

Executive Summary

In this report, we will briefly summarize the main findings from the project, “Price Volatility, Inventory, and Industry Consolidation in the Pulp and Paper Industry,” sponsored by the Center for Paper Business and Industry Studies (CPBIS). It covers our reports and research papers as a result of this project, including China’s pulp and paper industry, relationship between inventory, price and output, factors affecting vertical integration, price volatility, computer usage and demand for paper/board, price modeling and forecasting based on volatility, and discussions about a potential Karft futures market. Some findings listed in this summary are still preliminary. Details related to this summary can be found in the related reports or papers.

1. China’s Pulp and Paper Industry

In this report, we provide an overview of the pulp and paper industry in China, based on both industry level data and firm level data. The pulp and paper industry is one of the very few industries in China that has been experiencing shortages in supply. The domestic production cannot satisfy the consumption, especially for high quality paper and paperboard products, due to old production technique and lack of high-quality raw materials. Therefore, unlike other Chinese products, China has been importing more pulp and paper product than exporting. Other distinguishing characteristics of the Chinese pulp and paper industry include limited wood resources, rapid expansion of capacity, direct investment from foreign producers, co-existence of large modern mills vs. a large number of out-of-dated small mills, and a large portion of state-ownership. Moreover,

the advantage of low cost of labor for this industry in China is not significant. Those features raise many interesting questions for researchers and policy makers. We discussed the industry on its current stand, pattern and trends, relative importance in the world, and its transformation. More specifically, in addition to the general discussion of the pulp, paper, and paperboard sector, we also analyzed structural change on the demand during the course of economic transition, capacity expansion and foreign direct investment, company performance, and discrepancy of data from different sources. Finally, we introduced two representative companies visited in China for this study.

The relevant report is “China’s Pulp and Paper Industry: A Review” (Zhong Zhuang, Lan Ding and Haizheng Li)

2. Implications for formal futures trading in Pulp and Paper industry

In recent years, futures trading extended beyond physical commodities in the 1970s and 1980s – currency futures in 1972; interest rate futures in 1975; and stock index futures in 1982. Firms lacking formal means of hedging strategies might be taking positions that expose them to the uncertainty and overall market risk more seriously than some other commodities market. Our study illustrates the relevance of a formally organized futures market for the Pulp and Paper industry in general where firms can potentially have access to means that enable them to take short or long positions depending on their investment plans and inventory level, to hedge against the risks associated with the variation in prices over certain time periods.

Our findings indicate that optimal hedging strategies should include time variation in the variances and covariance across different investment strategies. In the absence of

formal futures trading means, obtaining information on future behavior of prices of Kraft and other related products is difficult and may not be accurate. This may lead to inefficiencies in the market. One of the striking findings in our study involved the unpredictability of prices or price changes from the past price movements, which is rarely the case in financial and commodities markets. Our results show that Kraft markets are far from being efficient in the sense of economic theory. This indicates that firms cannot process the information available on prices efficiently and hence, there are systematic price errors made by the market participants. We argue that this can potentially be eliminated by formally developing means to trade future contracts. In other words, there is some evidence indicating that the presence of a formal futures market may enhance the overall efficiency in the market and provide “better” means for the firms to hedge their positions by allowing them to better incorporate information from time-varying volatility and risk in the market.

The relevant research report is “A Report on Time Varying Volatility in Kraft Market and Hedging throughout the Futures Market”, Rehim Kılıç (2006).

3. Price Volatility in the Pulp and Paper industry

In this study, we investigate the effect of demand shocks and market consolidation on price volatility in the pulp and paper industry. We find that the fluctuation of material costs has a positive and statistically significant effect on product price variation, but the fluctuation in the cost of labor and energy does not show any effect. On the demand side, operation rate shows a positive effect while inventory level shows a negative effect on the

volatility of product prices. However, market concentration, measured by CR4 ratio or HHI, does not appear to have a statistically significant effect on price variation.

The relevant research paper is “Price Volatility in the Pulp and Paper industry” (Geweï Wang and Haizheng Li)

4. Price Volatility Dynamics and Forecasting of Volatility

Our research uncovered that monthly price in several Kraft types contained stochastic components that can be modeled by Integrated Autoregressive Moving Average (ARIMA) models with time variation and excess kurtosis in the higher moments of the distribution of monthly price changes. These results are quite similar to findings from financial and other commodity markets. We find that information from higher moments need to be incorporated when modeling prices in Kraft market and ignoring the dynamics in the higher moments of the price series may lead less efficient forecasting models. Therefore, ARIMA models with Generalized Heteroskedastic Autoregressive models (GARCH), which are used extensively in assets and commodities as well as exchange rate markets, can be utilized to model temporal dependence in market volatility.

It is shown that throughout expansive experiments GARCH models outperform several alternatives including pure ARIMA and exponential smoothing models both in predicting the monthly price changes as well as their volatilities, and hence the overall risk in the Kraft market. In particular, our results show that GARCH models perform considerably well in predicting the volatility in very short to medium term ranging from one-month to nine months ahead in terms of several statistical loss functions. We also find that as measured by the conditional standard deviation of prices changes, risk

determines the price changes in the Kraft market. As the risk increases, the price changes tend to be lower, indicating that investors/firms in the market tend not to get higher returns by accumulating inventory. In other words, firms with more inventory accumulation will be penalized by taking the risk.

The relevant research paper is “GARCH effects in another market: Modeling and forecasting Kraft prices and conditional volatility” (Rehim Kilic).

5. Inventory, Price, and Output in the Linerboard Industry

In this study, we investigate the market dynamics in the linerboard industry. Using discrete choice modeling techniques, we estimate the probability of price and production response to inventory changes based on monthly data from 1980 to 1999. Our tests show that inventory causes changes in price, but not vice versa. Moreover, price responses to inventory are asymmetric, and upward adjustment in price is “stickier” than downward adjustment. In contrast, production is found to lead inventory change, but a reverse causal relationship exists.

It appears that the industry cuts output in response to inventory pressure, but the response seems to be temporary. Moreover, price drops earlier in response to inventory buildup and output drops much later. There seems to be a tendency for the industry to adjust price first before adjusting output. The output adjustment seems to be short-lived and thus does not help remove the price pressure.

The relevant research paper is “Inventory, Price, and Output in the Linerboard Industry” (Haizheng Li and Feng Zhang).

6. Market Concentration and Vertically Integration of Pulp and Paper Mills

Paper mills vertically integrated into pulp production, partly because internalizing the production of their inputs, allows them to avoid transaction costs. Higher market concentration, a proxy of higher asset specificity and transaction costs, should encourage vertical integration in the pulp and paper industry. However, this relationship has not been robust in previous studies or in our replication with updated FPL-UW data. Upon a deeper analysis of the data, this study aims to clarify the mechanism by which transaction cost can induce vertical integration in this particular industry, which does not have well-defined intermediate goods markets.

In order to specify the pulp markets where paper mills are likely to trade, we construct a mill-specific concentration measure as a substitute to traditional regional concentration measures. We also narrow our sample to mills producing free sheet paper, the most profitable paper grade in this industry. With such model refinement, this research exhibits a significantly positive correlation between transaction cost and vertical integration.

The relevant research paper is “Does Market Concentration Motivate Pulp and Paper Mills to Vertically Integrate?” (Haizheng Li and Gewei Wang).

7. Computer Usage and Demand for Paper/Paperboard Products

This study is to analyze the effect of computer usage on the demand for paper and paperboard products, including four categories of paper, newsprint, printing/writing paper, packaging paper and household/sanitary paper. The analysis is divided into two parts. The first part is based on US monthly data. We create computer number index as a

measurement for computer usage. The results support the hypothesis that the increasing usage of computer has a significantly negative effect on the demand for printing/writing paper, and a significantly positive effect on the demand for packaging paper. But it doesn't provide clear evidence about the effect on the demand for newsprint.

The second part is based on the data from 16 countries, which constitute major countries for paper/paperboard consumption and with widespread usage of computer and the Internet. Using the yearly data from 1961 to 2002, we find that computer usage has a significantly positive effect on demand for packaging paper.

The relevant research paper is “Computer Usage and Demand for Paper/Paperboard Products” (Lei Lei and Haizheng Li)