Convergence Of Market Shares In The U.S. Cigarette Industry

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Abstract

Many studies examine the degree of rivalry in an industry by utilizing measures of market share instability, with greater (lesser) volatility of market shares coinciding with greater (lesser) rivalry. This short paper extends this line of research by addressing long run instability of market shares. In particular, we test for the convergence of market shares in the U.S. cigarette industry using unit root procedures. Our finding that market shares for pairs of firms rarely converge suggests that market shares are unstable in the long run. Hence, rivalry has remained quite intact in the cigarette industry.

1.0 Introduction

Market share data has been used extensively in the literature to assess the degree of rivalry within an industry. For instance, several studies (e.g., Caves and Porter (1978), Sandler (1988), Eckard (1991), and Das et al. (1993)) use various measures of market share instability, arguing that greater volatility of market shares is indicative of more intense rivalry within an industry. That is, since greater rivalry is often associated with push-and-pull tactics to secure market share, this coincides with significant fluctuations in market shares from one firm to the next. Conversely, relatively stable market shares across firms are indicative of less rivalry.

This short paper utilizes recent advances in time-series techniques to provide an alternative means of assessing the degree of rivalry within an industry. Namely, using market share data for the six producers of cigarettes in the U.S., over the 1934-1994 period, unit root tests are done to determine whether market shares for all i-j pairs of firms are converging. Briefly, the results indicate that for many of the firm pairs market shares do not converge. This implies that many of the firms are able to secure market share at the expense of their rivals; and as such, rivalry has remained quite strong in the cigarette industry.

In the remainder of the paper, Section II presents the convergence procedure, while Section III applies the procedure to the cigarette industry. The paper concludes with a summary in Section IV. Section V offers suggestions for future research.

2.0 Time-Series Test of Convergence

Following the seminal work of Nelson and Plosser (1982), numerous studies have tested for the presence of a unit root in time-series data; whereby a unit root implies that the series is not mean reverting, such that shocks to the series are permanent in nature. Alternatively, the rejection of a unit root suggests that shocks to the series are transitory.

Given the properties of a unit root, procedures of late have used unit root tests to examine spatial convergence of various factors, most notably per capita incomes. For example, following Solow's (1956) neoclassical growth model, which claims that a region's growth rate of per capita income is inversely related to its initial per capita income level, per capita incomes should be converging across poor and rich regions. To see whether or not this holds, Carlino and Mills (1993, 1996) and Loewy and Papell (1996) test for a unit root in the log

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of relative (to that of the overall economy) per capita income for a variety of regions in the U.S., with convergence of incomes being supported by rejection of the unit root.

We use similar techniques in this paper to test whether or not market shares of firms are converging. That is, we test whether or not shocks to the market share of firm i, relative to firm j, are permanent or transitory. If the shocks are permanent, implying that market shares do not converge, then firm i (j) can secure market share at the expense of firm j (i). In this case, the market shares of the two firms are unstable from a long run perspective, supporting more intense rivalry between the firms. Alternatively, if shocks to the relative market shares are transitory, then the ability of firm i (j) to sustain additional market share, at the expense of its rival, is limited in the long run. Accordingly, with market shares being relatively stable, rivalry is less prominent.

To begin, in the spirit of Carlino and Mills (1993, 1996) and Loewy and Papell (1996), we analyze the log of the market share of firm i at time t, relative to the market share of firm j (MS_{ijt}), which consists of two parts, the time invariant equilibrium differential (MS^e_{ij}) and the deviations about this equilibrium (u_{ijt}), such that (for simplicity, the ij subscript is suppressed hereafter):[1]

$$MS_t = MS^e + u_t \tag{1}$$

where u_t is a stochastic process with drift and trend, given by:

$$u_t = v_0 + \beta t + v_t \tag{2}$$

with v_0 being the initial deviation from the equilibrium, β being the rate of convergence, and t being the time trend. Substituting (2) into (1), we get:

$$MS_t = \mu + \beta t + v_t \tag{3}$$

where $\mu = MS^e + v_0$. Convergence of market shares is indicated in equation (3) if the deviations, v_t, are temporary.

To complete the model, we make two modifications to equation (3). First, we adopt the Augmented Dickey Fuller (ADF) procedure of adding a lag operator to both sides of the equation and including a lagged change in MS as a right-hand side variable. Second, according to Perron (1989), ignoring the presence of a structural break in a series may cause non-rejection of the unit root null due to mis-specification. For example, with respect to the current application, antitrust litigation or an abrupt change in regulatory structure could impact the nature of rivalry within an industry, thus contributing to a structural change in the dynamics of market shares. Therefore, to account for these possibilities, we adopt Perron's (1989) sequential innovation outlier (IO) model, which results in the following modification to equation (3):

$$\Delta MS_t = \mu + \beta t + \alpha MS_{t-1} + \sum_{m=1}^{k} d_m \Delta MS_{t-m} + \varphi D(T_B)_t + \eta DU_t + \gamma DT_t + \varepsilon_t, \tag{4}$$

where μ, β, and t are as defined above, ΔMS_{t-m} is the change in the m-period lag of MS, MS_{t-1} is the one-period lag of MS, T_B is the estimated date of structural change, $D(T_B) = 1$ if $t = T_B + 1$ (0 otherwise), $DU_t = 1$ if $t > T_B$ (0 otherwise), $DT_t = t - T_B$ if $t > T_B$ (0 otherwise), and ε_t is the stochastic term. The break is implemented by estimating equation (4) sequentially for every possible break period $T_B = k+2,...., T-1$, where T is the number of observations and the period that minimizes the t-statistic for α (t_α) is the break period.[2] In this case, the unit root coincides with $\alpha = 0$, such that rejecting (failing to reject) $\alpha = 0$ implies that the market shares of the two firms are more (less) stable to each other.

3.0 Application to Cigarettes

Due to its tight oligopolistic structure, which has contributed to allegations of coordinated behavior, much has been written about the behavior of firms in the U.S. cigarette industry. For example, according to Scherer and Ross (1990), while price leadership has dominated the conduct of cigarette producers for much of the past century, episodes of more intense competition (e.g., price wars throughout the 1930s) have occurred. Hence, by applying the convergence procedure to market shares in the cigarette industry, we hope to gain additional insight into the historic nature of rivalry in the industry. Accordingly, annual market share data for the six producers of cigarettes in the U.S. was obtained from Maxwell (1998), covering the 1934-94 period. Although the data, which is plotted in Figure 1, suggest that market shares have trended in the cigarette industry, the nature of rivalry from one firm to the next remains unclear.

Figure 1. Market Shares of Cigarette Producers, 1934-94

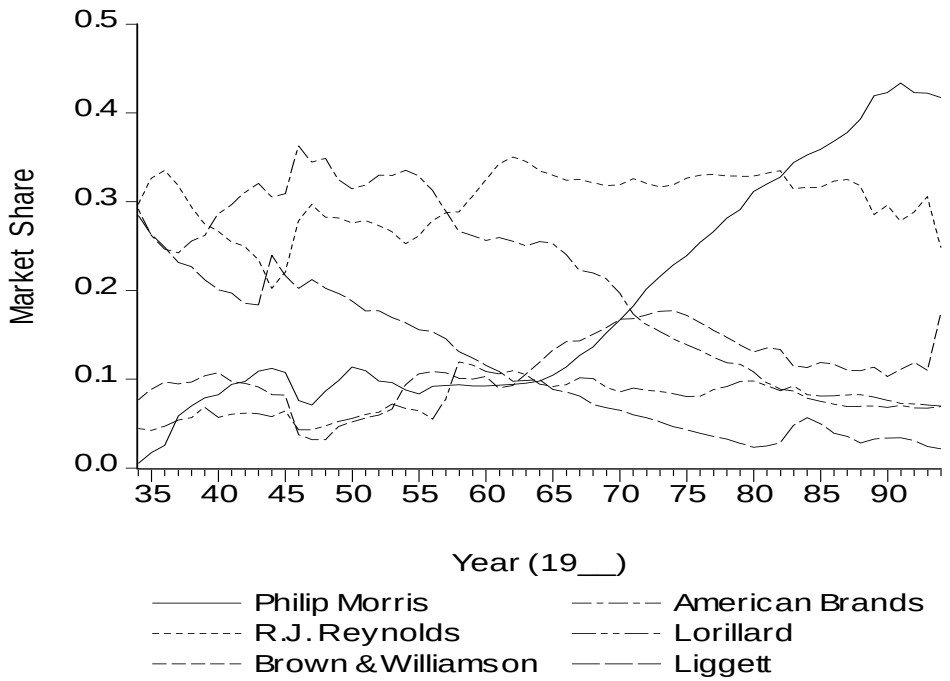

Table 1 provides several interesting results from the estimation of equation (4). First, across the 15 possible firm pairs, since the absolute value of $t_{\square}$ rarely exceeds the critical value, we fail to reject the unit root for many market share pairs. With market shares largely not converging, therefore, the results suggest that rivalry has generally remained quite intact over the 1934-94 period.[3] Second, although convergence is rare, we do nonetheless reject the unit root for the following pairs of firms: Philip Morris/R. J. Reynolds, Philip Morris/Lorillard, R. J. Reynolds/Lorillard, Liggett/American Brands, and Brown & Williamson/American Brands. This suggests that for these pairs rivalry is less intense.[4] Lastly, across the 15 firm pairs, the structural break dates predominantly occur between the 1950s and 1970s. Interestingly, this period coincides with increased government involvement in the affairs of the cigarette industry, particularly efforts to educate the public of the health risks of smoking.[5]

Table 1. Empirical Results[a]

Firm Pair	∀	$t_{\square\forall}$	k	Break Year
Philip Morris - R. J. Reynolds	-0.59	-7.01***	8	1953
Philip Morris - Liggett	-0.22	-3.01	8	1949
Philip Morris - Lorillard	-0.40	-9.73***	0	1955
Philip Morris - Brown & Williamson	-0.43	-4.49	8	1961
Philip Morris - American Brands	-0.17	-3.35	8	1949
R. J. Reynolds - Liggett	-0.31	-3.88	1	1972
R. J. Reynolds - Lorillard	-1.27	-7.63***	6	1955
R. J. Reynolds - Brown & Williamson	-0.50	-4.18	5	1961
R. J. Reynolds - American Brands	-0.21	-3.83	8	1990
Liggett - Lorillard	-0.63	-4.16	8	1975
Liggett - Brown & Williamson	-0.32	-3.62	6	1961
Liggett - American Brands	-1.99	-6.15**	8	1977
Lorillard - Brown & Williamson	-0.45	-4.18	5	1960
Lorillard - American Brands	-0.92	-4.30	8	1955
Brown & Williamson - American Brands	-0.53	-5.33*	5	1944

[a] Critical values, taken from Perron's (1997) Model 2 (T = 100, k(t-sig)), are: -5.25 (10%), -5.55 (5%), and -6.21 (1%).
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

4.0 Conclusion

By wedding the concepts of market share instability and time-series convergence, this short paper has provided another means of assessing the nature of rivalry within an industry. Using market share data from the U.S. cigarette industry as an application, the finding that market shares generally fail to converge suggests that long-term rivalry has remained intact in this industry. Nonetheless, since this is merely one indicator of rivalry, we advise that a more thorough examination of an industry include other measures of firm behavior.

5.0 Suggestions for Future Research

Since we find structural breaks in market shares during the period of heightened anti-smoking efforts, it would be worthwhile to pursue this issue further. In particular, with emphasis typically placed on either the demand-side or supply-side of the market, a fruitful avenue of future research would simultaneously estimate the link between public policy, consumer demand, and producer supply in the cigarette industry. 🕮

Notes

[1] This differs from Gallet and List (2001), who test for a unit root in individual market shares. In this paper, we test for the convergence of series i relative to series j, much like Greasley and Oxley (1997), with the benefit being that we can identify pairs of firms for which rivalry is more intense, as compared to other pairs.
[2] The number of augmentation terms (k) in equation (4) is determined using a method similar to Perron (1989). In particular, with k initially set equal to 8, the equation is estimated. If the last lag term is significant (i.e., t-statistic exceeds 1.645 in absolute value), then k remains at 8. If the last augmented term is insignificant, then k is reduced to 7. The equation is then re-estimated, with the process stopping when the coefficient of the last lag term is significant, or k is set equal to zero. Ng and Perron (1995) show this procedure to be superior to others.
[3] We also tested for a unit root without the allowance of a structural break. Similar to the sequential IO results, market shares generally failed to converge.
[4] Our finding that firms in the set containing Philip Morris, R .J. Reynolds, and Lorillard all pair-wise converge is appealing due to its consistency. Unfortunately, though, with Liggett and American Brands converging, and Brown & Williamson and American Brands converging, we do not also find statistical convergence between Brown & Williamson and Liggett.

[5] Given that several studies (e.g., Mitchell and Mulherin (1988), Eckard (1991), Barnett et al. (1995), and Gallet (1999)) find government involvement affected producer behavior in the cigarette industry, evidence of a structural break in the path of market shares from one firm to the next may be an indication of changes in producer behavior.

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