Prices, Industry Consolidation, and Profit Margins

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Abstract

In this study, we discuss the pattern and trend of price movement in the pulp and paper industry. We also present our estimates of quantitative responses of price to changes in demand and supply factors in the economy. Moreover, as merger and acquisition activities in the pulp and paper industry have accelerated in recent years, we study the effect of industry consolidation on price. Finally, we evaluate whether the increased industry concentration has helped to improve efficiency, and has resulted in higher profit margins for the industry.

I. Introduction

The importance of understanding price behavior can hardly be underestimated. Price level and volatility affects industry profitability, returns to investments, and capacity planning. However, myriads of factors can influence price movements, and thus make it a highly challenging task to study price behavior.

In this study, we first discuss the pattern and trend of price movement in the pulp and paper industry. We then investigate price responses to changes in demand and supply factors in the economy. Moreover, as merger and acquisition activities in the pulp and paper industry have accelerated in recent years, we study the effect of industry consolidation on price, and evaluate whether the increased market concentration has resulted in a higher profit margin for the industry, and discuss its implications on industry efficiency.

II. Historical Pattern of Price Movement[1]

The overall price movement represented by the Producer Price Index (PPI) for the pulp, paper, and paperboard sector can be seen in Figure 1. The price indexes show a clear upward trend; and pulp displays a higher degree of variation. Overall, we see an increasing level of volatility since late 1980s. In-depth researches are needed to understand why all three price indexes exhibit a changing pattern of volatility in the last decade.

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[1] This section is mainly based on our project report "Forecasting Containerboard Prices."

Figure 1   Commodity-based Producer Price Indices (CPPI), 1970-2000.
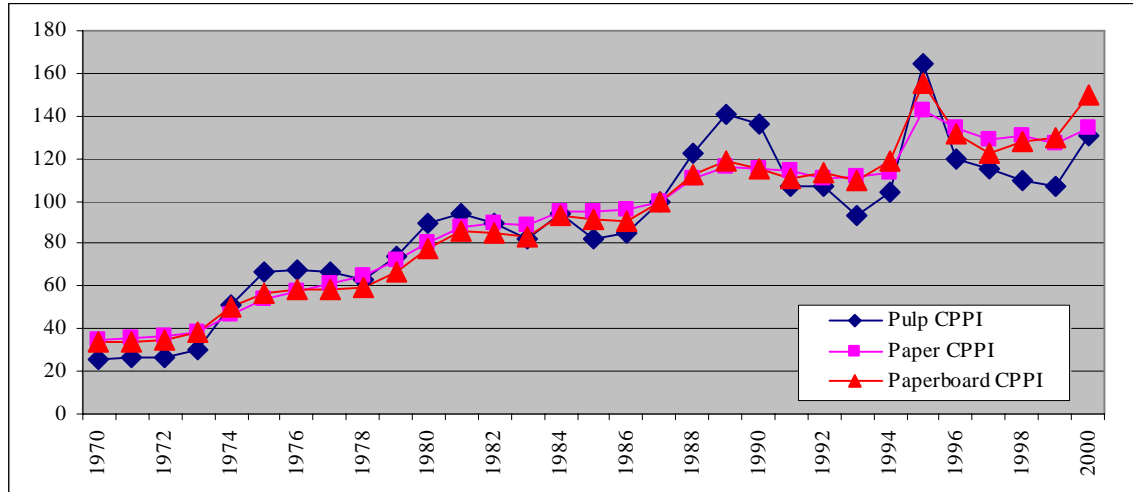
PPI represents an overall price movement. If we look at a particular group of paper products such as containerboard, the actual price pattern is quite different. As seen in Figure 2, the upward trend of linerboard is not as steep as the overall price index. Yet, it also shows higher volatility in 1990s. For example, linerboard price increased more than 60% over one year in 1994. The price peaked in 1995, and then dropped dramatically. From September 1995 to July 1996, the linerboard price dropped by about 35%. The price reached the peak level in 2000, and began to move down. In a two-year period starting in July 2001, the price dropped by about 18%.

In order to remove the impact of inflation, we calculate the real price using Producer Price Index (PPI) for all commodities to deflate the nominal price, with December 1982 the base. In general the real price follows a similar pattern of the nominal price, but with slightly less fluctuations. The standard deviation of real price is

$43/ton, while for nominal price it is $63/ton. It appears that the current real price is not much higher than that in early 1980s, and even lower than that in later 80s.

Figure 2   Nominal and Real Linerboard Prices (1980-2002)
(price: US $/short ton)
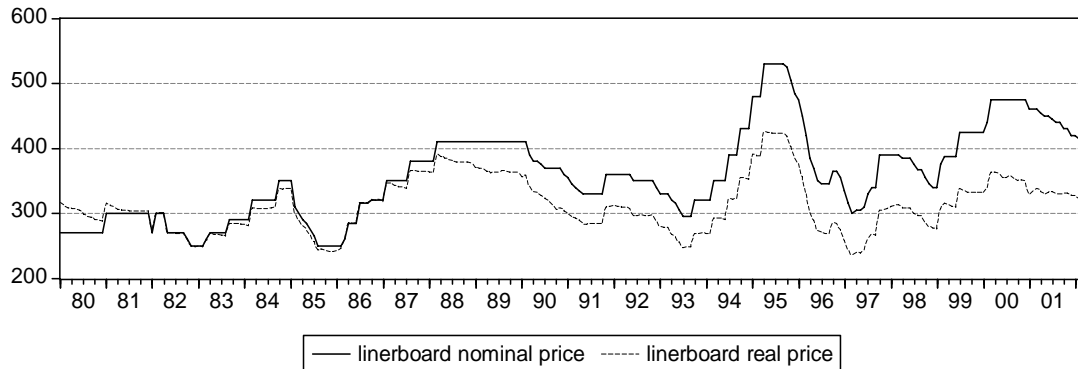
In addition, our regression analyses show that both nominal and real prices do not have a regular seasonal pattern. Both prices, however, exhibit a quadratic trend, i.e., the price increases slowly and at a gradually slower speed. As expected, the upward trend of real price is much flatter than that of nominal price (about a half of its magnitude).

III. Price Responses to Economic Factors [2]

In general, price is determined in a complex demand/supply system. In order to understand price behavior, it is important to investigate how the price responds to changes in major economic variables. We use monthly data from January 1982 to December 1999 to estimate the demand/supply system for containerboard.

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[2] This section is based on the working paper "Demand, Supply and Elasticities in the Containerboard Industry" by Haizheng Li and Jifeng Luo (2004).

Figure 3 shows the relationship between the real linerboard price and demand for linerboard. The demand is the monthly sales of linerboard in the United States measured in thousand of short tons. The price is the real price with 1982 as the base year. Clearly, the price varies in a very different pattern from that of the demand. Due to many other factors in the equilibrium system, it is hardly to tell visually that there is any relationship between the price and demand.

Figure 3 Real Price and Demand for Linerboard, 1982-1999
(demand: thousand of short ton, price US$/short ton)
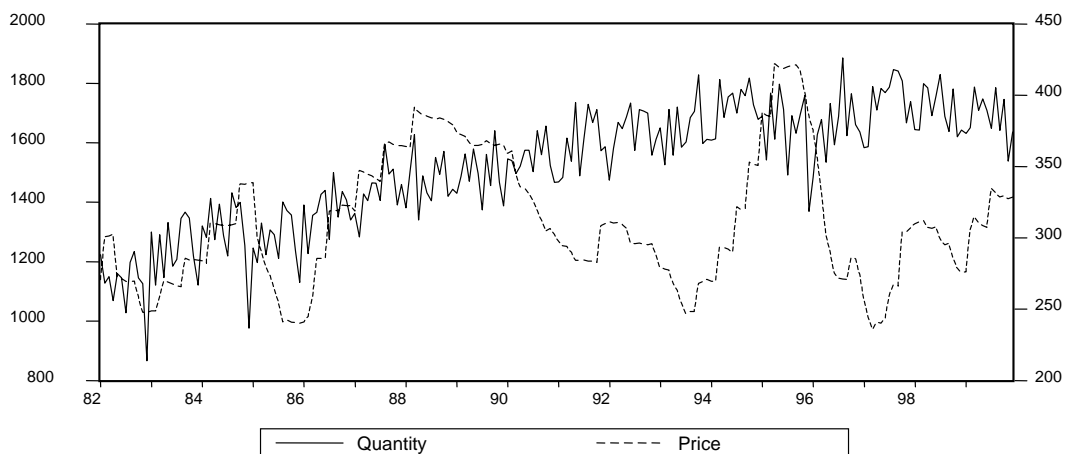
However, using econometric techniques, we estimate a number of different models for the demand/supply system. Based on our results, when price increase, the demand will drop, and this is statistically significant. However, the response of demand to price is fairly inelastic, lying in the range of -0.11 to -0.18. It indicates that, when price increases by one percent, the demand will drop by 0.11-0.18%. Therefore, the demand is not sensitive to price changes.

This small magnitude of own-price elasticity is consistent with findings in previous studies. Buongiorno and Kang (1982), for example, finds that the short-run price elasticities lie in the range from -0.10 for paper to -0.26 for paper and paperboard. Chas-Amil and Buongirono (2000) finds that the demand for paper and paperboard is price inelastic in the European Union, with price elasticities ranging from -0.13 to -0.30 for different countries.

The results also show that the demand for linerboard is more sensitive to macro-economic activities. When the total production index increases by 1%, the demand will increase by 0.60-0.73%. This is probably because the demand for linerboard is mainly determined by the shipments of manufacturing and durable goods.

Additionally, plastics appear to be penetrating into the containerboard market. This has been the case in certain segments of the packaging market like groceries and auto parts going to assembly lines. Our regression results show that the demand for linerboard is affected the price of plastics. In our models, plastic price is measured by the PPI for polypropylene resins, a main material of plastic packaging. The response of demand for containerboard is positive and significant to the price of plastics, indicating that plastics are a substitute for containerboard. In particular, when the price of plastics decreases by one percent, the demand for linerboard will decrease by 0.12-0.14%. The substitution effect, however, is quire small.

On the supply side, it appears that the price response to changes in demand is very small, almost insignificant. More specifically, an increase in demand induces a very small increase in price. For example, when the demand increases by one percent, the price will increase by approximately 0.1%. Moreover, for linerboard, only the price of

pulpwood, one major material, has a positive and significant effect on price. If the pulpwood price increases by 1%, the linerboard price will increase by 0.18-0.32%.

On the other hand, the prices of other inputs such as labor and energy do not seem to affect the linerboard price. This is probably because pulpwood accounts for approximately 40 percent of the total cost, while labor and energy only account for 10 percent and 12 percent, respectively. Other studies like Buongiorno and Lu (1989) also find that material costs are more important in influencing price than labor costs.

Among other results, we find that operating rate has significantly positive effects on price. On average, when operating rate increases one percentage point, the price will increase 0.2%. More interestingly, despite the accelerated consolidation in the paperboard sector, we find that industry concentration, measured by the share of top four companies that commonly used in the literature, has not shown any statistically or economically significant effect on price. Since our data cover only the period up to 1999, it is possible that we are not able to discern the true effect, because merger and acquisition activities continued after 1999.

IV. Industry Consolidation, Efficiency, and Profit Margin [3]

In recent years, the U.S. pulp and paper industry has experienced a series of mergers and acquisitions. Industry consolidation has occurred in all three sectors: pulp, paper, and paperboard. The process of consolidation has been on the rise since the 1980's and continued throughout the 1990s. As can been seen in Figure 4, the pace of

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[3] This section is based on the working paper "Industry Consolidation and Price-cost Margin—Evidence from the Pulp and Paper Industry" by Haizheng Li, Patrick McCarthy, Aselia Urmanbetova 2004, and on the master these "The Effect of Consolidation on Price-Cost Margins in the Pulp and Paper Industry" by Aselia Urmanbetova, 2003.

change, measured by the number of mergers per year, has picked up in the late 1990's.
From 1970 to 1979, the average annual merger for all three sectors is 9; from 1980 to
1989, the number becomes 20. From 1990 to 1999, there were 26 mergers per year on
average. The most activity is observed in paperboard industry with the record 35 number
of mergers in 1998. In 2000, the pulp and paperboard sector each has 6 mergers; while
the paper sector has 24 mergers.

Figure 4   The Number of Mergers in Pulp and Paper Industry 1970-2000.
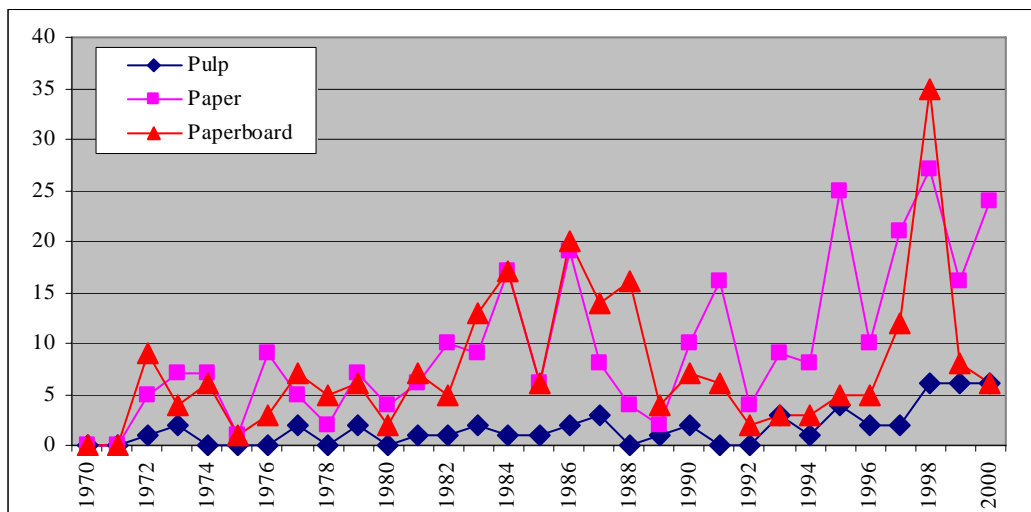
As a result, market concentration has increased considerably. Based on the share
of top four producers (CR4) from the Census, from 1972 to 1997, the market
concentration for the paper sector raised from 24% to 33.6%; while for the paperboard
sector, increased from 29% to 33.6%. As for the pulp sector, after a decline of market
concentration from 1972 to the middle 1980s, the market concentration has been rising
steadily from 44% to 58.6% from 1987 to 1997. Since 1997, the concentration in all

three sectors has been increasing even further, especially in paperboard, with the CR4 climbing up to 45%.

Figure 5 and 6 show the dynamics of industry concentration based on the data from the Census. We also calculate our own industry concentration using the panel data for 500 mills over 30 years. Our data are from the Forest Products Laboratory (FPL) of the US Department of Agriculture located in Madison Wisconsin. In the graphs, the Census CR4 is calculated using sales/output and the FPL CR4 is calculated based on capacity.

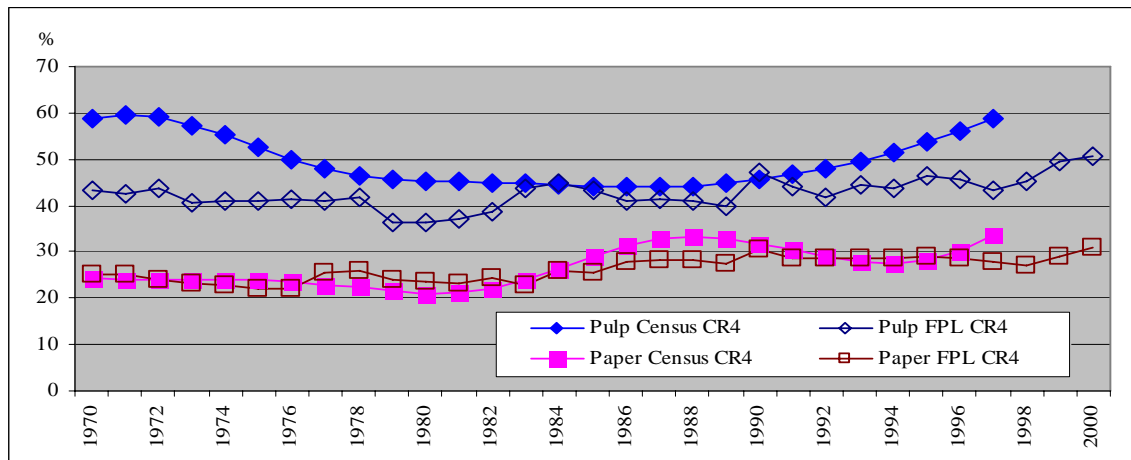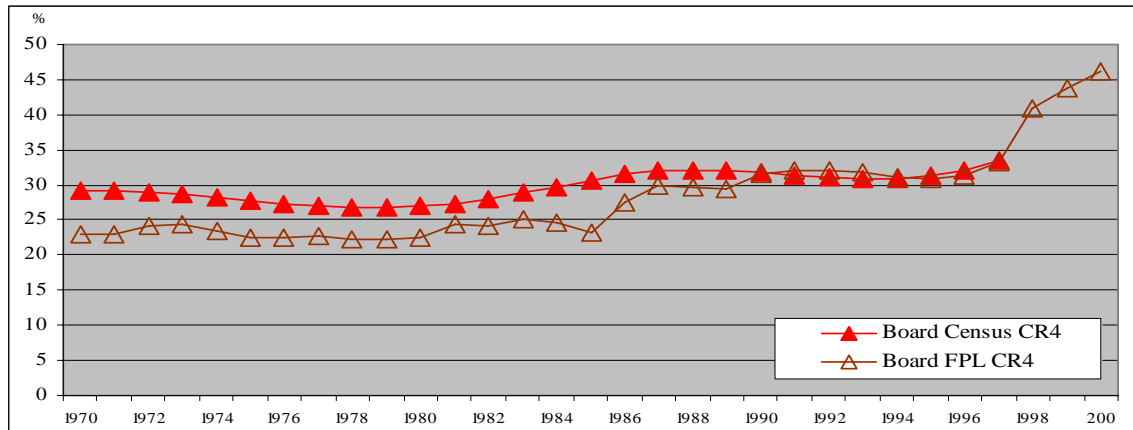Figure 5 Census and FPL CR4s for Pulp and Paper, 1970-2000

Figure 6   Census and FPL CR4s for Pulp and Paper, 1970-2000

As the market gets more concentrated due to industry consolidation, it is interesting to ask whether the increased degree of concentration has helped to improve the efficiency in the industry. In general, industry consolidation is expected to improve efficiency by reducing production costs through greater economies of scale, as well as by technological innovations through larger R&D investments. In addition, consolidation may improve the ability to support product prices. Yet, it is unclear whether the pulp and paper industry has experienced these effects.

Figure 7 shows the dynamics of cost efficiency, measured by materials cost per ton of output (including energy costs). It shows that there is no obvious downward trend in all three sectors.

Figure 7   Cost of Materials per Ton of Output, 1970-1997
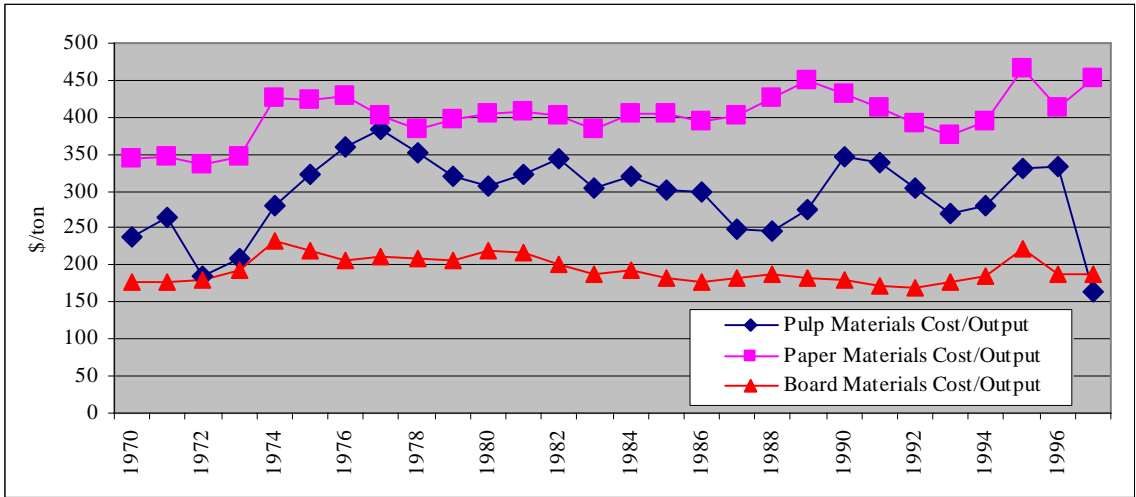
In contrast, mills managed to reduce their labor cost, measured by payroll costs over 1970-1997. As shown in Figure 8, labor costs exhibits a downward trend in all three sectors, although very slight.

Figure 8   Payroll Costs per Ton of Output
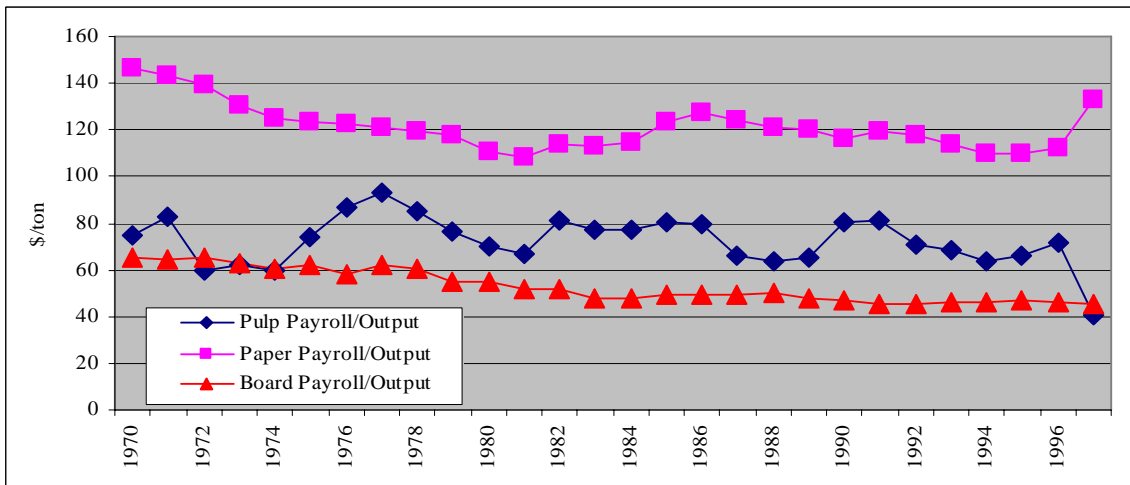
Nevertheless, price-cost margins (PCMs) in the pulp and paper industry have been increasing in the past three decades. Following the literature, the price-cost margin is measured by $PCM = \dfrac{(p - AVC)}{p}$. In general, it is calculated using the formula,

PCM = (Value of Sales + Δ Inventories – Payroll – Cost of Materials)/

(Value of Sales + Δ Inventories).

As shown in Figure 9, price-cost margins exhibit a clear upward trend. Measured by 10-year average, in the pulp sector, the price-cost margin increased from the average of 31% in 1971-1980 to 34% in 1991-2000. Changes in paper and paperboard PCMs are more dramatic—from 25 to 34 percent in the paper sector, and from 28 to 36 percent in paperboard sector. Based on the Annual Survey of Manufacturers data from the Census, the three decade averages for 1971-1980, 1981-1990, 1991-2000 are respectively: pulp: 31, 32, 34, paper: 25, 30, 34, and paperboard: 28, 32, 36 percent.

Figure 9   Price Cost Margins, 1970-2000.
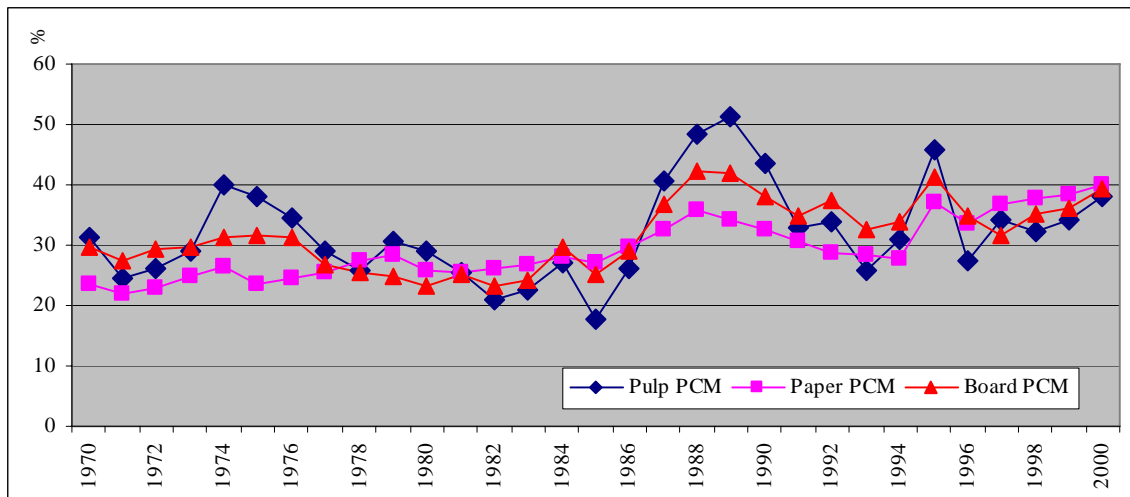
In order to investigate the effect of industry consolidation on profit margin, measured by price-cost margin, we apply regression analysis using panel data from FPL from 1970 to 1997. The results show that the effect of concentration on price-cost margin is positive and significant. Based on annual CR4 data, we find that if the market concentration increases by one percentage point, the price-cost margin will increase by 0.4 to 0.5 percentage points. This result is robust to different estimation methods. The effect, however, fluctuates with business cycle and displays a cyclical pattern, as it drops to about 0.2 during a recession and rises to 0.7 at its peak.

In addition, import competition appears to have a negative and significant effect on the price-cost margin of the domestic industry. When import intensity, measured by its market share, increases by one percentage points, the price-cost margin will decline by approximately 0.2 percentage point.

Additionally, based on our results, the large amount of expenditures in the pulp and paper industry on environmental protection due to government regulations has a positive effect on price-cost margin. Therefore, it indicates that these costs have been passed on to industry consumers in the form of higher price.

In the past three decades, price-cost margins generally show a trend of increase in all three sectors of the pulp and paper industry. However, when it comes to actual profits and returns to investment, the trend has not been so optimistic. It is generally viewed that the profitability for the whole industry is at least not getting better. As shown in Figure 11, the profit rate, measured by the ratio of net profit after taxes to net worth, for paper

and allied industries has been very flat since 1970, with increasing volatility in the last decade.

Figure 11   Net Profit after Taxes / Net Worth for Paper and Allied Industry

Profit Rate in the Pulp and Paper Industry 1970-1998

Source: AF & PA Annual Review (1998)
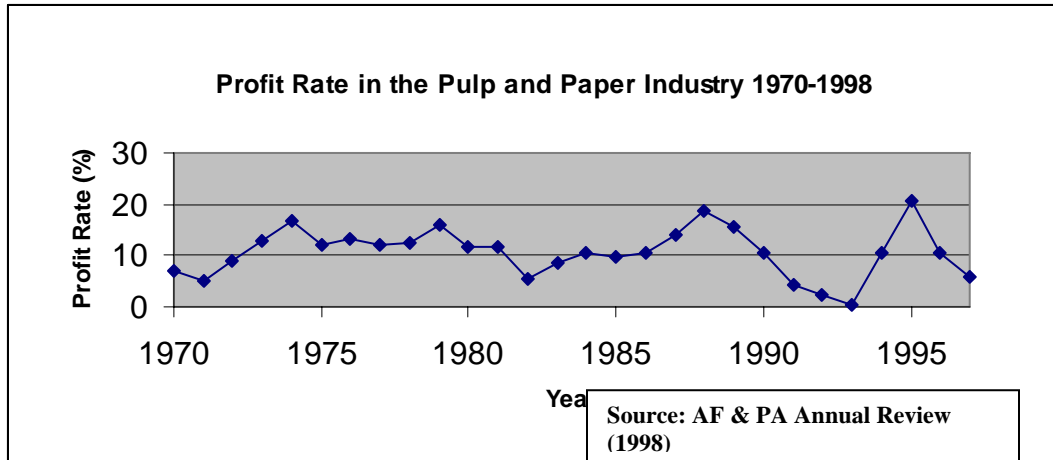
One explanation of this phenomenon, the joint occurrence of relatively high price-cost margin and low actual profit rates, is due to chronic excess capacity in the industry. Other possible reasons include high expenditures caused by environment regulations and/or high administrative costs. Detailed researches in the future are needed to search for the answers.

V. Conclusion

In this study, we discuss the characteristics of price movement in the pulp and paper industry, and estimate price response to economic factors from both demand and supply side, and analyze the impact of industry consolidation on profit margin.

We think that there are a number of challenges facing the pulp and paper industry. First of all, the real price has been quite flat in the last three decades. For containerboard, for example, the current real price is not much higher than that in early 1980s. Additionally, the price movement appears to become more volatile in recent years. Moreover, the ongoing industry consolidation has not shown a significant effect on supporting price. All of these will cause pressure on industry profitability.

Secondly, the price-cost margin has been rising, and industry consolidation has shown a positive effect on price-cost margin. However, the profit rate or the return to capital has been very flat. This is probably the consequence of overcapacity that caused large capital cost in the industry. Additionally, high administrative costs and costs related to environment regulations could have also contributed to the low profit rate.

Third, it appears that price does not respond to energy and labor costs, and the response to demand change is also very small. These findings indicate the difficulty of raising price even when there is a reason to do so. Thus, producers generally absorb the shocks caused by price hike in inputs.

Although there is no general solution for all the above problems, we believe that disciplines in capacity expansion, efficient production planning to stabilize price, and continued consolidation to take advantage of the economy of scale and production efficiency, and especially to reduce non-production costs will generally help to improve the performance of the industry.

There are many questions remain to be answered. For example, what factors cause the increasing price volatility observed in the last decade? What factors will affect the profitability? We will leave these issues for future research.