# Reflection Paper – Mathematical Economics

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## 1 Introduction

The paper I am analyzing in this reflection paper is *The Effect of Ownership Structure on Prices in Geographically Differentiated Industries* by Raphael Thomadsen (2005), which was published in the RAND Journal of Economics. His paper discusses how ownership structure and geographic differentiation jointly shape pricing in retail markets. He presents results using two different methodologies. First being regression results which give estimates that show a connection between ownership, geography, and prices. Secondly, he presents a structural model that estimates demand and supply that includes the geographical element of his paper. From this structural model he conducts experiments to see how differing geographies affect pricing under different ownership structures. Thomadsen finds that mergers between franchisees can significantly increase prices. In the data, some outlets charge substantially higher prices than they would have under independent ownership. The price effects are strongest when commonly owned outlets are located close to one another, because the owner internalizes the competitive pressure between nearby stores. However, the study also finds that even outlets located far enough apart, such that they would not directly influence each other's pricing under separate ownership, still experience price increases after consolidation. This shows that the impact of a merger extends beyond immediate geographic proximity. The analysis further indicates that the price effects of consolidation differ across chains, suggesting that antitrust authorities should focus their attention more heavily on mergers involving firms whose consumers view outlets as close substitutes.

## 2 Motivation and Background

### 2.1 Motivation

The central motivation of Thomadsen's paper is to understand how ownership structure and geographic differentiation jointly shape pricing in retail markets. Many consumer facing industries such as fast food, retail, gasoline, and grocery are composed of firms that operate multiple outlets spread across local geographic areas called franchises. In these settings, changes in ownership structure, such as mergers between nearby outlets, may change competitive incentives by allowing firms to internalize price competition across the outlets they control.

This raises an important policy question: *How do mergers in geographically differentiated industries affect equilibrium prices?* This is the question that Thomadsen is answering in his paper. Addressing this question matters for antitrust authorities such as the Federal Trade Commission (FTC), who evaluate mergers partly on the basis of whether they increase market power and harm consumers. Determining the price effects of multi-store ownership is therefore directly relevant for merger review and competition policy.

The contribution of this paper is to combine literature that had typically been studied separately. Previous research examined either (i) the role of geography in price competition or (ii) the implications of multi store ownership, but few papers had incorporated both elements in a structural framework. Thomadsen fills this gap in the literature by estimating a model of demand and firm pricing that explicitly accounts for spatial differentiation and ownership structure, allowing him to simulate how prices would change under alternative merger scenarios.

A key novelty of the paper is that it integrates spatial differentiation with multi-store ownership in a fully structural pricing model. Earlier empirical studies of spatial competition typically held ownership constant and focused on how geographic distance affects substitution patterns and price sensitivity. Likewise, previous work on multi-store ownership often abstracted away from geography, treating markets as undifferentiated or relying on aggregate data. Thomadsen's framework brings these two dimensions together by embedding ownership structure directly into firms' profit-maximization problems while also modeling how consumers substitute across geographically dispersed outlets. This allows the analysis to capture how a merger between nearby franchisees alters not only direct competition between two outlets, but also the broader pattern of consumer substitution across space. As a result, the paper can generate policy-relevant counterfactuals that earlier approaches were not able to evaluate.

## 2.2 Background

Thomadsen's empirical setting is the fast food industry in Santa Clara County, California, focusing on McDonald's and Burger King outlets. These chains are perfect for this type of analysis for several reasons. First, they are two of the largest fast food brands in the United States and are a substantial share of local consumption in the study area. Second, most outlets are franchised rather than corporately owned, creating variation in ownership structure across locations. Third, their menu offerings are very standardized, which helps isolate pricing incentives rather than product differences.

To construct the dataset, Thomadsen collected prices and outlet characteristics by personally visiting each restaurant. He recorded menu prices, documented outlet features, and mapped precise geographic coordinates. Corporate owned stores and outlets located inside airports or military bases were excluded to avoid atypical pricing environments. To maintain comparability across locations, he only focuses on the price of the Big Mac and Whopper value meals, which are the most commonly purchased items at McDonald's and Burger King. The summary statistics of his dataset are below.

Table 1: Summary Statistics

| Variable | N | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Burger King price | 38 | 3.26 | .11 | 3.19 | 3.69 |
| McDonald's price | 41 | 3.46 | .27 | 2.99 | 4.09 |
| Burger King dummy | 79 | .481 | .503 | 0 | 1 |
| Number BK/McD within 2 miles | 79 | 3.835 | 1.918 | 1 | 8 |
| Number co-owned within 2 miles | 79 | .532 | .765 | 0 | 2 |
| Number other hamburger within 2mi | 79 | 4.443 | 1.831 | 0 | 9 |
| Distance to BK/McDonald's | 79 | .691 | .488 | .006 | 1.933 |
| Multiple-owner dummy | 79 | .633 | .485 | 0 | 1 |
| Distance to co-owned | 79 | 1.426 | 1.550 | 0 | 5 |
| Distance to other hamburger | 79 | .630 | .548 | .005 | 2.739 |
| Number directions | 79 | 2.671 | .930 | 1 | 4 |
| Playland dummy | 79 | .279 | .451 | 0 | 1 |
| Drive-thru dummy | 79 | .684 | .468 | 0 | 1 |
| Mall dummy | 79 | .089 | .286 | 0 | 1 |
| Population density | 79 | 6,454.6 | 4,251.4 | 11.4 | 20,964.6 |
| Worker density | 79 | 934.6 | 5,879.8 | 0 | 49,260.1 |
| Fraction nearby kids | 79 | .241 | .057 | .109 | .334 |
| Fraction nearby 30–64 | 79 | .447 | .041 | .334 | .530 |
| Fraction nearby >64 | 79 | .084 | .027 | .038 | .134 |
| Fraction male | 79 | .506 | .012 | .484 | .541 |
| Fraction black | 79 | .038 | .019 | .008 | .084 |
| Fraction Asian | 79 | .169 | .098 | .034 | .401 |
| Fraction Hispanic | 79 | .223 | .140 | .050 | .558 |
| Median income ($) | 79 | 46,250 | 7,811 | 28,750 | 67,500 |

Note: Population density and worker density are measured as (number of people)/(mile$^2$).

This setting provides a clean and realistic environment for studying how geography and ownership structure interact to determine equilibrium prices. The combination of detailed price data, geographic information, and natural variation in franchise ownership allows the structural model to estimate demand and simulate counterfactual pricing outcomes under alternative ownership.

# 3 Empirical Strategy and Theoretical Model

The motivation for incorporating a structural model in Thomadsen's analysis is that reduced-form regressions, while useful for establishing correlations, cannot fully characterize the economic mechanisms that determine prices. Thomadsen begins with descriptive regressions that relate prices to ownership concentration, competitor distance, and outlet attributes. These regressions consistently show that prices are higher when nearby outlets share the same owner and lower when competing outlets are closer. This provides important empirical motivation by demonstrating that ownership and geography matter for pricing. However, the regressions have clear limitations: they rely on ad-hoc measures of competition, cannot account for the full geometry of market layouts, and do not identify causal effects or equilibrium behavior. As Thomadsen emphasizes, these regressions cannot predict how prices would change under alternative ownership structures because they do not embed the firms' profit-maximization or the strategic interactions across outlets.

A structural model overcomes these limitations by explicitly modeling consumer demand, geographic substitution patterns, and firms' pricing decisions under multi-store ownership. By recovering underlying primitives—such as utility parameters, distance disutility, marginal costs, and markups—the structural approach allows the researcher to simulate counterfactual mergers and compute equilibrium prices under different ownership configurations. This deeper modeling framework therefore provides a more credible and policy-relevant tool for analyzing the competitive effects of mergers than reduced-form regressions alone.

## 3.1 Reduced Form Model

Thomadsen estimates a series of regressions to show how prices vary with local competition and ownership concentration. In his paper, he does not present the regression equations explicitly, but a representative specification consistent with Table 2 can be written as

$$\log(P_j) = \alpha + \beta_1 \, \text{Comp}_j + \beta_2 \, \text{CoOwn}_j + \beta_3 X_j + \beta_4 \text{Demo}_j + \varepsilon_j, \tag{1}$$

where $\text{Comp}_j$ measures the number of competing outlets within a two-mile radius, $\text{CoOwn}_j$ measures the number (or proximity) of commonly owned outlets, $X_j$ includes outlet characteristics (such as drive-through or mall location), $\text{Demo}_j$ captures local demographic composition, and $\varepsilon_j$ is an idiosyncratic error term.

We can rewrite this in matrix form, similar to how we presented it in class, as

$$\mathbf{y} = \mathbf{X}\beta + \varepsilon, \tag{2}$$

where $\mathbf{y}$ is the vector of log prices across outlets, $\mathbf{X}$ contains the covariates described above, and $\beta$ is the vector of regression coefficients. Then, exactly as we discussed in lecture, the OLS equation is given by solving

$$\hat{\beta} = (\mathbf{X}^\top \mathbf{X})^{-1} \mathbf{X}^\top \mathbf{y}, \tag{3}$$

## 3.2 Structural Model

### Demand

Conditional indirect utility for consumer $i$ at location $j$ is:

$$V_{i,j} = X'\beta - D_{i,j}\delta - P_j\gamma + \eta_{i,j} \tag{4}$$

Where $X'$ is a vector indicating chain index, if the location has a drive through or play area, and if it is located in a mall. $D_{i,j}$ represents the distance between consumer $i$ and outlet $j$. The price of a meal at outlet $j$ is denoted by $P_j$.

If a consumer consumes elsewhere (other than BK or McDonald's) they have conditional utility:

$$V_{i,0} = \beta_0 + M_i\pi + \eta_{i,0} \tag{5}$$

where $M_i$ is a vector of the consumer's age, gender, and race. The share of consumers particular location, $b$, and demographic type, $M$, who consume from outlet $j$ is given by

$$S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi) = \int_{A_j} f(\eta_i)\, d\eta_i \tag{6}$$

where $P$ is the $J$-dimensional vector of prices for every outlet in the market, and

$$A_j = \{\eta_i \mid (V_{i,j} > V_{i,t}\ \forall t \neq j) \cap (V_{i,j} > V_{i,0})\} \tag{7}$$

is the set of match values, $\eta_i$, between consumers and outlets such that the consumer derives a higher utility by consuming from outlet $j$ than from any other outlet $t$ or from the outside good. The fraction of consumers of demographic type $M$ located in location $b$ who choose to purchase a meal from outlet $j$ is given as

$$S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi) = \frac{e^{X_j'\beta - D_{b,j}\delta - P_j\gamma}}{e^{\pi M} + \sum_{t=1}^{J} e^{X_t'\beta - D_{b,t}\delta - P_t\gamma}}. \tag{8}$$

Total demand for each outlet is then calculated by summing the product of the fraction of consumers of demographic $M$ and location $b$ who patronize the outlet and the mass of consumer of that demographic at that location, $h(b, M)$, across all demographic-location pairs:

$$Q_j(P, X \mid \beta, \delta, \gamma, \pi) = \sum_b \sum_M h(b, M) S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi) \tag{9}$$

Taking the partial derivative of demand with respect to price and getting the first order conditions is

$$\frac{\partial Q_j(P, X \mid \beta, \delta, \gamma, \pi)}{\partial P_k} = \frac{\partial \sum_b \sum_M h(b, M) S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi)}{\partial P_k} \tag{10}$$

## Supply

Assume that there are $F$ firms, franchisees, each owning a subset $F_f$ of the $j = 1, \ldots, J$ outlets. Also assume firm costs consist of fixed costs, as well as constant unit marginal cost. Firm profits to firm $f$ are then given by:

$$\Pi_f = \sum_{j \in F_f} (r_k P_j Q_j(P) - c_j Q_j(P) - FC_j) \tag{11}$$

where $FC_j$ is the fixed cost of operating outlet $j$, $c_j$ is the marginal cost of a meal at out the fraction of revenue that the franchisees belonging to chain $k$ retain after paying their royalties, and $P$ is the $J$-dimensional vector of prices for every outlet. Rewriting, we get

$$\Pi_f = \sum_{j \in F_f} (P_j Q_j(P) - (\frac{c_j}{r_k}) Q_j(P) - \frac{FC_j}{r_k}) \tag{12}$$

where

$$C_j = \frac{c_j}{r_k} \tag{13}$$

and

$$C_j = (C_k + \varepsilon_j) \tag{14}$$

The firm problem on this supply side of the model is to maximize firm profits, formally:

$$\max \quad \Pi_f = \sum_{j \in F_f} (P_j Q_j(P) - (\frac{c_j}{r_k}) Q_j(P) - \frac{FC_j}{r_k})$$

This is the exact type of problem that we work with in 414 when we covered unconstrained maximization at the beginning of the semester. As in 414, we start maximizing by taking the partial derivative, which will yield the first order conditions:

$$Q_j(P) = \sum_{r \in F_f} (P_r - C_k - \varepsilon_r) \frac{\partial Q_r(P)}{\partial P_j} = 0 \tag{15}$$

These $J$ equations can be solved for each $\varepsilon_j$. To do this he defines a matrix $\Omega$ as

$$\Omega_{j,r} = \begin{cases} \dfrac{\partial Q_r}{\partial P_j}, & \text{if } r \text{ and } j \text{ have the same owner,} \\ 0, & \text{otherwise.} \end{cases} \tag{16}$$

This simplifies the first order to condition to

$$Q(P) + \Omega(P - C - \varepsilon) = 0 \tag{17}$$

$$Q(P, X \mid \theta) + \Omega(P, X \mid \theta)(P - C - \varepsilon) = 0 \tag{18}$$

$$\varepsilon = P - C + \Omega(P, X \mid \theta)^{-1} Q(P, X \mid \theta) \tag{19}$$

$$E[\varepsilon_j(\theta^*) \mid Z_j] = 0 \tag{20}$$

$$G_J(\theta) = \frac{1}{J} \sum_{j=1}^{J} Z_j \, \varepsilon_j(\theta) \tag{21a}$$

$$G_J(\theta) = \frac{1}{J} \sum_{j=1}^{J} \left[ R_{\text{18-29}} \frac{Q_j(M_{\text{Age}}, \theta)}{\text{Pop}(M_{\text{Age}})} - R_{\text{Age}} \frac{Q_j(M_{\text{18-29}}, \theta)}{\text{Pop}(M_{\text{18-29}})} \right] \tag{21b}$$

$$G_J(\theta) = \frac{1}{J} \sum_{j=1}^{J} \left[ R_{\text{Male}} \frac{Q_j(M_{\text{Female}}, \theta)}{\text{Pop}(M_{\text{Female}})} - R_{\text{Female}} \frac{Q_j(M_{\text{Male}}, \theta)}{\text{Pop}(M_{\text{Male}})} \right] \tag{21c}$$

$$G_J(\theta) = \frac{1}{J} \sum_{j=1}^{J} \left[ R_{\text{Black}} \frac{Q_j(M_{\text{White}}, \theta)}{\text{Pop}(M_{\text{White}})} - R_{\text{White}} \frac{Q_j(M_{\text{Black}}, \theta)}{\text{Pop}(M_{\text{Black}})} \right] \tag{21d}$$

## References

[1] Thomadsen, Raphael. 2005. “The Effect of Ownership Structure on Prices in Geographically Differentiated Industries.” *RAND Journal of Economics* 36(4): 908–929.