PWP-067

Understanding Competitive Pricing and Market Power in Wholesale Electricity Markets

Severin Borenstein

August 1999

This paper is part of the working papers series of the Program on Workable Energy Regulation (POWER). POWER is a program of the University of California Energy Institute, a multicampus research unit of the University of California, located on the Berkeley campus.

University of California Energy Institute
2539 Channing Way
Berkeley, California 94720-5180
www.ucei.berkeley.edu/ucei

Understanding Competitive Pricing and Market Power in Wholesale Electricity Markets

Severin Borenstein*

August 1999

Abstract: Discussions of competition in restructured electricity markets have revealed many misunderstandings about the definition, diagnosis, and implications of market power. In this paper, I attempt to clarify the meaning of market power and show how it can be distinguished from competitive pricing in markets with significant short-run supply constraints. I also address two common myths about market power: (a) that it is present in all markets and (b) that it must be present in order for firms to remain profitable in markets with significant fixed costs. I conclude by arguing that, while a finding of market power in an industry does not necessarily indicate that government intervention is warranted, such analysis is an important part of creating sound public policy.

* Director, University of California Energy Institute and Professor of Business Economics, Haas School of Business, University of California, Berkeley, CA 94720-1900.
email: borenste@haas.berkeley.edu.

In the brief period that the restructured California electricity market has been operating, a number of issues have arisen that relate to the competitiveness of the wholesale electricity market in the state. There have been lively debates over the need for price caps in the California Power Exchange (PX) day-ahead market and the California Independent System Operator's (ISO) real-time and ancillary services markets. These debates have raised the question of whether the high prices that have been observed at times are a natural result of peak demand times or whether they have been exacerbated by strategic behavior by some firms attempting to manipulate market prices. The debate about the appropriate treatment of Reliability Must-Run (RMR) plants has likewise focused attention on the possibility that some producers may attempt to supply power in ways designed to influence market prices. The questions raised in these discussions are central to judgments about the need for intervention by the PX, ISO, or government regulatory institutions to alter the operation of the wholesale electricity market.

In this paper, I discuss what market power is, how it is often confused with competitive behavior – particularly competitive peak-load pricing – how it can be distinguished from competitive behavior, and what implications this has for wholesale electricity markets.

2. The Behavior of Price-Taking Firms and Competitive Markets

A firm exercises market power when it reduces its output or raises the minimum price at which it is willing to sell output (its offer price) *in order to change the market price.* A firm that is unable to exercise market power is known as a price taker; the firm makes decisions taking the price it faces for its output as given, believing that the actions it takes cannot change that price. Common examples of price-taking firms are wheat, rice, corn, or soybean farmers, gold, silver, or platinum mining companies, and natural gas producers. Many industry observers suggest that producers of oil are price takers, while others argue that OPEC is able, as a group, to manipulate oil prices. OPEC has certainly tried to do this, but has had difficulty dissuading their members or other non-OPEC producers from responding individually to higher oil prices by increasing their production.

A price-taking firm is willing to sell output so long as the market price (which it believes that it cannot profitably influence) is above the firm's marginal cost of producing and selling the output, properly calculated. In the electricity industry, the marginal cost

of production will include the variable costs due to fuel and the other variable operating and maintenance costs, *i.e.,* all costs that actually vary with the quantity of power that the plant produces. Costs that don't vary with the quantity of power the plant produces in the given time period, such as fixed costs of operating and maintaining the plant, are not part of the marginal cost and are thus irrelevant to the firm when it makes its short-run production decision.

Still, the cost of selling a unit of electricity can be greater than the simple production costs if the firm has an *opportunity cost* that is greater than its production cost. An opportunity cost is the revenue the firm would get from putting the power to an alternative use, such as selling it in a different location. For instance, a power producer in the northwest U.S. can sell power into California or can sell power in its own location or some other location in the WSCC. If the producer expects that it can earn $21/MWh selling the power in another location, and if transmission were available and no more costly than transmission into California, then it would not be willing to offer power in California for any price less than $21/MWh. This would not indicate market power: the firm is not raising its offer price in California in order to raise the California market price. It is simply choosing to sell its power where price is highest. The marginal cost that a firm faces for selling power is the greater of its marginal production cost and its opportunity cost. Of course, a high price in an alternative market can reflect market power in that market, resulting in high prices that are then transmitted across markets by the response of competitive suppliers.

It is important to understand that a price-taking firm does not sell its output at a price equal to the marginal cost of each unit of output it produces. It sells all of its output at the market price, which is set by the interaction of demand and *all* supply in the market. The price-taking firm is *willing to sell* at that market price any output that it can produce at a marginal cost less than that market price.

In markets run as a uniform-price auctions, such as the day-ahead market run by the PX, a price-taking seller that wishes to maximize its profits would bid its power into the market at its own marginal cost. That is not the price it would receive for its power. It would receive the price that equates the entire supply and demand in the auction. It would then be awarded sales exactly equal to the quantity of power that it could produce

at a marginal cost less than or equal to the market price. Note that this means it would produce all power for which its marginal cost is less than the market price and it would not produce any power for which its marginal cost is greater than the market price.

If the industry marginal cost (*i.e.,* supply) function, which is the aggregation of all firms' supply functions, exhibits distinct steps – as is often thought to be the case in the electricity industry – then a competitive market equilibrium may be reached at which the price exceeds the marginal cost of even the last unit of output produced, but is still less than the marginal cost of producing one more unit of output (see figure 1). Similarly, if all units of production are in use, then the intersection of supply and demand can occur at a price above the marginal production cost of any unit (see figure 2). Thus, *in the absence of market power by any seller in the market, price may still exceed the marginal production costs of all facilities producing output in the market at that time.*

Because a price-taking firm sells its output at the market price, and that market price is usually above the marginal production cost of all or almost all the output it produces, price-taking firms *can* still cover their full costs of production, including their going-forward fixed costs of operation. This is illustrated in figure 3 for a single price-taking firm: the area above the firm's marginal cost curve and below the price line is revenue that contributes to covering fixed costs of operation. It is possible that this area is greater or less than the firm's fixed costs of operation. If it is less than the firm's fixed costs, the firm will eventually shut down or at least scale back its operations. If the area is greater than fixed costs, this is a signal that the firm (or some competitor) might be able to profitably expand. Assuming that there are not barriers to either new entry or existing firm expansion, large profits among existing generators would likely lead to entry of new firms and plants that would drive down prices and dissipate extranormal profits.

Some analysts of the electricity industry have raised the concern that price-taking behavior on the part of every firm is simply too strict of a standard to be used as a benchmark. They argue that it is unrealistic to think that no market power will exist, since there is market power present in most markets. Though market power exists in many markets, there are also many markets in which virtually no market power exists: most agricultural and natural resource markets, for instance. These industries are notable for producing virtually homogenous products and selling them over a large geographical

area, characteristics that bear an important similarity to the electricity industry.

A more extreme view than the inevitability of market power is the view that market power is *necessary* to allow firms to cover their total costs of operation. In the absence of market power, the argument goes, marginal cost pricing will leave nothing to cover fixed costs and firms will not be profitable enough to survive. This view represents an unfortunate confusion about the economics of competitive markets. Price-taking behavior, the manifestation of competitive markets, means simply that a firm is producing every unit of output that it can produce at a marginal cost below the market price is not producing any output for which its marginal cost is greater than the market price. Thus, most or all output produced is produced at a marginal cost below the market price, and the difference between price and the marginal cost of each unit of output makes a contribution towards fixed costs. During very high demand times, for instance, price spikes will occur even in competitive markets as price rises to ration demand to the available supply. In a competitive market, however, all output that can be produced at a marginal cost less than the market price will be produced, and no generator will inflate its offer bid in an attempt to raise the market price.[1]

If the net revenue earned (after covering variable operating costs) is more than is necessary to cover the fixed costs for some type of generation, then in a competitive market with no barriers to entry, new generation of that type will enter the market. Conversely, if the net revenue is less than is necessary to cover the fixed costs for some type of generation, then some generators of that type are likely to exit. When exit occurs, the supply curve in the industry shifts to the left and the equilibrium market prices rise, so that all remaining firms earn higher prices and greater contributions to fixed costs. In a competitive market,

---

[1] Some analysts have argued that this standard economic analysis cannot be applied to electricity markets because demand is effectively completely price-inelastic (vertical) at any point in time. They argue that price will then never exceed the marginal cost of the highest cost generator, so that generator will never be able to recover its fixed costs. However, it is because of the short-run price inelasticity of demand, that all wholesale electricity markets have reserve markets, essentially insurance markets that pay generators to stand by ready to produce in case they are needed. In a competitive electricity market with completely inelastic demand, the price of energy indeed would never exceed the marginal cost of the highest marginal cost producer, but that producer would also be receiving revenues in the reserve market in return for standing ready to produce when demand peaks. The California electricity market has this "stand-by payment" structure for spinning, non-spinning, and replacement reserves, and well as regulation energy. When the technology is developed and deployed for consumers to respond in real time to energy price changes, the need for these reserve markets will diminish, since demand reduction will provide such "reserves."

this process of entry and exit occurs until, in long-run equilibrium, all generators in the market are able to cover their fixed costs and no other generator could enter and cover its fixed costs at the current market prices. There is no economic argument for the necessity of market power to ensure the viability of the industry.

Note that this does not mean that all current capacity in an industry will be able to cover its (past) sunk investment costs or even its fixed going-forward costs in a deregulated market. Some firms or generating units may have to exit the market because they cannot cover their total going-forward costs of operation. This can occur because such generators are just not sufficiently efficient to be viable in a competitive market, or because there is simply too much capacity in the market and some of it must exit in order for market prices to rise to a level that allow the remaining firms to break even as an outcome of the competitive supply/demand process. See the Numerical Illustration in the appendix for an example of this.

3. The Behavior of a Firm with Market Power

In contrast to price-taking firms, a firm that exercises market power sets its production quantities and/or the prices at which it is willing to sell output in order to influence the market price. It influences the market price by withholding output at the margin or raising the price at which it is willing to sell this marginal output. By taking such actions, the firm risks selling less, but it raises the price it will get for all output that it does sell.

The central idea behind market power is that in a market where all output is sold at the same price, a firm that can influence price in the market will do so in order to raise the price for *all* the production it sells. Consider, for instance, a firm that is selling 10 units of output and the market price is \$15. If that firm could influence price by reducing its output to 9 units – causing price to rise either to the point that total demand is reduced by one unit or some other seller is induced to increase its production by one unit to compensate, or some combination of these two effects – then it would compare the profit from selling 10 units at \$15 with selling 9 units at some higher price. In the latter case, the firm would also save money by having to produce only 9 units instead of 10. If reducing its output to 9 caused price to rise to \$17, then the firm's total revenue would rise (from \$150 to \$153) causing its profits to rise even before accounting for its cost saving from having to produce

only 9 units of output instead of 10.

The same effect occurs if the firm doesn't reduce its output, but instead offers to sell its 10th unit of output for some higher price, some price above $15. If the firm offers that unit for $17, then either that offer is accepted and the market price is increased to $17, or that offer is not accepted. If that offer is not accepted, it is because either demand adjusts by demanding less total output or the supply of other producers adjusts by offering to supply more at some price less than $17, or some combination of these adjustments. In either of these cases the market price must still rise to some extent in order to equalize supply and demand after this firm has raised the offer price of its 10th output unit.

When is it profitable for a firm to behave this way, restricting its output or raising its offer price in order to affect the market price? It is profitable so long as the gain in profit by selling all the output it stills sells after the market price increases is greater than the loss it faces by selling fewer units, if that occurs. Calculation of the change in profits takes into account both the change in the firm's revenues and the change in its production costs if it ends up producing fewer units of output.

Two factors are critical in determining the extent to which such behavior is likely to be profitable for the firm: the sensitivity of demand to price changes and the sensitivity of the supply of other producers to price changes. If demand must adjust to having one less unit to consume, then the price must rise to reduce demand accordingly. If demand is very sensitive to price – *i.e.,* in economic terminology, if demand has a high *price elasticity* – then it won't require much of a price rise to reduce the quantity demand by one. If that is the case, then restricting output is less likely to be profitable: in the extreme, the firm might end up selling 9 units for $15.01 each, probably less profitable than selling 10 units for $15.00 each. Conversely, if the demand has a low price elasticity, then a large price increase would be necessary before quantity demanded would be scaled back by one unit. In that case, the reduction of sales to 9 units is much more likely to be profitable.

Similarly, if the supply that other firms are willing to offer is very sensitive to price – *i.e.,* if supply has a high price elasticity – then any one firm is unlikely to find it profitable to reduce its output or raise its offer price on marginal units in order to raise the market price. If the firm attempted to do this, then even a small increase in the market price,

maybe to $15.01, would bring forth additional supply from other producers that would replace the unit of supply that the firm has decided not to offer or to offer at only a higher price. The small increase in price would then not be sufficient to make up for the firm's reduction of sales from 10 to 9, so the firm would not find it profitable to reduce its output of its offer price on the marginal unit. Again, conversely, if the supply of other firms has a low price elasticity – *i.e.,* if others would not increase output unless price increased by a large amount or if they were unable to increase output at all – then the strategy of reducing output or raising the offer price on marginal units is more likely to be profitable.

The ability to exercise market power is correlated, albeit imperfectly, with a producer's market share. If, for instance, a firm supplies 1% of the total output in a market, then if it were to reduce output in order to raise its profits, it would run into two problems. First, demand would not have to adjust very much to absorb the loss of part of the firm's production – remember that this only makes sense if the firm still has *some* output left in the market that it can sell at the new higher price – so price would not have to rise very much.

Second, with 99% of the output produced by other companies, these other companies probably could expand their output by the small amount necessary to replace the firm's reduced production without driving up their own costs appreciably. So, even a slight increase in price would probably bring forth a replacement of the reduced supply, undermining the firm's intent when it reduced its supply. In other words, a firm with a very small market share is more likely to see demand as relatively price elastic, and the supply of other firms as relatively price elastic, over the range of output that it might contemplate removing from the market or offering to sell only at a high price.

In contrast, a firm with a large share of the market is more likely to be able to lower its output, or raise the offer price on part of its output, in a way that is difficult for demand to adjust to because the firm's action constitutes a significant share of the entire market production. Likewise, other companies may find it much more difficult to replace the output reduction of a large firm without themselves running into production constraints that would drive up their own costs.

The connection between market share and market power, however, can be overstated.

In some situations, a firm with even a relatively small market share might find it profitable to restrict its output or raise its offer price on marginal output. Think about a situation in which demand is not at all price elastic, in the extreme a situation in which buyers don't even know the price at the time they are buying. Then add to that a situation in which other factors, such as a very hot day, have driven up the quantity that buyers want to consume to the extent that virtually every company is operating at its absolute production limit. That is, the price elasticity of supply from other producers is very low because they are at their capacity constraints. In that case, a firm with even a small share of the market might be able profitably to reduce output or raise its offer price. Because consumers would react little to an increase in price and other producers would not be in a position to fill in output that the firm threatens to withdraw from the market, even a slight reduction of output (or very high offer price on that output) could raise the market price substantially and, thus, make such behavior profitable.

This situation is particularly relevant to markets in which demand is highly variable – so that there are times when virtually all production capacity is necessary to meet contemporaneous demand – and the output cannot be stored – so that inventories are not available as an alternative supply source if a firm tries to exercise market power. For this reason, electricity markets are, all else equal, more vulnerable to the exercise of market power than are other energy markets, such as gasoline markets.

When a firm does exercise market power, all firms in the market benefit. In fact other firms may benefit more than the company that is exercising market power. This is because the company that is exercising market power reduces its sales quantity, or risks doing so, in order to raise the market price. Other firms do not have to reduce their output – in fact they may even increase output – but still benefit from receiving the higher market price. Thus, even a small price-taking firm in a market might have a strong incentive to resist attempts to detect or undermine the exercise market power by other firms.

Thus far, I have discussed only situations in which a firm unilaterally exercises market power. In some markets, firms may try to collude to jointly exercise market power. The idea behind collusion is for each firm to recognize that when it expands its output, it *may* raise its own profits, but it pushes down the market price and reduces the profits of other producers. Conversely, when a firm reduces its output (or raises its offer prices), it *may*

harm its own profits, but it raises the market price and the profits of other producers. Recognizing this interdependence, firms may try to reach an agreement to restrict their output or raise their offer prices in order to jointly raise profits. OPEC tries to do exactly this. But OPEC faces the problem that any set of colluding firms face: each firm would individually like to raise its output while its collusive partners reduce theirs.

Attempts by companies in the U.S. to reach such agreements to jointly raise price or lower output are illegal under section 1 of the Sherman Antitrust Act. In contrast, the antitrust laws in the U.S. do not forbid unilateral exercise of market power. A firm is free to unilaterally restrict its output or raise its offer price in order to increase its profits.[2]

4. Distinguishing Competitive Behavior from Market Power

The previous two subsections have explained how prices are determined in competitive markets and in markets in which some firms exercise market power. In both cases, prices can end up being higher than the marginal costs of all generating units in the market. In analyzing electricity markets, it is critical to be able to distinguish between competitive market pricing and pricing that results from the exercise of market power. Two indicators clearly distinguish these two possible market results:

1. In a competitive market, no firm takes an action, including output decisions or offer prices, with the *intent* of affecting the price in a market.

2. In a competitive market, a firm is always willing to sell a unit of output so long as its marginal cost of selling that unit is less than the price it receives for that unit. In a uniform-price auction market for electricity such as the PX, a competitive firm's offer price will be equal to its marginal cost, which will be the greater of its marginal production cost or its opportunity cost of selling the power elsewhere.

---

[2] Even if firms do not explicitly collude, it is possible that firms that interact frequently will gradually come to an "understanding" of cooperative behavior, known as "tacit collusion" in the antitrust and economics literature. For instance, through its behavior, a firm might make it clear that it will restrict its output only if another firm does the same, but it will punish if the other firm overproduces by increasing its own output dramatically and driving prices very low. It is widely acknowledged that such tacit collusion is difficult to carry out unless firms interact repeatedly, and is always difficult to detect. But it is also seen as a real phenomenon that can occur. Tacit collusion is a gray area of the U.S. antitrust laws. Few cases have been prosecuted successfully against tacit collusion, but the government continues to argue that it can and will pursue evidence of such behavior.

5. Efficiency and Equity Concerns with Market Power

In the media and public policy discussions, market power is usually raised as an issue of equity: market power is said to allow sellers to "unfairly" extract revenues from buyers. These sorts of equity judgments are often difficult to justify since there are individuals and corporations of varying degrees of wealth on both sides of the market. Some of the sellers who benefit from market power, even if they cannot exercise it themselves, are small entrepreneurs who are struggling to keep their companies afloat. Others are wealthy corporations, small and large, who are making very high rates of return. Likewise on the buying side, some of the participants affected are individual consumers who are struggling to pay their electricity bills, but the impact of market power also falls on the investor-owned utilities and other corporations who are quite sound financially. For these reasons, it is difficult to make definitive statements about the effect of market power on wealth distribution without a much more detailed analysis of how the gains from market power are distributed among the sellers and how the losses are distributed among the buyers.

It is much less difficult to reach clear conclusions about the impact of market power on the efficiency of the market. Market power interferes with the efficient dispatch of generating resources. This happens because a firm exercises market power by taking some of its generation off the market (or risking doing so by raising its offer price). Given that demand is fairly inelastic, this means that some other firm must fill in that production with output from a generator that is less efficient. Smaller price-taking firms are likely to be producing from every generator that has a marginal cost less than the market price, while firms with market power are likely to idle some generators with cost below the market price. In general then, efficiency would be improved if the highest cost generation from firms with less (or no) market power were reduced and additional power were generated from lower-cost generators that firms with market power have idled when they reduced their output (usually by bidding higher offer prices). Every firm is individually still producing its output in the least-cost way given its resources, but the total production of power is not distributed efficiently among firms.[3]

---

[3] In addition, there is the standard economic inefficiency (or "deadweight loss") when price is above the marginal cost of producing one more unit: some product is not consumed (or produced) even though the consumer values the output more than it would cost the producer to make it. A deal that would make both the buyer and seller better off (ignoring the effect it would have on the price the seller gets for its other units) fails to occur.

In addition, futures markets are less likely to be successful and stable in the presence of market power. This is because transactions in futures markets are effectively bets about what the spot price of a good will be at a specific future point in time. They are used, in general, to mitigate price risk or to speculate on price changes that a participant anticipates will occur. If, however, a participant in the futures market also has market power in production of the good, it can, through its production decision, affect the profitability of its position in the futures market. Recognizing this, others become hesitant to use the futures market. They realize that they are likely to end up betting against someone who can actually determine, or influence significantly, the outcome upon which they are betting. As a result, market power in the production of a good can undermine the viability of any futures markets for that good.

6. Conclusion: Market Power in the Long Run and Government Intervention

Market power is present in many markets, only a small share of which are likely to benefit from government intervention. The diagnosis and measurement of market power is just one step in the process of developing sound public policy in a market. In responding to a finding of market power, policy makers must recognize that both the costs of market power and the ameliorative effect of government intervention can easily be overstated.

When market power is found to be present, the logical next step is to examine the sustainability of that market power. In markets with low barriers to entry, market power is likely to be quite transitory. The profits from market power are likely to attract new entrants into the market or encourage incumbents to expand in order to gain market share.[4] In that case, the best government policy may be to let these forces do their work undermining the existing market power.[5] On the other hand, if entry is likely to be slow, due to institutional, regulatory, or other barriers, more active public policy may be wise.

Government intervention, however, is likely to have its own formidable costs. History

---

[4] Actually, market power may not lead to extranormal profits, at least as reported by the firm. Such excess profits may be dissipated in high compensation to managers, high worker wages, organizational slack, or investments in other projects with low expected returns.

[5] It is worth noting, however, that new entry itself can be inefficient if it means duplicating construction of existing facilities, facilities that are being used at less than their full potential by an owner that possesses market power.

teaches us that regulators have a difficult time figuring out the best prices, technologies, or levels of investment in an industry. Regulators also are susceptible to the influences of private parties who encourage them to take actions that do not benefit the general public. And, of course, it is very difficult for regulators to limit the returns that firms can earn without dampening their incentives for efficiency and innovation. Thus, it is clear that some degree of market power in an industry is preferable to heavy-handed regulation, with all of the inefficiencies that accompany such regulation.

None of these concerns, however, lessens the importance of analyzing and estimating the degree of market power in an industry. They simply mean that a finding of market power is just one part of a public policy debate about government intervention in an industry. The important public policy question is what amount of market power is acceptable and which, if any, government policies are likely to do more good than harm.

A Numerical Illustration of Competitive Peak-Load Pricing

Consider a market in which there are two types of electricity generating plants: those with high fixed costs, but low marginal costs and those with low fixed costs, but high marginal costs. To be concrete, assume that each of the 50 low-MC plants in the market has a monthly fixed cost of \$926,400, a marginal production cost of \$15/MWh and a capacity of 80 MW. Assume that each of the 100 high-MC plants has a monthly fixed cost of \$288,000, a marginal production cost of \$25/MWh and a capacity of 60 MW. Finally, assume that each plant is owned by a different firm and all firms behave as price takers.

On the demand side, assume that there are two levels of demand: 300 high-demand (peak) hours each month, when demand is $Q = 50000 - 1000 \cdot P$ and 420 low-demand (off-peak) periods each month, when demand is $Q = 30000 - 1000 \cdot P$. During peak periods, all generators will be running, total consumption will be 10,000 MW and the market clearing price will be $P = 40$. During off-peak periods, all of the low-MC plants will be running and some of the high-MC plants will be running. Total consumption will be 5,000 MW and $P = 25$. Note that during off-peak periods, the high-MC plants are indifferent between running or not, since price is exactly equal to their marginal cost.

Now we can calculate the operating profits of each type of plant, total revenue minus variable costs, and see how they compare to the fixed costs of the plant. The low-MC plants earn operating profit equal to $300 \cdot (40 - 15) \cdot 80 + 420 \cdot (25 - 15) \cdot 80 = 936,000$. The high-MC plants earn $300 \cdot (40 - 25) \cdot 60 + X \cdot (25 - 25) \cdot 60 = 270,000$. X is the number of hours the particular high-MC plant runs during off-peak periods. Note that X has no effect on the profit of these plants since price just covers their variable costs during the off-peak. It appears that the low-MC plants are making money (\$9600 per month), more than covering their fixed costs of operation, while the high-MC plants are losing money (\$18000 per month).

That is not the end of the story however. In a competitive market without barriers to entry, new low-MC plants will enter since there are positive profits to be made and some of the existing high-MC plants will leave the market, since they are losing money. One can solve simultaneously for the number of low-MC and high-MC generators who could exist in the market in equilibrium. In this case, the solution is that in the long-run competitive equilibrium the peak price is \$41, the off-peak price is \$24, there are 75 of the low-MC generators and 50 of the high-MC generators. (While calculating this is rather tedious, it is straightforward – and a worthwhile exercise – to verify that the all generators are just covering their fixed costs.)

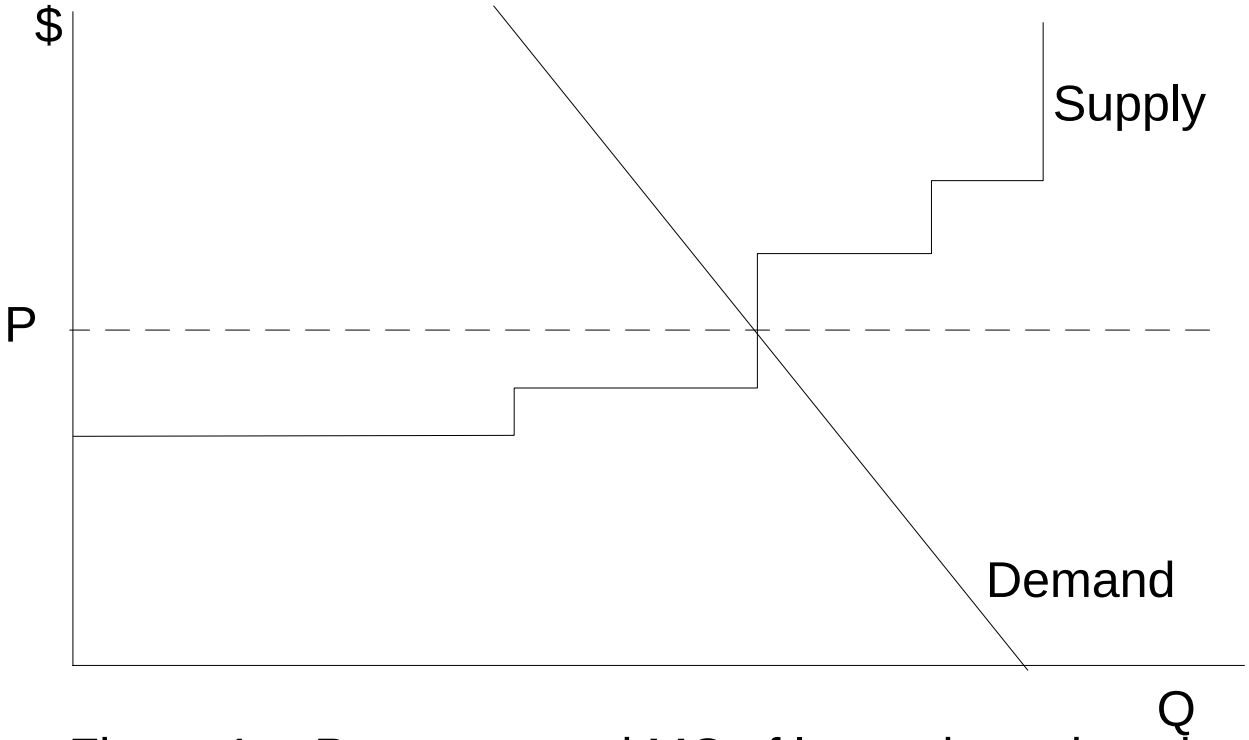

Figure 1 -- P can exceed MC of last unit produced

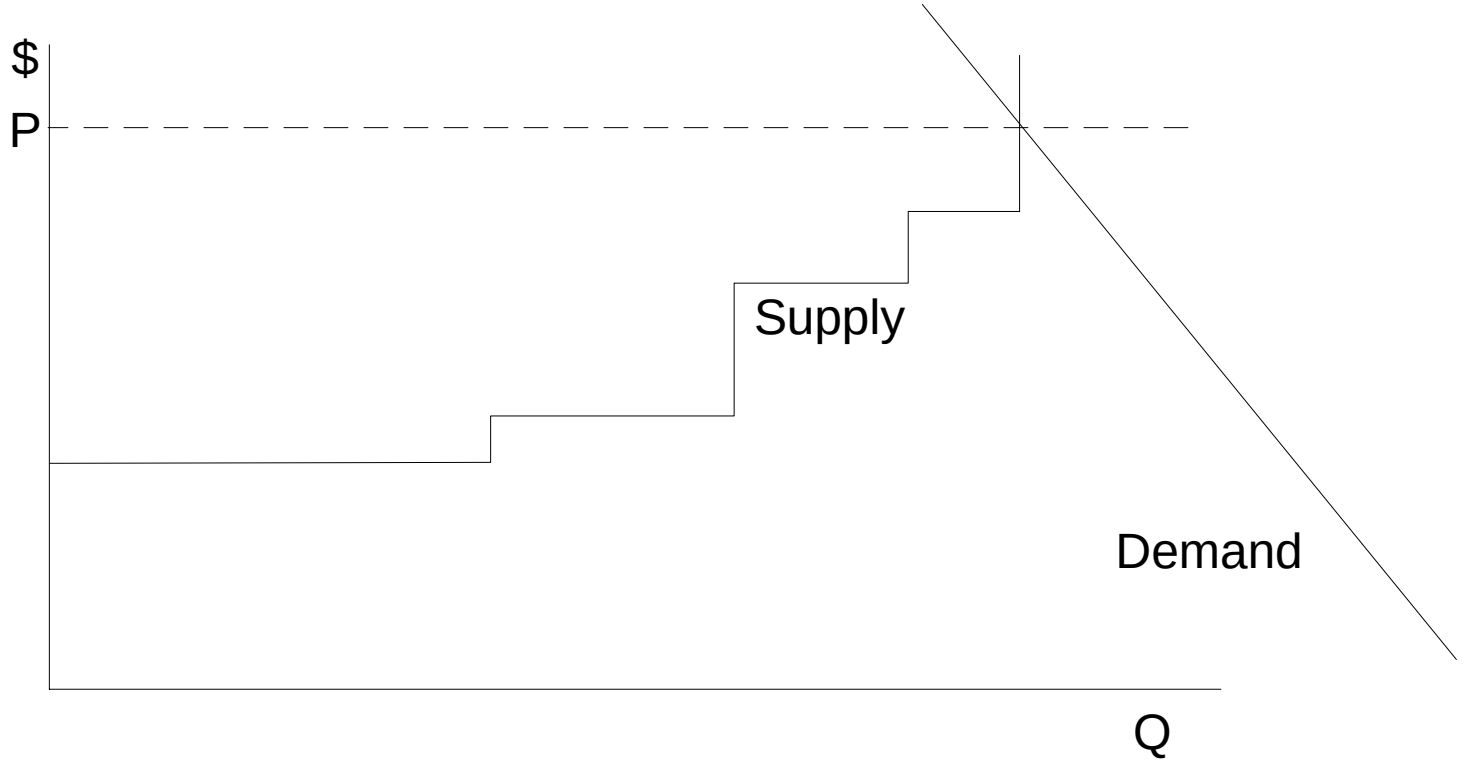

Figure 2 -- P can exceed MC of all production

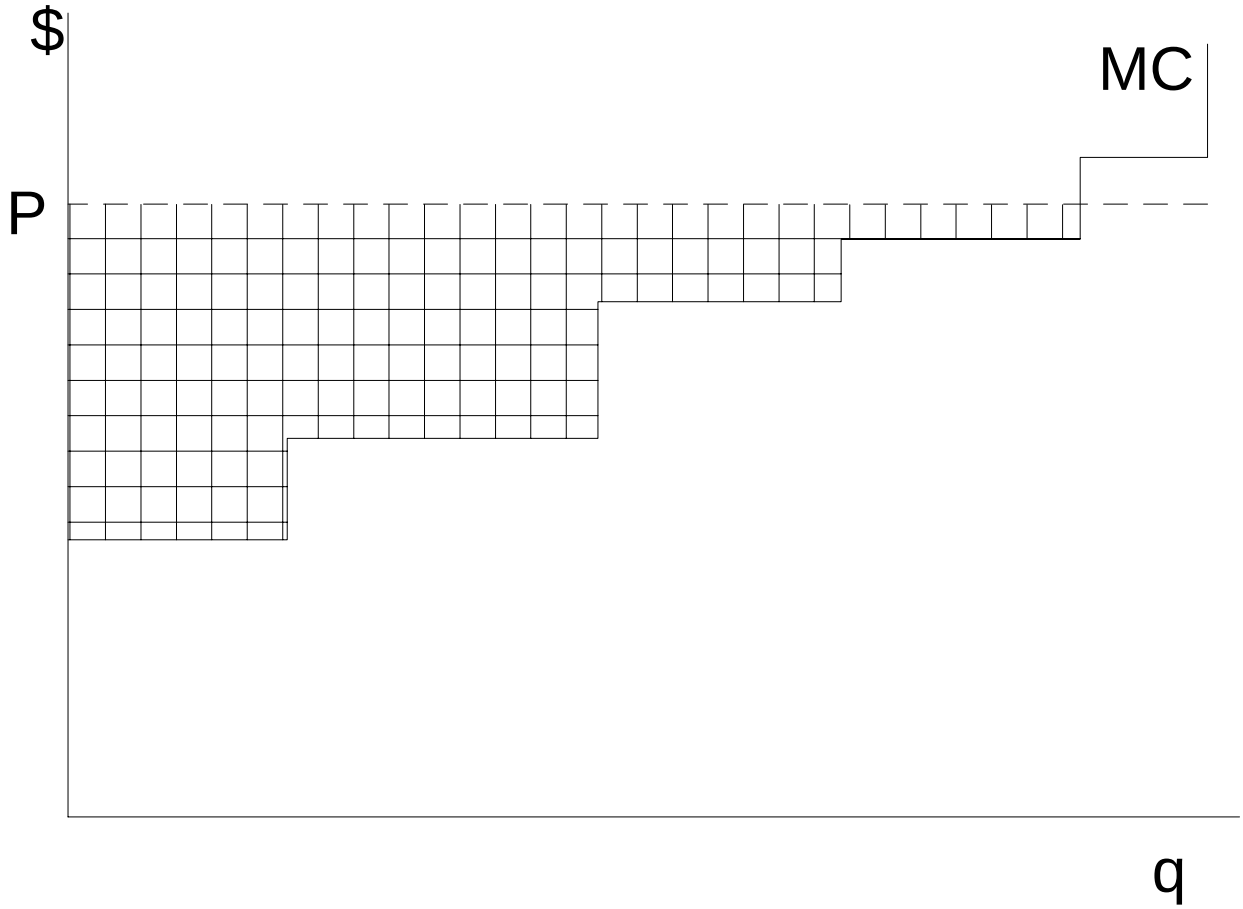

Figure 3 -- Revenues Earned above MC Contribute to Fixed Costs