Will the leading firm continue to dominate the market in the Taiwan notebook industry?

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Abstract

This study investigates whether the market share leader in the notebook industry in Taiwan is likely to maintain its dominant position. Market share data are used to investigate the intensity of competitiveness in the industry, and data on the gap in market shares are employed to elucidate the dominance of the leading firm in Taiwan's notebook industry during the 1998–2004 period. The newly developed Panel SURADF tests advanced by Breuer et al. [Misleading inferences from panel unit root tests with an illustration from purchasing power parity, Rev. Int. Econ. 9 (3) (2001) 482–493] are employed to determine whether the market share gap is stationary or not. Unlike other panel-based unit root tests which are joint tests of a unit root for all members of a panel and are incapable of determining the mix of $I(0)$ and $I(1)$ series in a panel setting, the Panel SURADF tests have the advantage of being able to investigate a separate unit root null hypothesis for each individual panel member and are, therefore, able to identify how many and which series in a panel are stationary processes. The empirical results from several panel-based unit root tests substantiate that the market shares of the firms studied here are non-stationary, indicating that Taiwan's notebook industry is highly competitive; however, Breuer et al.'s [12] Panel SURADF tests unequivocally show that only Compal is stationary with respect to market share gap. In terms of sales volume, Compal is the second largest firm in the notebook industry in Taiwan, and the results indicate that it alone has the opportunity to become the market share leader in the notebook industry.
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1. Introduction

As a general rule, the leading firm in a market is usually able to maintain its position since it dominates the market share of that industry. Firms that are behind in terms of market share virtually have little chance of taking over the leading role. In this study, we employ the gap in market share to analyze whether the followers can catch up with the leader in the highly competitive environment of the notebook industry of Taiwan.

According to a report by Taiwan's Market Intelligence Center (MIC), the market share of the world's notebooks manufactured in Taiwan rose from 65% in 2003 to an impressive 70% in 2004. In other words, Taiwan's notebook firms have been able to further enhance their dominance in the global notebook industry. Important here, in that the notebook industry has reached a mature stage, is that most of Taiwan's notebook producers have aggressively expanded their manufacturing capacity in attempt to seize their rivals' market share.

In this study, we delve into the extent to which this market is truly competitive—that is, whether the leading firm will continue to lead the market and whether those who lag behind still have a chance to catch up with the leader. There are nine firms whose core products are notebook computers in Taiwan. Quanta is the leading firm in this industry and the largest notebook manufacturing company in the world. The other major players are Compal, Acer, FTC, Inventec, Asustek, Clevo Co., Twinhead and Arima.

In previous studies [1–8], market share data have mostly been used to analyze whether an industry is truly competitive or not. By and large, the greater volatility there is in the distribution of market shares in an industry, the more competitive that industry is. In a mature industry, the leading company earns greater profits because it is better able to exploit its economic scale and market power. However, it should not be overlooked that when the market leader increases its market share, this may reflect a decrease in competitiveness. Recently, some studies have applied unit root tests on this issue. Gallet and List [7] have used conventional unit root tests (of the augmented Dickey–Fuller and Zivot–Andrew) to analyze market shares in the US cigarette industry. Conventional unit root tests, however, fail to consider information across firms, and worse, have lower power when compared with near-unit root but stationary alternatives.

In order to increase the power in testing for a unit root, many researchers have employed panel data. Levin et al. [9] and Im et al. [10], for instance, have developed the asymptotic theory and the finite-sample properties of the ADF tests for use with panel data. Resende and Lima [8] have used a panel unit root test, the Im et al. [10] test to be exact, to analyze the market shares in Brazilian industry. This test has significantly improved power even with relatively small panels, but its inherent problem to this method is cross-sectional dependence.

Taylor and Sarno [11] and Breuer et al. [12] have shown that the "all-or-nothing" nature of panel unit tests has not been fully addressed by recent methodological refinements to the Levin-Lin-Chu test. In this regard, Breuer et al. [12] claim that, by analogy to a simple regression, when an F-statistic rejects the null hypothesis that a vector of coefficients is equal to zero, it is not necessarily true that each coefficient is nonzero. Likewise, when the unit root null hypothesis is rejected, it may very well not be justified to assume that all series in the panel are stationary.

In contrast to those panel-based unit root tests that are joint tests of a unit root for all members of a panel and that are incapable of determining the mix of $I(0)$ and $I(1)$ series in a panel setting, Panel SURADF tests investigate a separate unit root null hypothesis for each and every individual panel member. In so doing, they clearly identify how many and which series in the panel are stationary processes. Hence, this paper uses Panel SURADF tests to test whether the notebook industry market is truly competitive; we then test whether followers are in a position to catch up with or even surpass the leader in Taiwan's notebook industry.

This empirical study makes some important contributions to this line of research in its determination of whether there was a highly competitive environment in Taiwan's notebook industry during the 1998–2004 period. Taiwan's notebook industry provides an interesting forum for empirical research for several reasons. First of all, Taiwan's notebook firms have manufactured more than 70% of all notebooks sold around the whole world. The notebook industry is in a mature stage, and we would expect that market demand for notebooks is not going to grow substantially in the near future. Secondly, given current conditions, it would be interesting to determine whether the market leader can easily maintain its position or whether the followers can seize the leader's market in this mature industry. Thirdly, our results have an important policy implication for policymakers with a strong commitment to and extreme interest in this industry.

The paper is organized as follows. Section 2 presents the data we use. Section 3 briefly describes the theoretical reasoning behind our choice of market share and market share gap. Section 4 first outlines the methodology we employ, then discusses the empirical findings and explains a few important policy implications. Finally, Section 5 reviews the conclusions we draw.

Table 1
Summary statistics of market shares in Taiwan's notebook industry from 1998 to 2004

Firm	Mean	Std	Max.	Min.	Skewness	Kurtosis	J–B
Acer	6.751	2.538	12.033	3.884	0.733	2.287	3.101
Arima	8.088	4.402	15.613	1.194	−0.199	1.984	1.389
Asustek	13.001	3.776	18.669	6.238	−0.513	2.022	2.347
Clevo Co.	2.284	1.171	4.324	0.753	0.462	1.598	3.286
Compal	16.916	2.255	20.872	13.024	0.068	1.986	1.221
FTC	3.303	2.268	8.980	0.794	1.084	3.233	5.556*
Inventec	15.024	4.701	23.762	8.282	0.274	1.818	1.978
Quanta	24.568	5.009	35.297	17.148	0.482	2.457	1.427
Twinhead	2.040	1.748	5.663	0.463	0.987	2.416	4.950*

Notes: Std denotes standard deviation and J–B denotes the Jarque–Bera test for normality.
***, ** and * indicate significance at the 0.01, 0.05 and 0.1 level, respectively (in all tables).

2. Data

The source of the data is the *Taiwan Economics Journal* (TEJ). The data of TEJ is classified by different industry. We analyze notebook industry which is nine firms. In order to measure the degree of competitiveness in Taiwan's notebook industry we use quarterly data of the total sales over the 1998–2004 period to compute market share and market share gap. The datasets for market share indicate that Quanta is the leading firm in terms of market share, followed by Compal, as shown in Table 1. The Jarque–Bera test results indicate that the datasets for market share are all normal except for FTC and Twinhead.

3. Theoretical model

In recent years, we have witnessed a wealth of research that examines panel unit root in economic data. If a series does contain a unit root, or follows a random walk, shocks to the series are deep in nature, permanently affecting the series. We use market share to test whether shocks to the market shares are permanent. Market share is defined as *Total Sales$_{i,t}$/Total Sales in the industry* ($MS_{i,t}$). Maintaining market share indicates that at least some degree of market rivalry is present. However, in no way does this determine whether the leading firm can continue to dominate the market and whether the followers can catch up with the leader in the mature notebook industry. Our measure of market share gap is the difference between the market share of the leader and each of the followers:

$$GAP = \ln MS_{leader} - \ln MS_{followers}, \tag{1}$$

where MS_{leader} and $MS_{followers}$ represent the market share of the leader and each of the followers, respectively. The assessment of market share gap stability between leader and follower indicates whether the leader is dethroned or not. As shown in Table 1, during the study period, the market share leader is Quanta, and all of the other firms are followers. If the market share gap is stationary, which means the market share of followers converge to leader's, this indicates the followers have an opportunity to catch up with the leader; however, if it is not, the leader will likely go on dominating the industry. The study raises an interesting point that we can test which followers have chance to dominate the market in given years.

4. Methodology and empirical results

4.1. Breuer et al.'s [12] seemingly unrelated regressions (SUR) augmented Dickey–Fuller test (SURADF)

Breuer et al. [12] have introduced the "seemingly unrelated regressions augmented Dickey–Fuller" (SURADF) tests which are augmented Dickey–Fuller tests based on the panel estimation method of seemingly

unrelated regressions (SUR). The system of the ADF equations that we estimate here is:

$$\Delta X_{1,t} = \alpha_1 + \beta_1 X_{1,t-1} + \gamma t + \sum_{j=1}^{k1} \theta_{1,j}\Delta X_{1,t-j} + \varepsilon_{1,t}, \qquad t = 1, 2, \ldots, T,$$

$$\Delta X_{2,t} = \alpha_2 + \beta_2 X_{2,t-1} + \gamma t + \sum_{j=1}^{k2} \theta_{2,j}\Delta X_{2,t-j} + \varepsilon_{2,t}, \qquad t = 1, 2, \ldots, T,$$

$$\cdots \tag{2}$$

$$\cdots$$

$$\Delta X_{N,t} = \alpha_N + \beta_N X_{N,t-1} + \gamma t + \sum_{j=1}^{kN} \theta_{N,j}\Delta X_{N,t-j} + \varepsilon_{N,t}, \quad t = 1, 2, \ldots, T.$$

We test the N null and alternative hypotheses individually:

$$\mathrm{H}_0^1 : \beta_1 = 0; \quad \mathrm{H}_A^1 : \beta_1 < 0,$$
$$\mathrm{H}_0^2 : \beta_2 = 0; \quad \mathrm{H}_A^2 : \beta_2 < 0,$$
$$\cdots$$
$$\cdots$$
$$\mathrm{H}_0^N : \beta_N = 0; \quad \mathrm{H}_A^N : \beta_N < 0,$$

where we compute the test statistics from the SUR estimates of system (2). Breuer et al. [12] have demonstrated that the imposition of an identical lag structure across panel members could bias test statistics; thus, we select the lag structures for each equation based on the approach introduced by Perron [17].

The major difference between the Panel SURADF and other panel unit tests, such as the MADF test of Taylor and Sarno [11], lies in the formulation of the null hypothesis. While the others are joint tests of a unit root for all members of a panel, the Panel SURADF tests investigate a separate unit root null hypothesis for each individual panel member and, therefore, are able to identify how many and which series in the panel are stationary processes.

4.2. Empirical results

For the sake of comparison, we first apply several panel-based unit root tests to examine the null of a unit root in the market share and market share gap of the nine notebook firms in Taiwan that we study. To avoid small-sample bias, we determine the critical values based on Monte Carlo simulations using 10,000 replications for each test, and we report these in Tables 2–4. We find that both the Im–Pesaran–Shin [10] and MW [13] tests fail to reject the null of non-stationary for both market share and market share gap of the nine notebook firms. Our results signify that both the market share and market share gap are non-stationary. In other words, Taiwan's notebook firms are highly competitive and the leader dominates the market.

We then proceed to ascertain which, if any, players in the market can catch up with the dominant firm. Breuer et al.'s [12] Panel SURADF test results substantiate that there is only one firm whose market share gap

Table 2
Panel unit root test results on market share in Taiwan's notebook industry

Method	Statistics	*P*-value	Critical values		
			1%	5%	10%
IPS					
$\varphi_{\bar{t}}$	−1.710	0.169	−3.561	−2.718	−2.297
$\varphi_{\overline{LM}}$	1.402	0.188	3.316	2.524	2.118
MW-Fisher chi-square	33.908	0.245	185.532	112.182	92.180

Critical values are based on Monte Carlo simulations using 10,000 replications.

Table 3
SURADF test results and critical values of market share in Taiwan's notebook industry

Firm panel label	SURADF	Critical values		
		1%	5%	10%
Acer	−0.169	−3.603	−3.028	−2.720
Arima	−1.793	−3.547	−3.005	−2.717
Asustek	−0.737	−3.495	−2.915	−2.620
Clevo Co.	−0.948	−3.562	−2.989	−2.682
Compal	−3.470**	−3.754	−3.191	−2.899
FTC	−2.192	−3.730	−3.098	−2.791
Inventec	−1.499	−3.577	−2.926	−2.630
Quanta	−2.651	−3.617	−3.029	−2.722
Twinhead	−2.464	−3.394	−2.804	−2.512

Critical values are calculated using Monte Carlo simulations with 10,000 draws, tailored to the present sample size. (For details of this simulation, see Ref. [12].)

Table 4
Panel unit root test results on market share gap in Taiwan's notebook industry

Method	Statistics	P-value	Critical values		
			1%	5%	10%
IPS					
$\varphi_{\bar{t}}$	−4.295	0.156	−8.490	−6.474	−5.449
$\varphi_{\overline{LM}}$	4.363	0.134	7.056	5.700	4.912
MW-Fisher chi-square	36.997	0.242	326.861	189.399	149.714

Critical values are based on Monte Carlo simulations using 10,000 replications.

Table 5
SURADF Test results and critical values of market share gap in Taiwan's notebook industry

Firm panel label	SURADF	Critical values		
		1%	5%	10%
Acer	−2.144	−3.456	−2.877	−2.576
Arima	−0.799	−3.505	−2.873	−2.591
Asustek	−0.879	−3.445	−2.867	−2.574
Clevo Co.	−0.844	−3.512	−2.876	−2.571
Compel	−3.164*	−3.510	−2.883	−2.565
FTC	−2.146	−3.514	−2.889	−2.593
Inventec	−1.180	−3.455	−2.856	−2.563
Twinhead	−0.902	−3.507	−2.887	−2.575

Critical values are calculated using Monte Carlo simulations with 10,000 draws, tailored to the present sample size. (For details of this simulation, see Ref. [12].)

does not have a unit root, as shown in Table 5. This means it is the sole firm that has a chance of catching up with the market share leader. To avoid small-sample size bias, we estimate the1%, 5% and 10% critical values, obtained from simulations based on 28 observations for each series and 10,000 replications using the lag and covariance structure from the panel of market share gap data series for each of the 8 panel members.

Several interesting findings are noted. Firstly, the Im–Pesaran–Shin [10] and the MW [13] tests indicate that market shares are non-stationary, reflecting the fact that Taiwan's notebook industry is highly competitive. Secondly, the Panel SURADF test indicates that there is only Compal which is stationary on the level

of market share and market share gap. Compal is the second largest player in the notebook industry. The implication here is that only the second-ranked firm has a chance to succeed in becoming the market share leader in the notebook industry. Moreover, it is impossible for the other firms in this mature stage not to exploit their economies of scale. Other things being equal, the market share leader will continue to be more profitable because it will go on engaging in economies of scale to gain market power. Needless to say, the leading firm will likely continue to dominate the market in the industry.

   Some important policy implications for policymakers emerge from our empirical results. In light of the competitive environment of the notebook industry, policymakers should consider increasing incentives for those whose market share gap shows non-stationarity and also consider formulating policy areas that would help them to achieve their desired objectives in this industry. In a mature stage as this industry is, the strategy of firms should be to sacrifice their margin in an effort to sell more products. It is clearly apparent that reducing costs and increasing manufacturing capacity have become important policies in the notebook industry in Taiwan. As the largest and second largest players in Taiwan's notebook industry, Quanta and Compal have aggressively expanded their manufacturing capacity, especially by establishing factories in mainland China. Policymakers might also help firms in Taiwan to gain more market power in the world market through mergers or strategic alliances. Taiwan's notebook firms have been able to increase their dominant position in the global notebook industry by adopting a business strategy of increasing their economies of scale, while lowering their overall production costs.

5. Conclusions

   In this empirical study, we first employ both Im et al. [10] and Maddala and Wu [13] tests to study competitiveness in the notebook industry and then Breuer et al.'s [12] Panel SURADF unit tests to assess whether the market leading firm is apt to continue dominating Taiwan's notebook industry. The results from both the Im et al. [10] and Maddala and Wu [13] tests cement the notion that Taiwan's notebook industry is highly competitive. The results from Breuer et al.'s [12] Panel SURADF tests indicate that only Compal that is the second large firm has the opportunity to catch up with the leading firm, Quanta. The other firms whose market shares have big distance from the leader mean that they do not have chance to be the leader. In other words, the notebook industry is in "the bigger the better" situation. Market leader has several advantages that include greater bargaining power with suppliers and distribution, quality signal, learning curve and economies of scale. Buzzel et al. [14] and Porter [15] have provided solid empirical evidence of the importance of firms' market share strategy. Furthermore, Bercovitz and Mitchell [16] claim that business scale, business scope and external ties providing organizational capital which offers survival benefits for large firms. This study sheds light on the competitiveness of the mature notebook industry, and as a result, provides a new angle on the strategy for those firms to consider. If the notebook industry does not have disruptive technology in R&D, the rank of market share is not changed in the mature stage. It is not easy to make changes in the firm that dominates the industry market. In this study, we find that only the second largest firm, Compal, poses a threat to the largest firm, Quanta. The market share of the remaining firms will either stay the same or shrink. If the small firms still want to survive in this market, the strategies of them are to merge, form strategic alliances and seek to disruptive technology in R&D. The rank of market share may have chance to rearrange.

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