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Merger Simulations of Unilateral Effects:

What Can We Learn from the UK Brewing Industry?

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Abstract:

I discuss the use of simulation techniques to evaluate unilateral effects of horizontal mergers and the pitfalls that one can encounter when using them. Simple econometric models are desirable because they can be implemented in a short period of time and can be understood by non experts. Unfortunately, their predictions are often misleading. Complex models are more reliable but they require more time to implement and are less transparent. The use of merger simulations and the sensitivity of predictions to modeling choices is illustrated with an application to mergers in the UK brewing industry. There have been a number of brewing mergers that have changed the structure of the UK market, as well as proposed but unconsummated mergers that would have had even more profound effects. I assess two of them: the successful merger between Scottish&Newcastle and Courage and the proposed merger between Bass and Carlsberg–Tetley.

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1 Introduction

Unlike most of the chapters in this book, my paper is not concerned with a specific case. Instead it is methodological. In particular, I discuss the use of simulation techniques to evaluate unilateral effects of horizontal mergers, bearing in mind the tradeoff that exists between simple and complex models. On the one hand, a simple model can be implemented in a short period of time and it can be understood by non experts. On the other hand, the conclusions concerning merger effects that can be drawn from a simple model can be very misleading. One is therefore often faced with the choice between implementability and accuracy. In this chapter, I assess the implications of that choice.

Due to the tradeoff between simplicity and accuracy, it is unlikely that merger simulations will ever replace more traditional analysis, such as an examination of the extent and structure of the market and the merging firms' shares of that market. Instead, the two sorts of analysis should be complementary, and, if the limitations of simulation techniques are understood, they can be useful supplements. It is a mistake, however, to oversell their potential or their precision.

The use of simulations is illustrated with an application to mergers in the UK brewing industry, which is an important market that has received much attention from competition authorities. In particular, there have been a number of mergers that have changed the structure of the market, as well as proposed but unconsummated mergers that would have had even more profound effects. Moreover, the positions taken by UK competition authorities towards brewery mergers have undergone fundamental changes in recent years.

The organization of the chapter is as follows. I begin with a presentation of the general method that is used to solve horizontal–merger simulations. That presentation is followed by more in–depth analyses of the building blocks that underlie the simulations — demand and costs. Section 4 discusses the UK beer market, the mergers, and public policy towards those mergers, whereas section 5 presents the data, which is a panel of brands of beer. Section 6 looks at implementation. In particular, the sensitivity of predicted prices, costs, margins, and merger effects to modeling choices is assessed. Finally, the chapter concludes with a more optimistic discussion of how quantitative techniques can be used to organize our thoughts concerning mergers, even if they are unreliable methods of obtaining point estimates of merger effects.

2 Simulation of Unilateral Effects

In North America, merger policy tends to be based on the notion of *unilateral effects*.[2] In other words, authorities usually attempt to determine if firms in an industry have market power and how a merger will affect that power, assuming that the firms act in an uncoordinated fashion. In practice, this change is often evaluated as a move from one static Nash equilibrium to a second equilibrium with fewer players.[3]

European authorities, in contrast, tend to base their policy on the notion of dominance. In other words, they seek to determine if a single firm or group of firms occupies a dominant position and if the merger will strengthen that position. Traditionally, single–firm dominance was emphasized. However, the notion of joint dominance has assumed increasing importance due to high–profile merger cases such as Nestle/Perrier, Gencor/Lonrho, and Airtours. Joint dominance is usually taken to mean tacit collusion or *coordinated effects*.[4]

In this chapter, I assess quantitative techniques that are based on the notion of unilateral effects and can be used to evaluate horizontal mergers. In particular, I consider mergers in a market for a differentiated product with many brands. Under those circumstances, it is difficult for firms to collude tacitly and uncoordinated decision making seems more plausible.[5]

The goal of a merger simulation is to predict the equilibrium prices that will be charged and the quantities of each brand that will be sold under the new, post–merger market structure, using only information that is available pre merger. The advantage of such an approach is that, if the simulation can forecast accurately, it is much more efficient to perform an *ex ante* evaluation than to wait for an *ex post* assessment. In particular, the likelihood of costly divestitures is lessened when merger effects can be forecast.

An understanding of the method that is used to solve horizontal–merger simulations is facilitated by an example. Consider the case of K firms that produce n brands of a differentiated product with $K \leq n$. The brands are assumed to be substitutes, but the strength of substitutability can vary by brand pair. It is standard to assume that the firms are engaged in a static pricing game. A market structure in that game

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[2] US antitrust authorities, however, often use the the notion of coordinated effects to analyze mergers in industries that produce homogenous products (see, e.g., Sibley and Heyer 2003).

[3] See, e.g., Werden and Froeb (1994), Hausman, Leonard, and Zona (1994), Nevo (2000), Jayaratne and Shapiro (2000), Pinkse and Slade (2004), and Ivaldi and Verboven (2005).

[4] See, e.g., Lexicon (1999), Kuhn (2000), Compte, Jenny, and Rey (2002), and Kuhn (2005).

[5] Nevo (2000) and Slade(2004a) test and fail to reject the Bertrand assumption for breakfast cereals and beer respectively.

consists of a partition of the brand space into K subsets, where each subset is controlled by one firm or decision maker. Specifically, each firm can choose the prices of the brands that are in its subset. A merger then involves combining two or more of the subsets and allowing one player to choose the prices that were formerly chosen by two or more players.

Consider a typical player's choice. When the price of brand i increases, the demand for brand j shifts out. If both brands are owned by the same firm, that firm will capture the pricing externality. If they are owned by different firms, in contrast, the externality will be ignored. After a merger involving substitutes, therefore, prices should increase, or at least not fall. The question that horizontal–merger simulations aim to answer is by how much. Clearly the answer depends on the matrix of cross–price elasticities. Merger simulations have therefore focused on modeling and estimating demand. Nevertheless, it is also necessary to have estimates of costs, ideally marginal costs. A demand equation and a cost function are thus the basic building blocks upon which a merger simulation is based.

3 The Building Blocks

There are many ways to obtain estimates of demand and costs and, in what follows, I discuss some of them. When choosing a specification, one must keep in mind the important tradeoff that must be made between simplicity and accuracy. In particular, time is of the essence, since the competition authority has only a limited period in which to decide if a merger will be challenged. This means that simple models are preferred. If a model is constructed too hastily, however, it is apt to be simplistic, and conclusions that are based on it are apt to be misleading. I therefore discuss specifications that range from extremely inflexible to moderately flexible.

3.1 Demand

Firms can possess market power because they have few competitors and thus operate in concentrated markets. Even when there are many producers of similar items, however, they can possess market power if their products have unique features that cause rival products to be poor substitutes. To evaluate power in markets where products are differentiated, it is therefore important to have good estimates of substitutability.

A number of demand specifications have been developed to deal with differentiated products. In this paper, I look at three functional forms — the logit, the nested

logit, and the distance metric — that range from extremely simple to more flexible. With all three, there are n brands of a differentiated product with output vector $q = (q_1, \ldots, q_n)^T$, as well as an outside good q_0 that is an aggregate of other products. Furthermore, I assume that there is only one market with exogenous size M.[6]

The Logit

There are many specifications of demand that are based on a random-utility model in which an individual consumes one unit of the brand that yields the highest utility. The logit, which is the simplest of those specifications, results in the demand equation

$$ln(s_i) - ln(s_0) = \beta^T x_i - \alpha p_i + \xi_i, \tag{1}$$

where $s_i = q_i/M$ is brand i's market share, s_0 is the share of the outside good, x_i is a vector of observed characteristics of brand i, p_i is that brand's price, and ξ_i is an unobserved (by the econometrician) characteristic.

The popularity of this equation is due to its simplicity and the fact that it can be easily estimated by instrumental–variables techniques. Its drawback is that it is highly restrictive. To illustrate, let ε_{ij} denote the price-elasticity of demand, $(\partial q_i/\partial p_j)(p_j/q_i)$. With the logit-demand equation, those elasticities take the form

$$\varepsilon_{ii} = \alpha p_i (s_i - 1) \quad \text{and} \quad \varepsilon_{ij} = \alpha p_j s_j, \quad j \neq i. \tag{2}$$

Clearly, the substitution patterns that are implied by (2) are unappealing. For example, all elasticities increase linearly with price and with market share,[7] and all off-diagonal elements in a column of the elasticity matrix are equal. Furthermore, since s_i is i's share of the total market, which includes the outside good, estimated elasticities are very sensitive to the choice of the outside good. In particular, by defining the market, M, more generously, one can cause own price elasticities to rise in magnitude and predicted markups to fall (see appendix A). In this sense, simulations based on logit demand equations have much in common with more traditional analyses, which involve defining the market and calculating concentration indices based on firms' shares of that market.

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[6] The single–market assumption can easily be relaxed, and it almost always is in practice.

[7] A second very simple demand model that has been used for merger simulations, the PCAIDS, also relies on the proportionally assumption and thus has similar problems. Specifically, it assumes that, when the price of one brand rises, the probability that a customer who stops purchasing that brand will switch to a particular substitute is proportional to the substitute's market share (see Epstein and Rubinfeld 2002).

The Nested Logit

The nested–logit (NL) is distinguished from the ordinary logit by the fact that the n brands or products are partitioned into G groups, indexed by $g = 1, ..., G$, and the outside good is placed in group 0. The partition is chosen so that like products are in the same group. For example, when the differentiated product is beer, the groups might be lager, ale, and stout.

The NL estimating equation is

$$ln(s_i) - ln(s_0) = \beta^T x_i - \alpha p_i + \sigma ln(\bar{s}_{i/g}) + \xi_i, \tag{3}$$

where $\bar{s}_{i/g}$ is brand i's share of the group g to which it belongs.[8]   The parameter σ $(0 \leq \sigma \leq 1)$ measures the within-group correlation of tastes, and the ordinary logit is obtained by setting σ equal to zero.

With the NL–demand equation, the own and cross–price elasticities take the form

$$\varepsilon_{ii} = \alpha p_i [s_i - 1/(1 - \sigma) + \sigma/(1 - \sigma)\bar{s}_{i/g}], \tag{4}$$

$$\varepsilon_{ij} = \begin{cases} \alpha p_j [s_j + \sigma/(1 - \sigma)\bar{s}_{j/g}], & j \neq i, \quad j \in g \\ \alpha p_j s_j, & j \neq i, \quad j \notin g. \end{cases}$$

The substitution patterns that are implied by (4) are only slightly more general than those implied by the logit. In particular, the off–diagonal elements in a column of the elasticity matrix take on at most two values, depending on whether the rival product is in the same or a different group.

Extensions to the Nested Logit

There are at least two ways in which the nested logit can be extended. First, the price coefficient, α, can be a function of product characteristics, $\alpha_i = \alpha(x_i)$.[9] When the product is beer, for example, the characteristics might be the brand's alcohol content, product type (e.g., lager, ale, or stout), and brewer identity, and the modification allows elasticities to vary with those characteristics.

Second, the within–group correlation of tastes can vary by group, $\sigma_g, g = 1, \ldots, G$.[10] This modification allows cross–price elasticities to be systematically larger in some groups than in others. For example, stout drinkers might be less willing to switch than lager drinkers.

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[8] See McFadden (1974).

[9] This extension is used in Slade (2004a).

[10] This extension is used in Brenkers and Verboven (2006) and Slade (2004a).

The Distance Metric

Brands of a differentiated product can compete along many dimensions in product–characterisitc space. For empirical tractability, however, one must limit attention to a small subset of those dimensions. Nevertheless, it is not desirable to exclude possibilities *a priori*. The distance–metric (DM) demand model, which is based on a normalized–quadratic utility function, is somewhat more flexible than the NL. In particular, it allows the researcher to experiment with and determine the strength of competition along many dimensions.[11] Indeed, virtually any hypothesis concerning the way in which products compete (any distance measure) can be assessed in the DM framework. However, only the most important measures are typically used in the final specification.

A feature that distinguishes the DM from the NL is that, with the former, cross–price elasticities depend on attributes of both brands — i and j — whereas with the latter, they depend only on the characteristics of j. To achieve this dependence, however, one must interact prices with distance in characteristic or geographic space. Unfortunately, with a large number of brands it is clearly impractical to include all rival prices on the right–hand side of the estimating equation and even less practical to interact those prices with own and rival characteristics. In what follows, I describe how one can formulate a tractable model that condenses this information.

With the DM specification, demands for the differentiated product are[12]

$$q_i = a_i + \Sigma_j b_{ij} p_j - \gamma_i y + \xi_i, \tag{5}$$

where y is aggregate income. Although the functional form is very simple, equation (5) is empirically intractable for most applications, since the matrix $B = [b_{ij}]$ has $n(n+1)/2$ parameters.

To simplify, assume that a_i and b_{ii}, $i = 1, \ldots n$, are functions of the characteristics of brand i, $a_i = a(x_i)$ and $b_{ii} = b(x_i)$. This assumption is similar to one of the extensions to the nested logit. In addition, the off–diagonal elements of B, are assumed to be functions of a vector of measures of the distance, d_{ij}, between brands in some set of metrics, $b_{ij} = g(d_{ij})$. For example, when the product is beer, the measures of distance, or its inverse closeness, might be alcoholic-content proximity and dummy variables that indicate whether the brands belong to the same product type (e.g., whether both are stouts) and whether they are brewed by the same

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[11] See Pinkse, Slade, and Brett (1998) and Pinkse and Slade (2004).

[12] Equation (5) should be divided by a price index, $p_0(\gamma_0 + \gamma^T p)$. However, that index can be set equal to one in a cross section or very short time series.

firm. The function $g(\cdot)$ can be estimated by parametric or semiparametric methods. Finally, the random variable ξ, which captures the influence of unobserved product characteristics, can be heteroskedastic and spatially correlated.

The own and cross-price elasticities that are implied by equation (5) are

$$\varepsilon_{ii} = \frac{p_i a(x_i)}{q_i} \quad \text{and} \quad \varepsilon_{ij} = \frac{p_j g(d_{ij})}{q_i}. \tag{6}$$

As with the nested logit, DM elasticities depend on prices and market shares. However, they can be modeled very flexibly. In particular, by choosing appropriate distance measures, one can obtain models in which substitution patterns depend on *a priori* product groupings, as with the NL. There are, however, many other possibilities. For example, one can also obtain models in which cross-price elasticities depend on continuous distance measures, such as differences in alcohol contents.

Discussion

In the application I assess whether the functional form chosen for the demand equation is an important determinant of predicted prices and markups. Due to the need to restrict attention to simple models, a simple parametric version of the DM equation with two distance measures is used.

The four demand equations are estimated from the same panel data set. Those equations could also be calibrated, where by calibration I mean finding an exact solution for their parameters. To illustrate, consider the logit demand equation (1) with two product characteristics, x_1 and x_2. There are four parameters in that equation, $\beta_0, \beta_1, \beta_2$, and α. Calibration requires only as many observations as parameters; one simply solves the system of four equations for the four unknown parameters. Estimation, in contrast, is a statistical process that requires more observations than parameters. In what follows, I do not consider calibration. However, we know *a priori* that, although it is simpler, calibration is less accurate than estimation.

3.2   Marginal Costs

A demand equation is one of the building blocks that is used to assess merger effects. In addition, one must have estimates of marginal costs, $c_i, \ i = 1, \ldots, n$. There are at least three methods that can be used to obtain those estimates.

Exogenous Costs

With the first method, researchers obtain independent information (e.g., engineering or accounting data) on unit costs. This information is then substituted into

the first-order conditions that are solved to obtain equilibrium prices and markups. The advantage of this method is its simplicity. The disadvantage is that, unless the cost data are very accurate, it is difficult to distinguish between average–variable and marginal costs. Exogenous estimates of marginal costs are denoted $\check{c}_i$, $i = 1, \ldots, n$.

Implicit Costs

With the second method, which involves estimating marginal costs implicitly, researchers assume that firms are engaged in a particular game (e.g., Bertrand) and write down the first-order conditions for that game. Those conditions typically include marginal costs as well as demand parameters. One can therefore substitute the estimated demand parameters into the first-order conditions and solve those conditions for implicit costs. In other words, implicit costs are the estimates that rationalize the observed prices and the equilibrium assumption.

To illustrate, consider a simple pricing game where each firm produces one brand and sets its price so that $(p_i - c_i)/p_i = -1/\varepsilon_{ii}$. There are n first-order conditions of this form that can be solved for the n unknowns, c_i. With the example, given estimates of demand elasticities and observed prices, an implicit estimate of marginal cost is $p_i(1 + 1/\hat{\varepsilon}_{ii})$. This method is valid if the firms are indeed playing the assumed game. If they are playing a different game, however, the estimates of marginal costs so obtained are biased. The implicit estimates are denoted $\tilde{c}_i$, $i = 1, \ldots, n$.

Estimated Costs

The third method involves estimating marginal costs econometrically from first-order conditions. In particular, one can replace c_i with a function of standard cost variables such as factor prices, v, and product attributes, x_i, $c_i = c(v, x_i)$, and estimate that function. To illustrate, with the example above, one could estimate the equation $p_i = c(v, x_i)[\frac{\epsilon_{ii}}{1+\epsilon_{ii}}]$. This procedure is subject to the criticisms of method 2. Furthermore, since demand and cost are estimated jointly, if the equilibrium assumption is incorrect, the misspecificaton contaminates the estimates of demand. A two–step procedure, with demand estimated in stage one and first–order conditions in stage two, is therefore recommended. Econometric estimates of marginal costs are denoted $\hat{c}_i$, $i = 1, \ldots, n$.

In the application, I also assess whether the method that is chosen to estimate marginal costs is an important determinant of predicted prices and markups.

3.3 The Game

When products are differentiated, it is common to assume that the firms in the market are engaged in a static pricing game. This is, however, by no means the only reasonable assumption. For example, it is possible that firms choose some other variable, such as quantity, or a vector of variables, such as price and quality. In addition, if the firms collude tacitly or overtly, prices and markups will be higher than those predicted by Bertrand competition.[13] If, in contrast, competition is destructive or cutthroat, they will be lower. Indeed, the famous folk theorem of repeated games tells us that, if players are sufficiently patient, any outcome between competitive and joint–profit maximizing can be supported as a subgame–perfect equilibrium of the repeated game.

Bertrand competition is an obvious focal point for the estimation of unilateral effects in markets where products are differentiated. However, it is also interesting to obtain bounds on possible outcomes, which can be done by examining predicted competitive and perfectly collusive prices and margins. The general method of solution is the same as that discussed in section 2. Indeed, given any equilibrium solution concept, one can obtain n first–order conditions that can be solved for the prices that correspond to that concept.[14] Bounds on prices and markups can be used to assess whether simulation predictions are sensitive to assumptions concerning the game that players are engaged in.

4 The UK Beer Market

4.1 International Comparisons

Although beer markets have certain features in common across countries, cross–country differences are also striking. It is therefore useful to begin with a few international comparisons. Table 1 summarizes some of the differences between the UK, US, Canada, France, and Germany. This table shows that, when it comes to beer consumption per head and the fraction of beer sales that originate abroad, the UK lies between France and Germany, with Germany having higher per capita consumption and France relying more heavily on imports. Consumers in the US and Canada, who are similar to each other, drink less beer per capita and tend to con-

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[13] In this case, one is no longer considering unilateral effects.

[14] If firms choose j variables, there will be $j \times n$ first–order conditions.

sume fewer imports than their counterparts in the UK. Finally, over time, per capita beer consumption has fallen in most countries, whereas imports have risen.

Whereas the UK is not an outlier with respect to the statistics contained in the first two parts of table 1, it is clearly different from the other countries with respect to the ratio of draft to total beer sales, as can be seen in the last part. Indeed, draft sales in the UK accounted for almost three times the comparable percentages in France and Germany and about six times the percentages in North America. In all countries, however, draft's fraction has fallen, as more beer has been consumed at home.

Turning to production, table 2 compares one important aspect of the industry — its concentration, or lack thereof, into the hands of a small number of brewers. The table shows concentration ratios that were calculated in 1985, before the UK mergers that are discussed below occurred.[15] The UK industry was clearly less concentrated than its counterparts in the US, Canada, and France, where beer tends to be mass produced. Production in Germany, in contrast, where specialty beers predominate, was much less concentrated. It thus seems that brand heterogeneity and an unconcentrated brewing sector go hand in hand.

4.2 The UK Industry

The UK beer industry has undergone substantial changes in both production and consumption in the last few decades, some of which are summarized in table 3. Beers can be divided into three broad categories: ales, stouts, and lagers. Although UK consumers have traditionally preferred ales to lagers, the consumption of lager has increased at a steady pace. Indeed, from less than 1% of the market in 1960, lager became the most popular drink in 1990, with sales exceeding the sum of ale and stout, and its popularity continues to grow. Most UK lagers bear the names of familiar non–British beers such as Budweiser, Fosters, and Kronenbourg. Almost all, however, are brewed under license in the UK and are therefore not considered to be imports.

A second important aspect of beer consumption is the popularity of 'real' or cask–conditioned ale. Real products are alive and undergo a second fermentation in the cask, whereas keg and tank products are sterilized. The statistics that are shown in table 3, however, which show that real ale's market share has remained relatively constant, must be interpreted with caution, since they show percentages of the ale

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[15] With the exception of Germany, the table shows three–firm concentration ratios. Any other concentration measure, however, would tell the same story.

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market. As a percentage of the total beer market, which includes lager, real products have lost ground.

The final trend in consumption is the decline in on–premise sales. On–premise consumption includes sales in bars, hotels, and clubs, whereas off–premise consumption refers to beer that is purchased in a store and consumed at home, out of doors, or in nonlicensed establishments. Clearly, draft sales are a subset of on–premise consumption, since some packaged products are consumed in licensed establishments.

With respect to production, table 3 shows that the number of brewers has declined steadily. Indeed, in 1900, there were nearly 1,500 brewery companies, but this number fell during the century and is currently below sixty. In addition to incorporated brewers, however, there are many microbreweries operating at very small scales. In fact, most brewers are small, and few produce products that account for more then 1/2% of local markets.

This snapshot of the UK beer industry shows significant changes in tastes and consumption habits as well as a decline in the number of companies that cater to those tastes. Nevertheless, as we have seen, compared to many other countries, the UK brewing sector was only moderately concentrated. Recent developments in the industry, however, have resulted in substantial changes in ownership patterns.

4.3   Public Policy Towards the UK Beer Industry

It is not unusual for the beer industry to attract the attention of politicians and civil servants. Government involvement in the industry stems from four concerns: the social consequences of alcohol consumption, the revenue obtained from alcohol sales, the level of concentration in the brewing sector, and the extent of brewer control over retailing. In recent years, moreover, public scrutiny of the industry has accelerated. Indeed, there have been over thirty reviews by UK and European Union authorities since the 1960s. Many of those investigations were triggered by proposed mergers in the industry. Several, however, were more general assessments of prices, profits, and tied sales.[16]

Figure 1 shows actual and proposed changes in the structure of the UK beer market. In particular, there were three successful mergers; between Courage and Grand Metropolitan (Grand Met) in 1990, Allied Lyons and Carlsberg in 1992, and Courage and Scottish & Newcastle (S&N) in 1995. In addition, there were two proposed mergers that were unsuccessful; one in 1997 between Bass and Carlsberg–Tetley (CT) was

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[16] For an analysis of tied sales in the UK brewing sector, see Slade (1998).

denied, and the second in 2000 between Bass and Whitbread eventually resulted in divestiture of Bass's brewing assets.

Each of the mergers is discussed below. However, it is difficult to understand the positions taken by the Monopolies and Mergers Commission (MMC) and Office of Fair Trading (OFT) with respect to the horizontal mergers without considering their views on the vertical links between brewers and their retail outlets. Vertical issues are therefore discussed first.

4.3.1 The Beer Orders

Prior to the late 1980s, a large fraction of UK public houses (pubs) were owned by brewers and operated under exclusive–purchasing agreements (ties) that limited the pubs to selling brands that were produced by their affiliated brewer.[17] Public officials have long been concerned that those tying arrangements would somehow extend the market power that they perceived in the upstream or brewing sector to the downstream or retailing sector. Absent the system of ties, they believed that retailing would be competitive.

In the late 1980's, the OFT requested the MMC to undertake a major industry review. The product of that investigation was the 500–page MMC report entitled "The Supply of Beer," which appeared in February of 1989. The MMC recommended measures that eventually led brewers to divest themselves of 14,000 public houses. The Commission claimed that their recommendations would lower retail prices and increase consumer choice. There has been considerable doubt, however, that their objectives were achieved. Indeed, after divestiture, retail beer prices rose (Slade 1998).

The MMC report is unclear about the economic reasoning that led to the decision to force divestiture.[18] Nevertheless, the MMC alleged that, due to high concentration, the brewers possessed market power and their involvment in retailing protected that power.

The Beer Orders were rescinded in 2002.

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[17] Such tying arrangements are illegal in the US. See Slade (2000) for a discussion of the legal differences.

[18] See Lafontaine and Slade (2006) for a summary of theories of anticompetitive foreclosure, exclusion, and extension of horizontal market power through vertical integration, as well as the empirical evidence on the subject. They find that the evidence of anticompetitive effects is weak.

4.3.2 The Mergers

After the Beer Orders, the brewing industry became more concentrated. Increases in brewing–market concentration were due to mergers, which the MMC allowed, as well as to the fact that some firms (e.g. Boddingtons) ceased brewing, whereas others (e.g. Courage) ceased retailing. Nevertheless, as we illustrate below, for some time the MMC favored recommendations that focused on the retail sector and the vertical linkages between brewers and public houses in spite of their claim that the source of monopoly power lay in brewing.

The Courage/Grand Met Merger: The merger between Courage and Grand Met that occurred in 1990, just after the Beer Orders were passed, reduced the number of national brewers from six to five. At the time of the merger, Grand Met controlled 11% of the beer market, whereas Courage controlled 9%. The merger transformed Courage into the second largest producer, just behind Bass, which had a market share of 22%. Nevertheless, three of the four MMC recommendations involved the tied estate rather than increases in brewing concentration *per se.*

The Allied Lyons/Carlsberg Joint Venture: In 1992, Allied Lyons, a British food company that owned breweries, formed a joint venture with Carlsberg, a Danish brewer. Their combined UK brewing assets were renamed Carlsberg–Tetley. At the time of the joint venture, Allied Lyons controlled 12% of the beer market, whereas Carlsberg controlled 4%. Their shares of the lager market, however, were higher, with 8 and 13%, respectively. The joint venture became the third largest brewer, behind Bass and Courage. The number of national brewers, however, was unchanged, since Carlsberg was not one of them. The MMC was principally concerned with the fact that Carlsberg was one of a very few brewers without a tied estate.[19]

The Courage S&N Merger: In 1995, the merged firm Courage merged again with Scottish & Newcastle. This event, which reduced the number of national brewers from five to four, created the largest brewer in the UK. The combined firm, with a market share of 28%, was substantially larger than Bass, which had a market share of 23% and thus dropped from number one to two. In spite of the fact that the majority of the groups that were asked to comment on the merger favored a full investigation by the MMC, the OFT did not refer the matter to the MMC. Instead, it allowed the merger

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[19] Brewers without tied estates are not vertically integrated into retailing and have no exclusive–purchasing agreements.

to proceed subject to a number of undertakings, all of which involved the tied estate. The OFT rejected the idea of divestiture of breweries or brands but instead favored *"the alternative remedy that has generally been adopted following previous references ... to weaken the extent of vertical links with the merged company."* (DGFT, 1995).

The Bass/CT Merger: The fourth and largest merger was proposed in 1997 but not consummated. This involved the numbers two and three brewers, Bass and Carlsberg–Tetley, and would have created a new firm, BCT, with an overall market share of 37%. Moreover, it would have further reduced the number of national brewers from four to three. At the time, Bass controlled 23% of the beer market, CT controlled 14%, and Scottish Courage, which would have become the second largest firm, had a market share of 28%. The MMC estimated that, after the merger, the Hirshman/Herfindahl index of concentration (HHI) would rise from 1,678 to 2,332. Furthermore, it noted that the US Department of Justice's 1992 Merger Guidelines specify that a merger should raise concerns about competition if the post–merger HHI is over 1,800 and the change in the HHI is at least 50 points. Nevertheless, the MMC recommended that the merger be allowed to go forward.[20] In spite of the MMC's favorable recommendation, the merger was not consummated because the president of the Board of Trade did not accept the MMC's advice.

The Bass/Whitbread Merger: More recently, in May of 2000, the world's largest brewer, the Belgian firm Interbrew, acquired Whitbread, the UK's fourth national brewer. That acquisition did not change the number of brewers in the UK, but it transferred the ownership of some brands. More importantly, in August of the same year, Interbrew also acquired Bass, which gave it a UK market share of approximately 36%. This time the MMC did not approve the merger. Instead, it recommended that Interbrew be required to divest the UK brewing assets of Bass to a buyer approved by the Director General of Fair Trading. Interbrew appealed the MMC decision to the High Court, however, and won on a legal technicality.[21] Nevertheless, although Intebrew kept the Bass brand name, the majority of Bass Brewing's assets were sold to Coors in 2002.

The MMC's attitude towards earlier mergers in the brewing industry is puzzling. It seems that either they concluded that brewers had little market power or that

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[20] The one economist on the Commission, David Newbery, wrote a dissenting opinion.

[21] Specifically, it was decided that Interbrew had not been allowed sufficient time to consider alternative remedies.

large increases in concentration would not change that power. However, their own calculations estimated that brewing margins were approximately 30%, which is moderately high. For example, margins of approximately 20% are more common in the food sector.

The MMC's views, however, changed over the decade of the 90s. In particular, early on the Commission was almost exclusively concerned with vertical relationships in the industry, whereas, by the end of the decade, a concern with horizontal concentration assumed prominence.

Was increased concern with horizontal–market power justified? As a first cut to answering that question one can examine the market shares of the firms before and after each merger. Those shares are shown in table 4, which reveals that, with all three consummated mergers, a few years afterwards the merged firm's market share was less than the sum of the premerger shares. This suggests that increased efficiency did not overwhelm increased market power. However, although one might arrive at this conclusion with hindsight, it is more relevant to see if one could have reached the same conclusion *ex ante*.

5   The Data

5.1   Demand Data

The data are a panel of brands of draft beer sold in different markets, where a market is a time–period/geographic–region pair. The panel also includes two types of establishments, multiples and independents. Brands that are sold in different markets are assumed not to compete, whereas brands that are sold in the same market but in different types of establishments are allowed to compete. A complete description of the data, which is summarized here, can be found in the appendix B.

For each observation, there is a price, PRICE, sales volume, VOL, and coverage, COV, where coverage is the percentage of outlets that stocked the brand. Each brand has an alcohol content, ALC. Moreover, brands whose alcohol contents are greater than 4.2% are called premium, whereas those with lower alcohol contents are called regular beers. This distinction is captured by a dummy variable, PREM. Finally, brands are classified into four product types, lagers, stouts, keg ales, and real ales using dichotomous variables, $PROD_i$, $i = 1, \ldots, 4$. Those types form the basis of the groups for the nested logit.

A number of interaction variables are also used. Interactions with price are denoted PRVVV, where VVV is a characteristic. To illustrate, PRALC_i denotes price times alcohol content, $\text{PRICE}_i \times \text{ALC}_i$.

5.2 The Metrics

Using the same data, Pinkse and Slade (2004) experimented with a number of metrics or measures of similarity of beer brands. These include several discrete measures: same product type, same brewer, and various measures of being nearest neighbors or sharing a market boundary in product–characteristic space. Two continuous measures of closeness, one in alcohol–content and the other in coverage space, were also used.

They found that one metric stands out in the sense that it has the greatest explanatory power, both by itself and in equations that include several measures. That metric, WPROD, is the same–product–type measure that is set equal to one if both brands are, for example real ales, and zero otherwise, and then normalized so that the entries in a row sum to one. A second measure, a similar–alcohol–content measure, is also included in their final specification. That metric is calculated as $\text{WALC}_{ij} = 1/(1 + 2 \mid \text{ALC}_i - \text{ALC}_j \mid)$. I use the same metrics here.

To create average rival prices, the vector, PRICE, is premultiplied by each distance matrix, W, and the product is denoted RPW. For example, RPPROD is WPROD×PRICE, which has as ith element the average of the prices of the other brands that are of the same product type as i.

5.3 Cost Data

The Monopolies and Mergers Commission performed a detailed study of brewing and wholesaling costs by brand and company. In addition, they assessed retailing costs in managed public houses.[22]   A summary of the results of that study is published in MMC (1989). Although the assessment of costs was conducted on a brand and company basis, only aggregate costs by product type are publicly available. Those data, which are discussed in appendix B, are used for the exogenous costs, $\check{c}$.

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[22] Managed public houses are owned and operated by a brewer.

6 Results

6.1 Demand

The four demand equations are summarized in table 5. Consider first the logit and its variants. With all three specifications, the market is sales of beer. The outside good is therefore on and off–premise sales of beer in bottles and cans. The table shows that the price coefficient, $-\alpha$, increases in magnitude and significance as one moves from the logit to the nested logit to the extension of the nested logit,[23] which is an indication that the estimated elasticities will be progressively larger. Furthermore, the parameter σ is large (recall that it is bounded by one) and highly significant, which indicates that the nested logit or its extension is preferred. Finally, when σ is allowed to vary by product type, there is substantial variation in the estimates of that parameter.

Now consider the distance–metric demand estimates. Due to differences in dependent variables and functional forms, one cannot compare magnitudes of price coefficients directly. However, the price coefficients are clearly more significant than with the logit variants.[24] The estimates show that demand is more elastic for popular national brands with high coverage and for brands that have many neighbors in product–characteristic space.[25]

The estimated average own and cross–price elasticities that are shown in table 6 are easier to interpret, since they are comparable across demand specifications. That table shows that, using the logit, one would conclude that demand at the brand level is inelastic, which is clearly unrealistic. As one moves from logit to nested logit to extended NL to distance metric, however, average own–price elasticities increase in magnitude. Nevertheless, all estimates are lower than the elasticities that were found by Hausman, Leonard, and Zona (HLZ, 1995) for US brands. However, since US brands are more homogenous, they could be more substitutable, and there is no *a priori* reason to expect that UK–brand elasticities will be as large as those found for the US.

The estimated cross–price elasticities display similar patterns — increasing as one goes down the table, and all are substantially below the HLZ cross–price estimates.

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[23] Only one extension of the nested logit is shown — variation in σ by product type. When α was modeled as a function of product characteristics, there was little change in estimated elasticities.

[24] Recall that the price coefficients begin with PR.

[25] COVR is the reciprocal of coverage and NCB measures the number of common–boundary neighbors in alcohol/coverage space (see appendix B.)

However, HLZ consider fewer brands which, all else equal, will result in higher cross–price elasticities.

Inelastic demand at the brand level, as implied by the logit, leads to an unrealistic model. In particular, markups over cost will be negative on average. For this reason, the logit is not discussed in the remainder of this chapter.

6.2   Costs

Table 7 shows exogenous costs, $\check{c}$, implicit costs, $\tilde{c}$, that were obtained under three demand specifications, and estimated costs, $\hat{c}$, that were obtained by estimating a marginal–cost function jointly with the distance–metric demand equation.

The exogenous costs show very little variation, which is due to the aggregate nature of the cost data that was released by the MMC. As noted earlier, those numbers are average variable costs and only equal marginal costs if marginal costs are constant.

The implicit costs were obtained from first–order conditions for a static pricing game (Bertrand) under three demand specifications. The table shows that those estimates increase as one moves from nested logit to extended NL to distance metric, which must be true. Indeed, when the estimated elasticities increase in magnitude, the implied markups fall. Holding prices constant, this can only happen if costs rise. On average, implicit distance–metric costs are closest to exogenous costs. However, there is substantially greater variation in the implicit–cost estimates.

Table 8 assesses the sensitivity of implicit costs to the assumption that is made concerning equilibrium behavior. That table shows estimates that correspond to marginal–cost pricing, a static pricing game, and joint–profit–maximizing behavior. The two extremes bound the possibilities that one might expect to observe. The table shows that implicit costs fall as one moves from competitive to imperfectly competitive to monopoly pricing. This pattern is also expected. Indeed, since prices are the same in all three scenarios, the only way for markups to increase is for costs to fall. Most of the variation across specifications, however, comes from variation at the low end. The maximum implicit cost is relatively constant.

It is important to notice that the numbers in table 8 bound the possible cost estimates only under the distance–metric specification. Indeed, table 7 shows that the implicit costs obtained from solving a static pricing game using the nested–logit demand specifications are lower on average than the lowest possible estimates using the distance–metric specification (79.0 and 98.6 versus 99.1). Cost estimates are thus very sensitive to both demand and equilibrium assumptions.

Finally, econometrically estimated costs were obtained using a two–step GMM procedure (demand estimated first and first–order conditions second) with a marginal–cost function that depends on volume, q_i, as well as product characteristics, x_i.[26] The estimated cost functions, which are shown in table 9, indicate that marginal costs rise with output (VOL). In addition, marginal costs are higher for premium (high alcohol) beers and in managed public houses. Finally, it is more costly to produce lagers and stouts than ales.

Mean estimated costs are shown in the last row of table 7.[27] On average, they are somewhat higher but not far from exogenous costs and more variable than both exogenous and implicit costs.

6.3   Predicted Prices and Margins

Table 10 shows predicted prices and margins under the three demand specifications. Those numbers were obtained by solving the first–order conditions for a static pricing game using the indicated demand function and the exogenous cost estimates, $\check{c}$. This exercise is in some sense the opposite of the one that was performed to obtain the implicit costs shown in table 7. In that table, prices are held constant and the cost estimates are those that rationalize the observed prices, given the estimated elasticities. In table 10, costs are held constant and the predicted prices are those that rationalize the observed costs, given the estimated elasticities. It is therefore not surprising that, whereas implicit costs rise as one moves down table 7, predicted prices and margins fall as one moves down table 10. As in earlier tables, the prices that are obtained using the distance–metric demand equation are closest to the observed prices.

6.4   Merger Simulations

The final exercise involves using the three demand equations with the exogenous costs to simulate changes in industry market structure. All simulations are performed using the procedure that is described in section 2. In particular, suppose that there are K firms or decision makers in the industry before an event and $K - J$ firms afterwards. If $J > 0$, the event is a merger, whereas if $J < 0$, it is a divestiture. In other words, a merger (divestiture) results in fewer (more) decision makers.

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[26] A two–step procedure was chosen so that any misspecification in the nature of equilibrium would not contaminate the demand equation.

[27] The numbers shown in the table were evaluated at the means of the explanatory variables.

The data were collected in 1995, after the Scottish/Courage (SC) merger occurred and before the Bass/Carlsberg–Tetley (BCT) merger was proposed. The *status quo* is thus an industry with four national brewers and a number of smaller firms. Two events are considered. The first, which is a divestiture, involves undoing the Scottish/Courage merger. It is thus a move from four to five national brewers. The second, which is a merger, involves allowing Bass and Carlsberg–Tetley to combine. It is thus a move from four to three national brewers.

Table 11 summarizes the results of those exercises. The first set of numbers (marked *Status Quo* in the table), which merely duplicates the information that is contained in table 10, is included for comparison purposes. The second and third portions of the table summarize the results of simulations of the two events. For each simulation, the table shows mean predicted prices and percentage changes from the *status quo*. Predicted post–event prices are always compared to predicted *status quo* prices rather than to observed prices, since that comparison gives each demand model the benefit of the doubt. In particular, since the NL models over predict prices in the *status quo*, comparisons with observed prices would predict unreasonably large changes (in absolute value) for most specifications.

First consider differences in predictions across events. With the simple logit, brand–level demand was estimated to be inelastic on average. For that reason, the table does not show logit simulations. However, we know *a priori* that the logit model would predict price changes that are not very different in magnitude across mergers. This is true because the sums of the pre–merger market shares of the merging firms, as well as the changes in the HHI, would have been roughly equal for the two events.[28]

The simulations that are shown in table 11, in contrast, predict smaller changes for the Scottish/Courage merger than for BCT. This is partly due to the fact that the similarity of the merging firms' brands was less for SC. In particular, whereas Courage had two best–selling lagers, Fosters and Kronenbourg, S&N had little presence in the lager market. In contrast, both Bass and Carlsberg–Tetley had best–selling lagers, Carling and Carlsberg, respectively. Unlike the logit, the other specifications are capable of capturing these differences in brand fit across mergers.

Now consider differences in predictions across specifications, which are substantial. In particular, predicted price changes are greatest for the nested logit, second for the extended NL, and smallest for the distance metric. This pattern is due to the fact that the estimated cross–price elasticities increase as one moves from the first demand

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[28] Although the sum of the per–merger national–market shares was 30% for SC and 37% for BCT, the SC sum was 37% of the markets in the data.

model to the third. In other words, the brands become more substitutable.

Finally, the price changes that are predicted by both NL models seem unrealistically large, especially when one notes that, although each event involves only two firms, the averages that are shown in the table reflect the prices of all brands in the market. Clearly, changes in the prices of the affected brands are larger than average changes.

7 Conclusions

What general conclusions can we draw from this analysis? First, the predictions about markups and merger effects that can be obtained from simple models are often very misleading. Unfortunately, however, a number of economists have attempted to convince competition authorities that user–friendly canned programs can provide reasonable predictions. Moreover, in addition to per–merger market shares, those programs often require only one or two numbers as inputs.[29] This can be true, however, only if all elasticities are functionally related to one another in ways that are preset by the program. Put another way, this means that answers are determined by functional form and only back–of–the–envelope calculations are required.

Second, merger models that rely heavily on market shares and a choice of the outside good are not very different from traditional analyses that involve market definition and calculation of share–based indices of concentration. Moreover, in some sense they are worse, since they are less transparent and they offer point predictions of merger effects that give spurious impressions of accuracy.

The first two points can be illustrated using the simple logit demand model. Suppose that 100 brands of a differentiated product are produced in an industry. There are then 10,000 different own and cross–price elasticities. However, as we have seen, all off–diagonal entries in a column of the logit elasticity matrix are identical. Nevertheless, one might be tempted to conclude that that fact is unimportant, since there are still 100 different cross–price elasticities, one for each brand. Whereas this is true, it is not very interesting, since relative magnitudes are determined entirely by market shares. Furthermore, absolute magnitudes can be manipulated by a strategic choice of the outside good, with larger markets implying lower markups. Clearly, this is also true of traditional merger analysis. However, most noneconomists who work in

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[29] To illustrate, the abstract of a recent working paper states that a particular simulation program "can be implemented using market shares and two price elasticities."

the area understand the role that market definition plays. Unfortunately, they are less apt to realize that the choice of the outside good plays a similar role. Nevertheless, the logit model has been used extensively by competition authorities.[30]

Third, models that are capable of predicting with some accuracy are often difficult to construct and estimate. Moreover, there are many modeling choices that must be made that require experience and judgment. Unfortunately, when such models are used, other economists can criticize those modeling choices on technical grounds that serve to confuse lawyers, tribunal members, and jurors.[31]   When this occurs, the econometric evidence is apt to be disregarded, since the 'experts' do not agree and no one else can understand what they are saying.

Does this mean that we, as antitrust economists, are caught in a Prisoners' Dilemma? Would we all be better off if simulation models did not exist? Not necessarily. I think that there is a role for quantitative techniques to play, but we must be careful not to oversell them.

An understanding of the strengths and weaknesses of different merger models can serve to organize our thoughts concerning mergers. In particular, we should stop thinking about market definition and market shares and think about brand fit instead.[32]   For example, a merger between two firms that produce lagers can have very different consequences from one between a producer of lager and a producer of stout, even though the HHI changes by the same amount after the two mergers. Clearly, this is due to the fact that cross–price elasticities differ in the two cases. One might therefore counter that it is merely necessary to define smaller submarkets (e.g., lagers and stouts) and calculate shares of those submarkets. Whereas this is partly true, it begs the question, since there can be other important dimensions along which brands compete. Furthermore, since those dimensions can be continuous (e.g., alcohol content), the 0/1 classification under which brands are in the same or in different markets is frequently not helpful.

There is a second way in which merger simulations can help us think sensibly about merger effects in circumstances where mergers might be challenged. Specifically, academic evidence on brand elasticities and merger effects is beginning to accumulate, and much of that work was not undertaken in a consulting environment. Presumably, the authors of many of those studies were interested in learning about the industry and

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[30] See, e.g., Werden and Froeb (2002).

[31] See, e.g., Hausman and Leonard (2005).

[32] This discussion applies to industries that produce differentiated products. The traditional analysis is much better suited to handling mergers among firms that produce homogeneous products (see Slade, 2004b).

were not motivated by considerations of winning a case. Furthermore, since published articles have been subjected to the refereeing process, their credibility is increased. One should be able to draw on that literature to obtain a better understanding of the forces that determine substitution patterns in particular industries. This will usually mean drawing qualitative conclusions from quantitative evidence rather than focusing on point estimates. Moreover, back–of–the–envelope calculations can be based on such studies, and, as long as everyone understands the assumptions that underlie those calculations and no spurious claims of accuracy are made, they can be useful. However, we should eschew generic, one–size–fits–all merger models and numbers that come out of black boxes.

In concluding, I should note that I have not mentioned merger–related efficiencies, an issue that is potentially important.[33] A complete merger–simulation model requires a cost function that is capable of capturing economies of scale and scope. Unfortunately, it is not obvious how one should embed long–run cost functions in merger–simulation exercises, which are by assumption short run. Finally, there are important merger–related dynamic issues, such entry, exit, and brand repositioning. Those issues only make the problems that I have been discussing more complex.

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[33] My personal opinion on this subject is that, in the horizontal context, merger–related economies are often exaggerated. In particular, in manufacturing, most economies of scale and scope occur at the plant level. Moreover, although there are often substantial economies in distribution, distributional costs are often not a high fraction of total costs.

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Appendix A: The Role of the Outside Good

Consider the logit demand equation (1), which is equivalent to

$$ln(q_i) - ln(M) = ln(q_0) - ln(M) + \beta^T x_i - \alpha p_i + \xi_i. \tag{7}$$

or

$$ln(q_i) = ln(q_0) + \beta^T x_i - \alpha p_i + \xi_i. \tag{8}$$

It is obvious from (8) that the choice of q_0 affects only the estimate of the constant
term. In particular the estimate of α is unaffected.

On the other hand, own and cross–price elasticities, which are given by

$$\varepsilon_{ii} = \alpha p_i(s_i - 1) \quad \text{and} \quad \varepsilon_{ij} = \alpha p_j s_j, \quad j \neq i, \tag{9}$$

are sensitive to the choice of q_0. Specifically, since s_i falls when the market is defined
more broadly, the elasticities increase.

To understand the implications of this fact, consider the following example. There
are two 'inside' goods that are symmetric and one outside good to be chosen. We wish
to compare the situations in which one firm owns the two inside goods (monopoly)
to separate ownership (duopoly).

Under monopoly, it is straight forward to show that the price/cost margins or
Lerner indices will be set so that

$$L_i^M = \frac{-1}{\epsilon_{ii} + \epsilon_{ij}}. \tag{10}$$

Under duopoly, in contrast, the cross–price effects will be ignored and each firm will
set a margin according to

$$L_i^D = \frac{-1}{\epsilon_{ii}}. \tag{11}$$

Let the estimate of α be $\hat{\alpha}$,[34] the average price be $\bar{p}$, and suppose that $\hat{\alpha}\bar{p} = 20$. Figure 2, which is based on those parameter values, contains graphs of predicted

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[34] Since there are only two brands of the differentiated product, for estimation purposes one must
use data from a number of markets.

markups, $\hat{L}^M$ and $\hat{L}^D$, as functions of the share of the outside good, s_0. It shows that, as one moves from larger to smaller markets, duopoly markups double. Monopoly markups, in contrast, increase much more rapidly.

The figure also highlights several plausible choices of q_0. The inside good is draft beer. The smallest market is on–premise beer sales, which means that the outside good is on–premise consumption of beer in bottles and cans. The next market candidate is beer sales, which includes off–premise sales, the third is alcoholic beverages, which includes wine and spirits, the fourth is drinks, which includes soft drinks, juices, and bottled water, and the broadest market is food and beverages.

One can imagine a case where the two parties present evidence obtained from the same merger–simulation model. The defense, however, claims that the outside good should be food and beverages and notes that markups are small (5%) and that they will not change after the merger.[35] The plaintiff, in contrast claims that the market is on–premise beer sales, that markups are substantial, and that they will increase five fold after the merger. Moreover, each party demonstrates that the simulation program produces tight confidence intervals around his or her preferred estimates.

Appendix B: The Data

B1: Demand Data

Most of the demand data were collected by StatsMR, a subsidiary of A.C. Nielsen Company. An observation is a brand of beer sold in a type of establishment, a region of the country, and a time period. Brands are included in the sample if they accounted for at least one half of one percent of one of the markets. There are 63 brands. Two types of establishments are considered, multiples and independents, two regions of the country, London and Anglia, and two bimonthly time periods, Aug/Sept and Oct/Nov 1995. There are therefore potentially 504 observations. Not all variables were available for all observations, however. When data for an observation were incomplete, the corresponding observation was also dropped in the other region.[36]

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[35] The qualitative conclusions do not depend on the fact that merger to monopoly is considered. Indeed, if there are three inside goods and the producers of two of them want to merge, the defense would still claim that markups will not change after the merger, whereas the plaintiff would claim that they will increase by 75%.

[36] Observations were dropped in both regions because prices in one region are used as instruments for prices in the other.

This procedure reduced the sample to 444 observations.

Establishments are divided into two types. Multiples are public houses that either belong to an organization (a brewer or a chain) that operates 50 or more public houses or to estates with less than 50 houses that are operated by a brewer. Most of these houses operated under exclusive–purchasing agreements (ties) that limited sales to the brands of their affiliated brewer. Independents, in contrast, can be public houses, clubs, or bars in hotels, theaters, cinemas, or restaurants.

For each observation, there is a price, sales volume, and coverage. Each is an average for a particular brand, type of establishment, region, and time period. Price, which is measured in pence per pint, is denoted PRICE. Volume, which is measured in 100 barrels, is denoted VOL, and coverage, which is the percentage of outlets that stocked the brand, is denoted COV.

VOL is the dependent variable in the distance–metric demand equation. With the nested–logit specifications, in contrast, the dependent variable is LSHARE — the natural logarithm of the brand's overall market share — where the market includes the outside good. The outside good here consists of all other alcoholic beverages. Beer's share of the alcoholic–beverage market averaged 55%.[37]

In addition, there are data that vary only by brand. These variables are product type, brewer identity, and alcohol content.

Brands are classified into four product types, lagers, stouts, keg ales, and real ales. Unfortunately, three brands — Tetley, Boddingtons, and John Smiths — have both real and keg–delivered variants. Since it is not possible to obtain separate data on the two variants, the classification that is used by StatsMR was adopted. Dummy variables that distinguish the four product types are denoted $PROD_i$, $i = 1, \ldots, 4$. The product types also form the basis of the groups for the NML specifications, and those specifications include an explanatory variable LGSH, the natural logarithm of the brand's share of the group to which it belongs.

There are ten brewers in the sample, the four nationals, Bass, Carlsberg–Tetley, Scottish Courage, and Whitbread, two brewers without tied estate,[38] Guiness and Anheuser Busch, and four regional brewers, Charles Wells, Greene King, Ruddles, and Youngs. Brewers are distinguished by dummy variables, $BREW_i$, $i = 1, \ldots, 10$.

Each brand has an alcohol content that is measured in percentage. This continuous variable is denoted ALC. Moreover, brands whose alcohol contents are greater than

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[37] When the NML is estimated, the log of the share of the outside good is moved to the right–hand side of the equation, where it is captured by market fixed effects.

[38] Brewers without tied estate are not vertically integrated into retailing.

4.2% are called premium, whereas those with lower alcohol contents are called regular beers. A dichotomous alcohol–content variable, PREM, that equals one for premium brands and zero otherwise, was therefore created.

Dummy variables that distinguish establishment types, MULT = 1 for multiples, regions of the country, LONDON = 1 for London, national brewers, NAT = 1 for nationals, and time periods, PER1 = 1 for the first period, were also created.

Finally, a variable, NCB, was created as follows. First, each brand was assigned a spatial market, where brand i's market consists of the set of consumers whose most preferred brand is closer to i in taste space than to any other brand. Euclidean distance in alcohol/coverage space was used in this calculation. Specifically, i's market consists of all points in alcohol/coverage space that are closer to i's location in that space than to any other brand's location. NCB_i is then the number of brands that share a market boundary (in the above sense) with i, where boundaries consist of indifferent consumers (i.e., loci of points that are equidistant from the two brands).[39]

A number of interaction variables are also used. Interactions with price are denoted PRVVV, where VVV is a characteristic. To illustrate, $PRALC_i$ denotes price times alcohol content, $PRICE_i \times ALC_i$.

B2: Cost Data

Brewing and wholesaling costs include material, delivery, excise, and advertising expenses per unit sold. Retailing costs include labor and wastage. Finally, combined costs include VAT. Two changes to the MMC figures were made. First, their figures include overhead, which is excluded here because it is a fixed cost. Second their figures do not include advertising and marketing costs. Nevertheless, several of the companies report advertising expenditures per unit sold, and the numbers in the table are averages of those figures.

Costs were updated to transform them into 1995 pence per pint. To do this, the closest available price index for each category of expense was collected and expenditures in each category were multiplied by the ratio of the appropriate price index in 1995 to the corresponding index in 1985.

If average variable costs (AVC) in brewing are constant, these numbers are marginal costs, but if AVC vary with output, they either over or underestimate marginal costs. However, it is difficult to predict the direction of the bias. Indeed, due to the presence of fixed costs, AVC can increase with output even when there are increasing returns.

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[39] The details of this construction can be found in Pinkse and Slade (2002).

Table 1: Selected International Comparisons

Consumption/Head (Liters)	Country	1975	1985	1995	2003
	UK	118.5	109.2	100.9	101.3
	US	81.8	89.7	83.5	81.6
	Canada	87.0	82.2	66.5	68.4
	France	41.3	40.1	39.1	35.5
	Germany	147.8	145.4	137.7	117.7
Imports (%)	Country	1975	1985	1995	2003
	UK	4.4	6.0	8.8	10.7
	US	1.1	4.3	6.0	11.6
	Canada	0.6	4.4	3.3	9.7
	France	8.6	11.1	15.4	24.0
	Germany	0.8	1.2	2.3	2.8
Draft Sales (%)	Country		1991	1996	2003
	UK		71	66	57
	US		11	10	9
	Canada		10	12	10
	France		25	23	23
	Germany		23	20	20

Source: The Brewers and Licensed Retailers Association and the British Beer and Pub Association

Table 2: Three–Firm Concentration Ratios in 1985

UK	US	Canada	France	West Germany (CR$_5$)
47	74	96	81	28

Source: The Monopolies and Mergers Commission (MMC 1989)

Table 3: Selected UK Beer Statistics

Year	1970	1980	1990	2000
% Lager	7	31	51	63
Real Ale/Total Ale (%)	NA	30	37	30
% On Premise Sales	90	88	80	67
Number of Brewers	96	81	65	57

Source: The Brewers and Licensed Retailers Association and the British Beer and Pub Association

Table 4: National Brewer Market Shares, Draft and Packaged

Brewer	1985	1991	1996
Allied Lyons	13	12	
			14
Carlsberg	NA	4	
Bass	22	22	23
Courage	9		
		19	
Grand Metropolitan	11		
			28
Scottish & Newcastle	10	11	
Whitbread	11	12	13
Total	77	78	78

Source: The Monopolies and Mergers Commission (MMC 1989)

Table 5: IV Demand Equations

Functional Form	$-\alpha$	σ	σ_1	σ_2	σ_3	σ_4
Logit[a]	-0.0007					
	(-0.1)					
Nested Logit[a]	-0.0026	0.830				
	(-1.0)	(12.3)				
Extended NL[a]	-0.0050		0.762	0.668	0.944	0.739
	(-1.7)		(12.4)	(9.6)	(12.9)	(9.3)

	PRICE	PRCOVR	PRPREM	PRNCB	RPPROD	RPALC
Distance Metric[b]	-1.125	0.165	-0.030	-0.117	0.712	0.215
	(-2.9)	(7.8)	(-0.1)	(-2.7)	(2.6)	(1.6)

a) Contains ALC, LCOV, product, time–period, and regional fixed effects. α is the coefficient of price, and σ measures within–group correlation of utilities.

b) Contains ALC, LCOV, time–period, establishment type, and regional fixed effects. A prefix of PR implies that price is interacted with that variable. A prefix of RP means that that distance measure is used to create an average rival price. Standard errors corrected for heteroskedasticity and spatial correlation of an unknown form.

Asymptotic t statistics in parentheses.

Table 6: Estimated Elasticities: Brand Averages

Functional Form	Own–Price Elasticity	Cross–Price Elasticity
Logit	-0.97	0.0005
Nested Logit	-2.4	0.0344
Extended NL	-3.4	0.0517
Distance Metric	-4.6	0.0632
AIDS Hausman, Leonard, and Zona (1995)	-5.0	0.121

Table 7: Summary of Cost Estimates

Method		Mean	Standard Dev.	Minimum	Maximum
Exogenous, $\check{c}$		129.1	5.2	124.0	147.0
Implicit, $\tilde{c}^a$					
	Nested Logit	79.0	14.6	51.6	132.3
	Extended NL	98.6	23.0	46.1	158.4
	Distance Metric	128.0	35.7	35.1	205.5
Estimated, $\hat{c}^{a,b}$		133.5	40.6	30.9	211.7

a) Static Nash equilibrium in price.
b) Using the Distance Metric demand equation.

Table 8: Sensitivity of Implicit Costs to Equilibrium Assumptions

Assumption	Mean	Standard Dev.	Minimum	Maximum
MC Pricing	167.8	20.2	117.0	204.5
Bertrand	128.0	35.7	35.1	205.5
Joint–Profit Max	99.1	41.3	15.1	201.7

Using the Distance Metric demand equation.

Table 9: Two–Step GMM Estimates of Marginal–Cost Functions

EQN	VOL	PREM	ALC	PUBM	PROD$_1$	PROD$_2$	PROD$_3$	CONST	J statistic d.f.= 8
1	0.0008	0.221		0.256	0.429	0.190	-0.011	4.519	12.1
	(2.5)	(3.4)		(3.2)	(5.1)	(4.4)	(-0.2)	(51.6	
2	0.0012		0.178	0.257	0.359	0.239	-0.012	3.877	12.3
	(2.3)		(3.1)	(3.0)	(4.9)	(4.2)	(-0.2)	(2.9)	

Using the Distance Metric demand equation.
Asymptotic t statistics in parentheses.
Corrected for heteroskedasticity and spatial correlation of an unknown form.

Table 10: Predicted Equilibrium Prices and Margins

Demand Model	Mean Price	Standard Dev.	Mean Margin
Nested Logit	244.7	44.2	89.5
Extended NL	211.0	38.1	45.1
Distance Metric	168.4	29.5	30.4
Observed Prices	167.8	20.2	29.9

From a static pricing game using the exogenous cost estimates, $\check{c}$.

Table 11: Merger Simulations

Market Structure	Demand Model	Predicted Price Average	% Change from Status Quo
Status Quo (Actual structure)			
	Nested Logit	244.7	0
	Extended NL	211.0	0
	Distance Metric	168.4	0
Scottish/Courage (Divestiture)			
	Nested Logit		
	Extended NL		
	Distance Metric	167.4	-0.6
Bass/Carlsberg–Tetley (Merger)			
	Nested Logit	413.0	69
	Extended NL	302.1	43
	Distance Metric	173.5	3

Static pricing game using the exogenous cost estimates, $\check{c}$.

Figure 1:
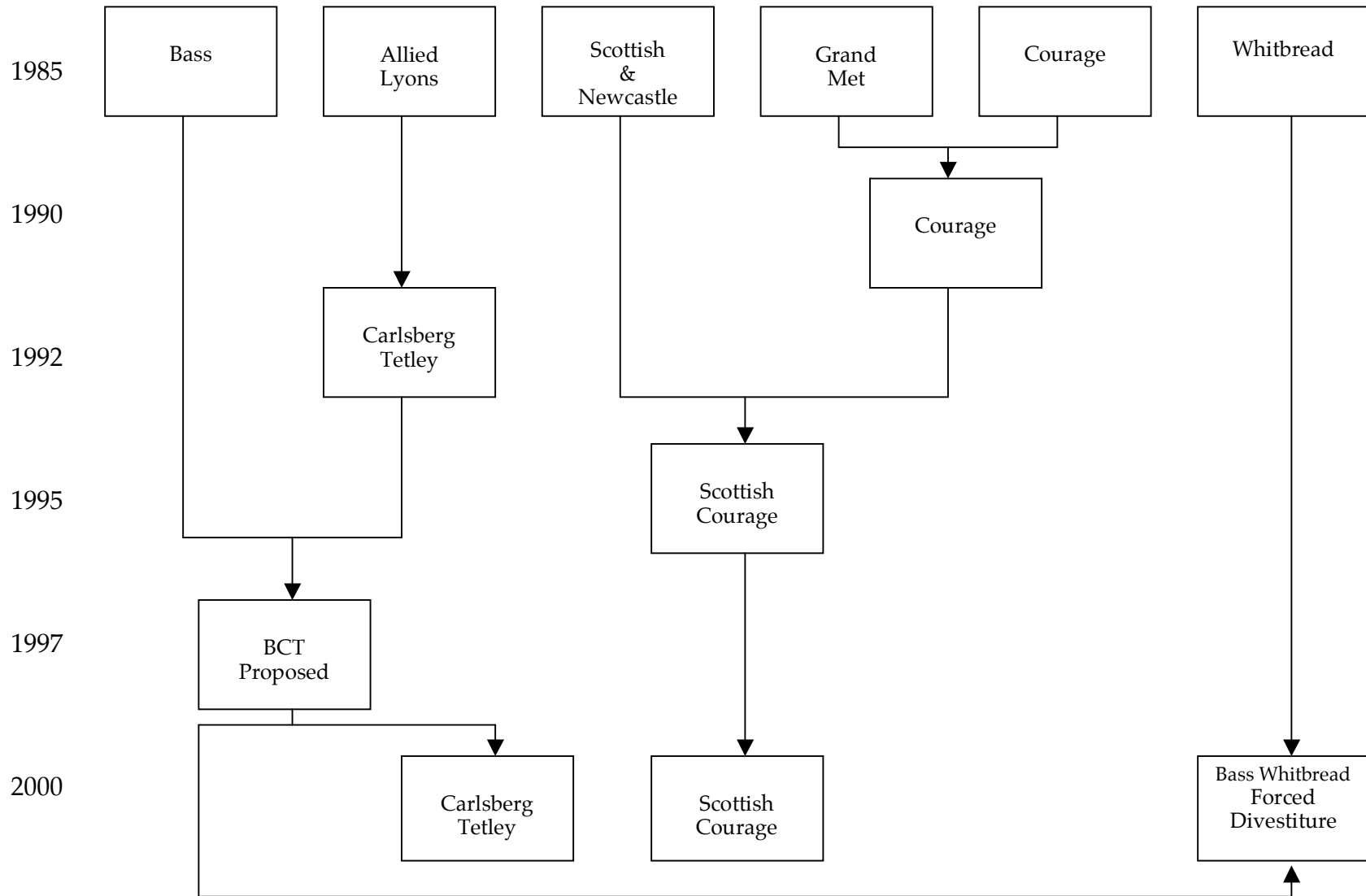
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Figure 2: **Predicted Markups as a Function of the Share of the Outside Good**