Do Profit Rate Differentials Diminish Over Time? A Statistical Analysis of Long-term Financial Data

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1. Introduction

One of the key concepts of economics is that profit rates will tend to equalize across markets in the long term. This is because if a particular company enjoys a high profit rate, competitors will seek similar profits by offering the same products or services, stimulating competition and driving down profit rates. On the other hand, if companies are losing money because of poor business results, they will be forced to undergo management system reforms and restructuring, which will boost their profit rates to the level of other companies.

Looking at the experience of companies mainly in industries that have experienced a surge in demand, we find that profit rates may rise temporarily, but eventually decline to normal in several years. For example, around 1990 Aoyama Shoji and other men's apparel retailers achieved impressive operating profits for a very high return on assets exceeding 15%, but this subsequently declined to the average profit rate level of approximately 3%.

However, other companies like Toyota, Nintendo, and Taisho Pharmaceutical have consistently maintained high profit rates over the long term. Apparently, companies that constantly develop new products, build strong brands, and nurture marketing prowess gain a competitive edge that cannot be easily duplicated by others.

Judging from these contrasting cases, there appear to exist forces working both to eliminate differences in profit rates as well as to perpetuate them.

In this paper, we examine the financial data of over 1,000 companies to determine which of these opposing forces has the stronger effect on corporate profit rates in the long term.

2. Long-term Profit Rate Trends and Corporate Rankings

Our survey covers 1,056 manufacturing companies listed on stock exchanges throughout Japan and the

OTC market, for which continuous data is available from fiscal 1976 to 1999. We analyzed annual profit rate trends to see whether differentials actually disappear. For company *i* at time *t*, the return on assets (ROA) consisting of operating profit plus interest and dividend income (EBIT) is denoted P_{it} . The average ROA for all companies at time *t* is denoted $\overline{P}_t$ and the profit rate of company *i* at time *t* is defined as $\pi_{it} = (P_{it} - \overline{P}_t) / \overline{P}_t$. Defining the profit rate relative to the average profit rate in this way eliminates the effect of economic cycles.

We first divided the 1,056 companies into eight sub-samples based on profit rates in fiscal 1976. The sub-samples, each of which contains 132 companies, are ranked from first to eighth by profit rate (from highest to lowest) as of fiscal 1976. We then tracked profit rates in each sub-sample to see if initial differences persist over the long term.

Next, we compiled a company ranking based on annual profit rates, and examined whether any patterns can be found in the corporate characteristics of ranked companies.

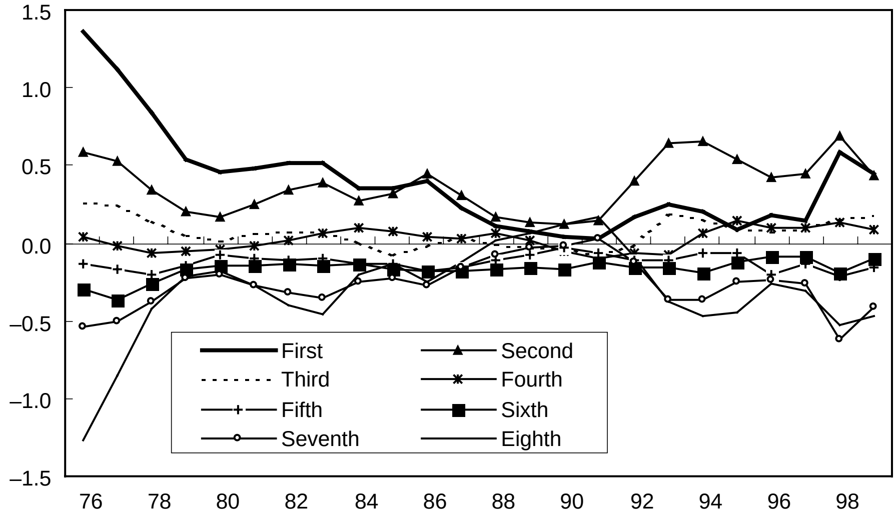
(1) Profit Rate Trends by Initial Ranking (1976)

Figure 1 shows profit rate trends for the initial ranking, which is based on 1976 profit rates. The following observations can be made.

1. In 1976, the base year for grouping the companies into eight ranks, large differentials exist in profit rates; the first and eighth ranks have a differential of almost three percentage points.
2. From 1976 to the bubble period in the late 1980s, differentials tend to shrink, and almost disappear around 1990. We surmise that strong forces were at work to equalize profit rates during the bubble period.
3. However, in the 1990s, differentials expand once again, such that the higher (lower) the rank, the higher (lower) the profit rate tends to be.

These results suggest that demand expansion in the bubble period exceeded the capacity of superior companies and spilled over to inferior companies, thereby blurring differences between the two. But in the floundering economy of the 1990s, differences in competitiveness resurfaced. Even considering such cyclical factors, however, profit rate differentials have not shrunk very rapidly, suggesting that the differentials will persist in the long term.

Figure 1 Profit Rate Trends by Initial Ranking (1976)



(2) Trends in Corporate Rankings

From the annual profit rates and annual profit rate rankings, we also calculated averages for various time periods, and compiled rankings of the top and bottom 15 companies.

Figure 2 lists companies with high sustained profit rates over the long term. The 24-year average profit rate column ranks companies over the full time span of our study from fiscal 1976 to 1999. Next to it, the rank column lists companies by their average annual ranking (from first to eighth) over the 24-year period. The 10 and 20-year average profit rate columns rank companies over the 10-year and 20-year period ending in fiscal 1999.

Certain companies including Nintendo, Taisho Pharmaceutical, Ono Pharmaceutical, Biofermin Pharmaceutical, and Uni Charm appear consistently in the top rankings. By industry, many of the companies are in pharmaceuticals and foods.

In the same way, Figure 3 lists the bottom 15 companies. Again, we find that certain companies such as Econach, Shintom, Sansui Electric appear consistently throughout the rankings. By industry, many companies are in AV-related electrical equipment, machinery, and textiles.

From the top and bottom 15 rankings, two characteristics are apparent: (1) the effect of industry category is too large to be ignored, and (2) there is a huge gap in profit rates between the top 15 and bottom 15 companies.

Figure 2 Top 15 Rankings

Posi-tion	Average profit rate (24-year)		Average rank		Average profit rate (24-year)		Average profit rate (10-year)	
1	Nintendo	3.82	Taisho Pharmaceutical	1.00	Nintendo	4.50	Nintendo	5.03
2	Ono Pharmaceutical	2.81	Biofermin Pharmaceutical	1.04	Ono Pharmacuetical	3.32	Ono Pharmaceutical	4.52
3	Taisho Pharmaceutical	2.54	Hirose Electric	1.04	Biofermin Pharmaceutical	2.83	Sankyo	3.95
4	Bifermin Pharmaceutical	2.49	Santen Pharmaceutical	1.08	Taisho Pharmaceutical	2.67	Bifermin harmaceutical	3.55
5	Fanuc	2.23	Eisai	1.08	Hirose Electric	2.31	Santen Pharmaceutical	3.53
6	Hirose Electric	2.10	Yamanouchi Pharmaceutical	1.08	Sankyo	2.30	Taisho Pharmaceutical	3.39
7	Santen Pharmaceutical	2.00	Fanuc	1.13	Santen Pharmaceutical	2.22	Uni Charm	2.92
8	Sankyo	1.91	Fuji Photo Film	1.17	Mikuni Coca-Cola Bottling	2.05	Hirose Electric	2.82
9	Uni Charm	1.87	Max	1.17	Uni Charm	2.03	Mikuni Coca-Cola Bottling	2.80
10	Mikuni Coca-Cola Bottling	1.82	Amano	1.21	Fanuc	1.97	Hokkaido Coca-Cola Bottling	2.75
11	International Reagents	1.66	Nintendo	1.25	Fuji Photo Film	1.87	Takeda Pharmaceutical	2.58
12	Fuji Photo Film	1.65	Nifco	1.29	Danto	1.80	KOA	2.40
13	Eisai	1.52	Uni Charm	1.33	Fuji Machine Mfg.	1.73	Fuji Machine Mfg.	2.39
14	Danto	1.50	House Foods	1.33	Daiichi Pharmaceutical	1.62	Sonton Food Industry	2.34
15	Hokkaido Coca-Cola Bottling	1.46	Chofu Seisakusho	1.33	Hokkaido Coca-Cola Bottling	1.59	Daiichi Pharmaceutical	2.32

Figure 3 Bottom 15 Rankings

Posi-tion	Average profit rate (24-year)		Average rank		Average profit rate (24-year)		Average profit rate (10-year)	
1	Econach	–2.73	Lohmeyer	7.54	Econach	–2.83	Shintom	–4.64
2	Sansui Electric	–2.18	Kotobuki Industry	7.50	Shintom	–2.50	Econach	–4.48
3	Shintom	–1.96	Maruishi Cycle Industries	7.46	Sansui Electric	–2.43	Union Optical	–3.08
4	Lohmeyer	–1.79	Econach	7.46	Lohmeyer	–1.87	Tosco	–2.51
5	Kotobuki Industry	–1.76	Showa Rubber	7.38	Kotobuki Industry	–1.74	Silver Seiko	–2.48
6	Daido-Maruta Finishing	–1.61	Unozawa-gumi Iron Works	7.29	Daido-Maruta Finishing	–1.71	Sansui Electric	–2.43
7	Union Optical	–1.39	Tokyokoki Seizosho	7.29	Silver Seiko	–1.65	Surugaya	–2.36
8	Silver Seiko	–1.39	Yamashina	7.25	Union Optical	–1.59	Daido-Maruta Finishing	–2.32
9	Orika Capital	–1.32	Meiji Machine	7.21	Akai Electric	–1.51	Orika Capital	–2.19
10	Akai Electric	–1.28	Omikenshi	7.21	Omikenshi	–1.35	Omikenshi	–2.10
11	Hitachi Seiki	–1.25	Kowa Spinning	7.17	Orika Capital	–1.34	Kimuratan	–2.03
12	Omikenshi	–1.20	Jidosha Buhin Kogyo	7.17	Oye Kogyo	–1.33	Kanda Tsushin Kogyo	–2.03
13	Taihei Machinery Works	–1.19	Kitanihon Spinning	7.17	Sumikura Industrial	–1.32	Hitachi Seiki	–1.99
14	Unozawa-gumi Iron Works	–1.19	Shibaura Mechatronics	7.13	Hitachi Seiki	–1.29	Taihei Paper Mfg.	–1.95
15	Sumikura Industrial	–1.18	Hino Auto Body	7.13	Unozawa-gumi Iron Works	–1.27	Kotobuki Industry	–1.88

3. Measurement of Long-term Profit Rate

Thus far, we have found that many initially high-ranking companies from the first year of the survey have maintained high profit rates during the survey period. Below, we measure the size of these sustained profit rates, and their speed of adjustment.

We used two measurement methods: a time series model, and partial adjustment model.

① *Time series model*

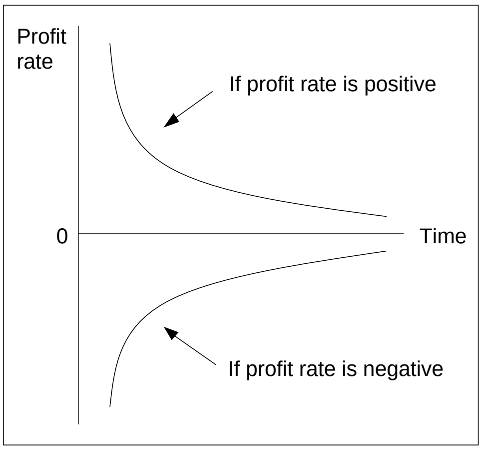
The time series models assumes that initially positive (or negative) profit rates will gradually decline (or rise) over time, and statistically verifies whether profit rates ultimately converge to zero (Figure 4).

Specifically, it assumes that corporate profit margin π_{it} follows a typical pattern:

$$\pi_{it} = \alpha + \beta / t + \mu_{it} \qquad (1)$$

where error term μ_{it} has a normal distribution with mean zero and variance δ^2_μ, and α and β are estimated from profit margin data. Since the value of Equation (1) approaches intercept α as time passes (because t becomes very large), α is taken to express the size of the long-term profit rate.

Figure 4 Profit Rate Convergence Pattern



② *Partial adjustment model*

The partial adjustment model is expressed as follows:

$$\pi_{it} = \omega + \lambda \pi_{i,\,t-1} + v_t \qquad (2)$$

where ω and λ are estimated for each company (and error term v_t has a normal distribution with mean zero and variance δ_v).[1]

This equation can be rewritten as follows:

$$\pi_{it} - \pi_{i,\,t-1} = (1-\lambda)\,[\omega/(1-\lambda) - \pi_{i,\,t-1}] + v_t$$

In this equation, $1-\lambda$ expresses the speed of adjustment (the larger the value, the faster the adjustment), and $\omega/(1-\lambda)$ is the long-term profit rate.

We estimated Equations (1) and (2) for the 1,056 companies covered in the survey, and obtained the long-term profit rates and adjustment rates.

Figure 5 shows the average slope and intercept by rank. While the time series model results show reversals between the first and second ranks and seventh and eighth ranks, long-term profit rates (intercept values) are generally correlated with rank. Similarly, the partial adjustment model results show reversals between the first and second ranks and third and fourth ranks, but overall, rank and long-term profit rate and generally correlated. These results confirm the tendency for companies with initially high profit rates to retain high rates in the long term.

Figure 5 Model Simulation Results

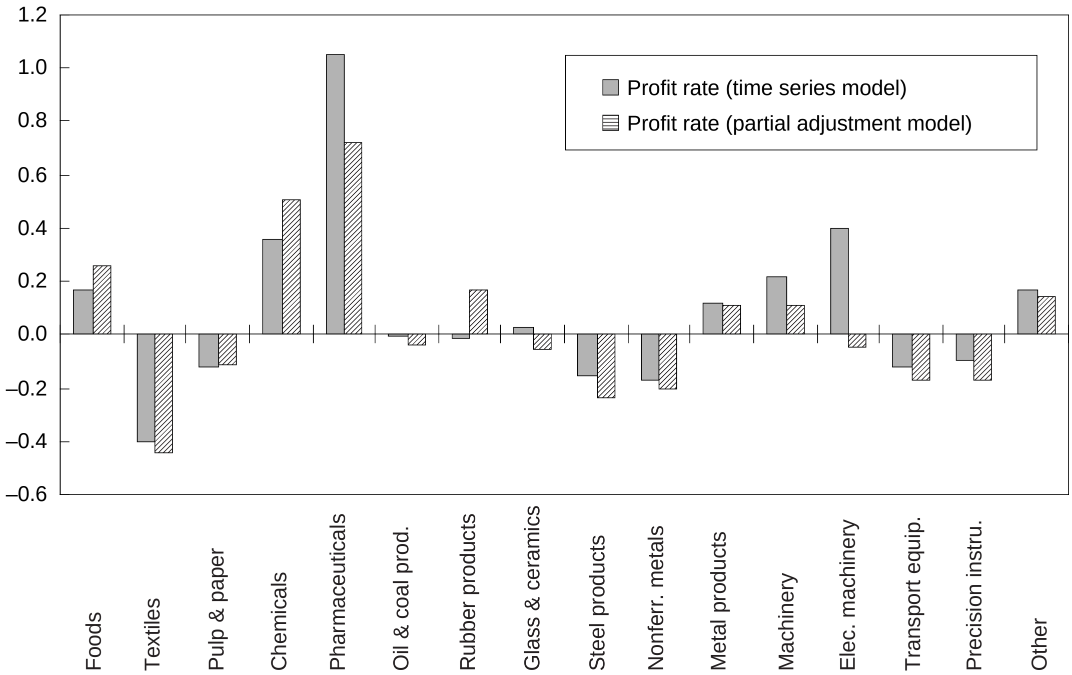
Ranking	Time series model		Partial adjustment model		
	Slope (α)	Intercept (β) (long-term profit rate)	Slope (λ)	Intercept (ω)	Long-term profit rate
First	1.38	0.18	0.67	0.07	0.25
Second	0.15	0.35	0.62	0.11	0.38
Third	0.24	0.03	0.58	0.00	0.03
Fourth	–0.06	0.03	0.62	–0.01	0.10
Fifth	–0.04	–0.12	0.60	–0.08	–0.06
Sixth	–0.22	–0.13	0.57	–0.09	–0.14
Seventh	–0.36	–0.21	0.57	–0.12	–0.20
Eighth	–1.10	–0.13	0.54	–0.12	–0.22

The adjustment speed $1-\lambda$ from the partial adjustment model is distributed in the range of 0.33 to 0.46, and generally decreases as rank increases. In other words, profit rates that are initially high tend to decline more slowly.

It is also apparent from the rankings that many companies at the top belong to specific industries. To explore this further, we calculated long-term profit rates by industry (Figure 6).

Profit margins are high in pharmaceuticals and chemicals, and negative in textiles, steel, and nonferrous metals. As the results show, wide disparities exist between industries.

Figure 6 Profit Rate by Industry



4. Why Profit Rate Differentials Persist

In analyzing the factors that profit rate differentials to persist in the long term, we found that companies with high long-term profit rates tend to belong to industries with high profit rates, have a high shareholders' equity ratio and are financially stable, and receive strong external monitoring due to their high foreign ownership ratio.[2] These results indicate the importance to corporate management of adroitly entering industries with high profit rates, enhancing financial stability, and building a management organization that works with strong external monitoring.

However, it should be noted that the factors analyzed here explain only 10% to 20% of the overall differentials. We believe the remaining portion is determined by factors specific to each company (management competence, labor quality, corporate culture, technological knowhow, etc.).

Based on these findings, the critical elements for improving profit rates are to choose the right business lines, pay due consideration to corporate governance, and amass the necessary resources for enhanced competitiveness.

Notes

1. The theoretical backdrop to estimating long-term profit rates with the partial adjustment model is as follows.

The change in profit rate ($\Delta\pi_{it} = \pi_{it} - \pi_{i,t-1}$) can be expressed using potential or actual new entrant E_t, the previous period's profit rate $\pi_{i,t-1}$ as a steady-state feedback factor, and residual factor μ_t.

$$\Delta\pi_{it} = \theta_0 + \gamma_0 E_t + \gamma_1 \pi_{i,t-1} + \mu_t \qquad (1)$$

Since new entrants will stimulate competition and reduce the profit rate, and the current period's profit rate is more likely to decline if the previous period's profit rate is high, we have the condition $\gamma_0<0$, $\gamma_1<0$. The term μ_t consists of various external factors, and has an independent and identical normal distribution with mean zero and variance δ_μ^2. The equilibrium profit rate when no new entrants are present is π^*, and a positive excess profit rate ($\pi_{it} - \pi^* > 0$) causes new entrants to enter, while a negative excess profit rate ($\pi_{it} - \pi^* < 0$) causes companies to exit the industry.

As a result, the equation for new entrants can be expressed as follows.

$$E_t = \phi\,[\pi_{i,t-1} - \pi^*] + \varepsilon_t \qquad (2)$$

The term ϕ in Equation (2) is positive, and its size denotes the inflow rate of new entrants. The term ε_t expresses the exogenous inflow of new entrants occuring even when the previous period's profit rate is equal to the equilibrium level, and has an independent and identical normal distribution with mean zero and variance δ_ε^2.

Substituting equation (2) into equation (1) and rearranging terms, we obtain the following equation used in the partial adjustment model:

$$\pi_{it} = \omega + \lambda\pi_{i,t-1} + \nu_t \qquad (3)$$

where $\omega = (\theta_0 - \gamma_0\,\phi\,\pi^*)$, $\lambda = (\gamma_0\,\phi + \gamma_1 + 1)$, and ν_t has a normal distribution with mean zero and variance $\delta_\nu^2 = \gamma_0 \delta_\varepsilon^2 + \delta_\mu^2$.

2. For details, refer to K. Komoto, "Factor Analysis of Long-term Profit Rate Differentials," (in Japanese), *Economic Research Report*, NLI Research Institute, November 2001.