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Firm efficiency, advertising and profitability: Theory and evidence

Jihui Chen*, George Waters[1]

Department of Economics, Illinois State University, Campus Box 4200, Normal, IL 61790, USA

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ABSTRACT

This paper presents a linear-city model where firms compete on price and levels of advertising, which affects the perceived utility of products. More cost efficient firms extend their advantage with more advertising, which leads to higher profits, if advertising is sufficiently effective. We test this relationship using a unique S&P sample. Our empirical results indicate a positive relationship between profits and levels of advertising for all model specifications.

1. Introduction

In the third quarter of 2013, Mattress Firm Holding Corp. reported a 46% increase in profit, thanks to increased advertising that "helped drive customer traffic and sales growth."[2] Incidentally, Gannett Co. Inc. recently experienced a 12% decline in earnings attributable to lower advertising expenditure.[3] Presumably, firms advertise to increase profitability, as indicated by a number of supporting studies (see, for example, Comanor & Wilson, 1974; Erickson, 1992; Lambin, 1976; Porter, 1974). However, identifying the reasons why one firm might advertise more than another is not a simple task. For example, a highly productive firm may be able to extend its market share with advertising. Alternatively, an inefficient firm may use advertising to compensate for its high cost of production. Explaining the relationship between firm efficiency, profits and advertising is the goal of the present work.

We first develop a linear city model where two firms decide on advertising expenditures then choose prices. Advertising is costly and has a status effect on the good perceived by consumers. The primary finding is that firms with an advantage in productive efficiency, advertise more and have higher profits if advertising is sufficiently cost effective. The stylized model provides testable theoretical predictions for a subsequent empirical study. The estimation results using Compustat data across several industries show support for the latter interpretation where advertising expenditures and profits are directly related. The results are consistent for OLS regression on differenced data and dynamic panel (the two-step Arellano-Bond generalized method of moments, or GMM) estimation on levels. Moreover, we show that industry concentration is not a significant variable in the estimations in contrast to the results in Bain (1951).

As a robustness test to mitigate problems of aggregation, we conduct similar estimations on firms within individual industries. Furthermore, to guard against endogeneity issues, estimations of a system of equations for data from manufacturing industries are included as well. The qualitative results are unchanged in both cases.

This paper belongs to the vast theoretical literature on market structure, conduct, and performance, or SCP.[4] One strand

* Corresponding author. Tel.: +1 309 438 3616; fax: +1 309 438 5228.
E-mail addresses: jchen4@ilstu.edu (J. Chen), gawater@ilstu.edu (G. Waters).
[1] Tel.: +1 309 438 7301; fax: +1 309 438 5228.

[2] *Source*: "Mattress Firm profit rises 46% as ads boost sales" by Tess Stynes, December 4, 2013, *Wall Street Journal* (http://www.marketwatch.com/story/mattress-firm-profit-rises-46-as-ads-boost-sales-2013-12-04).

[3] *Source*: "Gannett Q4 profit down 12% on lower ad spending" by Kerry Feltner, *Rochester Business Journal*, February 5, 2014 (http://www.rbj.net/article.asp?aID=205400).

[4] Bagwell (2007) provides an excellent review on the economics of advertising. Our simple model is also related to other studies on network externalities, including

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studies informative advertising in the framework of spatial models. Grossman and Shapiro (1984) study a circular Hotelling model where firms independently and simultaneously make pricing and advertising decisions. They conclude that product differentiation increases advertising. However, in contrast to the conclusions of most empirical studies, they argue that advertising does not boost profit due to enhanced price competition.

Early empirical studies on the relation between advertising and profitability mostly analyze inter-industry data (Comanor & Wilson, 1967, 1974; Nelson, 1974; Porter, 1974; Telser, 1964) and more recently firm- or brand-level data become prevalent (Thomas, 1989 on cigarettes and software drinks; Kwoka, 1993 on auto; Thomas, 1989 and Nevo, 2001 on ready-to-eat cereals; Tremblay & Tremblay, 2005 on beer). In an important study, Comanor and Wilson (1974) find that advertising has a significant and positive effect on profitability based on consumer-good industry-level data spanning three consecutive years. Using two industry-level samples, Sherman and Tollison (1971) show that the inclusion of cost variability, as opposed to advertising, better explains the profitability in consumer-good and other industries. More recent studies generally provide supportive evidence for the latter conclusion. For example, Notta and Oustapassidis (2001) compare the effectiveness of media advertising using firm-level Greek data and argue that television advertising significantly affects profitability. More recently, Vardanyan and Tremblay (2006) show the importance of market efficiency to business success, both theoretically and empirically, in the brewing industry. These studies focuses on advertising effectiveness across different media (e.g., television, printing, and radio), while we evaluate the efficiency of marketing media at the aggregated level.

One of the major empirical challenges in studying SCP involves the endogeneity concern about advertising and market concentration, for which the literature proposes several approaches. Early studies usually estimate single equation models (Bain 1951; Comanor & Wilson, 1967). Later studies often adopt a system of simultaneous equation models, which account for the interconnections among key elements of SCP in an industry. For example, Lambin (1976) estimates simultaneous equations using European brand-level data in the 1960s, but finds little evidence that advertising affects sales, especially in saturated industries. Pagoulatos and Sorensen (1981) estimate three equations of profitability, advertising, and concentration simultaneously and conclude that advertising affects profitability, which in turn affects both advertising and concentration. In addition to proposing a simultaneous equation model, their empirical contribution is to take into consideration several key control variables (i.e., international trade and interindustry differentials in price elasticities of demand) that had been missing in the previous studies. Using the Greek data, Vlachvei and Oustapassidis (1998) use 3SLS method to estimate a system of profitability, concentration and advertising model, and find supportive evidence of Pagoulatos and Sorensen's (1981) main finding.

In a seminar work, Martin (1979) proposes a system of profit, concentration, and advertising equations which reflects long-run dynamic adjustments of industry concentration. More recently, Jeong and Masson (2003) establish a non-monotone relationship between steady-state profits and concentration dynamics, using a panel of Korean manufacturing data from 1978 to 1982. Further extending the approach, Iwasaki, Seldon, and Tremblay (2008) apply a system of dynamic models to the U.S. brewing industry, taking into consideration the war of attrition, and argue that both advertising and economies of scale attribute to rising concentration level in the industry.

While previous studies use either cross-sectional or time-series data, our analysis contributes to the literature by applying the dynamic panel estimation method to a wide range of industries, as the Arellano-Bond GMM estimation offers a rigorous treatment for the potential simultaneity/endogeneity issues (Tregenna, 2009). Our paper also adds to the literature on the SCP paradigm by providing more recent evidence of the relationship between advertising and profitability.

The remainder of the paper is organized as follows. In Section 2, we develop a stylized model which results in several testable implications. In Section 3, we collect a unique data set from Standard & Pool's Compustat to test the theoretical predictions derived in Section 2. Incorporating additional data from the Census Bureau, we also estimate a system of advertising, concentration, and profitability as a robustness test in Section 3. Finally, Section 4 offers several concluding remarks.

2. A simple model

To motivate the empirical analysis, this section describes a linear city model where advertising impacts consumer utility but is also an extra cost to the firms. Production costs vary across firms. Consumers are distributed uniformly along the interval $[-1, 1]$, firm x is located at the left endpoint, and firm y is located at the right. The advertising by firms x and y are denoted a_x and a_y respectively and the prices they charge are p_x and p_y. The utility to a consumer located at $\omega \in [-1, 1]$ buying a good at firm i is $U_i(\omega)$. The per unit cost of travel is d, the intrinsic value of the good is f, and the parameter γ measures the effect of advertising on the utility of the consumers of the goods of each firm, so the utility for the consumer using each firm is

$$U_x(\omega) = f + \gamma a_x - p_x - d(1+\omega),$$

$$U_y(\omega) = f + \gamma a_y - p_y - d(1-\omega).$$

Since the model includes heterogeneous marginal cost of production, one can assume without loss of generality that the intrinsic utility of the good f is the same for both firms. The effect of advertising on utility could be due to consumer perception, or status conferred on the seller, or both.

The consumer who is indifferent between the goods of the two firms is located at $\widehat{\omega}$, where $U_x(\widehat{\omega}) = U_y(\widehat{\omega})$. Computation gives an expression for $\widehat{\omega}$.

$$\widehat{\omega} = \frac{\gamma(a_x - a_y) - (p_x - p_y)}{2d} \tag{1}$$

Firms must choose the level of advertising a, for which they pay a cost $C(a)$, then set prices. Assuming the market is covered, each consumer buys one good from the firm that gives higher utility. The cost of production is linear and heterogeneous with marginal costs c_x, c_y for each firm. Hence, profits for firm x and firm y are

$$\pi_x = (p_x - c_x)(\widehat{\omega} + 1) - C(a_x),$$

$$\pi_y = (p_y - c_y)(1 - \widehat{\omega}) - C(a_y).$$

For given levels of advertising a_x and a_y, the prices satisfying the Nash equilibrium are as follows.

$$p_x = \frac{1}{3}[\gamma(a_x - a_y) + 2c_x + c_y + 2d] \tag{2}$$

$$p_y = \frac{1}{3}[\gamma(a_y - a_x) + 2c_y + c_x + 2d]$$

Firms face increasing marginal costs of advertising. The cost function take the functional form $C(a) = \frac{\delta}{2}a^2$, so the parameter

Chwe (2001), Pastine and Pastine (2002), and Clark and Horstmann (2005). Hamilton (2009) examines the efficiency of informative advertising in a differentiated-good market in a linear city model.

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