 1928. We suspect a misprint in the data source.

ability of these firms to produce positive profits than investors in the big international oil companies.

Other extractive industries

Oil was not the only mineral commodity Mexico produced. In fact, before the Revolution, Mexico was one of the world's leading producers of silver, copper, and lead. By 1911, Mexico accounted for 32 percent of world silver production, 11 percent of world lead production, and 7 percent of world copper production. In all three categories, it was the second or third most important producer in the world behind the United States.⁷⁹

From the perspective of Mexico's governments and revolutionary factions, Mexico's mining industry looked a lot like petroleum. They were immobile investments with high sunk costs—in other words, like the oil wells, they were perfect revenue sources. Thus, like the oil industry, the mining industry also saw an attempt to redefine its property rights and attempts by every government to increase the tax rate.⁸⁰ In 1920, total federal and state taxes on mining came to 10.2 percent of the gross value of output, more than twice the 1910 rate.⁸¹ In short, if institutional change and increases in tax rates caused a decline in Mexican oil output, then they should also have produced a decline in Mexican mineral production.

Mexico's mining output *rose* and remained high throughout the 1920s in every major mineral product. In Table 12 we present estimates of the production, by volume, of Mexico's major mineral products: silver, lead, copper, and zinc. Mexican mining production

⁷⁹ *Anuario de Estadística Minera*, 1925, p. 37; *Anuario de Estadística Minera*, 1929-30, pp. 18 and 20.

⁸⁰ Article 27 of the Constitution of 1917 declared that the ownership of all minerals in the subsoil belonged to the federal government. It also made clear that miners had to work their claims in order to maintain their usufruct property rights. "Concessions shall be granted by the Federal Government to private parties ... only on the condition that said resources be *regularly developed*." Bernstein, *The Mexican Mining Industry*, p. 288.

⁸¹ Calculated from data on prices, output, and tax rates in *Anuario de Estadística Minera*, various years. (See table 5). Taxes fell after 1922, but remained above their 1910 level. In 1922, total federal and state taxes had fallen to 7.5 percent. By 1926 they were down to 6.0 percent. By 1929, the combined federal and state tax rate was 5.2 percent, which was close to the combined Porfirian rate of 4.3 percent. It should be noted that these tax rates

began to increase rapidly in 1917, and exceeded its Porfirian levels by the early 1920s, the exact year depending on the product.

INSERT TABLE 12 HERE

Mexico's silver output in 1929 was 40 percent higher than in 1910. The same is true for lead production, which doubled. Copper output in 1929 was 67 percent above Porfirian levels. The production of zinc went through the roof, reaching a level 95 times that of 1910, and almost eight times its 1907 peak.⁸²

INSERT TABLE 13 HERE

Most of Mexico's extractive industries—*except petroleum*—maintained or gained world market share during the 1920s. In fact, in most products Mexico out-performed the United States. In table 10 we present data on Mexico's market share in silver, lead, and copper, its three most important mineral products by both value and volume. For example, Mexico's share of world silver production increased from an average of 34 percent in 1900-10 to 40 percent in the decade 1920-29. During the same two periods, the market share of the United States declined from 30 percent to 27 percent. Mexico's share of world lead production increased from an average of 9 percent in 1906-10 to 13 percent in 1922-29. It did at least as well, therefore, as the United States, whose average market share grew more slowly, rising from 31 percent to 39 percent. In only one case, copper, was Mexico's average market share lower in the 1920s than before 1910. It produced 8 percent of the world's copper from 1905 to 1910, but only 4 percent of the world's copper from 1922 to 1929. Even in the case of copper, however, Mexico's market share was rising in the 1920s. That is, the market share it had lost during the production shut-downs of the civil war years of 1913-17 (when its share

were substantial. Typical margins in the Mexican mining industry were in the range of 20 to 25 percent of gross revenues. *Engineering and Mining Journal*, March 14, 1903, p, 398.

of world production was only 3 percent) was steadily regained in the 1920s. By 1929 it had 6 percent of world production. During the same period, the United States *lost* market share, falling from 52 percent in 1922 48 percent in 1929. Only in oil did Mexico permanently underperform the rest of the world. The reason is simple: What Mexico's miners *did not face*—and the oil men did—was the exhaustion of their mineral deposits.

Conclusion

This paper pursues an area of New Institutional Economics that has not been addressed in the literature to date: the conditions under which institutions do not matter. In order to operationalize an argument about the specific features of industries and the ability to protect property rights by employing a foreign power, we analyze the Mexican oil industry. The data we have presented here— the drilling of new wells, the extent of landholdings, the value of petroleum investments, the value of capital goods imports, the entrance of new firms, the impact of taxes on profits, the expectations of investors, and the performance of the country's other extractive industries—all point to the same conclusion. The oil companies and their investors perceived that they could weather any threat to their property rights. American saber rattling, often taken by historians as evidence that the oil companies were genuinely threatened, should instead be understood as a signal by the U.S. government that it would enforce American property rights. Saber rattling made it clear to the Mexican government that any attempt to expropriate—or levy confiscatory taxes—would be off-the-equilibrium path behavior. The oil companies realized this, and invested regardless of the government's rhetoric or formal institutional changes.

Uncle Sam was not the oil companies' only recourse. The oil companies were able to parry most of the minor thrusts made by various Mexican governments. The very fact that

⁸² The imposition of an American tariff almost destroyed the Mexican zinc mining industry in 1907.

Mexican governments faced multiple violent threats to their existence gave the oil companies a very powerful weapon. They could withhold output and deny the Mexican government crucial tax revenues. The oil companies and the government both understood that an empty treasury and politically ambitious generals was (quite literally) a deadly combination.

It took a confluence of three events in the 1930s to enable the Mexican government to expropriate the petroleum industry. First, the Mexican government had to face a relatively peaceful environment without imminent violent challenges. Second, production shortfalls caused by expropriation had to be of little consequence to the fisc. Third, the Roosevelt Administration had to announce that it would not intervene to protect American property. Once these conditions held, there was no longer any impediment to expropriating the industry. By the time these three conditions came together, however, Mexico's geology had already undermined the industry.

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