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PRICE DISCRIMINATION  
WITHOUT MARKET POWER

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## **PRICE DISCRIMINATION WITHOUT MARKET POWER**

Michael E. Levine\*

### *Abstract*

Regulators and antitrust analysts have often used the presence of price discrimination as an indicator of market power. They are often motivated to regulate price-discriminating industries by political pressure from buyers facing the higher of the discriminatory prices. Their justification for doing so is provided by economic models that equate deviation from marginal cost with market power. Where costs are separable, this position may have validity. But most commonly, real-world goods and services are produced under conditions where costs, whether sunk costs like R&D or advertising or production or distribution costs like common facilities, are shared with other products. Under these usual conditions, firms constrained by competition from earning monopoly rents will adopt price discrimination as the optimum strategy to allocate common costs among buyers. Not only is this welfare enhancing (as Ramsey pricing suggests it is for monopolists), it is not evidence of the unilateral or collusive power to affect industry output, which is at the heart of the “monopoly power” or “market power” concepts. While some price discriminating sellers can earn monopoly rents, price discrimination alone is not evidence of market power and should not be used to justify regulatory intervention.

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# PRELIMINARY DRAFT: PLEASE DO NOT CITE

## PRICE DISCRIMINATION WITHOUT MARKET POWER

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Even as airline deregulation has made airline markets generally competitive, airline fare structures have become more complex. Aggressive market segmentation has become a feature of most airline markets, as it is in telephone markets and other network businesses, and its existence has generated discussions of just how competitive the deregulated airline industry is. Airline executives have responded, among other things, by pointing out that returns to capital remain substandard, which they say should be taken as evidence that markets are competitive. Of course, not all price segmentation is discriminatory. Some price differences in airline tickets and elsewhere are supported by product cost differences and some by opportunity cost differences. But many are not. Since airline price segmentation has generated accusations of predation and proposed regulatory responses<sup>1</sup> and these accusations and responses have broader implications, there is a need for clearer understanding of market segmentation through complicated pricing structures.

More broadly, pricing structures designed to accomplish segmentation are widely used elsewhere in the economy. This phenomenon is widely misunderstood, even among academics, partly because of the history of the businesses in which this segmentation is most obvious, and partly because that history has linked price discrimination with monopoly power. Improved understanding of the basis of price discrimination and its relationship to competition will help make better public policy and correct gaps in existing economic theory.

In thinking about price discrimination, economists have historically constructed the following argument: In a competitive market, price equals marginal cost. Wherever there is price discrimination, price deviates from marginal cost. Therefore, if there is price discrimination, the market must not be competitive and there must be market power. Economists then often go on to say that given that market power already exists, price discrimination can be output-increasing and is therefore not necessarily bad, but there is a general assumption that the existence of price discrimination implies the existence of market power.

In the hands of those who make economic policy, this formulation is dangerous. Price discrimination is often unpopular, at least among those paying the higher of the discriminatory prices. And market power is inefficient, since it implies a state of the world in which it is in the interest of producers to reduce output and distort price signals

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compared to those that would prevail under competition. Thus, political pressure generated by resentment of price discrimination is usually expressed as calls for measures that eliminate the market power assumed to underlie it. And given that perfect regulation is as rare as perfect markets, those measures can easily produce results inferior to those they were intended to remedy. This is a special problem when the market power that the regulation is designed to cure doesn't exist. And particularly pernicious are measures designed to eliminate directly the price discrimination itself, thus attempting to ameliorate the effects of market power by controlling one of its symptoms. These measures almost always produce outcomes less efficient than the ones that they were designed to change.

Note that the historic discussion depends heavily on the association of price discrimination with market power and with the presumed inefficiencies that attend it. But price discrimination even where there is market power is not necessarily inefficient. In fact, it can alleviate or cure the output-reducing incentives where market power exists. It is a commonplace of economic theory that a monopolist that could perfectly price discriminate would not reduce output and hence cause inefficiency (a "welfare loss") although it would transfer wealth from consumers to itself. But perfect price discrimination is extremely difficult to accomplish in practice and unregulated monopolists almost always price in ways that reduce output and welfare.

The concept of beneficial price discrimination has been extended to situations where there is no market power. Prescott<sup>2</sup> and Eden<sup>3</sup> have observed that price discrimination and price dispersion can occur in a competitive environment. Associated with this kind of price discrimination can be a price dispersion equilibrium in which competitive firms all charge discriminatory prices, but the mix of prices varies among firms. Dana has extended this model to airline capacity management under uncertain demand and has noted the apparent paradox that as the industry he studied (airlines) became more competitive, price dispersion apparently increased. At the same time, he notes that there are other apparently discriminatory features of airline pricing under competition that apparently have their genesis elsewhere. He characterizes his framework as, "...too simple to satisfactorily explain airline or hotel pricing, but nevertheless informative."<sup>4</sup> He extends the analysis further (still under uncertain demand) to cover "yield management" systems that allocate seats to different customers at different times and at different prices and finds that there are many circumstances under which this is efficient and warns that "the model serves as another warning against the use of price dispersion or yield management as evidence of price discrimination or monopoly power." He further points out that "policy makers should consider other evidence of market power before concluding that behavior that appears to be discriminatory is anticompetitive."<sup>5</sup>

It is possible to extend the basic thrust of this result to a much wider set of circumstances. It is my contention that, contrary to the standard formulation, price discrimination in the sense of price differences unsupported by cost differences is common and generally, although not always, beneficial. While price discrimination can be associated with and used to exploit market power, much of it is not.

Price discrimination without market power and a price dispersion equilibrium can occur without the uncertainty of demand modeled by Dana. Even where demand is uncertain, coping with uncertainty is not the only, or most important, reason for price discrimination. Price discrimination and a price dispersion equilibrium very often occur in competitive markets as a way of recovering costs common to producing more than one unit of a good or service. In these instances, price discrimination is simply a way of distributing the burden of common costs among customers in the least output-restricting way.<sup>6</sup> In a competitive market, all producers of goods or services involving substantial common costs will need to adopt discriminatory prices or product strategies to survive.

This phenomenon is sufficiently widespread that the existence of price discrimination should not be taken as evidence of market power, which needs to be inferred either from structure or conduct independent of market segmentation. Accordingly, even where price discrimination generates complaints, it should not be the basis for efficiency-justified regulatory intervention based on the market power supposedly associated with it.

Economists have had difficulty applying the classical model of perfect competition to a world which has friction, (from transaction and information costs) various nonlinearities and obstacles (temporal or physical) to perfect separability of costs.<sup>7</sup> And at the same time that they strive for the presumed efficiency of marginal cost pricing, economists also note that marginal cost pricing, while efficient, may not allow the recovery of sunk costs, depending on the shape of the supply curve. Since the recovery of total costs is necessary to sustain production in the absence of government intervention, this presents a problem.

There is a substantial literature devoted to this problem focussed on declining-cost industries (that is, industries in which unit costs decline with greater output over the entire relevant range). These industries will never recover total cost if they price at marginal cost. A variety of solutions was urged historically, from subsidy and government ownership (which then had better reputations than they have today) to multipart pricing. The solution now usually advocated is one or another form of multipart pricing<sup>8</sup> or Ramsey pricing,<sup>9</sup> coupled with some form of rent limitation through regulation, rent extraction by taxation, or rent redistribution by a combination of the two.

Ramsey pricing can increase output, but often generates rents. In Ramsey pricing, higher prices are charged to those consumers with relatively inelastic demand curves and lower prices to those with more elastic demand curves. Inframarginal costs are recovered from those consumers paying the higher prices. The higher prices may sum to an excess over total cost, and it is the task of the regulator to constrain or redistribute them. In a perfect world using this pricing, no consumer willing to pay marginal cost or more would ever be priced out of the market and the producer would recover the inframarginal costs of production. If any rents were generated, a perfect tax would then take them away and redistribute them to consumers in a way that did not distort their purchase behavior.

Ramsey pricing is a form of price discrimination which is regarded as benign and preferable to alternatives because the declining cost structure of the industries for which it is prescribed makes monopoly, and hence market power, inevitable.<sup>10</sup> From a policy

standpoint, eliminating market power is irrelevant, so the exercise becomes one in comparative statics, with output and price compared in different states of the world, all involving market power. Price discrimination becomes a tool whose results can be compared favorably with, for example, single-price monopoly.

The problem with identifying price discrimination with market power is that it is singularly unhelpful in interpreting many instances of the pricing behavior seen in the real world. First, unlike the declining-cost industries discussed above, the classic cases that fit the market-power model involve separable costs. The paradigm is to sell for two different prices, at least one of which is above marginal cost, two identical units that can be efficiently produced separately. The separability of production costs makes marginal cost easily observable and the inefficiency of deviating from it obvious. Because it is hard to see how a firm could succeed with such a strategy without the power to affect total industry output (thus preempting the possibility of someone else's making the sale to the "high-price" customer at a price closer to marginal cost), it is easy to attribute the deviation of price from marginal cost to the exercise of market power. Where cost separability is violated through the existence of economies of scale over the entire relevant output range (producing more units of the same thing together lowers costs), the implied natural monopoly implies market power as well.

Unfortunately this model does not adequately fit a real world in which many, perhaps most, products and services are sold in competitive markets<sup>11</sup> under conditions where the cost of efficient production of each unit is inseparably joined with at least some of the costs of some other units and of other products or services. While one can talk of the marginal cost of producing each bundle of associated products and services, only an accounting convention would say that the marginal cost of each unit is  $1/n$ th (by weight? by number? by package lot?) of the marginal total cost of producing the group. No unit can be produced without the joint input, but eliminating the production of one of the commonly produced units would not reduce the marginal common cost. To which unit or units should this common cost be assigned? And how should we interpret the marginal cost of a unit of a product when it contains inputs whose costs are shared across several products? To which product should which cost be assigned?

To make things harder, many of these costs, in addition to being common, are sunk. In principle, in the comparative static analysis used to discuss price discrimination, all such producers should have difficulty under competitive conditions recovering their sunk costs. Finally, some of the common or sunk costs, like R&D or brand advertising, which are not product specific, have declining cost characteristics.

Many, if not most, products and services produced with common costs are produced and sold in markets in which market power is de minimis. How do private producers faced with these problems solve them in competitive markets? If they are constrained to recover total cost from total revenues, how can they do so? Do they face marginal cost prices in the markets into which they sell? If prices are based on something other than marginal cost, does that mean that there is inefficiency? And is it possible to have prices based on something other than marginal cost while facing competition?

Standard analysis is vague on these points. A common way to avoid answering them precisely is to posit workably competitive markets with modest locational or brand market power allowing rents that finance sunk cost recovery. Another is to assume that inframarginal rents exist which are not competed away in setting total output. But purely separable costs are rare, and markets in which producers make competitive returns are not. And it would take quite a belief in coincidence to posit a general rule that producers in workably competitive markets have just enough local monopoly power and/or inframarginal rents to cover sunk and common costs without generating large profits or significant losses.

What competitive producers of products and services that share common costs do is to charge different customers who buy different units or different products different prices. The prices are market clearing prices determined by the slope of the total demand of each group of customers for each of the units or products, in a way that resembles Ramsey pricing but without monopoly. Entry is free and total supply for all the connected units equals the output which can be financed by the sum of the revenues available at each of the set of prices. Quantities are bounded by the constraint that total revenue has to equal total costs (disregarding factor rents) for each producer and prices are bounded by the fact that under competitive conditions, rents will continue to call forth supply until total cost can't be recovered and a reduction in total revenue will require a reduction in total output. Price for each unit includes all separable costs, plus a share of common costs determined by the elasticity of demand of the customer set. This price is subject to change as demand for other connected units produces revenue and output changes producing a new market-clearing price for the quantity of the individual product produced jointly with the others. Efficient production requires full use of all common inputs, except those of public goods character like R&D or advertising for which full use is in principle impossible.<sup>12</sup> No producer has market power and no monopoly or oligopoly rents are taken.

How does the industry reach these prices? Typically, through a repeated non-cooperative game whose outcomes tends toward equilibrium, and in which deviations from equilibrium exist but tend to be addressed in the next iteration, which is the way most markets reach equilibrium.

Consider the market for beef: The cost of producing cattle is determinate and the animals are produced in a competitive market. They are sold to processors at prices that tend toward equilibrium at the marginal cost of producing beef-on-the-hoof. But almost no final or intermediate consumer buys beef or beef products in this way. Processors in a competitive market buy whole animals and dress and cut them up in the way that maximizes revenue subject to competitive constraints, using prices from which they must recover the total cost of purchasing and processing the animal. Consumers or intermediate producers buy parts of processed animals at a variety of prices that include components of both the common costs and any separable costs of preparing the particular cut.

Some parts of the animal (say, sirloin steak) are valued more highly than other parts (bones). These parts were bought from the grower at the same price per pound but are sold to customers at very different prices per pound. The price for each cut is a function of the intersection of the demand for that cut and the supply available from the number of animals that can be produced and sold for prices that pay the marginal cost of producing an animal. As wealth changes, tastes change or across cultures, the relative prices of particular cuts may change or differ. Hispanic immigration and the popularity of Mexican food have raised the price of skirt steak relative to other cuts. This should produce higher revenue, calling forth a larger supply of beef and inducing a decline in the price of hamburger as more cattle are produced and byproducts must be sold. Organ meats sell for relatively higher prices in countries where they are more highly prized than they are in the U.S. and the equilibrium output and relative prices of different cuts should change. Finally, processors may cut up animals in different ways to maximize their value to consumers, as an American who has tried to get her favorite cut of meat from a European butcher can attest.

In the end, the parts will be sold at “discriminatory” prices based on demand, not cost, which in total equal the total cost of processing the animal. What market power or collusion supports these prices? None. If the processor tries to get too high a price for steak, it doesn’t sell and her total revenue goes down. If she charges less than the market price, she sells out and gets less steak revenue to add to the hamburger revenue, bone revenue, etc., thus reducing her ability to pay for the cattle. She can’t produce more steak without producing more hamburger. If we relax the model so that she can somehow substitute steak for hamburger (perhaps by buying a different breed of cattle), so can the other producers (unless she has unique access to the technology and thus gains market power), who will match her price. If the new steak/hamburger price set will support more cattle supply, supply expands. If less, supply contracts.

The regulatory and antitrust literature is unclear about what exactly “market power” is, except that it is tied to the evils of monopoly. It is often associated with market structure, as in natural monopoly or monopoly achieved through barriers to entry or predation, sometimes with price levels or price structure, as the ability to price above marginal cost, and sometimes with the ability to earn rents, or above-competitive levels of return. Fundamentally understood, market power is the unilateral or collusive power to restrict output to levels lower than could be supported by total revenue. While market power in this sense gives producers the opportunity to price above marginal cost, the converse is not necessarily true: the presence of prices unrelated to marginal cost does not signal market power. When the only determinate marginal costs produce more than one product or unit, unit prices will commonly be undetermined by the marginal cost of producing the nonseparable group. This lack of tie to marginal cost does not imply market power. Prices above marginal cost may be a sign of market power when costs are separable, but what the market power allows is restricting industry output so that prices can then be raised to clear the market. Without the power to restrict industry output, there is no market power.



If total cost recovery in the face of sunk costs requires using prices set with reference to demand in order to generate enough revenue to cover them, competing producers will be required to adopt such a strategy to survive. If common costs mean that cost per unit is indeterminate, that doesn't mean that markets can't clear. It just means that industry output limited by unit marginal cost will give way to industry output constrained by the equation of marginal total cost for a group of units or products and the total revenue that can be extracted from industry-wide discriminatory pricing based on demand. In all cases, the producers will be price takers, not price setters, although in practice here as in real-world single-product markets tatonnement may produce behavior that looks like price setting as producers search to find where the competitive price is for each product or service they produce.

Is the set of prices under any given conditions unique? For some cases, where all producers face exactly the same costs and sell the same mix of products in the same market, the answer would appear to be affirmative. The steak/hamburger analogy should be generalizable to the common supply of any set of multiple outputs to the same set of consumers under competitive conditions. Imagine three distinct goods produced competitively in fixed ratio of one unit each (at a marginal cost of \$6 per set of three) sold into markets with three different sets of consumers for each good, with differently sloped demand curves. There will be unique market clearing prices (say, \$1, \$2, and \$3) for the available supplies of each good and these will individually make different contributions to the cost of producing each set of units. Output should be expanded until the supply at \$6 per set is exhausted.

If any producer chooses to charge different prices from these, higher (she won't be able to sell the overpriced units) or lower (she will lower her unit revenue, since she can't expand her production of any of the goods without paying for the others), her total revenue will decline and she will not be able to cover the cost of the marginal set of units. If in the course of a repeated game, competitive matching of too-low prices results in industry revenue falling below industry total cost, firms (acting without coordination) will either have to adjust output or pricing strategy with the hope of correcting the imbalance in the next iteration. While any producer could experiment with other price strategies, charging the market-clearing prices dominates all the others.

But the typical case is less simple. For example, not all the output using the common units comes from identical production or is sold into the same markets and the precise mix of products sharing the common costs may differ from producer to producer. In such cases, the demand curve faced for each output in each market will be the same, but each producer may produce the products in somewhat different proportions in response to those prices, so that the total set of prices offered by different producers may exhibit dispersion.<sup>13</sup>

In this model, market power only arises when collusion or a declining natural cost function leaves one or a few firms of efficient size, protected from competitive entry. In these circumstances, individual producers (or a cartel) are able to restrict industry output. In that case, prices might well rise above the competitive multiprice case, and they should

rise along the multiple demand curves at different rates. Output will then be set at a new level that maximizes profit and leaves unsatisfied demand that could have been satisfied under competition. Welfare will decrease. This certainly is not optimal, but note that one will not be able to distinguish between the market power and competitive cases by observing multiple prices. To find market power, one will be required to do a conduct or structure analysis that is independent of the existence of multiple prices and which is designed to find restriction of output by intention or effect.

None of this argues that market power cannot be found along with competitive markets in a complex multiprice real-world environment. Local monopolies can exist even where global markets are competitive. Distinctive product attributes may make one brand less than a perfect substitute for another for particular consumers. Input rents can affect output and price. Scale indivisibilities may leave only one firm in a market, giving it power to reduce output locally, with substitution limited by transportation, transaction or transition costs (such as the sunk cost of displacing a monopoly producer whose monopoly is sustained by indivisibility). Where such cases involve joint costs, there can be two different sets of discriminatory prices, one without rents and one with. But in each case, it is not the existence of the price segmentation that signals the market power.

Next consider the case in which what is being produced is a service, a perishable good or a good technically difficult to transfer from user to user.<sup>14</sup> In such a case, there need be no physical difference between units of the good or service to allow multiple prices to prevail, and if the production conditions for these units entail common costs, it will be possible to observe what appears to be particularly egregious price discrimination under competitive conditions (without market power). The analysis is similar to the beef case, but here the “cuts” may not look or taste very different. Recovery of common costs from the production of this service or good will be undertaken through market segmentation. The producer who neglects to do this will have lower total revenues. Since competitive conditions mean that marginal total cost must be recovered from revenues without market rents (as opposed to factor rents), sacrificing revenue will mean that the producers lose money. If there is a producer unable to wait until the next iteration, she will leave the market and output will drop. If producers stay in, they will learn that the dominant strategy is to price discriminate among customers, even if what is being supplied to different customers is identical.

This case depends critically on the ability to identify and separate customers on demand curves with different demand slopes. One way to do so is to sell services in different geographic markets, even if there are no differences in the cost of serving them. Another is to separate submarkets by distribution system or even language.<sup>15</sup> And a third is to artificially differentiate services or products by deliberately making those sold at the cheaper prices less attractive to the buyers in the more expensive markets, even if there is no associated cost saving in supplying the less desirable product to the cheaper market and even if there is a cost increase associated with developing, holding in inventory or selling the cheaper product.

As long as segmentation of demand is feasible, total revenue is increased by the segmentation and all producers have the same cost functions (including common costs), producers will all have similar incentives to discriminate and will tend toward a discriminatory equilibrium in a repeated non-cooperative game. And as long as there is no restriction on entry or output, producers will be price takers in each submarket, and continue to invest in production or development as long as incremental total revenue (from all of the units using the common input) equals or exceeds the incremental cost.

A very prevalent example of this phenomenon can be found in the airline industry, where many elements of common cost exist. First, all the seats on a particular flight are produced in common at identical cost (leaving aside class of service issues). Second, the infrastructure costs of running the airline (examples include station costs, flight control, maintenance, reservations overhead and reservations labor) are not produced separately for each passenger or often even for each flight. Third, for a network airline, the cost of providing each passenger with a trip is shared with passengers with different itineraries. Airline networks combine passengers originating at and/or destined for multiple cities on the same flight in order to share the indivisible burdens of providing desirably frequent service in markets which don't attract enough passengers to support nonstop service at competitive costs.

As an example, let's say that Ruritania produces a number of passengers a day sufficient to all destinations sufficient to fill a number of aircraft of minimum efficient size, but not enough to offer satisfactorily convenient service to any one destination. It can easily be seen that useful service can only be achieved by combining passengers with different itineraries. The most efficient way to do that is to take these passengers to a central point we'll call Centralia (a "hub") and recombine them with travelers from other origins so as to form groups of adequate size to sufficiently fill aircraft of minimum efficient size. Consider a city big enough to produce enough passengers to do this on several competing airlines, but not big enough to fill with local passengers aircraft of efficient size flying at the minimum competitive frequency to any individual city. In such an example, passengers could receive service from competing firms, each of which would have to combine service for many itineraries on the same plane.

What is the marginal cost of carrying a passenger from Ruritania to Metropolis? We know the cost of flying an airplane from Ruritania to Centralia, but only a few of the passengers on board are going to Metropolis. We know the cost of flying an airplane from Centralia to Metropolis, but only a few of the passengers on board came originally from Ruritania (or Centralia, for that matter). We know the cost of operating the whole network for a day or a year. But leaving aside separable costs such as meals and the small amount of extra fuel burned by filling a seat, we simply do not know the marginal cost of carrying a passenger from Ruritania to Metropolis, or for that matter between any two points in the network.

Now suppose that passengers vary greatly in the price-sensitivity of their demand for travel. A business passenger values time and convenience highly. She wants to go at a time that allows her to make her meeting without wasting time and may wish to combine

stops on a business trip in a way that requires very precise flight selection. She is willing to pay a relatively high fare for a flight that leaves on her preferred schedule. If she cannot get the schedule she wants, she may not want to go at all. At the opposite end of the spectrum is a retiree with a car. She is willing to drive on shorter trips if the airfare is too high and on longer trips she is willing to endure stops, long connections, flights departing over a wide range of departure times and other inconveniences in order to save airfare. She is only willing to pay a small fraction of what the business passenger will pay for the trip, but she is even willing to stop or change planes at Nowheresville instead of flying nonstop to Centralia if that is required to get her price.

In this model, producing a network of competitive size (with respect to both scope and scale) requires finding a way to combine the demand of the business traveler with the demand of the leisure traveler so as to allow frequent service at competitive prices. This requires price discrimination to provide capacity and frequency efficiently for all the reasons discussed above, as well as to accommodate uncertain demand in the way that Dana notes. Passengers willing to pay more are combined with more price-sensitive passengers and production is increased in frequency and scope to attract convenience-oriented higher-paying passengers, while indivisibilities are accommodated by offering capacity to price-sensitive travelers. In this way, firms can remain scope-competitive while remaining price-competitive as well. Firms that experience indivisibilities (common costs), sunk costs and uncertain demand cannot operate efficiently without price discrimination. In a competitive market, all surviving firms will adopt a variant of this strategy, although common costs may be shared in more than one combination of outputs and prices.

But there is a significant obstacle to this result: Since (unlike beef cuts) the transportation offered is identical, how can the firm price discriminate? What keeps the business traveler from flying at leisure fares? Asking the customer the purpose of her trip or how much she is willing to pay will only elicit strategic behavior. And even if one firm could somehow separate these customers, how can it keep a competitor from offering lower prices to the “high-price” customers?

For the first question, the answer in the airline industry is to artificially limit access to the lower fares by putting conditions on them that will be unacceptable to business travelers. Requiring a 21-day advance purchase will make the fares unusable by customers whose trips arise out of a last-minute business need. Requiring a round-trip purchase makes it harder to put together an uncertain or complicated itinerary. And requiring a Saturday night stay will make business travelers who wish to take advantage of weekends for leisure reluctant to use the lower fares and their employers reluctant or unable to force them to do so.

The answer to the second question is that, as suggested above, firms which do not price discriminate can neither offer as wide a choice of flights nor can they minimize their capacity costs. Over time, they will tend to disappear. Because competition moves toward a set of prices that generate no rents, it will be necessary to maximize revenues (subject to the competitive constraint) and minimize costs. Since the only way to

maximize revenue and to minimize costs is to have price segmentation based on elasticity of demand, surviving firms will tend to do so.

Network airlines with effective revenue management (price discrimination) systems consistently operate at higher revenue per available seat mile and higher load factors (percentage of seats filled, meaning less capacity cost per unit of output) than airlines without good revenue management systems. These systems are readily available to any network airline, either by self-development (no longer common, given the quasi-public-good character of software) or by purchase from several different vendors.

Even point-to-point airlines whose business model does not exhibit the extreme common-cost characteristic of network airlines find that the indivisibilities that come from constant aircraft size in the face of fluctuating demand and the attractiveness to customers of increased flight frequency force them to price discriminate.<sup>16</sup> But because discount point-to-point or “quasi-network” airlines have lower costs, offer less convenience at less cost (less extensive networks, less-coordinated connections and fewer customer service features) and limit their high-end fares to attract customers from network airlines to their less attractive product, their optimum discriminatory pricing mix is different from network airlines, and the optimum price set for network airlines exhibits a much higher difference between the highest and lowest fares.

If the competitive equilibrium is to have price discrimination in airline fares, how can the industry distinguish between low-fare and high-fare customers? Multiple classes of service offer a partial answer. They use commonly produced space on the plane but price it differently. But this is only a partial answer, since many passengers won't pay for amenities. And unlike beef, a business ticket in coach doesn't look or feel any different from a bargain-priced leisure ticket – same seats, same meals or lack thereof, same departure and arrival times. The answer is to degrade the attractiveness of tickets bought at lower prices by imposing restrictions that make them less attractive to those willing to pay high fares for convenient travel.

As mentioned above, the most common of these is to put advance purchase, roundtrip and Saturday-night stay restrictions on access to those fares. While the advance-purchase and roundtrip requirements may also have cost-saving aspects,<sup>17</sup> they clearly also function as “fences” (as these kinds of restrictions are called in the industry) to keep out business travelers whose demand often arises at short notice. The Saturday night stay has no cost-saving justification, but represents an effective way to screen out business travelers who wish to spend weekends with their families or in other leisure pursuits not at their business destination. Other price-discriminating features are to limit notice of availability of short-notice low fares to certain distribution channels (consolidators) or to a random selection of routes publicized on very short notice (internet fares).

The phenomenon of price segmentation is also linked in an important way to the structure of networks. Networks exist to provide economies of scope, but they also are built around indivisibility thresholds, that is, the size of the network sustainable is in part a function of the smallest unit of production that produces unit costs consistent with

maintaining service. That unit size depends on technology, of course, but it also depends on the structure of prices that the network can charge. Hence, the apparent lowering of the indivisibility threshold in airline networks to allow the use of small jet aircraft to provide relatively frequent jet service between points that previously couldn't sustain it is related perhaps more to the increase in the spread between the highest and lowest fares charged in the network than it is to any technological advance in the design and manufacture of aircraft. (It is also highly dependent on an anomaly in the labor contracts typical of large network airlines.)

Arguably, this same phenomenon is seen in pricing express package delivery services. Depending on capacity and load at any given points, once the infrastructure for providing overnight service is in place, it may be no more costly except on peak days to provide overnight service than 2-day service. But rather than simply undertake peak/off-peak pricing, giving premium service priority and delivering two-day packages overnight when capacity permits, the typical and better strategy is to actually incur additional costs to store 2-day packages enroute and thus fully segment the market by offering two consistent "products" to customers with different elasticity of demand for package express service. In the same way, high speed internet access subscribers are charged on a monthly basis by the data transfer rate they wish to purchase, even though the "cost" (other than the modem) of serving them is the same. The result of all this segmentation is the ability to support large networks with relatively ubiquitous service, offering some very low prices and some very high prices and many prices in between.

But there is nothing unique to airlines or networks or even to services about this strategy. It works easily for services, because the provider can withhold service at the lower price to a customer she and her competitors can reliably identify as a "high-paying" customer. And it is common in networks, because the scope of a network is crucial to its competitiveness, and price segmentation is essential to spreading the common costs of a network in a way that will allow the greatest scope of service.

This strategy will be adopted for transferable goods as well, as long as a way can be found to make it more expensive for customers to alter characteristics to make the less desirable product variant than the spread in price. Hence, auto manufacturers will choose to limit the availability of optional equipment which is thought to be attractive to high-end buyers so that it can only be ordered on a higher-priced product line which shares common costs with a lower-priced line. Price-sensitive buyers who don't care so much for features or who are not as brand-sensitive get a low-priced offer. Buyers who care more about what they drive pay more. For example, when air conditioning was a novelty, it was only made available on expensive car lines. Similarly, even today antilock brakes are not an available option on some manufacturers' lowest price lines. Why wouldn't a manufacturer make these options available at the same price on both? Because it wants to spread common engineering and production costs across several model lines, must maximize revenue by price discriminating to compete and needs to provide incentives for customers to purchase the higher-priced line. Price discrimination and broad model scope will allow the spreading of common research, production and

marketing costs over the largest number of units. Again, because competitors face the same cost function, they will be forced to the same solution.<sup>18</sup>

Carried to its most extreme, this strategy can find its expression in the production of goods on which the manufacturer incurs extra cost to offer a lower-performance version. Consider computer chips. A computer chip with the same basic architecture is produced with several different clock speeds or even (in the case of the Celeron compared to the Pentium III) with a computing feature disabled. Research and development expenses and many production costs are shared in these chips, which are designed to a maximum performance specification. They are then sorted for production variation or disabled in a way that is prohibitively expensive for consumers to modify and sold at widely differing prices.<sup>19</sup> Until volume allows production of a submodel at a cost lower than the opportunity cost of occupying space on the chip with unneeded features, the chips may actually be identical, except for the speed setting. The fastest chips are priced considerably higher than the slowest, so that performance-minded buyers can pay more of the common costs than budget-minded customers. Competing producers need the revenue from the higher-paying buyers to maintain competitive R&D budgets and the volume from the lower-paying buyers to spread production costs. Once again, competing producers are forced to adopt similar strategies.<sup>20</sup>

Finally, even in rather atomistically competitive industries where there are significant non-separable costs, like ordinary restaurants without special cachet, discriminatory pricing strategies are often adopted. Items are available a la carte that aren't available on a combined dinner. Lunch is less expensive than dinner. Wine and liquor carry higher margins than food. While, for example, the lunch/dinner distinction may be based on peak/off peak needs, it is often the case that restaurants not full at either time price in this way, or that they are more crowded at lunch than at dinner. Lunch is usually more hurried and is not part or all of an evening's entertainment. The demand curve for lunch and dinner is differently sloped.

This general result partly explains the political paradox referred to at the beginning: by almost any measure and according to nearly every serious study that has been done, airline deregulation has been a great success and airline markets are generally competitive. But notwithstanding more than twenty years of evidence and a near-unanimous chorus of scholarly approbation, a steady drumbeat of political and media criticism continues. Complaints about airlines are a reliable audience-getter for congressional hearings, political speeches, newspaper stories and TV news segments.

While there are complaints about airline attitudes, about lost baggage and about on-time performance, in objective terms there has been little deterioration along these dimensions and in some areas, such as choice of service or reduction of the number of multistop itineraries, there has actually been improvement. Airline amenities have worsened, but that is because once the public was free to do so, it chose low-price service with tighter seating and worse food over the previous product of service competition at fixed high prices that prevailed under regulation. Deregulation has disadvantaged some while it has

benefited many; this is true of virtually every public policy change and doesn't explain either the intensity, popularity or durability of criticism of airline deregulation.

But under the pricing freedom of deregulation, the top fares paid, usually by business travelers, for walk-up fully refundable tickets have risen substantially. Coupled with falling leisure fares, this has created a spread between the highest and lowest fares paid by air travelers which is unprecedentedly wide.<sup>21</sup> Even as low fares continue to expand overall traffic substantially, market segmentation continues to increase and a relatively significant and increasing share of revenue comes from a relatively small number of passengers. Passengers paying very high fares sit next to passengers paying low fares, receiving the same inflight service and having purchased what appears to be the identical product. Finally, the fare structure is almost laughably complex.

In consequence, both academics and the public have engaged in a widely publicized hunt for the sources of the monopoly power in the airline industry that is presumed to underpin the highly discriminatory price structure which has emerged since deregulation. The strongest evidence adduced for the existence of substantial monopoly power is the price structure itself. Even strong defenders of deregulation seem to concede that some sort of monopoly power is necessary to support the current airline price structure.<sup>22</sup>

Armed with this sort of analysis, politicians have been pressured to bring the power of the government to bear to eliminate the pricing disparities. Since airline deregulation has eliminated the attraction of direct price regulation, the administrative branch and the Congress have been searching to identify remedies which can be directed at the presumed sources of monopoly power which have been "discovered" without introducing "reregulation." And even the academics and policy analysts who generally support airline deregulation have felt constrained by the "evidence" of the price structure to devote their energies toward trying to figure out how to eliminate the supporting monopoly elements while keeping the benefits that entry and pricing freedom have brought the public.<sup>23</sup>

The significance of all this from a regulator's standpoint is that the pricing described here presents a classic and politically salient dilemma. Very high discriminatory price differentials support larger networks in which total revenue equals total cost and every purchase is voluntary. The large price differentials, especially when there is little or no onboard service difference to "justify" it in the mind of the high-paying consumer, creates complaints of invidious discrimination. If the regulator is not seen to be responding to complaints, then political pressure will mount, news stories will point out the unfairness and "absurdity" of the wide disparity in fares paid by customers and the regulator will end up testifying before Congress and suffering abuse from the representatives of those paying high fares, many of whom are also representatives of previously underserved cities. Complaints of "monopoly" abuse will be widespread, and "action" will be demanded.

If the regulator heeds the complaints and attempts to compress the fare structure, service will be withdrawn from some markets or frequency (availability and variety) will be



reduced, thwarting some willing purchasers (perhaps even some of those who complained but bought the service previously!) and withdrawing transportation options preferred to not travelling or using other modes. Efficiency will suffer, and the regulator may not escape criticism, which will now be from geographic or consumer interests who suffer from the service reduction. Pressure will mount to mandate more service, for example to smaller communities. The regulator may end up testifying before Congress and suffering abuse from the representatives of underserved cities.

If an increase in price discrimination is part of the explanation of why airline deregulation has come under so much criticism, it still leaves the rest unanswered. If my observations are correct, this sort of pricing is widespread. Why don't the same complaints exist about goods and services that are priced similarly elsewhere in the economy? Here, I have no model and no systematic explanation. My surmise is that it is because the unregulated industries do not have a history of regulation that suppressed price differences that support greater output and more efficient use of common inputs. And most previous regulation of such industries as electricity and telephones enforced price discrimination in a way that accustomed consumers to this kind of pricing. The mandated difference between business and residential, and local and long-distance, pricing in the telephone industry is an example. Deregulation has certainly rearranged and expanded many of these discriminations, but it has not moved so dramatically from government-enforced pricing simplicity to widespread segmentation.

In that sense, the rest of the explanation here may be the historic fact of the elimination of government constraints on price segmentation. This is, of course, one of the major sources of the enormous expansion of output in the airline industry since deregulation. The resulting expansion both in the scale and scope (network extent and frequency convenience) of the industry has been welcomed, but the simplicity and apparent equity of pricing that constrained it are missed. It is to be hoped that the political pressures now operating against efficient segmentation will not prevail and that misunderstanding will not encourage academics to aid and abet the suppression of a pricing system that has brought so many benefits. We should strive to heed the caution of Ronald Coase that "... if an economist finds something - a business practice of one sort or another - that he does not understand, he looks for a monopoly explanation. And as in this field we are very ignorant, the number of ununderstandable practices tends to be rather large, and the reliance on the monopoly explanation, frequent."<sup>24</sup>

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<sup>1</sup> 63 Federal Register 17919-17922 (April 10,1998)

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<sup>2</sup> Prescott, E.C., "Efficiency of the Natural Rate", Journal of Political Economy, Vol. 86 (1975), pp. 1129-1236.

<sup>3</sup> Eden, "Marginal Cost Pricing When Spot Markets are Complete", Journal of Political Economy, Vol. 98 (1990), pp.1293-1306.

<sup>4</sup> Dana, J.D., "Advance Purchase Discounts and Price Discrimination in Competitive Markets", Journal of Political Economy, vol. 106, p. 396

<sup>5</sup> Dana, J.D., "Using yield management to shift demand when the peak time is unknown", Rand Journal of Economics, Vol 30 (1999), pp. 456-474, at 473.

<sup>6</sup> The logic of this is entirely consistent with the Dana's "capacity conserving" rationale.

<sup>7</sup> For an excellent discussion of these difficulties in the context of predation, along with a particularly elegant exposition of a form of monopolistic competition which allows free entry and eliminates rents, see Richard Craswell and Mark R. Fratrack, "Predatory Pricing Theory Applied: The Case of Supermarkets vs. Warehouse Stores, 36 Case Western Reserve Law Review 1-49 (1985)

<sup>8</sup> See R.H. Coase, "The Marginal Cost Controversy", 13 Economica 149- (1946)

<sup>9</sup> For an excellent short exposition of Ramsey Pricing, see W. Baumol, "Ramsey Pricing", in The New Palgrave Dictionary of Economics, pp. 49-51

<sup>10</sup> I leave aside the theoretical argument for market contestability, which separates market structure from market power by positing a producer facing costless and instantaneous entry, a very unusual situation.

<sup>11</sup> As we shall see, this does not deny that some, perhaps many, goods and services use input factors which earn rents or are sold under conditions in which rents are generated by location, brand uniqueness or otherwise. And some of these factors may also contribute to successful price discrimination. But where common costs exist, the existence of market power is not necessary for price discrimination and is often not the most important element in determining its presence or magnitude.

<sup>12</sup> Because important elements of production cost do not vary with output. For inputs that behave like public goods, it is necessary for those inputs to be available for purchase or for a firm to have sufficient scale or scope that the burden of producing them does not place the firm at a disadvantage compared to its rivals.

<sup>13</sup> See Dana (1998).

<sup>14</sup> It might, for example, be something that is permanently installed and cannot be changed by a subsequent purchaser at a cost which is not prohibitive in relation to the value of the modification, like many kinds of optional equipment on an automobile, antilock brakes, for example.

<sup>15</sup> It has been customary in airline markets to sell certain tickets at very low prices to travel agencies or wholesalers who have a price-sensitive customer base that speaks a different language than the dominant one. The agents advertise and sell in the "foreign" language without disturbing the prices at which tickets are sold to the dominant language-speakers.

<sup>16</sup> Entry and Competition in the U.S. Airline Industry, Transportation Research Board Special Report 255, pp 30-32 (1999).

<sup>17</sup> Dana (1998). The roundtrip requirement also slightly reduces transaction costs.

<sup>18</sup> This explains the acquisition of specialty auto manufacturers by large producers. Separable costs can be recovered from separate models and distribution systems (or spread discriminatorily within a brand line), but price discrimination managed through brands allows the most efficient recovery of common costs.

<sup>19</sup> As of January, 2000 Pentium prices ranged from \$851 (800MHz) to \$193 (500Hz). Perhaps most interesting was the way the price range declined at certain "break points", such as 750-733MHz and 650-600, suggesting discontinuities in common costs. AMD's prices, not surprisingly, show similar progressions and breaks. See "Intel and AMD Cut Prices", posted at <http://www.geek.com/news/geeknews>, "News", Jan. 25, 2000

<sup>20</sup> M. Kanellos, "Intel: Upcoming Itanium chip will hit 800 MHz", CNET News.com, Feb. 7, 2000.

<sup>21</sup> Entry and Competition in the U.S. Airline Industry, Transportation Research Board Special Report 255, pp 22-40 (1999).

<sup>22</sup> *ibid.* p. 73

<sup>23</sup> e.g., Borenstein, S. "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry, RAND Journal of Economics pp.344-365 (1989).

<sup>24</sup> Coase, R.H. "Industrial Organization: A Proposal for Research", in Fuchs, V.R., ed Policy Issues and Research Opportunities in Industrial Organization, (New York, NY, NBER, 1972), at p.67.