Case Study

A Fire Sale for an Incombustible Commodity: Entry and Exit in the Helium Market

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Abstract

In this paper, we present a case study based on National Public Radio's Planet Money episode 933, titled "Find the Helium" to illustrate to microeconomics students a firm's cost structure in a competitive industry and unintended consequences of government intervention. Specifically, this case study examines the consequences of the Helium Privatization Act of 1996, which ordered the U.S. government to begin selling off its stocks of helium by 2005. As a result, the government flooded the market with cheap helium, disrupting the helium industry and causing private companies to exit the market. Throughout this case study, students are presented with details of these government acts, descriptions of how these acts and decisions impacted the helium market, as well as figures to display firm and industry effects. The last section contains questions that can be used during class discussions of this case study. Available upon request are detailed teaching notes (with student learning objectives) and a set of multiple-choice questions that can be used on exams, quizzes, and homework assignments, and answers and metadata for all case study questions.

1 Motivation and Scope of Case Study

One of the most powerful concepts that we learn through an introduction to microeconomics is that market forces are nearly always present. These forces, led by the self-interested decisions of economic agents, tend to push markets back to equilibrium. Government interventions into markets that are not mindful of such forces may generate unintended consequences.

One of the most important applications of this concept is the model of firm entry and exit into markets. Unfortunately, it can often be difficult to teach this concept in an engaging and interesting way. One of the coauthors of this case has noticed what can be best described as a sense of betrayal upon the faces of students, who had previously thought of economics as relevant and exciting, when introduced to the often-tedious exercise of drawing out cost curves.

Here, we present a case study, based on a Planet Money episode, which we hope will cover these important concepts in a technical but engaging way, with material that is both challenging and accessible.

Prior to this case study, you should have listened to episode 933 of National Public Radio's Planet Money, titled "Find the Helium" (Gonzalez 2019).

2 A Brief History of the U.S. Helium Market

The molecules of helium are small, stable, and light. Helium is the second smallest element in the periodic table, after hydrogen, but with two electrons, it is a noble gas that is chemically inert. This means that it is nonreactive under most circumstances and does not combine with other elements. It has high thermal conductivity and liquifies at an extremely low temperature of 4 ° Kelvin (about -452 ° Fahrenheit). These characteristics make it perfect for many practical applications, in keeping things cold, finding leaks, preventing fire, and, of course, being lighter than air. Helium from balloons also helps sound waves travel

faster through your larynx, which can sound hilarious (although students should be cautioned that this can be fatal because it displaces oxygen in your lungs).

2.1 Producing Helium

Helium makes up a quarter of all matter in the universe, but it is very rare on earth because of its tendency to escape out to space. It was only identified as an element through solar observations in 1868, and in 1895 was found to be present in trace amounts in uranium minerals. It was finally discovered in useful amounts in 1903 when the mayor of Dexter, Kansas, found himself unable to light a fire with the town's new natural gas well (McCool; American Chemical Society 2000; Chaudhuri et al. 2010).

Virtually all helium on Earth comes as a by-product of the slow decay over eons of natural radioactive elements deep underground, and thus for practical purposes, it is a nonrenewable resource. Anderson (2018) reports that helium also exists in trace amounts in the atmosphere, but at current prices, its recovery is not economically viable. Helium accumulates in natural gas deposits. The vast majority of these deposits have 0.3 percent helium content or less, and the cost of extracting helium from these resources is higher than its economic value. As a result, the helium in these deposits is simply lost when the natural gas is produced.

Until relatively recently, most economically viable helium deposits have been found in the western United States, especially in a small region running from the Texas panhandle into western Kansas. Most of the helium actually extracted is a by-product of fuel production, as removing the helium makes the hydrocarbons (e.g., methane) burn better. When the helium content is even higher, typically between 3 percent and 10 percent of the natural gas, methane content tends to be low, and helium can become the primary product, not just a by-product. Until 2019, private producers had little incentive to access these high-quality resources on public lands, since retention of leases required the production of fuel.

In either case, upgrading is usually done through a cryogenic distillation process, as other gases liquefy first when the gas is cooled and can be drained off. The result is crude helium, which contains about 50 to 70 percent helium along with nitrogen and small amounts of hydrogen, neon, and non-liquified methane. Crude helium can then be purified through a multistage separation process using pressure, filtering, and temperature. Once its purity reaches 99.99 percent or higher, it is considered grade A (National Research Council 2010).

Grade A helium can be distributed in either gas or liquid form, and although the latter takes up less storage volume, it requires immensely cold temperatures. In 2019, the federal government's price per thousand cubic feet of crude helium ranged from $86 for government users to $119 for nongovernment users (U.S. Geological Survey), while the private sector's price for grade A helium was about $210 per thousand cubic feet in 2019. Retail market prices are negotiable for larger consumers, but small consumers may pay retail prices exceeding $1,000 per thousand cubic feet.

2.2 The History of Helium Production

Helium production in the United States can be divided into five separate stages, which we also represent graphically in Figure 1.

- The early consolidation period, running from the first world war through the second, in which helium production became a monopoly of the federal government.
- The early cold war period, in which the federal monopoly continued while the private sector began to find practical nonmilitary uses for helium.
- The conservation period, from 1960 through the 1980s, in which cold war concerns led to the private production of helium in order to create a large underground helium reserve.
- The privatization period, beginning in the 1990s, in which the federal government stopped producing helium and was required instead to sell off the helium reserve at cost.
- The stewardship period, starting only in the past decade, in which forced sales from the federal government's reserve were replaced by market-based auctions.
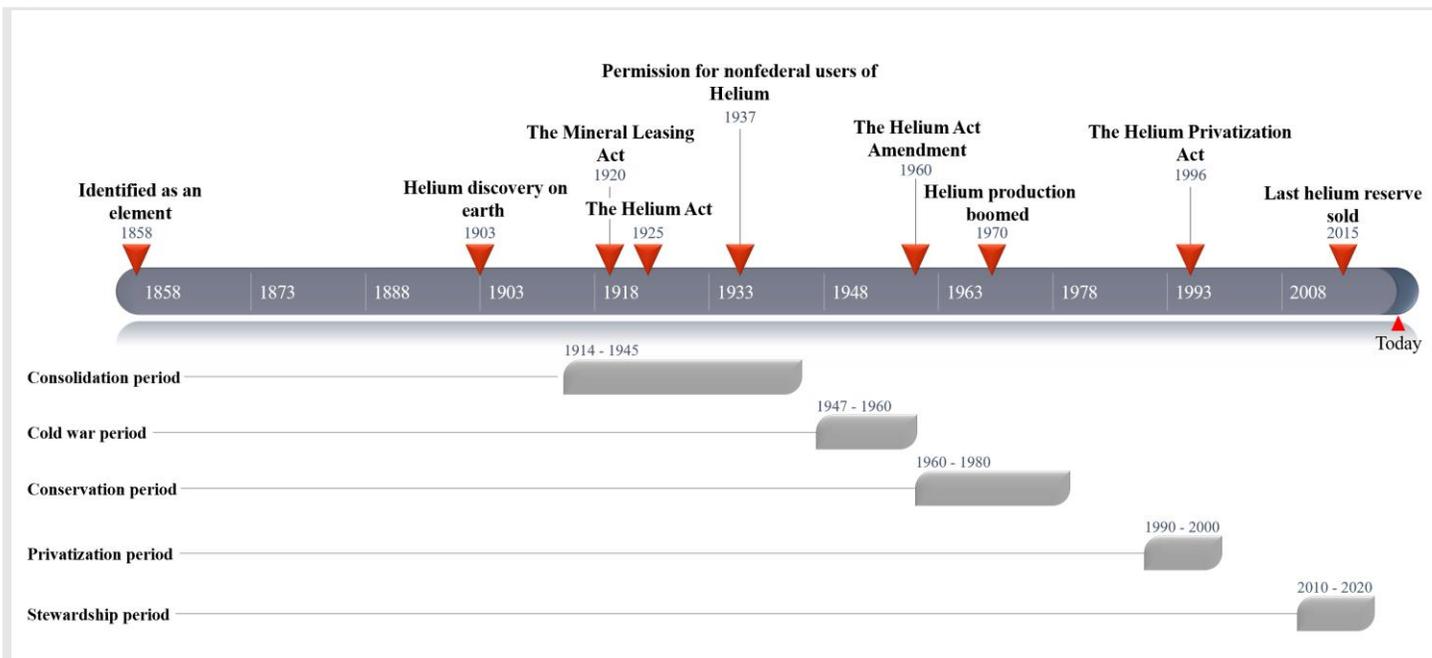
Figure 1: Timeline of Helium Market

Practical interest in helium began in 1917, when chemist Richard Bishop Moore suggested using helium in airships (Sears 2012). Helium is not flammable like hydrogen or the fuel used for hot air balloons. World War I ended before helium could be put to use, but the U.S. military remained very interested.

In 1918, Linde Air Products (now merged with Praxair) was awarded a military contract to build a plant near Fort Worth, Texas, to extract helium from natural gas pumped from the Petrolia oil field (Sears 2012). The Mineral Leasing Act of 1920 gave the federal government the right to extract helium from all U.S. natural gas fields (U.S. Department of the Interior, Bureau of Land Management 2007), but most natural gas fields contained too little helium to be considered economically viable. The Petrolia field was soon depleted, leading the government to search for more helium sources. The Helium Act of 1925 established the Federal Helium Reserve (FHR) at the new Cliffside field near Amarillo, Texas. The Helium Act designated the Bureau of Mines as the government's producer (U.S. Congress 1925) and empowered the bureau to acquire natural gas fields with the potential to produce helium. Exports were banned for national security purposes, effectively blocking Nazi Germany in its efforts to acquire access to a "uniquely indigenous" strategic natural resource (Levitt 2000). Instead, all production by the bureau was sold only to federal agencies at cost, and the bureau soon established a new production plant near Amarillo (Gomez and Huggard).

In the late 1920s, the Kentucky Oxygen-Hydrogen Company, soon known as the Helium Company and owned by the Girdler Corporation, was given a contract by the Navy to produce helium in Dexter, Kansas. In 1937, the year that broadcaster Herbert Morrison cried, "Oh, the humanity!" as he watched the Hindenburg, a German hydrogen zeppelin, burn, the bureau was finally given permission to lease helium to nonfederal users. Due to this, the Girdler Corporation—unable to compete with the federal government—requested that the bureau purchase its operations (Dick and Robinson 1985). As a result, the federal government had consolidated its control over all production and consumption of helium.

For the next quarter of a century, helium production remained a monopoly of the U.S. federal government, and the military was the primary customer through World War II (Price 1967). After the war and through the first half of the Cold War, new consumers began to enter the market as helium's primary appeal shifted from its lifting properties to its use in keeping rocket fuel very cold, in creating a safe atmosphere for arc welding, and in finding leaks in spacesuits, nuclear reactors, and other important

containers. Private industry increasingly found these properties useful as well. The bureau also began to sell helium to over 50 commercial distributors of industrial gas. The largest distributors were Chemetron's National Cylinder Gas Co. (which merged in 1953 with the Girdler Corp.), Air Reduction Co., Union Carbide's Linde Co., and Air Products and Chemicals.

2.3 Conservation and Privatization

The conservation period began in 1960, with amendments to the Helium Act. Motivated by the Cold War and by the realization that private sector production of natural gas for its hydrocarbons was leading to the loss of most helium, Congress authorized the Bureau of Mines to accumulate a large national stockpile (U.S. Congress 1960). Since the most impermeable container for helium was in its original underground location, the new act charged the bureau with storing crude helium in the Bush Dome, a portion of the FHR in the now-depleted Cliffside field (Sears 2012; Jolley 2016).

In order to stock the FHR, the bureau contracted with private firms to build five extraction plants near helium-rich fields in Kansas, Texas, and Oklahoma, and was authorized to borrow from the U.S. Treasury to fund their purchases of helium. By 1970, production boomed to almost ten times the annual U.S. demand. This is shown in Figure 2 as the difference between the red solid line and blue dashed line, using data from the U.S. Geological Survey. The crude helium stock in the FHR was enough to supply the United States for the next 25 years.

The Helium Act Amendments of 1960 set the bureau's wholesale price at $35 per thousand cubic feet of crude helium (Sears 2012), or around $300 in 2020 dollars.[1] However, as companies became more efficient at producing helium, they were soon able to sell crude helium at a significantly lower price than the bureau. As a result, private industry became the primary provider to nongovernmental users (Sears 2012).
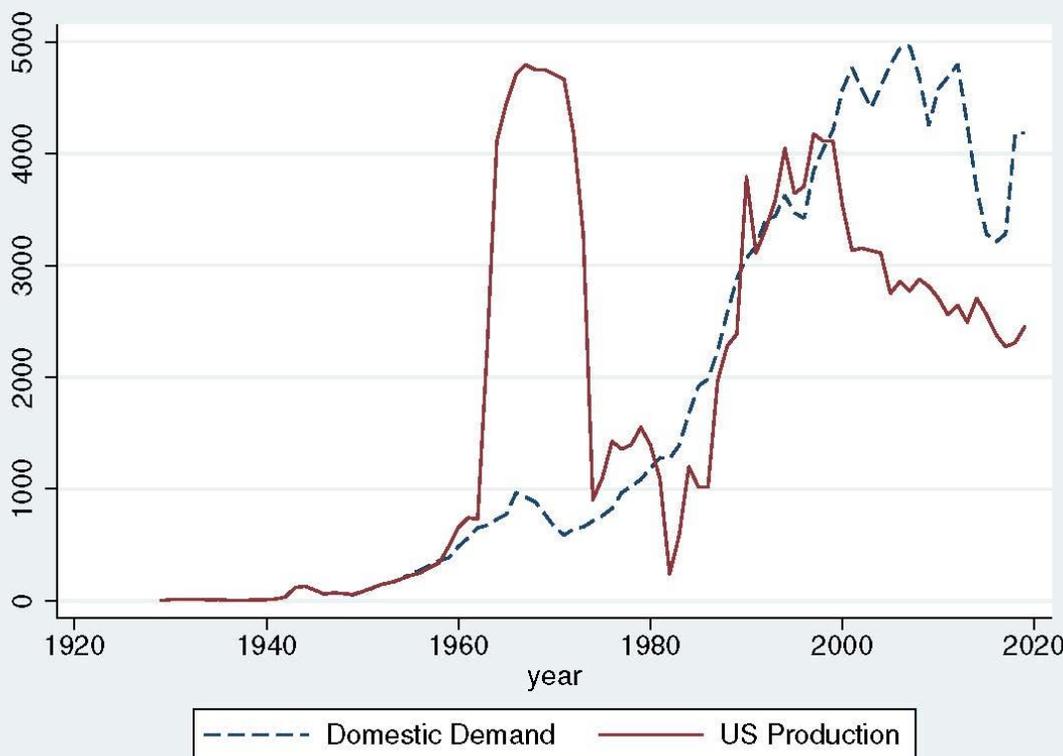
Figure 2: Production and Use of Crude Helium (Millions of Standard Cubic Feet)

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[1] https://data.bls.gov/cgi-bin/cpicalc.pl

Still, most U.S. production of crude helium during this period went into the FHR, and exports remained relatively low, inducing a few other countries with economically viable natural gas deposits who began their own production. In the 1960s, the United States accounted for 99 percent of the world's reported helium production and 95 percent of apparent world consumption. By the 1970s, the U.S. share fell to 93 percent of world production and 64 percent of consumption. In the 1980s, these shares continued falling to 72 percent and 56 percent, respectively. Foreign production of helium was first centered in Russia and Poland, but gradually shifted to Canada, Algeria, and Qatar.

The Bureau of Mines stopped adding to the FHR by 1980. Production slowed back down to only 50 percent more than U.S. demand, especially after the bureau's Keyes plant in Oklahoma was shut down in 1982 (Weaver), with the excess production exported to the rest of the world. Liu (1983) forecast a looming shortage of helium by the late 1980s that would require using the FHR stockpile, though Uri (1987) argued that the forecast was incorrect. By 1994, the U.S. helium industry was dominated by 14 private companies running 18 different extraction plants, and U.S. exports made up more than two thirds of all helium purchased around the rest of the world (U.S. Geological Survey). The Bureau of Mines still ran the Exell plant near Amarillo, but its production was a small share of overall output.

The privatization period began in the mid-1990s, as Congress concluded that helium conservation was no longer necessary due to private production. The Bureau of Mines was closed in 1995, and its helium operations were transferred to the Bureau of Land Management. Congress then decided that the federal government should get out of the business of producing and selling helium. The Helium Privatization Act of 1996 required that the federal government stop producing helium within two years. The Exell plant was soon closed. The act then required the Bureau of Land Management to sell off its reserve helium, starting by 2005 at the latest and ending by 2015 (U.S. Congress 1996).

Congress set the price of crude helium without regard to its market value. Congress priced helium at the average cost needed for retiring $1.4 billion in federal debt used to fund the FHR (National Research Council 2010). By 2006, the privatization period resulted in government prices that were below private (market) prices (J.R. Campbell & Associates, Inc. 2013). This would have major unintended implications upon private firms in the market, which we will explore in the next section. These implications would ultimately lead Congress to reconsider their actions. In 2013, the Helium Stewardship Act was passed. The chief purpose of this act was to convert federal sales mandated at a fixed low price into market-based auctions, which was expected to improve production incentives.

In 2017, however, a trade embargo of Qatar by its Arab neighbors led to a dramatic decline in the world supply of helium, reminding observers that sales from the FHR are not the only disruptive force in the helium market (Anderson 2018). The Helium Extraction Act was subsequently introduced in 2017 to improve incentives for private helium exploration on U.S. federal lands. This act was finally passed and signed in 2019, as a part of the Natural Resource Management Act (S.47 2019). Meanwhile, production continues in Qatar and Algeria, and new plants are coming online in Tanzania, Russia, and Canada (DeCarlo and Uy 2017).

3 Economic Analysis of the Helium Privatization Act
In this section, we will walk you through the economic analysis of the Helium Privatization Act.

3.1 Initial Equilibrium
In the decade before the Helium Privatization Act of 1996, the government held a large stock of helium, but otherwise remained on the sidelines of the market. We model the initial equilibrium in the market in Figure 3. This figure makes two important assumptions. First, we assume that this market can be modeled using the framework of perfect competition. In other words, while we will show that there is clearly a finite number of firms participating on the supply side of this market, we choose to assume that there is sufficient competition for the firms to act as price takers. In the appendix, we present an advanced question that relaxes this assumption. Second, we assume that all firms had the same
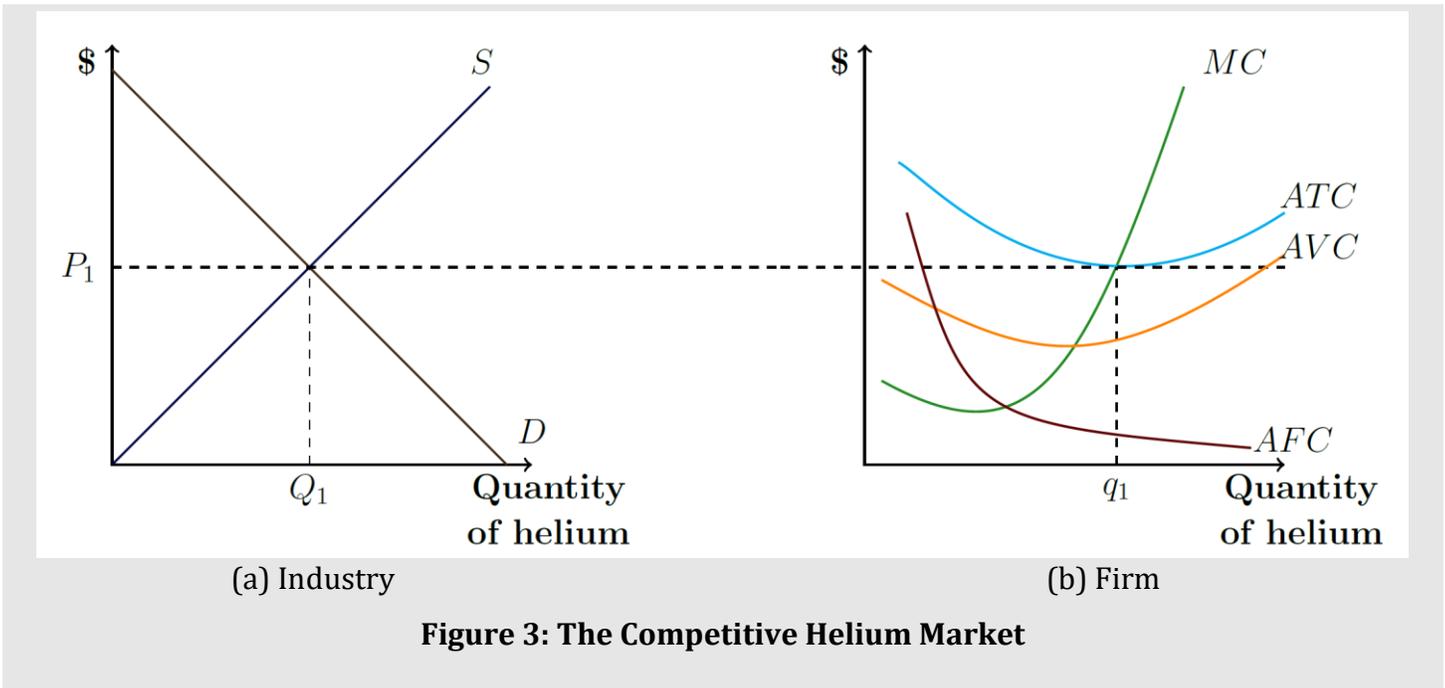
Figure 3: The Competitive Helium Market

hypothetical cost curves. Because of these assumptions, we will specify the helium market as perfectly competitive. See Karlan and Morduch (2014) and Acemoglu, Laibson, and List (2018) for a textbook presentation of such a model.

The industry price (P_1), with all firms acting as price takers, is determined where demand (D) equals supply (S) in Figure 3a. Assuming all firms face the same hypothetical cost curves, they produce q_1 cubic feet of helium. This quantity for the firms is determined where price (P_1), which is also marginal revenue (MR) under perfect competition, is equal to marginal cost (MC), in Figure 3b. This is also where price equals average total cost (ATC). Since profit can be calculated as $\pi = (P_1 - ATC) * q_1$, the economic profit for each firm is equal to zero, which must occur when an industry is in long-run competitive equilibrium. Recall that economic profits include opportunity cost, so stating that economic profits are equal to zero is essentially saying that firms cannot make any more money in competitive industry X than they could in competitive industry Y. If there were a difference in profits between two competitive industries, resources would flow out of one industry (raising the level of profit) and into another industry (decreasing the level of profit). This process would continue until the level of economic profits returned to zero in each industry.

3.2 Consequences of the Helium Privatization Act
At the time of passage of the Helium Privatization Act of 1996, there were 11 plants producing Grade A helium in the United States. For several years during the next decade, purchases from the FHR accounted for more than half of total U.S. sales. By 2011, U.S. production had declined by almost 20 percent even though exports had more than doubled and only 6 plants remained in operation (U.S. Geological Survey).[2] In this section, we examine how our model of firms within a perfectly competitive industry may help to explain these changes in the market.

First, we will model the impact of the government sell off of helium that took place on account of the Helium Privatization Act of 1996. Before examining the impact upon individual firms, it is worthwhile to carefully consider the exact impact that the government intervention had on the supply curve in the market. In order to do this, the left panel of Figure 4 displays, separately, the private and government supplies of helium to the market, while the right panel combines them.

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[2] We display details on the number of operating plants in Figure 8.

(a) Private and Government Supply   (b) Combined Industry Supply
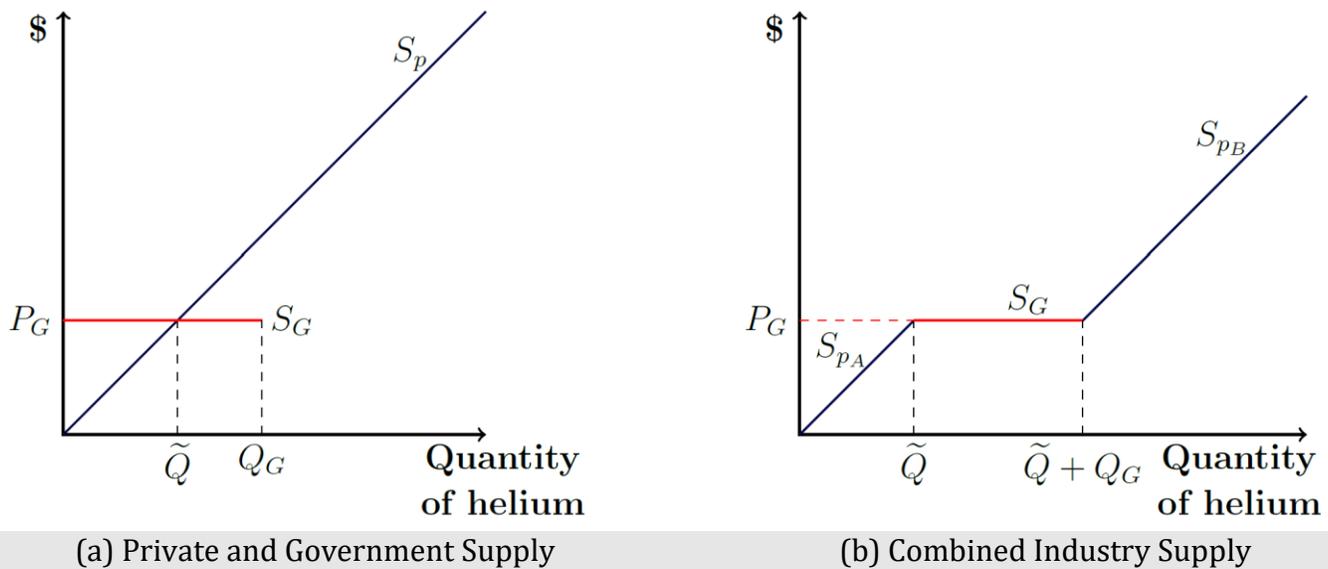
Figure 4: Helium Market Supply after Privatization

In Figure 4a, we see a standard upward sloping supply curve, labeled S_p. Let's think of this as the market supply curve for private firms. Recall that the Helium Privatization Act of 1996 initially tasked the administrators of the government's helium stock with selling it to private buyers as quickly as possible at a *set price*. Regardless of how much helium the government was selling, the price remained at the predetermined price. Because the government was selling the helium at a fixed price, we represent the government supply, S_G, as being perfectly elastic at a fixed price of P_G. The government had a large, but not infinite, supply of helium to sell. We assume that the government had Q_G to sell at this fixed price. Notice that the private supply curve passes through the government supply curve; we label this intersection point as $\tilde{Q}$.

In Figure 4b, we aggregate the two supply curves shown in Figure 5a. Remember that when we add up parts of supply or demand into market supply or market demand, we add things *horizontally*. The first units that will be supplied to the market are given by the units that the private firms could produce at a price below P_G. In the left panel, we saw that the private market was able to produce Q of these units. We refer to this portion of the supply curve as S_{p_A}. The next cheapest units to produce were the Q_G units of helium supplied by the government at a price of P_G. Combined, the market could supply a total of $\tilde{Q} + Q_G$ at P_G. As the price rose above P_G, the private firms would begin to supply the units beyond $\tilde{Q}$. This last portion of the market supply curve is referred to as S_{p_B}.

We now examine the consequences of the government's helium supply impact on the production decisions of individual helium plants. First, we will analyze the new short-run equilibrium followed by the new potential long-run equilibrium. Finally, we conclude by discussing how and why government policy changed in this market.

3.2.1 New Short-Run Equilibrium

Above, we stated that for some years sales from the FHR were the majority, but not all, of sales in the United States. We therefore assume that Q_G was less than the previous quantity exchanged in the private market, Q_1. In Figure 5a, the new equilibrium occurs where the unchanged demand curve intersects with the new supply curve. For reference, we represent with a dashed line the previous position of the units supplied by the private market beyond $\tilde{Q}$ as $\hat{S}_{p_B}$. The actual supply, once accounting for the government intervention into this market, is represented by S_{p_B}.

(a) Industry   (b) Firm
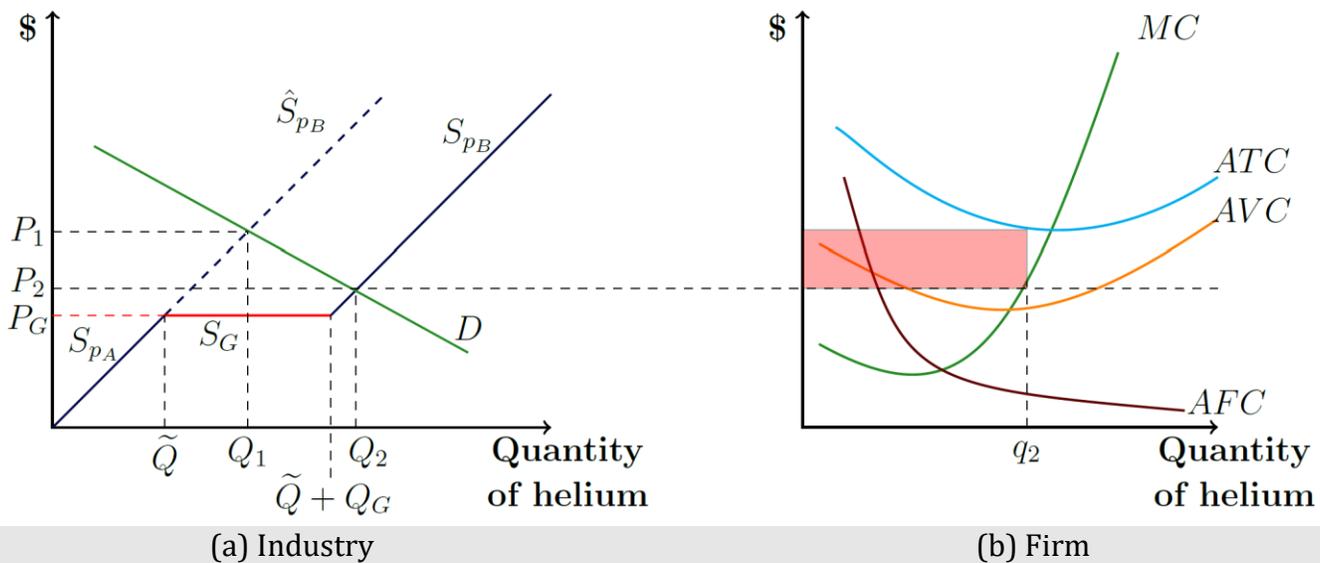
Figure 5: The Helium Market after the Helium Privatization Act

We observe the new market short-run equilibrium price in the left panel of Figure 5. Here, we see that the demand curve now intersects with supply at a price of P_2. This intersection occurs along S_{p_B}. This means that firms will supply all helium to the market that they would be able to produce at a price lower than the price at which the government was selling helium. In other words, the entire amount of helium represented by S_{p_A}, which we call $\tilde{Q}$, is sold. Additionally, in this example all helium made available by the government, Q_G is sold, such that $Q_2 > \tilde{Q} + Q_G$.

The consequence of the fact that the demand curve intersects the supply curve along the S_{p_B} segment is that P_2 ends up being greater than P_G; the government is not supplying so much helium to the market that it is selling to the highest value helium consumers in the market. Thus, in a sense the private market still sets the price for helium, but the price is much lower than it was without the presence of Q_G in the market.

In summary, the key impact of this intervention was to lower the market price. Recall that all firms in a competitive market are price takers, so they must now sell their helium at P_2. As firms were earning no economic profits in the previous equilibrium, we would expect economic losses to now occur. We examine this in Figure 5b.

Figure 5b reveals the short-run equilibrium for a firm in this market, as given by the market price set in Figure 5a, just like Figure 3a did for the initial equilibrium. Here, it becomes clear that the lower price faced by firms will indeed lead to negative profits. As can be seen in the figure, the intersection of price (P_2) and marginal cost (MC) is at q_2. Therefore, the firm's profit maximizing quantity is q_2. At this quantity, the price is below the average total cost and the firms are earning negative profits (losses), as profit is given by $(P - ATC) * q$. This negative profit is represented by the red shaded box.

3.2.2. New Long-Run Equilibrium
Generally, if firms are earning negative profit, there will be exit from the industry until the market reaches a new long-run equilibrium, and the number of firms is one of the determinants of supply. As firms exit a competitive market, market supply will shift to the left. This will increase the market price until remaining firms no longer lose money.

We take one more look at our model of this market structure in Figure 6. The process of firm exit may seem complicated in this context, but it is relatively straightforward if we go back to the graph that separated private supply from government supply. Because only private firms' supply decisions are

(a) Private and Government Supply   (b) Combined Industry Supply
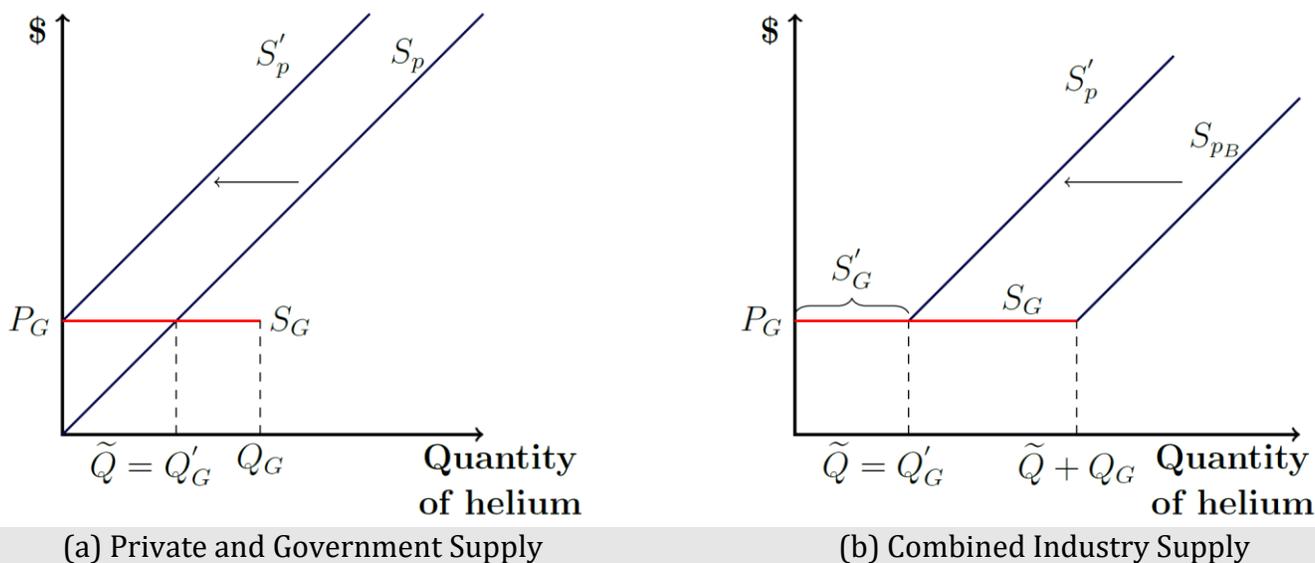
Figure 6: The Helium Market Supply after Exit

affected by the losses caused by the decrease in price, we simply need to shift S_p to the left, resulting in S_p'. We assume that this shift is sufficient to eliminate all of the private supply curve below P_G. In addition, in this market, the prior equilibrium can only be achieved if there is some change to government policy. Specifically, the government would either need to raise the price at which it is selling helium or decrease the quantity that it was selling. In fact, the government did move in this direction with auctions, as we will later discuss. We choose to represent this with a new smaller quantity being sold: S_G'. Combining these two curves now, we see the new market supply curve in Figure 6b.

We now turn our attention to Figure 7a, which shows the new market supply curve, along with demand. Here, we see that when we account for both the new government supply, along with the decrease in private supply that results from economic losses in the market, the price may recover to P_1.

(a) Industry   (b) Firm
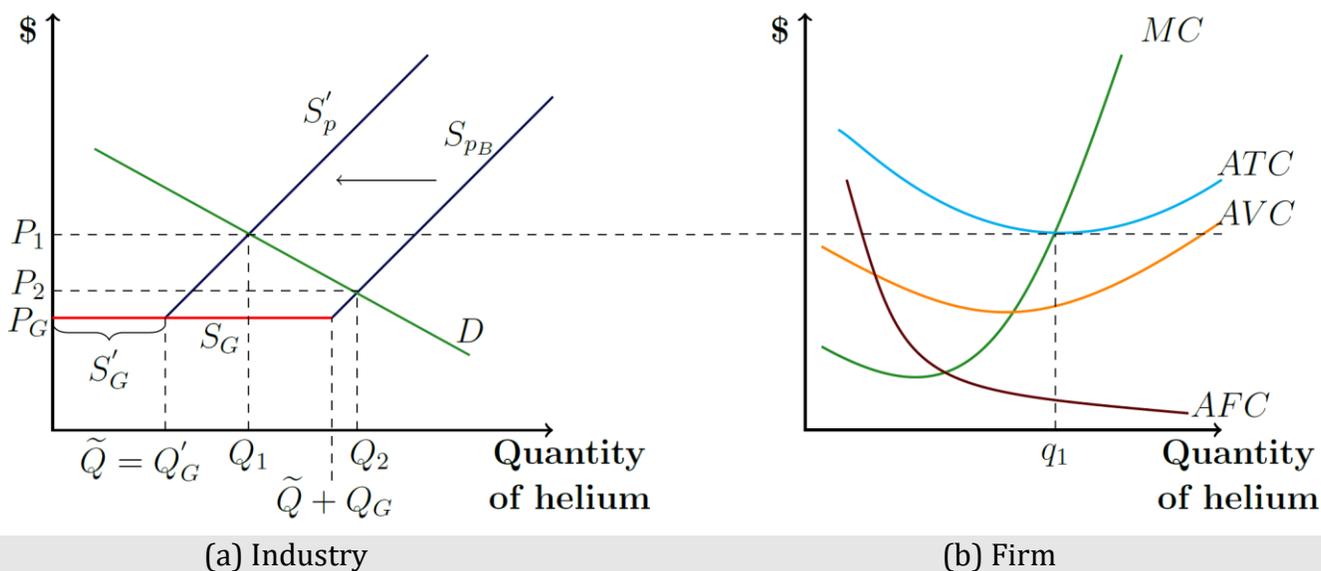
Figure 7: The Helium Market after Exit

When we turn our attention to Figure 7b, we can see that when the price returns to P_1, firms are back to earning zero economic profits in this industry. In other words, the market has returned to long-run equilibrium.

This, however, does not mean that there are no consequences to the government intervention in this market. Many firms were driven out of business and had to leave the market.

This can be understood by the fact that while the total quantity exchanged in the market has returned to Q_1, only $Q_1 - Q_G'$ of this supply is provided by private firms. In other words, while Figure 7b looks exactly the same as Figure 3b, with firms each producing q_1 units, there are less firms in the market who are producing. Previously, there were $\frac{Q_1}{q_1}$ firms, but now there are only $\frac{Q_1 - Q_G'}{q_1}$ firms.

4 Conclusion

Above we have seen the effects in the helium market of the government selling off a fixed amount of helium at a nonmarket driven price. In our modeling of this event, the primary effect of this action was to initially lower price. This then disrupted the private market from a long-run equilibrium, driving a representative firm's economic profits from zero into negative territory. As a result of negative profits, firms began to exit the industry. This exit from the market drove prices back up. In our modeling of this intervention, price was ultimately able to return to its original level, if the government reduced its own supply to the market. The number of private firms operating in the industry, however, is reduced. This outcome is largely consistent with the data that we have presented in Figure 2.

Ultimately, as we have alluded to earlier, the U.S. government shifted its policy away from selling off the helium stock at this fixed price. In an effort to stabilize the market and encourage private production, the Helium Stewardship Act of 2013 gradually phased in auctions of the helium reserve at market-based prices above the minimum necessary to retire the related debt (U.S. Congress 2013). As we see in Figure 8, this policy change was apparently significant enough not only to prevent further private exit from the industry, but also to encourage entry in the long run, as the number of helium plants began to recover as a result.
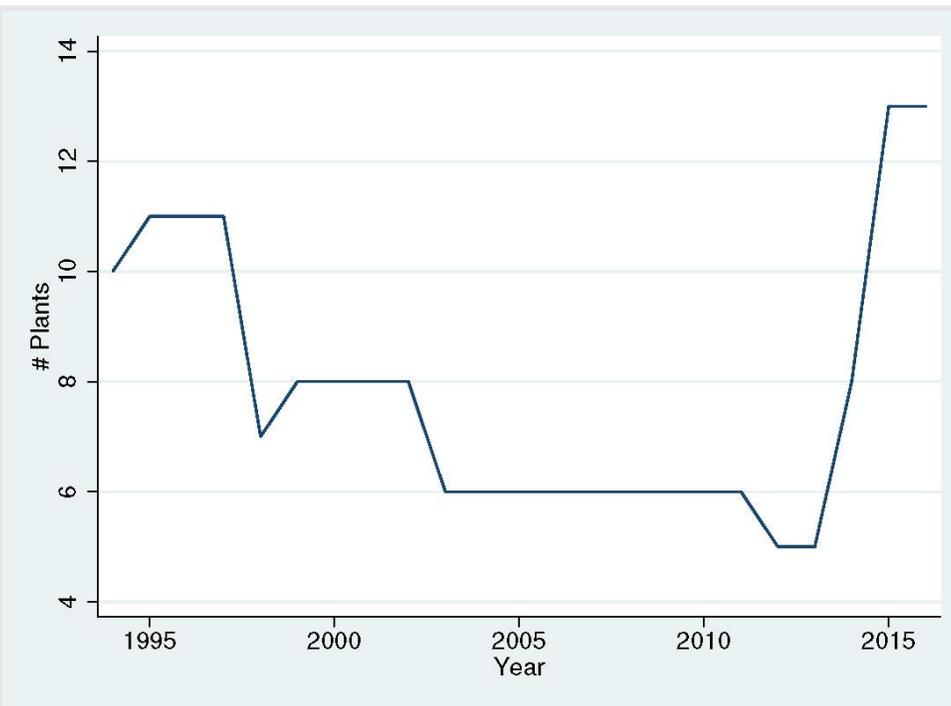
Figure 8: Plants Producing Grade A Helium

This case study provides a useful stylized example of a market adjustment, helping students to better understand the concepts of cost curves, the competitive market, and exit from an industry. The companion Planet Money episode covering this case should help ground the students in the material covered here, and we recommend that students be assigned to listen to it before class. Much as the case with Lacy, Sørensen, and Gibbons (2020), we believe that this material provides the students with an application of government intervention that illuminates specific standard economic principles in an entertaining example. In addition, it helps to make a good general point for students in these classes: policies often have unintended consequences, and those policies which can recognize how the goals of policy makers may be carried out in a way that is mindful of market forces may ultimately more effectively accomplish their goals.

5 Discussion Questions

1. Review the economic model that we presented in the case study.
   (a) Draw side-by-side industry and firm/plant graphs to display the long-run equilibrium in the helium market assuming it is perfectly competitive.
   (b) On the same graph, draw the effect on the industry and firms/plants from the government selling off its helium stock, as we have modeled it in the case study.
   (c) Finally, show how exit of firms/plants and reduced government supply returned the market back to competitive equilibrium.
2. Extending our analysis: let's now assume that the government made available twice as much helium as drawn in the graphs above. Answer the following questions:
   (a) Using this new information, draw the effect on the industry and firms from the government selling off its helium stock.
   (b) Can private exit bring the market back to equilibrium? Why or why not?
3. Anticipation Effects: As shown in Figures 2, some reduction in output occurred before the government began selling off helium at a lower price in 2003. Because future policy was clearly spelled out in the Helium Privatization Act of 1996, firms could see that the market was going to change and had some sense of what these changes were going to look like. Using your knowledge of economic analysis, explain why firms would react before the government began to sell off their helium.
4. Up until now, we have assumed that different helium plants all faced the same cost curves. We will now relax this assumption and assume that different plants may have had different cost curves. Below is some specific information about different plants that you will refer to when answering the questions below.

   In 1996, there were 10 plants owned by seven private firms that were producing exclusively Grade A helium. A decade later, this number had dropped by nearly half. Nitrotec closed both of its Colorado plants, the Burlington plant in 1998 and the Cheyenne Wells plant in 2002. Unocal sold its plant in Moab, Utah, to new owners, and Keyes Helium Company sold its Oklahoma plant. Meanwhile, Newpoint Gas opened up a new Grade A helium plant in Shiprock, New Mexico, in 2002, but this was soon sold to Shiprock Helium, which then sold the plant to Nacogdoches Oil. Throughout this time, only five plants operating in 1996 continued to produce Grade A helium: the Air Products Helium, Inc. plants in Liberal, Kansas, and Hansford County, Texas, the Praxair plants in Ulysees and Bushton, Kansas, and the BOC Gases plant in Otis, Kansas.

   (a) Draw the costs curves in one graph for Praxair's Ulysses plant. In a separate graph (you may want to draw these side by side) draw the cost curves for Nitrotec's Cheyenne Wells

plant. Assume that both firms faced the same decrease in price (from P_1 to P_2). Using the graph, show why one plant shut down and why the other did not.

(b) Using the result from above, refute the following statement: "the decrease in helium production can be explained by plants that left the industry, but not by the firms that remained."

(c) Consider Nitrotec's short-run decision to close its Burlington plant after the passage of the Helium Privatization Act of 1996, even before sales from the FHR began. Then consider its long-run decision to close the Cheyenne Wells plant, after sales began. Draw one graph for each plant, explaining why one plant shut down in the short run, while another plant exited in the long run.

(d) Even while other plants were exiting the market, a new plant owned by Newpont Gas entered in Shiprock, New Mexico. Explain why this may have happened.

(e) As mentioned above, firms could produce both Grade A helium as well as crude helium. Assume that Grade A helium is more expensive to produce. Also, assume that Grade A helium sells at a higher price than crude helium.

    i. Using two side-by-side graphs, draw graphs depicting a firm that will earn positive profits for each of these two products.

    ii. Now suppose that there is downward pressure on the price of helium. Decrease the prices in these markets (keeping the price for Grade A higher than the price for crude helium) and show that the firm may now find it optimal to produce only crude helium, but not grade A.

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