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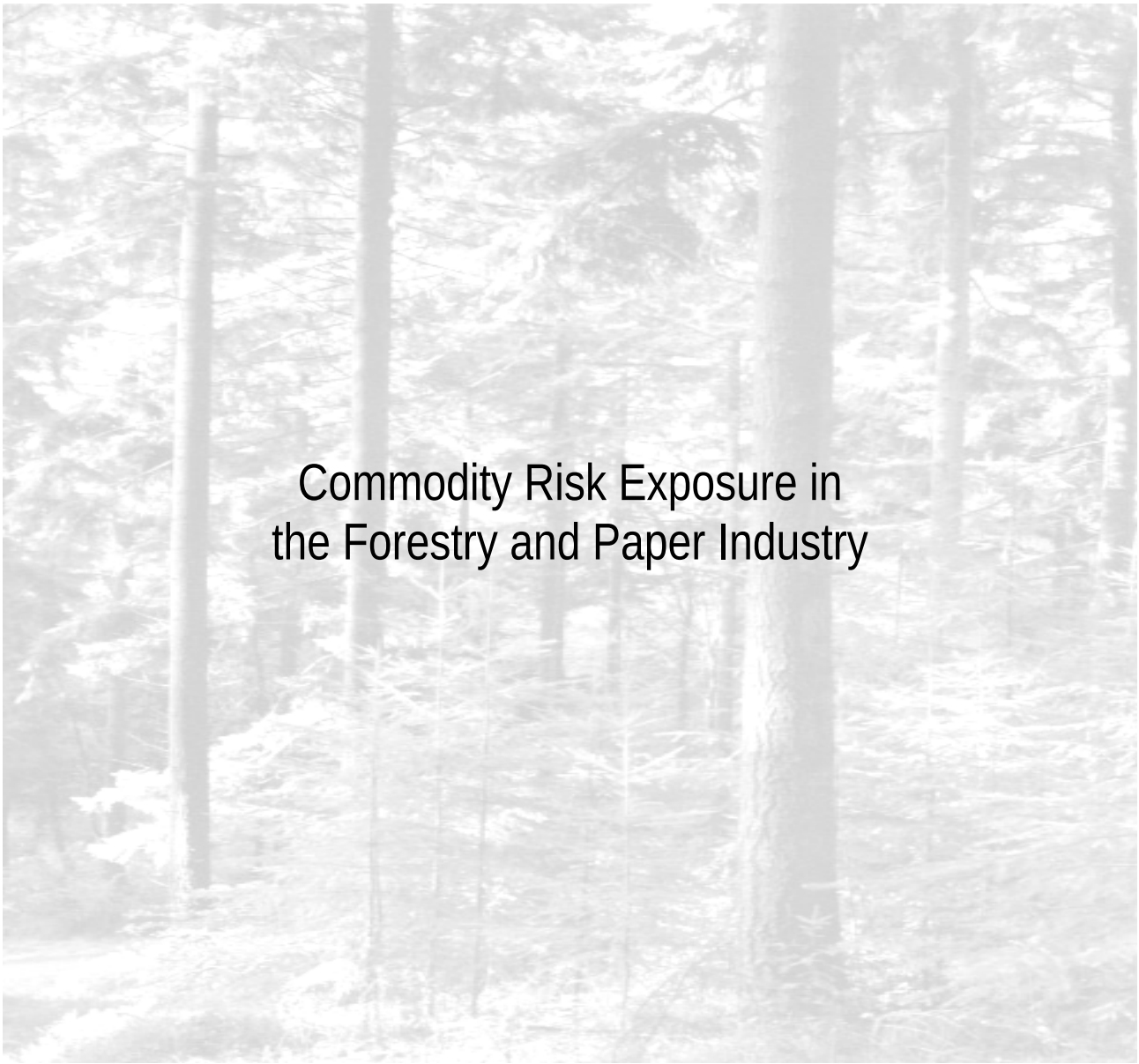

Commodity Risk Exposure in the Forestry and Paper Industry

Supervisor:
Göran Anderson

Authors:
Pia Albrecht
Carina Hugosson
Björn Lindberg

Abstract

Title: Commodity Risk Exposure in the Forestry and Paper Industry

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Authors: Pia Albrecht, Carina Hugosson and Björn Lindberg

Advisor: Göran Anderson

Key words: Risk Management; Commodity; Risk Exposure; Pulp; Timber; Energy

Purpose: The aim is to investigate what impact commodity risk exposure may have on the market value for Canadian, Finnish and Swedish companies within the forestry and paper industry.

Theoretical perspective: The theoretical perspective includes previous studies and important macro economical factors that will have an essential meaning for the interpretations and expectations throughout the thesis.

Methodology: With multivariate regressionanalysis we examine what impact the US dollar exchange rate, inflation, interest rate, pulp, timber and energy have on the market value for companies in the forestry and paper industry for a total of twenty years.

Empirical foundations: In our analysis we found that companies in Canada experienced the largest exposure towards commodity risks, while the exposure of companies active in Finland and Sweden was only minor.

Conclusions: Comparing companies on the Scandinavian market to companies on the Canadian market, the important commodities for the forestry and paper industry; pulp, paper and timber, does not seem the have any remarkable effect on the companies market value even though these are their main products.

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1. Introduction

1.1 Background

A company's risk management can concern both so called tactical risks as well as strategically. The former include commodity price risk, the latter concerns risks that affect the company in a long term perspective. Managing tactical risks often involves hedging using derivatives. (Meulbroek, 2002) A company that hedge themselves from tactical risks, i.e. commodity prices, is said to expect a zero net present value since hedging itself do not create value (Froot, 1994). What is said to be value creating is instead continuous risk management. Continuous risk taking and effective risk management can become a core competence and thus a sustainable competitive advantage (Chatterjee et al., 2003). Risk management that only occurs sporadically can instead have a destroying effect on the value on the company. Thus, a company's risk management programme is a factor that is crucial for the value of its equity and debt (Fehle & Tsyplakov, 2005).

During the last decades the use of derivatives has expanded to involve more specific commodities as an effect of an increase in the global commodity trading. The purpose has mainly been to find better solutions for both the sellers and the buyers to hedge their financial exposures against unexpected risks. But the need for risk management can differ from one company to the next. Some companies want to hedge their exposure against price movements, while others prefer to stay more strategically and gain value by using long or short positions to hedge against specific market conditions. (Finchem, 1998) A company's decision to hedge is determined by the exposure the company is facing and their choice of financial leverage. A study by Hentschel and Kothari (2001) regarding the derivative usage by US non-financial firms reveals that derivative-activity can be found in about 40% of the companies, while 53 % of the non-financial firms used it in Sweden (Hagelin and Alkeback, 1999), 75% in Canada (Jalilvand, 1999) and 64% in Finland. (Bartram, 2006) The non-financial firms use less derivatives compared to financial firms and derivatives used for commodity price risks is less common than hedging against interest rates and exchange rates, due to this study. This result is in line with other studies in this field (Bodnar et al. 1996), (Hagelin & Pramborg, 2006).

Commodities have historically had a high degree of price stability, while the stock market has been involving uncertainty and volatility. During the last decades of the 20th century, the commodity prices were barely moving. However, in the beginning of the 21st century, commodity prices generally had a strong acclivitous real price trend. Due to a demand from the world market in recent years there is a strong indication towards more expensive commodities in the future. One explanation to this would be the macro effects of fast growing economies in Asia and especially China. The fluctuations in the prices of some commodities during previous years have made financial analysts questioning what value hedging might have for different actors on the market. For a firm, dependent on commodity prices, this would raise a stronger interest in hedging. (Parker, 2005) Alan Garner (1989) notes that commodity prices tend to be closely related to the increase in the general price level and therefore affect the inflation rate. The reason behind this is that commodities tend to be important production inputs in industries and directly affect companies operating costs. Since many commodity prices are determined in auction markets they will also respond more rapidly to market changes of supply and demand, than other manufactured goods and services. Garner's analysis further indicates that changes in commodity price data can help improve forecast consumer price index and inflation rate to avoid demand pressures and supply shocks on the market.

The forestry and paper industry is capital intensive and its products are very homogenous. Differentiation is not possible for companies providing raw materials and to maintain low costs then becomes of great importance (Sadorsky & Henriques, 2001). Risk management in the forestry and paper industry has probably never been as complex as it is today. Another aspect of uncertainty in the industry is the long investment horizon. (Kangas & Kangas, 2004). According to Finchem (1998) the forestry industry is exposed to economical cycles that make uncertainty in commodity price volatility a constant concern. A way to manage this and create a higher value for shareholders, derivates could be used as a way to both increase future cash flows as well as reduce the market volatility, according to Finchem (1998). He also say that it is common that producers and consumers often sign long-term sales and purchasing agreements to reduce their risk exposure to price risk. Producers and their consumers compete globally today and the competition is intensifying. Furthermore, Finchem state that it is important to consider that commodity based derivatives behave differently compared to other financial asset based derivatives. One reason is that an

underlying asset like paper or pulp are seldom held as an investment and the companies that buys them either intend to use them in their production or sell them.

Companies in the pulp and paper industry could benefit from the following advantages in hedging their pulp prices: less bottom-line volatility; the financial risk of falling /rising prices can be reduced by using hedging as an insurance policy; easier and much reliable budgeting (Teräs, 1998). Sadorsky and Henriques (2001) found a positive relationship between commodity prices and stock return in the forestry and paper industry. They mean that via hedging commodity prices a better management of cash flow can be obtained. "Hedging exchange rate risk and commodity price risk would give the paper and forest industry more flexibility through better management of cash flow" (Sadorsky & Henriques, 2001).

1.2 Problem discussion

The studies that have been in the concern of commodity price exposure have mainly focused on industries as natural gas (Gezcy et al. 1999), oil (Haushalter, 2000) and mining (Chung, 2003; Tufano, 1998b; Petersen and Thiagarajan, 1997). Studies, aiming to explain what affects the market value of a company, are dominated by focus on exchange rate exposure and interest rate exposure (Bartram, 2007; Allayannis et al. 2001; Hodder, 1982). Bartram (2005) performed a study of 490 non-financial German firms regarding the degree of their commodity risk exposure. He found that commodity price risks are not affecting the stock return to greater extent than other financial risks and is not of importance. However, this study did not do any separation between different industries.

The products related to the forestry and paper sector involves a greater risk than the market and moves pro-cyclically. As a way to manage this and create higher value for shareholders, derivatives are sometimes used as a way to both increase future cash flows as well as reduce the volatility. A challenge facing the company is to create a risk management strategy on the basis on the type of exposure the company is facing and the risk-character of the management. (Finchem, 1998) Bartram (2005) states that commodity price exposure can be of both positive and negative character depending on whether the commodity is an input or an output factor and if it is hedged or not.

Using derivatives to hedge commodity price risks can reduce the variance in a company's earnings and increase the confidence to the company. The degree of variance in a company's

cash flow depends on the exposure they face against different variables, such as the market price variables price levels, exchange rates, interest rates and firm- and industry-specific variables (Oxelheim & Wihlborg 1997). A higher exposure will then automatically lead to higher variances in i.e. a company's cash flow or earnings. But what if the exposure only is minor? This raises a question regarding the necessity to hedge against the risk. Judge (2006) emphasise that previous studies (Haushalter, 2000; Tufano, 1998a) that focuses on the exposure to commodity price risks in the gas, oil and gold mining industry have not considered the hedging towards other risk exposures, such as interest rates and exchange rates.

1.3 Question

How severe is the risk exposure towards commodity prices for companies in the forestry and paper industry? And to what extent does this exposure differ between the greatest countries within this industry? How could the companies handle their exposure in the context of optimal hedging?

1.4 Purpose

We aim to investigate the risk exposure against commodity prices in forestry and paper industry. The intension is also to study the affect that the changes in commodity prices has on a company's market value.

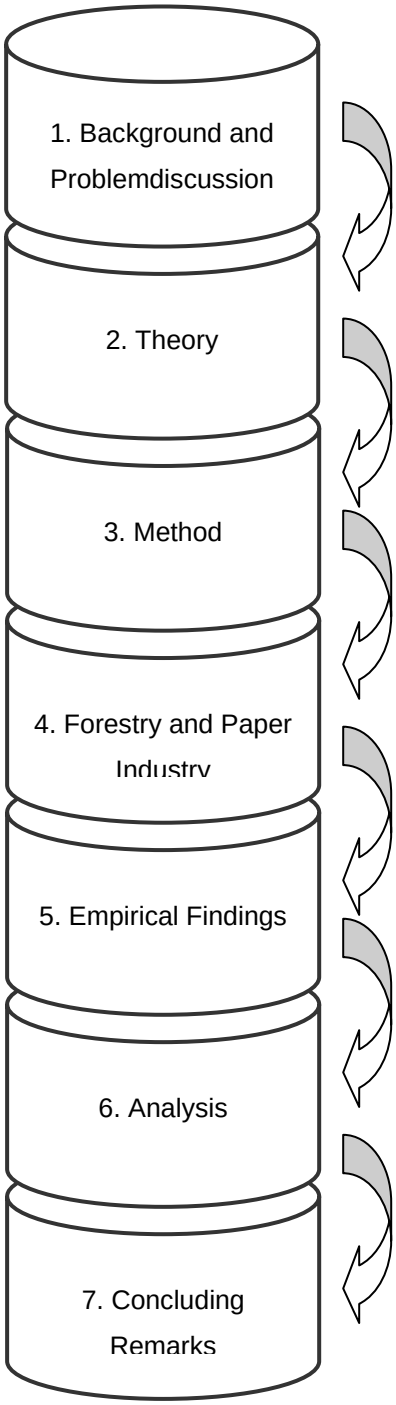
1.5 Limitations

We will limit this thesis by only considering public companies within the forestry and paper industry in Canada, Finland and Sweden, whereas these countries are the largest exporters within this industry (Skogsindustrierna, 2006). Furthermore our intention is not to create any hedging strategies for the companies exposed; we only want to acknowledge what options the companies might have.

1.6 Contribution to existing audience

The study might be of importance for companies within the forestry and paper industry when they seek to maximize their shareholder value and decide whether to hedge or not against commodities.

1.7 Thesis outline



These sections give an important introduction to the topic this study is handling and the problem being explored.

The theory will treat the different areas of risk and how risk exposure can be handled by a company.

A clarification of the method we chose to use, to collect and handle the data is presented in this chapter.

A brief overview will be introduced of the forestry and paper industry to give a better understanding of how the industry works.

The quantitative data are displayed and summarized in order to clarify the actual findings.

The received quantitative data are compared to the findings in other studies and to the existing theroretical findings.

Here, we draw a conclusion of the analysis of our findings.

2. Theory

2.1 Risk

Risk define a situation where there is not just one possible outcome and were we can assume to make reasonable estimates of the probability for each of the possible future outcomes. Furthermore, these possible outcomes can be estimated on the basis of either objective or subjective probabilities or even a combination of the two. The probabilities can then give a guideline to what to expect in terms of a positive or negative outcome concerning the investment. (Hertz, 1979). Risk could be defined as the uncertainty or volatility of a company's value against financial and economic exposure. To help stabilize earnings and budgets, hedging could help bring flexibility to financing and help reduce operating costs.

Hollein (2003) discusses different steps of importance when dealing with risk management and what a company should find to be an acceptable level of risk. According to her studies it is important to identify the size and the type of risk to which the company is exposed in order to develop a strategy that deals with the risk that has been determined. This risk can then be evaluated and examined for a future forecast of hedging strategies. When it comes to the company's ability of constructing risk management programs, more than 90 % of them are centralized. Meaning that a corporations headquarter develops a strategy that includes all the subsidiary companies and their financial risks and exposures. (Hollein, 2003)

When measuring the risk, companies usually tend to use different key ratios as a way to compare and evaluate results. By using ratios like profit margin and total debt ratio among others they are able to compare themselves against related competitors within the same industry. According to Kallman (2005), the objective definition of risk within finance and statistics usually incorporates three specific variables, where the "risk is the variation from the expected outcome over time". The expected outcome is the first variable and is based upon the average of previous situations to enable a forecast of future outcomes. Managers could basically add up the number of past observations and then divide these by the number of observations to find out if the average of the past outcomes equals current outcomes. The second variable includes the variance which is the square of standard deviation, concerning the range of outcomes and the standard deviation between them. The range is further

representing the spread between the lowest and highest possible outcome. The third variable is the time in aspects of timing and duration of losses of an outcome. The time limit of how long a loss will occur is of major importance when determining the total cost of the loss. (Kallman, 2005)

2.1.2 Macroeconomic risks

Macroeconomic Risks, affecting a companies cash flows (hence, then also the value of the company) are identified by Oxelheim and Wihlborg (1997). The risks are unanticipated changes in these variables. Macroeconomic risk can be related to uncertainty in the environment of all firms and the exposure to these risks is firm-specific.

2.1.2.1 Interest Rate Risk

The interest rate risk defines the risk to market value of a certain portfolio due to uncertainties concerning the future of the interest rates. A change in the absolute level of the interest rate tends to affect the risk variability of future value. Managing the interest rate may also help a company to gain a better position towards competitors who are not as active with handling their financial risks. It can also help predict a more stable future cash flow and reduce the risks of macroeconomic shocks. When it comes to the European interest rate, it has experienced an overall low and stabile rate during recent years. But whether this is to continue or not raises important considerations for the majority of companies that are affected by the long-term interest rates. Andrews (2005) states that a companies debts should be evaluated at least every sixth months over the whole lifetime as a way to enable the risk management of debt borrowing. Due to the less fluctuating interest rates in Europe, most companies have been able and chosen to keep their loans on a variable rate. A possible protection for future upward movements in interest rates could be using different hedge products. But these may also create a loss if the opportunity cost should fall below the fixed level. Another thing is the “break cost” that appears if a company decides to break the contract and repay the loan earlier. (Andrews, 2005)

2.1.2.2 Exchange Rate Exposure

Oxelheim and Wihlborg (1997) make a distinction between exposure of a firm's commercial operations and the exposure of financial assets and liabilities. The total exchange rate exposure to the firm is the sum of these two parts. Exchange risk can be priced in the international financial markets. According to International Fisher Parity the risk premia on the foreign currency and domestic currency should be equal to obtain an equilibrium relationship, then there is no risk premium and the IFP theory holds. The firm's size, multinational status, foreign sales, international assets and competitiveness, and trade at the industry level, are correlated with firms exchange rate exposure. Companies with international activities are more likely to be exposed to fluctuations in exchange rates. One purpose in founding a mutual currency such as the euro was to eliminate uncertainties in relative prices and exchange rates. Movements in the exchange rates have an impact on firms, but which firms are affected and on what level depends on the specific exchange rate and varies over time. (Dominquez & Tesar. 2006) Exchange rate risk affects on the stock prices and cash flows are similar and identified by related set of economic factors. These factors are consistent with economic theory and anecdotal evidence. (Bartram 2007) There is also a positive relationship between volatility of exchange rates and stock prices, which is in line with the exchange rate exposure.

A firm can implement risk management through operational hedging, which means by the location and the structure of operations, a firm's ability to respond to currency movements through modifying the operations. Implementing risk management through operational hedging will reduce the long- term impact of exchange rate changes on firm value. Firms' reasonable reaction to the exposures might lead to no exposure at all or the exposure is minimized. (Bartram & Bodnar 2007)

2.1.2.3 Inflation Risk

Inflation is a permanent increase in the overall price level and can therefore not be in the control of a manager and is integrated with other macroeconomic variables. (Doyle et al. 1994). Inflation is mostly driven by increases in wages and the marginal costs of a company (Campolmi & Faia, 2006) and is often measured by the known consumer price index, CPI (Silver, 2007). The higher costs are a result of more expensive commodities which can cause

an inflationary environment. Carlstrom and Fuerst (2007) publishes results that states that inflation have a negative effect on share prices and profits, since it increases a company's costs which in turn leads to lower dividends and thus share prices. They measure this by the change in expected inflation's effect on the log deviations in share price. This correlation between inflation and share price has also been noticed in studies by Fama (1981) and Gesky and Roll (1983), among others.

The inflation is also a driver of exchange rate movements according to the relative version of the purchasing power parity (PPP). It can also be the other way around, that the exchange rate has an impact on the domestic inflation because depreciation results in higher import prices and thus, a higher domestic general price level. (Bartram et al, 2005) The inflation is also affecting the interest rate since the nominal rate is determined by the inflation and the real rate, according to the Fisher parity. As a result, hedging inflation risk can be difficult to perform since it is difficult to isolate. However, hedging inflation risk can be done for instance by investing in so called Treasury Inflation Protection Securities, a U.S. consumer price index. These securities increase with inflation and decrease with deflation. (Herbst & Wu, 2008)

2.1.2.4 Country Risk

As the global competition increases, managers are searching for ways to lower the uncertainty when entering new unfamiliar markets. This demands certain knowledge about not only what will happen today but also what to expect in the future in aspects of economic and political events. A common approach to evaluate this situation is to investigate the country risk, which will help predict periods of instability and uncertainty. The main target of measuring country risk is to forecast economic and political events in a country that could, "affect the business climate in such a way that investors will lose money or not make as much money as the expected when the investment was made" (Howell, 1998). There is a general sense throughout the literature that country risk exposure is the result of political, economic and social factors. The problem concerning these three variables is that they are highly correlated and therefore often compounded into one single index. This makes it somewhat difficult to determine which one of the variables actually has the highest correlation with risk. Regarding the political risk analysis which involves conditions and events that could affect a company's international business, it can be divided into micro- and macro-risks. Where the

first is referring to selected firms and industries and their exposure to political environmental changes in a country, and where the macro-risk is referring to unanticipated and political changes for all foreign enterprises. Because of this the macro economical risk analysis are often more useful in order to include all firms in a certain industry and country. Ibrahimi et. al. (1989) mentions that the present value indicates that the stock markets in different countries of the world do not have to be highly correlated even in an integrated world. This mainly because the industrial structure differs for each country and therefore affects the sensitivity of cash flow. (Ibrahimi F, et.al., 1989)

When it comes to the economic factors that can affect the country risk, this is related to the macro-economic policies for each given country. In this case a country with a sound monetary policy and a low unemployment, along with a low inflation could be a good example of how to enable to lower the country risk. If a country's conditions on the other hand should experience instabilities along with an increasing unemployment and inflation, the country risk increases. Another relevant issue affecting the country risk is the stability of the currency, which can be affected by both economic and political events and result in a more fluctuating currency valuation. Currency risk is also considered to be one of the most important financial risk variables when it comes to the overall country risk exposure. (Geczy et al., 1997; Allayannis & Weston, 2000). Other theories concerning the country risk states that when a country is experiencing changes that are gradual or continuous, the future trends are usually expected and anticipated. (Oetzl et al., 2001)

2.1.2.5 Commercial Risk

Commercial risk can be explained according to Oxelheim and Wilhborg (1997) as unanticipated changes in firm- specific conditions and as in industry-specific prices and demand conditions. Assets that are used to produce firms output of goods is the substance for commercial risk. For non-financial firms commercial risk is called operation risk or business risk, which refers to firm's physical assets and their ability to produce value. Firms' liabilities have significant part in risk management because the formation of liabilities can be arranged in order to balance the commercial risk. A firm's ability to manage commercial risk is affected by other macroeconomic risks. Firms handling with international trade can be exposed to commercial risks.

Total risk is the sum of business risk and financial risk. Business risk is the risk type that often remains unhedged. The reason is that a risk becomes an appealing factor only when you are paid to assume it. Variance of operating income over time can be used as a measure for business risk, which will rely mostly on industry-specific practices. Volatility is one of the common methods to measure risk; business risk can be divided in two parts: sales variability and operating leverage. Sales variability and the degree of operating leverage have an impact on the volatility of operating income. (Howe, 1991) Operational risk can be measured in terms of economic loss, legal risk, business obstruction which can be related to indirect expenses and intangible costs. (Davidson, 2001)

2.2 Portfolio theory

2.2.1 Portfolio selection

In portfolio theory, risk is measured by the volatility of the assets and the investors strive after creating a portfolio with lowest possible volatility, given the same return. The so called efficient frontier provides the investor with all possible portfolios having the lowest variance given a certain level of risk or the maximal return given a certain level of variance (Markowitz, 1957). Markowitz states that "the portfolio with highest likely return is not necessarily the one with least uncertainty of return". And to reduce risk, it is of significant importance to avoid highly correlated securities (Markowitz, pp.5, 1959).

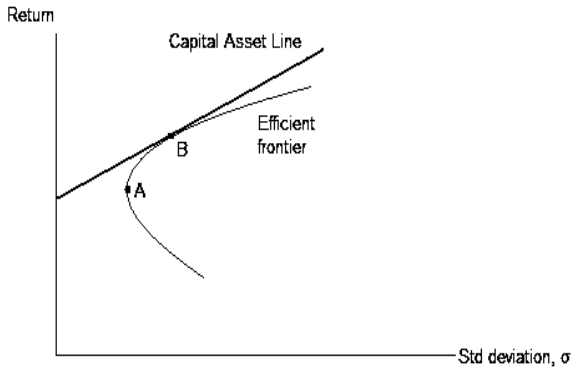


Chart 1: "The Efficient Frontier"

Point A at the efficient frontier in figure X is the global minimum variance portfolio, i.e. the portfolio that has the lowest variance of the observed. (Elton et al., 2003) The global

minimum variance portfolio is also the only portfolio at the efficient frontier where the asset weighting do not depend on the returns of the assets (Kempf & Memmel, 2003). Markowitz explains why this point is efficient: the portfolio has the smallest variance of all and therefore a higher return cannot be expected unless increased risk and given the expected return, a smaller variance is not possible (Markowitz, pp.140, 1959).

Minimum variance portfolio with only two assets:

$$X_1 = \frac{\sigma^2_2 - \sigma_1\sigma_2\rho_{12}}{\sigma^2_1\,\sigma^2_2 - 2\sigma_1\sigma_2\rho_{12}} \tag{1}$$

Equation X solves for the amount of asset X_1 the portfolio should consist of in order to minimize the variance. The amount of asset X_2 is $(1\text{-}X_1)$ (Elton et al., p.75, 2003).

The efficient frontier can be extended by allowing investments in a risk free asset and short selling. This provides us with the Capital Asset Line where possible combinations of the risk free asset and portfolios can be found. The optimal portfolio, also called market portfolio, is located at the tangency point, B, between the capital asset line and the efficient frontier. (Elton et al., p.84, 2003) The possibility to invest in a risk free asset will lead to the notion that all investors will hold an identical combination of the risky assets, according to Tobin's separation theorem (Tobin, 1958). The proportion of risky assets in the combined portfolio, X, is obtained by

$$X = \frac{\sigma_c}{\sigma_A} \tag{2}$$

where σ_c is the variance of the portfolio of risky assets and σ_A is the variance of the risk free assets. The proportion invested in the risk free asset is (1-X) (Elton et al., p.85, 2003).

Before calculating the efficient frontier, the portfolios' assets need to be specified. Some problems arise due to uncertainty regarding the future. By reason of inflation, a pure risk less asset cannot be found and the assets' return and risk characteristics are not self-evident to be static. There are also uncertainty regarding changes of correlations and the time horizon, which might have an impact on the optimal allocation. (Elton et al., 2003, p88ff) The

parameters needed are unknown and need to be estimated. Using historical data might then be the only solution (Kempf & Memmel, 2003).

2.2.2 Hedging

In 1960 Johnson explain the theory of hedging as following: *"... the hedger as a dealer in the "actual" commodity who desires "insurance" against the price risks he faces. ...if he purchases a unit of the commodity at a given spot price and then the price falls (rises) prior to his reselling it, he is exposed to a capital loss (gain). ...he would typically protect his inventory position of x units from the risk of such price fluctuation by simultaneously selling a sufficient number of future contracts to cover delivery of x units; when he resells his inventory he would simultaneously liquidate his position in futures by purchasing the same number of contracts as before".* 20 years later Smith and Stulz (1985) define hedging as a trading in a particular future, forward or option market. To do this a firm does not need to hold a distinctive cash position in the underlying commodity. Modigliani and Miller (1958, 1961) state that risk management is irrelevant to the firm and that shareholders can hedge on their own. They also argue that a company creates value only when they are making good investments which will lead to the increase of operating cash flows. (Modigliani & Miller, 1958, 1961) Hedging can be considered as a zero net present value (NPV) decision. This assumption will require that the markets are efficient and transactions are costless, also the assumptions of Miller and Modigliani should hold. Under these circumstances a value of hedge will be zero. Because utilizing a hedge is extremely expensive it will make hedging as a negative decision (Nelson et. al. 2005). The existing theories are presuming that hedging itself is not value adding to the firm, instead using of derivatives can be considered value adding by relieving the variety of market imperfections through hedging. (Adam & Chitru, 2006).

Instabilities on firms' supply and demand for funds affected by changes in exchange rates, commodity prices, and interest rates. Might be reason for aggressive hedging and if there is no impact to the supply and demand for funds, hedging could be minimized because the firm has a natural hedge. (Froot et al., 1994). According to Smith and Stulz (1985) a firm that seeks value-maximization should hedge for three reasons; taxes, cost of financial distress and managerial risk aversion. Hedging should be considered as part of corporate financing policy. Derivative using can also be connected to firms' financial characteristics, such as leverage,

debt maturity, holdings of liquid assets, dividend policy and operational hedges. (Bartram et al., 2006) The pricing of risk in financial market is an important part of risk management. Pricing the risk will give the cost of reducing the exposure in financial market. (Oxelheim & Wihlborg, 1997).

2.3 Previous studies

Sadorsky and Henriques (2001) investigated the relationship between various risk factors and the impact these had on the stock return for the forest and paper products in Canada between the years of 1974-1998. The results from the analysis indicate that the stock return was sensitive and impacted by several factors such as market, commodity price and exchange rate. An increase in the market or commodity prices increased the return to Canadian forest and paper products stock prices, while an increase in exchange rate decreased the return to Canadian forest and paper stock prices. The study also shows that fluctuations in the short run interest rate do not have any significant impact on the overall return for Canadian forestry and paper products stock prices. Furthermore the forestry and paper sector is known for being riskier than the market in general and to move pro-cyclically. Fluctuations in the value of the Canadian dollar relative to other foreign currencies are therefore important for the forest and paper industry because of the nature of high competitiveness and export of the products.

Bergman and Johansson (2002) analyse macroeconomical factors impact on the investment decisions for European companies in the paper and pulp industry between the years of 1988-1997. They find that the exchange rate and the price of paper as well as the production capacity to be of vital importance for the valuation of the company and the investment decisions. They also noticed that the market size for each country had little or no affect.

Thorp (2006) and Frandina and Prevost (2007), claims that managing the energy costs is critical for forest companies in order to compete and survive in the long run. Since 2001 they have observed the energy costs continue to rise and affect the profits for many companies in a negative way.

Akay et. al.,(2006) studies what impact different macro economical factors have on the import of forest products between the years of 1985-2002. The result shows a significant correlation between the currency rate and the size of import and export of forestry products.

Furthermore, increases in the income per capita and in the prices of domestic forest products results will increase the forest industry products import. While export of forest industry products and national currency devaluation by US dollar causes decrease in forest industry products import." (Akay et al., 2006)

3. Method

3.1 The Sample

Our analysis of the commodity price exposure for public companies within the forestry and paper industry will be investigated between the years of 1988-2007. The sample is gathered from DataStream and contains companies from Canada, Finland and Sweden. The criterion for the sample was to be a part in the Forestry and Paper industry (FSTPA). While we are going to examine the effect of commodity price changes on the companies since 1987, the sample contains all companies being traded during this period. Hence, they do not need to have been traded the whole time and the sample therefore also consists of companies that are not active today so the phenomenon called survivorship bias[1] can be avoided. These criteria results in a sample of 55 companies. The reason why we have chosen a period of 20 years is that we wish to study as long period as possible to maintain a high validity on our result. It is also a long term perspective that is of interest for both the investor as well as the strategy of the companies. An even longer period would have raised problems concerning lack of data.

3.2 Statistical Model

3.2.1 Regression analysis

The basis for this study will be a multiple regression analysis, using time-series as inputs. Regression analysis are suitable when measuring exposure and the coefficients can be seen as exposure coefficients if they are stable over time (Oxelheim and Wihlborg, 1987) Calculations are exercised via the statistical software eViews to receive the individual companies ex post sensitivity towards commodity price risks. A multiple regression analysis will make it possible to use more than one variable that can explain, in this case, change of the market value of the companies.

Multiple regression model (Elton et al., p. 148, 2003):

$$y_t = \alpha + \beta_1 xt_1 + \beta_2 xt_2 + \ldots + \beta_k x_{kt} + e_t \qquad (3)$$

[1] *Survivorsip bias is the tendency for failed, or no longer existing companies to be excluded in a study, leaving only succesful companies to be studied.*

The model shows how the dependent variable y_t, is explained by the explanatory variables x_{t1}, x_{t2},..., x_{tk}. The magnitudes of the explanatory variables effect on y_t are revealed by each β, the explanatory variables' coefficients. The α is the intercept of the regression model and e_t is an error term that explains what cannot be explained by the model itself.

Monthly data will be used in order to obtain observations. Using a higher frequency would have given us more observation, but CPI and the commodity prices are not available at daily frequencies.

3.2.2 The Dependent Variable

The dependent variable is the market value (MV) of the company. In order to identify the impact of the explanatory variable, the market value cannot be an absolute value but instead calculated as the daily returns. Using a company's MV as the dependent variable is utilized in studies by e.g. Tufano (1998b) and Bartram (2005) based on that the MV reflects the effect a price change in an output variable has on a company's cash flow. The use of a company's MV also contributes with more observations, while a company's cash flow for example only would be observable quarterly. The daily change in the MV is calculated by dividing the *ln MV* today by the *ln MV* yesterday:

$$\Delta MV = ln\ MV_t - ln\ MV_{t-1} \tag{4}$$

Transforming the dependent variable by taking the logarithm of market value is due to a strive for stabilising the variance (Matson and Huguenard, 2007). Several companies are being studied for a time period of 20 years; the transformation will moderate extreme price changes.

3.2.3 The Explanatory Variables

The explanatory variables are chosen on the basis of the market price variables presented in Oxelheim and Wihlborg (1997): exchange rates; inflation rates; interest rates; relative prices. They state that depending on the study's purpose, these can differ somewhat so a high explanation as possible can be perceived. Thus, investigating the forestry and paper industry as base for this study, there is a need to identify specific industry risk variables. Since this

forestry and paper industry are highly exposed to several commodity prices, the commodities have to be identified and separated into individual items. The explanatory variables are discussed below.

Exchange rate

The exchange rates required are: CAD/USD; SEK/USD; EUR/USD. Before joining the EMU and implementing the Euro, Finland's currency was the Finnish Markka. To solve this problem the Finnish Markka before 2002 is recalculated by FIM/USD. The exchange rates are all having the GTIS rate, i.e. the exchange rate quoted at 18.00 New York GMT by Global Treasury Information System. The exchange rates used are nominal. If one variable in the regression is real, then all the other variables also have to be denominated in real terms and since these are highly correlated, the effect they have on the company's market value will be similar (Khoo, 1994).

Inflation

The companies that operates within the same country are also facing the same inflation, thus, the inflation can differ between countries. Therefore, the national CPI of Canada, Finland and Sweden are used. The inflation is included since it reflects the general price level in their respectively home country and has an impact on the profits of a company via change in costs and demand. This in turn affects the market value and is included in studies by Kavussanos et al. (2002) and Ibbotson and Chen (2003).

Interest rate

Long-term interest rate is a market condition and cannot be excluded from the regression, it affect the market as a whole where the companies are operating. The middle rate of a US 10 year T-bill is used, which is common in when measuring commodity price exposure (Tufano, 1998b; Tufano, 1998a).

Energy Index

The forestry and paper industry is also affected by the prices of energy. The production needs, among others, oil, bio fuel and electricity to run. In Sweden, the paper and forestry industry account for a fifth of the total power consumption (Skogsindustrierna, 2008-04-20). Since companies use many different energy sources, and while this exposure is not an object

in our study, an international energy index will be used as input. DataStream provides us with time-series data of Reuters CRB Energy Index. The Reuters CRB Energy Index contains heating oil, crude oil and natural gas whose last settlement prices composes the index' price. (Reuters CRB Index: electronic)

Pulp prices

Commodity no.1: RL-Western SPF #2& Btr 2X4 R/L Mill[2] (LUMWSPF)

The commodity price of timber of coniferous trees processed in mills is issued by Random Lengths, an independent company that provides reports on prices, activities etc in the wood industry. The price of LUMWSPF is based upon the prices settled by producers and customers during a week and is an indicator of the current price. (RandomLength)

Commodity no.2: NBSK Pulp (CIF W. Europe) U$/MT

The NBSK Pulp[3] is mainly traded in Canada and in the Nordic countries and is the benchmark for the industry's grade of pulp (Pulpwatch).

We are aware of that paper is not represented among the explanatory variables, which could be expected when studying the forestry and paper industry. However, there is a lack of enough historical data available for the public and since paper is made out of pulp, paper can be considered be represented indirectly.

3.2.4 Modified Model

The model used in this study is the following:

$$R_{it} = \beta_1 EIndex_t + \beta_2 CPI + \beta_3 FX + \beta_4 CIndex + \beta_5 C1 + \beta_6 C2 + ...\beta_k CK \qquad (5)$$

R_{it} is our dependent variable, the market value of firm. The variable is derived from the monthly stock return. Eindex is the energy index while the $CIndex_t$, is an index based on commodities. CPI is the inflation and the companies will be regressed with their national CPI. The CK:s represents the commodities we will test the exposure for.

[2] SPF = Spruce – pine – fir
[3] NBSK Pulp = Northern Bleached Softwood Kraft Pulp.

Table 1: "Variable definitions"

R_{it}	monthly Δ in the stock's market value
FX	monthly Δ in the exchange rate
IR	monthly Δ in US T-bill middle rate
CPI	monthly Δ in national CPI
EIndex	monthly Δ in Reuters CRB Energy Index
C1	monthly Δ in NBSK Pulp cash price
C2	monthly Δ in RL Western SPF cash price

3.2.2 The Problem of Multicollinearity

Multicollinearity arises when the variables used in a model are highly correlated. Since some of the variables move together in the existence of this phenomenon, there are difficulties in separating the individual effects on the dependent variable. The variables that are correlated can be said to actually show the same information.

In order to detect if multicollinearity exists, we examine the correlation matrix and the variance inflation factor (VIF):

$$VIF = 1/(1 - \rho^2) \tag{6}$$

where ρ^2 is the squared correlation coefficient. (Hsieh et al, 1998) If the VIF is larger than 10, there exists a risk of multicollinearity (Marquardt, 1970) Using the inverse of equation (5), the squared correlation, ρ^2, should not exceed 0,8 or in other words, $\rho < 0{,}89$ ($\sqrt{0{,}8}$).

3.2.3 The Problem of Heteroskedasticity

The unobservable error in a regression, e, should have a constant variance, otherwise the variance of the dependent variable would change as the explanatory variables changes. Heteroscedasticity exists when the variance is not constant for all observations. The existence of heteroscedasticity results in unbiased estimators and incorrect standard errors. It can result in incorrect conclusions and a belief that variables are significant when they actually are not, and vice versa. To test for this phenomenon, White's test can be performed.

Heteroscedasticity exists if the probability of the calculated White's value[4] is lower than the significance level.

3.2.4 The Problem of Autocorrelation

Autocorrelation arises when the error terms, e, from a regression are correlated. This problem can also be called serial correlation. If autocorrelation exists, the estimators are not efficient and the standard errors are biased. However, the estimators are still unbiased. The existence of autocorrelation can danger the interpretation and validation of the model since the *t*- and *F*-test and their respective *p*-values cannot be trusted. (Jaggia & Kelly-Hawke, 2005). Autocorrelation can be detected by the Durbin-Watson test (DW). The critical regions of the Durbin-Watson test lies between 0 and 4. Zero represents positive autocorrelation, four represents negative autocorrelation and two means that there is no autocorrelation. If the Durbin-Watson is below one then there is cause for alarm. (Amir & Aczel, 2002)

The Durban-Watson test statistic is:

$$d=\frac{\sum^{n}_{i=2}(e_i-e_{i-1})^2}{\sum^{n}_{i=1} e^2_i} \tag{7}$$

Where, e_i is the residual associated with the observation at time i and n is the number of observations.

3.2.5 The Coefficient of Determination, R^2

R^2 represents the multiple coefficient of determination that measures the proportion of variation in the dependent variable. This variable is furthermore explained by the combination of the independent variables in the multiple regression models. R^2 measures how well regression model fits the data, goodness of fit of a model. The coefficient of determination is a measurement in the percentage of the variation in Y that is explained by the X variables. In the correlation analysis the X and Y variables are assumed to be random variables, where the multiple correlation coefficients R are a measurement of how strong the

[4] In eViews output White's value is recognized as Obs*R-squared

linear relationship is. If R^2 equals 1.00 or 100% this indicates that the line of regression perfectly fits the data. (Amir & Aczel, 2002),

$$R^2 = SSR/SST = 1 - SSE/SST \quad (8)$$

Where, SSR is the sum of squares, SST is the total sum of squares and SSE is the sum square errors.

3.2.6 Newey West

If we detect that multicollinearity and heteroscedasticity are present we will estimate all regressions with the help of the Newey West-method. Applying this method when regressing it will provide us with consistent estimates. (Verbeek, 2004)

3.2.7 Chow's Forecast Test

To test the usefulness of the models from the regressions, Chow's forecast test will be performed. This test estimates a model based on a number of observations, this model is then tested whether it can predict the values of the dependent variables. The smaller difference between the predicted value and the actual, the more valid is the model. The F-statistic of this test is calculated as follows:

$$F = \frac{(\bar{u}'\bar{u} - u'u)/T}{u'u/(T-k)} \quad (9)$$

where ū'ū is the residual sum of squares of all available observations and u'u is the residual sum of squares of the observations on which the model is based. If the statistical F-value > critical F-value, or the $p<0.05$, the current model cannot provide us with value that do not differ to a larger extent from the actual value. The model is then not useful in predicting values. (Thomas, p.441, 2005)

We aim to test the companies' models by their capacity to predict the companies' last active year. For companies still active 2008, the tested year is therefore 2007. Since we aim to have as valid models as possible, we do not test the forecast capabilities unless the number of

observations is high enough. To receive valid results the number must be >30 (Körner and Wahlgren, 2000) we therefore decide to base the models on at least 4 years, and predict the last year. This results in a criterion where the companies have to been traded minimum 5 years. Our final sample is therefore 39 companies and they are presented in appendix 1.

3.3 Optimal Hedging Ratio

Ederington (1979) presents a portfolio model where spot market holdings, X_s, are to be treated as fixed and the question is how large portion of the stock is going to be hedged. His model results in a hedge ratio where the variance is minimised. The proportion of the portfolio being hedged, i.e. taken in futures contract, *b*,* according to Ederington's model is calculated as follows:

$$b^* = \sigma_{sf}/\sigma_f^2 \tag{10}$$

where, σ_{sf} is the covariance between the returns of the future and the spot price and σ_f^2 is the variance of the return of the future contract. (Ederington, 1979), from time t-1 to t.

$$\Delta S_t = lnS_t - lnS_{t-1} = R_{s,t} \tag{11}$$

$$\Delta F_t = lnF_t - lnF_{t-1} = R_{F,t} \tag{12}$$

The future price of timber is represented by the CME Random Length Lumber Future. A time-series of future prices of pulp is however not publicly available during the current time frame. We therefore chose to use the available future price of a CPW Wood Pulp future with maturity of 110 days.[5] A future, assuming no possibility to arbitrage, is calculated the following way:

$$F_t = S_t e^{(r-c)T} \tag{13}$$

where F_t is the forward rate at time t. The forward rate is determined by the spot rate at time t discounted by the risk free interest rate from the forwards maturity T when t=0, otherwise T-t. (Schwartz, 1998) However, c is the convenience yield, i.e. the adjustment of the cost of

[5] The futures are presented in Appendix 2

carry the commodity, and since we do not have this information it has to be excluded and assumed to be zero. Using equation (13), the future prices for a CPW Wood Pulp future can be calculated back to 1988/01/15 with a risk free interest rate with a duration matched with the length of the contract. In this case a 6 month Treasury Bill. A complete match with the duration of the contract, 110 days, is not possible to make since there is no such maturity to be found.

3.4 Validity

We have chosen to perform OLS regression with a company's market value as dependent variable. Based upon previous studies, we can consider this method to be valid for this kind of analysis. The time period of 20 years, is to indemnify the validity of the test results, and prevent economical cycles which might affect our results and analysis in a misguiding way. We have also excluded companies that have been active less than five years, to avoid temporary trends in the market. We have decided to use monthly data; using lower frequent observations can danger the validity of the exposure measure of companies that only are traded during a limited period. The results from those companies would incorrectly only rely on very few observations. However, Scholes and Williams (1977) states that using daily data can give biased results if the stocks traded are illiquid. This problem results in a trade-off where we decide to use monthly data.

For the validity of the analysis we have chosen to test our data for possible multicollinearity, heterososcedasticity and autocorrelation. We have used White's test to detect heteroscedasticity, and in the case of autocorrelation, the Durbin-Watson test is perfomed. For the companies that were affected by multicollinearity and/or heteroscedasticity regressions were estimated with Newey West method to obtain more valid results. We also performed Chow's forecast test to secure the usefulness of the models from the regressions. For the possible autocorrelation and proportion of variations in the dependent variable are also taken in consideration. Both Durbin-Watson test and the coefficient of determination, R^2, are included in Newey West regression method. After all these precautions we believe our analysis can provide us with valid results.

The strength of the significance of the regressions is not taken into consideration, because of the small amount of companies, especially for Finland and Sweden. For the validity we

emanated from the *p-value* and chose to include all companies that has proven to be significant under the level of 5%, regardless of the strength.

3.5 Reliability

The reliability will depend on what measures we conduct and how careful the information is being processed. Concerning this matter we have chosen to secure our research by being extremely critical regarding all the companies information that has been gathered from DataStream and Reuters 3000Xtra. Information from these databases are considered being trustworthy. We have also collected information from the respective countries forestry organisations homepages to receive a wider insight of the forestry and paper industry. To strengthen that we have applied the right methods to perform a study like this we have collected information from different researchers and their previous studies.

The chosen variables are the largest factors in this industry and therefore it is crucial for the reliability that they are included in this study. Paper is not covered as a specific variable because of lack of relevant data for our chosen countries and the information that was available concerning paper would have jeopardized the reliability of this thesis. Previous studies by Oxelheim and Wihlborg (1997) have identified the macroeconomical variables that we have covered in our analysis, so we can assume that our financial variables are reliable.

The regressions are run through statistical software program eViews, the result from the regressions are therefore reliable. The small number of companies for Finland and Sweden makes it some what harder to draw any solid conclusions concerning the exposure in these countries. On the other hand we have included all the available public companies that have fulfilled our requirements for this study; that is companies with activities for more than five years.

4 The Paper and Forestry Industry

4.1 Industry

The greatest countries in the forestry and paper industry are Canada, Finland and Sweden. Among the countries, Canada is the largest exporter of pulp, paper and wood. However, the export of paper is very similar to both Finland and Sweden. The both Nordic countries, Finland and Sweden do have a very similar export, Sweden exports only slightly more when it regards pulp and wood.

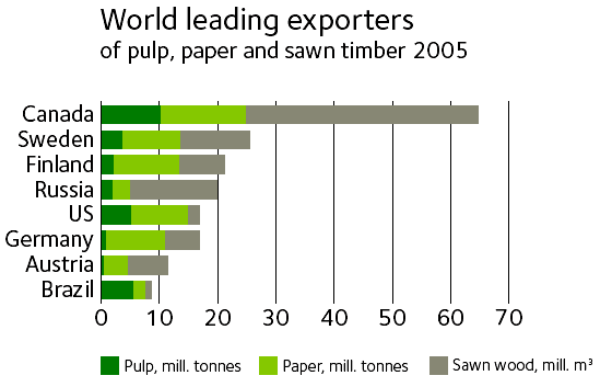


Chart 2: World Leading Exporters
Source: Skogsindustrierna, 2006

The forestry and paper industry have had different developments during the last 20 years in Canada and Europe. Chart 1 below expresses the industry's growth in both markets from 1988 to may 2008, rebased to the starting date.

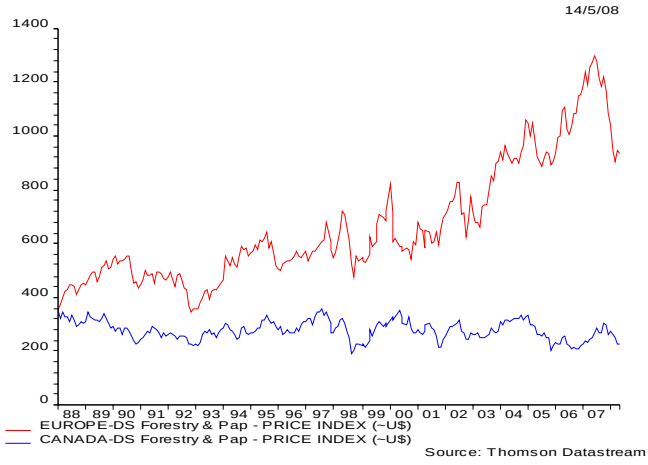


Chart 3: Forestry and Paper Industry
Source: Thomson DataStream

As the chart illustrates, the forestry and paper industry had a downturn in the beginning of the 1990's and in the end of 1990's. During the beginning of the 1990's, when the first downturn occurred, Canada faced a recession and the pulp and paper industry lost billions of Canadian dollars between 1991 and 1993 (DeKing et al, 1996). Entering the 2000th century, the

industry has grown faster in Europe than it has in Canada. The industry in Canada has had a quite modest growth in comparison.

The price of pulp has historically had a volatility of 20-25% (McMahon, 2005). During the last 20 years the pulp price hade peaks around 1989, 1995, 2001 and it seems like it is facing a peak as of the beginning of 2008.

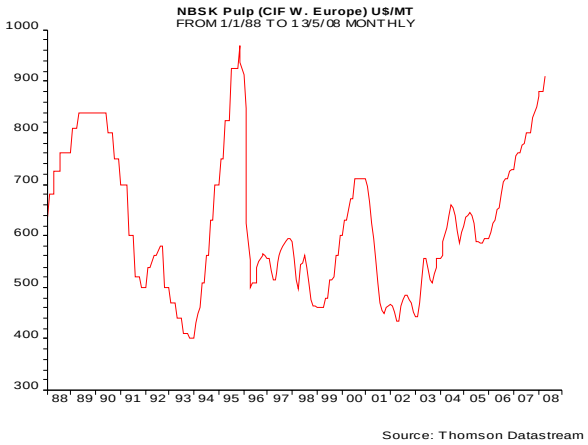


Chart 4: "Price of Pulp
Source: Thomson DataStream

Peaks of timber prices have not been as distinguished as pulp prices. The peaks recognized occurred 1993-1994, 1997, 2000 and 2005. It does not seem like the timber prices are facing a peak as of today, i.e. the beginning of 2008.

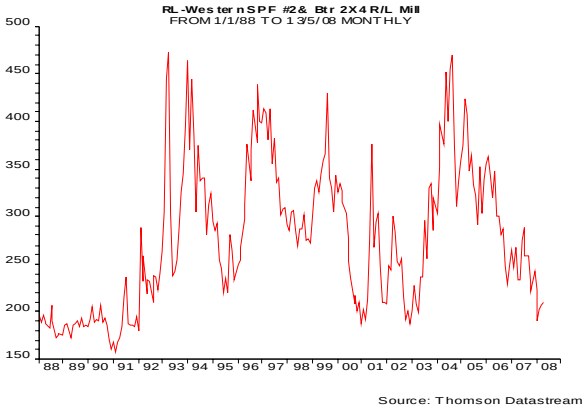


Chart 5: "Price of Timber"
Source: Thomson DataStream

The forestry and paper industry are high users of energy. In Sweden, the industry is the largest user of bio fuel, as well as producer, and the industry is also the largest transporters. The oil consumption has been stable since the end of 1980's on a level of about 500 000m^3, while the power consumption has increased. A reason is that the industry now uses more internally produced fuel that can replace oil. (Skogsindustrin, 2006) In Finland, the consumption of wood based energy stand for about a fifth of the total energy consumption in the country. The wood based energy comes from solid wood and by-products (Finnish Statistical Yearbook of Forestry 2007: Conclusion). Canada is no exception. The Canadian paper and forestry industry is also the largest consumers of energy within their country. But at the same time, the industry has become more efficient in their energy usage. (Canadian Council of Forest Ministers, 2008-05-10)

The energy index shows a dramatically increase of the energy prices in the 21st century, and in 2008, the index have reached its all-time-high. However, before 1999, the prices were on a fairly stable level.

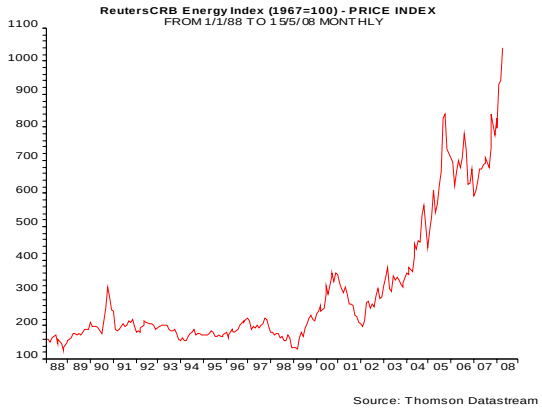


Chart 6: "Energy Index"
Source: Thomson DataStream

4.2 Derivatives in the industry

Teräs took a sample of 8-10 companies that were very dependent on pulp during 1992-1996. This sample was compared to an equal sample from the agriculture industry. It turned out that the companies from the pulp and forestry industry did not hedge while the agricultural companies did. (Teräs, 1998) However, publicly traded derivatives of pulp and timber, such as futures, have not been available for a long time. While for example soybean future could be traded already in 1936 (McMahon, 2005), OMX Exchange launched their first pulp future,

Pulpex may 1997 (Perrins, 1998). The Finnish Option Exchange (FOEX), who was the first market place that could offer price hedging of pulp (Teräs, 1998), did not launch it until 1996 (Puttonen, 1997). The futures regarding timber have been traded for a longer time-period than pulp. CME's Lumber futures have been traded since 1979 (DataStream).

4.3 CPI index and Exchange Rate Index

The CPI index has grown constantly since 1988 and there is no indication that the Consumer Prices would be slowing down, expect for Canada, in 2007, where there can be observed a minor stabilization. The development for Canada and Finland has been fairly similar, as for Sweden the annual growth has been slightly larger.

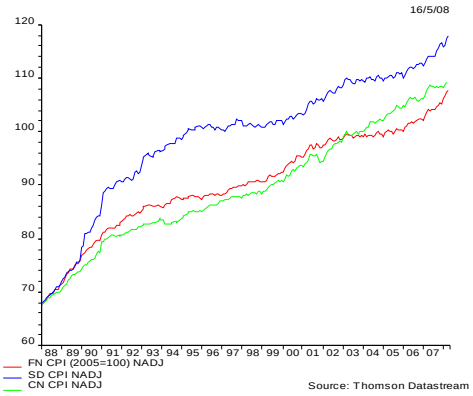


Chart 7: "CPI"
Source: Thomson DataStream

The Finnish and Swedish currencies have developed almost identically towards US dollar. There has been too large peaks; between 1992-1993 and 2001-2002. After the last peak the index has taken a fall down and even today US dollar is fairly low. The Canadian dollar has not experienced as radical changes as Finnish and Swedish exchange rates. Currencies tend to experience the same exchange rate as the neighbouring country, as can been seen from Finland and Sweden.

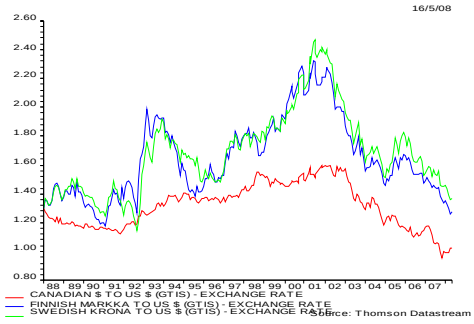


Chart 8: "Exchange Rate Index"
Source: Thomson DataStream

5. Empirical Findings

5.1 Detection of Multicollinearity and Heteroscedasticity

After running the explanatory variables in a correlation matrix, an existence of multicollinearity could be identified[6]. Collinearity exists between interest rate (IR) and the consumer price index (CPI) for all countries during the period 1988 to 2008. The correlation between those variables have a range of 0,8989 – 0,0163, which is above Marquardts advocated threshold of $\rho < 0,87$.

The explanatory variables were also tested for multicollinearity when dividing the total period in two 10-year periods. The discovery was that multicollinearity was only detected in Canada, and the variable it concerns was the energy index (EI) and the exchange rates CAD/USD and the EI and CPI.

We also detect a presence of heteroscedasticity after performed White's test of all the companies' individual models. Heteroscedasticity exists in eight of the Canadian companies, one of the Finnish and three of the Swedish[7]. Since multicollinearity and heteroscedasticity is found in the sample, all regressions are performed with the Newey-West method to receive consistent estimators in the outputs.

5.1.2 Detection of Autocorrelation

Almost all companies' lies in the region of two and this can be translated that there is no autocorrelation. The highest observation is 2.6 and it is still in the region of no autocorrelation. There can be observed few exceptions that are under two, lowest 1.59, but it is still fairly close to the region of no autocorrelation.[8] The rule of thumb for Durbin-Watson test is that everything that is below one is alarming. So we can consider this not to be crucial for our analysis.

[6] For more specified information, see Appendix 2
[7] For the results of White's test we refer to Appendix 4
[8] For the results of the Durbin-Watson test we refer to Appendix 5

5.1.3 The impact of Coefficient of Determination, R^2

The coefficient of determination is extremely low for all companies with highest observation of 0,20 and lowest 0,02.[9] This indicates that our data does not have perfect fit with our variables and that there are other substantial factors that have greater impact on the determination of the market value.

5.2 Exposure

In our research of the forest and paper industry we have found both differences and similarities for the commodity risk exposure for the chosen countries that are represented. As we presented in the beginning for this thesis we have chosen the tree largest market producers from the forestry and paper industry, for the purpose to analyze what affects the variables might have on the companies' market value. The results show that Canada is overrepresented to the risk exposure variables pulp, timber and energy for all the years. Concerning Finland and Sweden we have found a much less exposure that could imply that the Scandinavian market is affected by the changes in the commodity variables. The only variable that indicates a significance exposure towards all companies is the exchange rate.

Concerning the regressions and exposure we have to point that we have included 39 companies in our study for the time period of 20 years. This leaves us with large amount of data we have not been able to include as appendix. Therefore we have summarized the exposure for each country year per year in tables below. For the complete data sample we refer to contact the authors[10].

[9] For more specific information, see Appendix 5
[10] For complete data please contact pia.albrecht@lycos.com; carina_hugosson@hotmail.com; bjorn.lindberg.497@student.lu.se

Table 2: "Financial Exposure"

	CANADA			FINLAND			SWEDEN		
Year	**FX**	**CPI**	**IR**	**FX**	**CPI**	**IR**	**FX**	**CPI**	**IR**
1988	22 %	33 %	22 %						
min/max	-11.277/-3.300	9.658/10.542	-1.824/-1.938						
1989	17 %	8 %	17 %	100 %		100 %		50 %	
min/max	-8.242/-2.991	5.149	-1.495/1.724	-1.540		1.762		122.785	
1990	11 %	6 %	6 %	67 %	33 %	33 %	25 %		
min/max	-2.190/-1.418	-3.500	3.668	-3.956/-1.458	-20.551	4.656	-1.396		
1991	17 %	17 %							
min/max	-5.458/-1.355	-2.839/3.983							
1992	11 %	22 %	6 %				20 %	20 %	
min/max	-10.226/-1.910	-2.995/6.422	1.730				2.020	84.765	
1993	16 %	21 %						20 %	
min/max	-10.107/-1.771	5.260/30.820						87.432	
1994	16 %	16 %	5 %	25 %				20 %	
min/max	-9.215/-1.784	4.623/6.900	-0.829	-0.804				79.203	
1995	16 %	11 %	5 %	25 %			17 %	17 %	
min/max	-8.423/-1.712	4.604/6.608	0.957	-0.798			3.235	71.530	
1996	21 %	5 %	5 %	50 %			17 %	17 %	
min/max	-7.434/-1.699	20.536	1.365	-1.156/-0.977			1.755	67.261	
1997	37 %	16 %	11 %	50 %			17 %	17 %	
min/max	-6.620/-1.027	4.810/31.373	0.806/1.108	-1.135/-0.844			1.970	57.755	
1998	45 %	10 %	5 %	40 %		20 %	17 %	17 %	
min/max	-6.446/-1.127	5.272/2.745	1.455	-1.075/-0.769		0.872	2.066	55.943	
1999	35 %		9 %	40 %			17 %	17 %	
min/max	-4.968/-1.220		0.856/2.147	-1.102/-0.678			2.070	51.015	
2000	29 %	4 %	13 %	40 %			17 %	17 %	
min/max	-2.211/-1.192	4.655	0.798/2.093	-0.934/-0.744			-0.802	47.216	
2001	33 %	4 %	13 %	40 %		20 %	17 %	17 %	
min/max	-2.192/-1.413	4.779	0.561/1.981	-0.827/-0.789		0.413	-0.832	40.581	
2002	38 %	4 %	13 %	40 %		40 %	14 %	14 %	
min/max	-2.859/-1.432	5.678	-0.863/1.700	-0.836/-0.819		0.412/0.451	-0.932	38.673	
2003	38 %	4 %	21 %	60 %		20 %	14 %	29 %	
min/max	-7.629/-1.077	6.182	0.283/0.906	-1.312/-0.775		0.389	-0.757	9.172/36.109	
2004	48 %	10 %	24 %	50 %		25 %	14 %	29 %	
min/max	-5.867/-1.029	5.986/7.345	-0.580/0.902	-0.778/-0.742		0.332	-0.678	6.912/33.855	
2005	53 %	6 %	29 %	50 %		25 %	29 %	14 %	
min/max	-2.179/-1.108	5.468	-0.663/0.856	-0.810/-0.741		0.338	-0.936/-0.731	32.141	
2006	67 %	7 %	20 %	50 %		25 %	17 %	17 %	
min/max	-4.853/-1.019	5.609	0.467/0.761	-0.776/-0.744		0.327	-0.677	5.150/30.057	
2007	50 %	7 %	21 %	50 %		25 %	17 %	33 %	
min/max	-2.907/-1.072	5.727	0.396/0.484	-0.780/-0.751		0.345	-0.936	4.103/27.028	

The table summarizes the number of companies that have been exposed to the selected variables during the time period of 1988-2007. One regression is run for each year of the time period. The companies are selected through a significance level of 95% and the ones that are significant are divided by the total number of companies that were active that specific year (see appendix 5). The min/max represents the range between the lowest and the highest coefficient exposure.

Table 3: "Commodity Exposure"

	CANADA			FINLAND			SWEDEN		
Year	**NBSK**	**SPF**	**EI**	**NBSK**	**SPF**	**EI**	**NBSK**	**SPF**	**EI**
1988	33 %	56 %	11 %				100 %	100 %	
min/max	-2.581/-2.199	-3.061/-0.905	0.605				3.195	0.914	
1989		25 %	17 %	100 %	100 %		50 %	50 %	
min/max		-8.501/0.871	-0.996/2.107	1.996	1.324		2.246	1.205	
1990		28 %	28 %	33 %			25 %	25 %	
min/max		0.692/0.967	-2.541/0.430	1.468			2.292	0.840	
1991	11 %	44 %	39 %				25 %		25 %
min/max	0.479/2.594	-2.493/0.698	-1.175/-0.281				1.414		-0.458
1992	22 %	33 %	33 %				20 %		20 %
min/max	-0.365/2.036	0.222/1.039	-0.998/-0.285				1.029		-0.543
1993	11 %	42 %	37 %						
min/max	0.657/1.429	0.115/0.581	-0.969/-0.333						
1994	16 %	42 %	37 %						
min/max	-1.036/0.529	0.104/0.544	-0.884/-0.268						
1995	21 %	37 %	42 %					17 %	
min/max	-0.884/0.367	0.148/0.422	-0.838/-0.259					0.605	
1996	16 %	37 %	47 %						
min/max	-1.554/0.367	0.127/0.337	-1.2669/-0.323						
1997	26 %	32 %	26 %			25 %			
min/max	-1.578/0.704	0.142/0.333	0.346/1.019			-0.320			
1998	10 %	25 %	35 %				17 %		
min/max	-1.485/0.204	0.316/0.778	-0.777/1.226				0.366		
1999	13 %	26 %	17 %				17 %		
min/max	-1.297/0.287	-3.695/0.318	-0.288/1.035				0.384		
2000	8 %	29 %	17 %				17 %		
min/max	-1.123/0.200	0.134/0.633	-0.741/0.991				0.388		
2001	4 %	25 %	17 %				17 %	17 %	
min/max	0.275	0.155/0.357	-0.284/2.622				0.475	0.304	
2002	4 %	25 %	8 %				14 %	14 %	
min/max	0.284	0.144/0.244	-0.571/-0.292				0.483	0.308	
2003		25 %	4 %				14 %	14 %	
min/max		0.158/0.489	-0.256				0.405	0.282	
2004		19 %	5 %				14 %	14 %	14 %
min/max		0.154/0.663	-0.223				0.358	0.267	0.205
2005		24 %	6 %				14 %	14 %	14 %
min/max		0.150/0.290	-0.189				0.349	0.274	0.231
2006		40 %	13 %				17 %	17 %	
min/max		0.138/0.455	-0.185/-0.183				0.351	0.274	
2007		43 %	14 %				17 %	17 %	
min/max		0.134/0.394	-0.191/-0.188				0.337	0.254	

The table summarizes the number of companies that have been exposed to the selected variables during the time period of 1988-2007. One regression is run for each year of the time period. The companies are selected through a significance level of 95% and the ones that are significant are divided by the total number of companies that were active that specific year (see appendix 5). The min/max represents the range between the lowest and the highest coefficient exposure.

5.2.1 Canada

FX, CPI and IR

The exchange rate exposure in Canada has been constantly negative for a few companies since 1988. However more companies became exposed to exchange rate changes after 1997. The magnitude of the exposure has been about -1 with only one company that deviates. Considering the CPI, a very small number of companies have had a significant exposure. This is also the case for the interest rate, but when the number of companies exposed to CPI decreases with time, the number of companies exposed to interest rate changes increases.

NBSK, SPF and EI

The results show that the market value for the Canadian companies is highly exposed to changes in timber and energy prices. The exposure towards timber has been noteworthy for the whole sample period as same for the energy. The exposure to pulp price changes is very small and the highest observations are from the middle of 1990´s. During the earliest years of 2000, there is no obvious pattern that the companies are exposed to pulp price changes.

5.2.2 Finland

FX, CPI and IR

Half of the Finnish companies shows a negative exposure towards exchange rates, and have nearly been about -1 the entire time period. The CPI turned out to have no influence on the companies' market value. Changes in the interest rate have only affected one company during the whole time period, and then positively, with the exception of 2002 when another company also turned out to be significant.

NBSK, SPF and EI

None of the Finnish companies face any significant impact of changes in the energy prices, and have never done so in the past. Furthermore 2 out of the 5 companies showed a significant effect of pulp and timber price changes in relation to market value. However, this effect was only observable during the period of 1989-1990. After that there is no evidence that the changes concerning pulp, timber and energy prices would have an impact the market value for the companies.

5.2.3 Sweden

FX, CPI and IR

In the case of Sweden, the exchange rate has had an impact on basically only one company. The sign before the coefficient has been mixtured. During the 1990's, it had a positive influence and it became negative in the beginning of 21st century. The exposure towards CPI was remarkable high during the whole 1990's. The coefficient was as high as 122,8 in 1989, after which it started to decrease. The interest rate on the other hand turned out to have no significant impact on any of the Swedish companies.

NBSK, SPF and EI

For the earliest years in the sample period there is notable exposures towards pulp and timber. There is then a large gap between the years 1993-1998, where the companies haven't been exposed to any changes in the variables. From the year of 2001 and continuing the exposure has increased in general for pulp and timber and it has then been fairly stabile for the rest of the sample period. The energy exposure is minimalist and there are only few significant observations which are spread throughout the whole time period.

5.3 Chow's Forecast Test

The models obtained from the regressions are not always suitable for forecasting. Forecasting the last active year of the companies was not possible for 11 of the total 39 companies. Among the total sample, the change in companies market value could be forecasted of all companies in Finland, according to Chow's forecast test. None of the Finnish companies showed significance and the null hypothesis that the coefficients are stable could be accepted. In Canada, this was the case in 70,4% of the companies on the 95%-level and in Sweden 57% of the companies did not showed any significance.

5.4 Optimal Hedge Ratio

The calculated optimal hedge ratio (OHR) of the calculated CME Pulp future and CME Lumber future, differs to a large extent. The futures of pulp have had a fairly stable progress, as being visualized in Chart 7. During the time period, its ratio ranged from 0,9080 (1997) to 0,9495 (2007), i.e. the proportion of pulp that should be hedged to minimize the variance. Since an OHR equal to one means that the investor is fully hedged, the OHR of pulp

indicates that companies should almost been fully hedged since 1988 in order to minimize the variance.

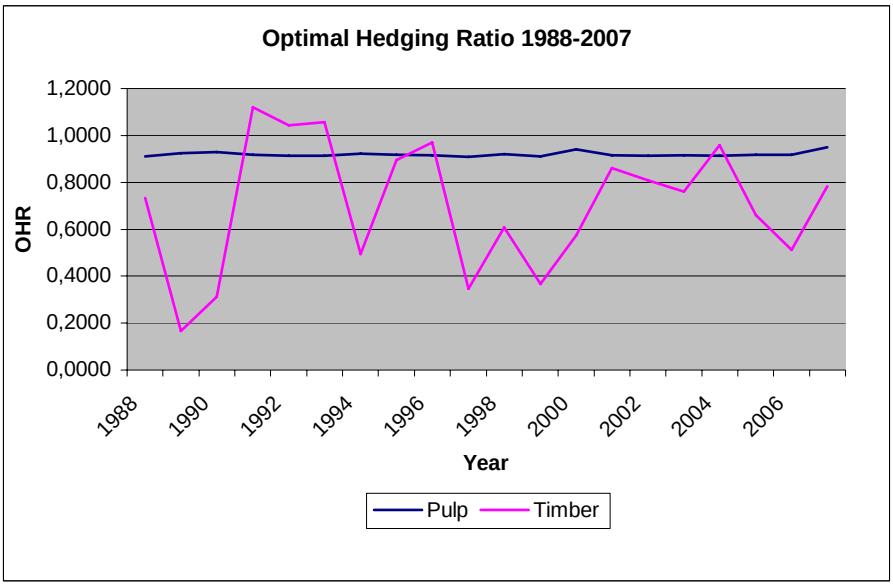


Chart 9: "Optimal Hedging Ratio 1988-2007"

The level of hedging towards timber prices with the help of CME Lumber future, have been very unstable (see Chart 7). The optimal hedging ratio have ranged between 0,1660 (1987) and 1,1210 (1991). A ratio >1 indicates that to minimising the variance, the position in futures were greater than the position in cash. However, most of the measured period for OHR was lower than one. Worth to notice is that the pulp future was calculated by equation (10) whereas the timber future was gathered from a database.

6. Analysis

6.1 Exposure coefficients

As for the exposure in these tree countries we noticed that the size of the company is of greater importance than the market size for each country. This is line with the study of Bergman and Johansson (2002), who acknowledged that the market size for a country had little or no affect for the value of the company.

6.1.1 Exposure to Exchange Rates

The Canadian currency has not experienced as high volatility changes against the US dollar as the Finnish and Swedish currencies. One of the reasons could be the closeness to the United States and often neighbouring countries tend to experience similar movements in the market. Still the negative coefficients for the Canadian companies raise questions because almost half of the companies are negatively exposed. Thorp (2006) stated that the strengthening Canadian dollar will have negative effect on pulp and paper mills which are relying on export and hence, Canada is the world's leader in exporting. This could be considered as one explanation to the negative coefficients.

The Finnish and Swedish currencies have experienced almost identical development towards the US dollar. The Finnish and Swedish currency volatility had a smaller effect on the exposure coefficients as one might expect. The coefficients for the both countries have also been mainly negative. This means that the stronger the national currency gets the more negative effect it will have on the market value. This could be related to the fact that the commodities are denominated in US dollar and as the national currency become stronger, less profit will occur as a result when transforming the sales back to the national currency. As for the exposure of the Finnish companies, the introduction of Euro did not have any significant influence on the degree of exposure, even though one of the purposes according to Dominquez and Tesar (2006) was with the euro to eliminate uncertainties in the exchange rates. However, we cannot tell whether the introduction of the euro have had any impacts on other industries in Finland.

Just like in the study of Dominquez and Tesar (2006), movements in the exchange rates have an impact on firms' market value but which companies are affected depends on the specific

exchange rate. Our study also shows that the companies are not affected in the same way by the changes in US dollar, even though the world prices of forestry and paper products are all denominated in US dollar. The detected differences between the countries exposure towards the US dollar might have a linkage to that Canada, Finland and Sweden export to different countries wich can either dilute or strengthen the effect. Bergman and Johansson's (2002) analysis of the investment decisions in the pulp and paper industry shows a high influence of the exchange rate, which is one of the most important factors.

6.1.2 Exposure to Consumer Price Index

The CPI index for Canada and Finland are almost perfectly correlated with each other. Sweden has experienced a slightly higher development in inflation from 1989 until 2007. The high exposure to changes in CPI is correlated with the increases in the general price level for each country. Since inflation increases the general price level, it should also have a negative effect on a company's market value, just as the study by Carlstrom and Fuerst (2007) indicates. Canada and Sweden, the only countries where companies can be said to be exposed to inflation, turned out to have positive coefficients. This is just the opposite of what Carlstrom and Fuerst (2007) found. This contradiction might arise since higher price level also makes commodity prices to rise according to Silver (2007). The effect of an increase in wages and other costs important to a company can perhaps be outperformed by the price increase in the output variable which means higher sales for the company.

6.1.3 Exposure to Interest Rates

Some Canadian and Finnish companies have been affected by changes in the interest rate for the entire time period. The exposure has been low which indicates that the effect is less relevant. Sandusky's and Henrique's (2001) findings that the interest rates do not have any impact on the stock return seems to be accurate since the exposure for our coefficients are low for both Canada and Finland; while the observations from Sweden are non-existing. This also helps us to understand Andrews (2005) about keeping loans on a variable rate in Europe, when the fluctuations in the interest rate are low.

6.1.4 Exposure to Pulp Prices

The price of pulp had two big peaks in the end of the 1980s and the mid 1990s. Sadorsky and Henriques (2001) detected a positive relationship between commodity prices and stock prices in Canada. This, in line with Bartram's (2005) statement that the sign of the commodity price exposure depends on whether it is an input or output factor, raise expectations of market value of the companies would increase since higher prices results in higher profits. However, the Canadian companies were negatively affected by the increase at both times. Finland and Sweden were positively exposed to pulp prices as expected, but only at the first peak. At the second peak, they were not affected by this. At the time of 1993, when Canada had a positive coefficient; the price of pulp went down almost by 25%. The year after when the price doubled the coefficient became far lower. As we mentioned before this is a contradiction that to what could be expected.

The introduction of pulp futures in Finland in 1996 did not show any noticeable affect. An introduction of futures within this field would if used actively be of positive value for the companies as Finchem (1998) mentions. After 1996, the exposure to pulp prices in Canadian companies starts increasing and in the 21st century the coefficients became positive and after another few years they did not have any significant risk exposure at all. This could be a result of an increase in the usage of pulp futures. A reason why the effect did not come immediately could be that it was first implemented in the Nordic countries 1996. In summary, the Swedish companies that do have a significant exposure, the coefficients are all positive. As in the case of Finland there is no significant exposure after 1990. The lack of exposure could depend on the small proportion of pulp compared to the total export of forestry products. The Finnish export of pulp is smaller than the Swedish and even smaller than the Canadian.

The world price of pulp is denominated in US dollar. It could therefore be expected that the exposure should reflect and move collaterally with the US dollar exchange rate, which is mentioned by DeKing et al. (1996). However, the exposures in respective country do not follow the exchange rate significantly.

6.1.5 Exposure to Timber Prices

The timber price has experienced an extreme volatility during the period of 1980-2007, with a declining trend since 2004. Just as in the case of pulp, an increase in timber prices would have a positive affect on the market value, since the commodity in this case also is an output. Some of the Canadian companies turned out to be exposed to timber during the whole period. The exposures for the companies have mainly been positive with only a few exceptions. In Sweden, only one company has been exposed to the changes in timber prices. Its exposure was positive and fairly stabile. We cannot find any pattern between price fluctuations and the significant exposures during the measured period, not even when the timber price reach extreme peaks. There is no obvious collaterally relation between the exposure and the changes in the US dollar exchange rate, just as the case with pulp.

Ibrahimi et al. (1989) says that the degree of the cash flow sensitivity could be explained by the industrial structure. The lack of exposure for many of the Finnish companies could result from a different industrial structure compared to the forestry and paper industry in Canada and Sweden. We can see that companies in Finland and Sweden have more similarities in their exposures than companies of Finland/Canada or Sweden/Canada. Whether this is a result of similarities/dissimilarities between the industry structures, we cannot conclude from our results.

The magnitude of the sensitivity of a change in timber, or pulp, on a company's market value, could also be a result of the size of the total market of the forestry and paper industry. If an investor aim to include the forestry and paper industry in a portfolio in order to diversify, he would probably chose a company that could contribute with minimize the variance and maximise the return, just as Markowitz' (1959) says. The larger the forestry and paper industry are, the more active companies exists and the alternatives of where to invest will also increase. The market value of companies exposed to timber, and pulp, can be more sensitive if the market have more options since when a price change occurs, the will seek the company with the least exposure and, thus, indirectly increasing the sensitivity for many companies. This discussion can explain why the Finnish companies are not exposed in the same extent as the Canadian. However, Bergman and Johansson (2002) mean that this should not have an impact.

Overall, the commodity risk exposure, i.e. pulp and timber, do not affect the market value in the same extent as financial exposures. This is what was pointed out by Bartram (2005) regarding non-financial firms. The exposure of exchange rates, interest rates and inflation, can be seen as being of greater concern for the company.

6.1.6 Exposure to Energy Prices

Energy is recognized as an input factor and is necessary for the production for the industry. It is a cost and an increase in energy and energy related products can therefore be expected to be negative for the market value. Several of the Canadian companies re highly exposed to changes in energy prices for the total time period of 1988-2007. From 1991-1996 the coefficients was negative, just what could be expected according to Bartram (2005) After 1996 the magnitude of exposure towards energy prices became less negative and has declined year by year. The number of companies exposed has also declined. Worth noticing is that the energy index had a drastic upward movement after 1998 and it has still a growing trend. This means that the companies are facing higher energy costs and thus, lower profits. Why the exposure has declined even though the energy prices never have been as high as of today, might be explained by the improved energy usage in the paper and forestry industry. According to Thorp (2006) energy can be considered as one of the biggest costs for the pulp and paper industry and to survive companies must learn to control these costs, otherwise they will face a phenomenon called the "Shutdown bubble"[11]. When companies are using less energy, they also reduce their dependency and exposure of energy prices and this improvement could be recognized by the market.

As for Finnish and Swedish companies the exposure is minor and there are only a few observations that are significant for the entire time period. The observations for the Swedish is scattered with two observations in the beginning of the 1990s and two observations in the middle of 2000. Thus, also Frandina and Frost (2007) seem to have the same opinion that the energy costs are critical for companies in the forestry and paper industry, but they do not seem to be of critical character from the markets point of view, at least not in Finland and Sweden. Again, it might result from improved efficiency of energy usage. Also one of the reasons that exposure towards energy in Finland is non-existing could be that the pulp and

[11] When costs are exceeding the profits, the company might face being insolvent.

paper industry owns most of their electricity, either directly or through shareholdings in the industry owned power production companies in Finland, as Kara et.al. (2008) point out.

6.2 Optimal Hedging

The optimal hedge ratio (OHR) was not stable as regards timber. The hedging ratio fluctuated remarkable during the measured time-period, and hedging according to this ratio can be difficult for the companies. Hedging does include a cost, and revise the portfolio this often can increase the costs for the company, just as Nelson et al. (2005) says. The OHR of pulp were on the other hand very stable, but the price of the future was calculated by only considering the current interest rate. The markets contingent expectations are therefore not considered. The ratio is therefore what can be called a correct theoretical ratio.

But calculating an OHR and use it strictly, might not be optimal for a company. As Miller and Modigliani (1958, 1961) argue, risk management and hedging should not be of a company's concern since the investors can hedge themselves by diversifying their portfolio. If a company is considered to be perfectly hedged and follows the OHR, the exposures can be expected to be non-existing. However, this is not was found in our study, even though Canada was overrepresented when it comes to exposure. It can therefore not be said that the companies in the forestry and paper industry, and especially the Canadian, are optimally hedged. But by seeing hedging in a long-term perspective, it should not be of importance. An investment should last for a longer time-horizon and revising the hedge ratio constantly will only mean a loss.

Since the OHR for timber have been so fluctuating, it will be very costful if a company decides to follow it strictly. They might have approved a certain deviation in order to keep their cost down and since it can be difficult to find the OHR. If the companies approve a certain deviation, a smaller exposure actually can be expected to exist since they are not perfectly hedged.

7. Concluding Remarks

The purpose of our thesis was to explore whether companies in the forestry and paper industry are exposed to commodity risk exposure, and to what extent this might affect the market value of the company.

For our research period 1988-2007, the important commodities for the forestry and paper industry; pulp and timber, does not seem to have any remarkable effect on the companies' market value even though these are their main products. Financial variables are instead of more significant character. The lack of commodity exposure is probably a result of that the market do not stress when price changes in pulp and timber occur and see the industry in a more long-time perspective. The differences between the Canadian, the Finnish and the Swedish companies are regarded both financial as non-financial exposure is a result from non-observed variables. The exchange rate is the only variable that reappears in all countries in the same extent and tends to have significance to the companies.

The forestry and paper industry opens an intriguing research area because of its close relation to the commodities, which are used as inputs and outputs in the production. The globalization of the world economy is another issue that will affect this industry, where a higher demand will raise the costs of the commodities and hence, the forestry products. The companies within this industry are also influenced by the regulations in environmental questions. Surviving in the long run companies need to adjust to the changes of macroeconomical factors otherwise they risk facing the phenomenon "shutdown bubble".

7.1. Future Research

This study has opened up for more questions that can be of interest for future research. We believe it can be of interest to gain an understanding of why the differences between the countries are so obvious. It could perhaps involve including even more variables such as the size of a company and the managements official way to handle those kinds of exposure, or complement this study by performing a qualitative study with companies in the forestry and paper industry from each country. Another relevant future study could be to investigate the possible implementation of different hedging strategies for the companies that are exposed to the chosen variables.

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Appendix 1: Company Presentation

CANADA						
Name	**Market**	**Currency**	**Status**	**Exchange**	**Traded from:**	**Traded to:**
ABITIBI-CONSOLIDATED	Canada	Canadian Dollar	Dead	Toronto	2.1.1976	30.10.2007
ABITIBIBOWATER CAN.ES.	Canada	Canadian Dollar	Active	Toronto	27.7.1998	
AMER.WILD WDLD.GNG.	Canada	Canadian Dollar	Dead	TSX Ventures	9.6.1997	1.10.2004
ARBEC FOR.PRDS.SUBD.VTG. SHS	Canada	Canadian Dollar	Dead	Toronto	10.7.1995	30.5.2006
ASSET MAN.SFTW.SYS.	Canada	Canadian Dollar	Suspended	TSX Ventures	30.3.1990	18.9.2002
CANADIAN OS.PACK.	Canada	South African Rand	Dead	Johannesburg	17.1.1990	21.12.2004
CANFOR	Canada	Canadian Dollar	Active	Toronto	22.9.1983	
CASCADES	Canada	Canadian Dollar	Active	Toronto	18.10.1984	
CATALYST PAPER	Canada	Canadian Dollar	Active	Toronto	2.1.1973	
CATHAY FOREST PRODUCTS	Canada	Canadian Dollar	Active	TSX Ventures	26.9.1988	
CED-OR	Canada	Canadian Dollar	Dead	TSX Ventures	30.10.1989	23.6.2006
DOMAN INDUSTRIES	Canada	Canadian Dollar	Dead	Toronto	2.1.1976	27.7.2004
GREEN FOR.LUM.	Canada	Canadian Dollar	Suspended	Toronto	13.11.1987	7.2.1995
INTL.ABSORBENTS	Canada	US Dollar	Active	AMEX	27.9.1989	
ORENDA FOR.PRODUCTS	Canada	Canadian Dollar	Suspended	Toronto	2.9.1988	18.9.1996
PAXTON INTL.RES.	Canada	Canadian Dollar	Suspended	TSX Ventures	13.10.1989	6.9.2005
RIVERSIDE FOREST PRDS.	Canada	Canadian Dollar	Dead	Toronto	30.12.1992	6.12.2004
SFK PULP FD.	Canada	Canadian Dollar	Active	Toronto	6.8.2002	
SINO FOREST	Canada	Canadian Dollar	Active	Toronto	23.6.1994	
SLOCAN FOREST PRDS.	Canada	Canadian Dollar	Dead	Toronto	18.4.1986	5.4.2004
TECHCANA	Canada	Canadian Dollar	Dead	TSX Ventures	10.12.1998	25.6.2007
TEMBEC 'A'	Canada	Canadian Dollar	Active	Toronto	30.10.1984	
TIMBERWEST FOREST UNT.	Canada	Canadian Dollar	Active	Toronto	6.10.1998	
WEST COAST FOREST PRDS.	Canada	Canadian Dollar	Suspended	TSX Ventures	13.9.1988	12.5.2005
WEST FRASER TIMBER	Canada	Canadian Dollar	Active	Toronto	7.5.1986	
WEYERHAEUSER EXH.SHS.	Canada	Canadian Dollar	Active	Toronto	3.11.1999	
FINLAND						
Name	**Market**	**Currency**	**Status**	**Exchange**	**Traded from:**	**Traded to:**
M-REAL 'B'	Finland	Euro	Active	Helsinki	31.8.1989	
METSAE TISSUE	Finland	Euro	Dead	Helsinki	10.12.1997	20.6.2003
STORA ENSO 'R'	Finland	Euro	Active	Helsinki	25.3.1988	
STROMSDAL 'B'	Finland	Euro	Active	Helsinki	15.8.1989	
UPM-KYMMENE	Finland	Euro	Active	Helsinki	15.1.1991	
SWEDEN						
Name	**Market**	**Currency**	**Status**	**Exchange**	**Traded from:**	**Traded to:**
BERGS TIMBER 'B'	Sweden	Swedish Krona	Active	Stockholm	11.5.1989	
BILLERUD	Sweden	Swedish Krona	Active	Stockholm	20.11.2001	
BONG LJUNGDAHL	Sweden	Swedish Krona	Active	Stockholm	17.5.1989	
HOLMEN 'B'	Sweden	Swedish Krona	Active	Stockholm	4.1.1982	
KLIPPAN	Sweden	Swedish Krona	Dead	Stockholm	4.11.1994	5.5.2006
LUNDBERGFORETAGEN 'B'	Sweden	Swedish Krona	Active	Stockholm	28.11.1988	
ROTTNEROS	Sweden	Swedish Krona	Active	Stockholm	2.10.1991	

Appendix 2: Test of Multicollinearity

Critical value $\rho < 0,89$

20 years period 1988/01/15 – 2008/01/15

CANADA

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	0.083041	-0.310356	-0.420224	-0.487159	0.220596
CPI	0.083041	1.000000	***-0.898903***	0.812880	-0.163195	0.381293
IR	-0.310356	***-0.898903***	1.000000	-0.583756	0.365294	-0.414775
EI	-0.420224	0.812880	-0.583756	1.000000	0.188135	0.135470
NBSK	-0.487159	-0.163195	0.365294	0.188135	1.000000	-0.431979
SPF	0.220596	0.381293	-0.414775	0.135470	-0.431979	1.000000

FINLAND

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	0.426877	-0.465569	-0.077568	-0.568738	0.265379
CPI	0.426877	1.000000	***-0.916255***	0.715830	-0.238932	0.406559
IR	-0.465569	***-0.916255***	1.000000	-0.583756	0.365294	-0.414775
EI	-0.077568	0.715830	-0.583756	1.000000	0.188135	0.135470
NBSK	-0.568738	-0.238932	0.365294	0.188135	1.000000	-0.431979
SPF	0.265379	0.406559	-0.414775	0.135470	-0.431979	1.000000

SWEDEN

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	0.512263	-0.549915	0.037767	-0.455775	0.241222
CPI	0.512263	1.000000	***-0.901521***	0.624809	-0.290922	0.494297
IR	-0.549915	***-0.901521***	1.000000	-0.583756	0.365294	-0.414775
EI	0.037767	0.624809	-0.583756	1.000000	0.188135	0.135470
NBSK	-0.455775	-0.290922	0.365294	0.188135	1.000000	-0.431979
SPF	0.241222	0.494297	-0.414775	0.135470	-0.431979	1.000000

10-year period

CANADA

1988/02/15-1998/01/15

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	0.701114	-0.664100	-0.254724	-0.219539	0.710820
CPI	0.701114	1.000000	-0.839254	0.233951	-0.447715	0.691966
IR	-0.664100	-0.839254	1.000000	-0.027837	0.483143	-0.645160
EI	-0.254724	0.233951	-0.027837	1.000000	-0.129233	-0.010768
NBSK	-0.219539	-0.447715	0.483143	-0.129233	1.000000	-0.581949
SPF	0.710820	0.691966	-0.645160	-0.010768	-0.581949	1.000000

1998/02/15-2008/01/15

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	-0.847554	0.341392	***-0.909370***	-0.723958	-0.187629
CPI	-0.847554	1.000000	-0.580923	***0.923457***	0.594673	0.034774
IR	0.341392	-0.580923	1.000000	-0.390301	0.029279	0.022987
EI	***-0.909370***	***0.923457***	-0.390301	1.000000	0.724232	0.031253
NBSK	-0.723958	0.594673	0.029279	0.724232	1.000000	-0.080942
SPF	-0.187629	0.034774	0.022987	0.031253	-0.080942	1.000000

FINLAND

1988/02/15-1998/01/15

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	0.546160	-0.690173	-0.224967	-0.687140	0.721677
CPI	0.546160	1.000000	-0.833305	0.225554	-0.447092	0.681057
IR	-0.690173	-0.833305	1.000000	-0.027837	0.483143	-0.645160
EI	-0.224967	0.225554	-0.027837	1.000000	-0.129233	-0.010768
NBSK	-0.687140	-0.447092	0.483143	-0.129233	1.000000	-0.581949
SPF	0.721677	0.681057	-0.645160	-0.010768	-0.581949	1.000000

1998/02/15-2008/01/15

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	-0.522520	0.494729	-0.662029	-0.454834	-0.331259
CPI	-0.522520	1.000000	-0.596286	0.852740	0.557072	-0.101346
IR	0.494729	-0.596286	1.000000	-0.390301	0.029279	0.022987
EI	-0.662029	0.852740	-0.390301	1.000000	0.724232	0.031253
NBSK	-0.454834	0.557072	0.029279	0.724232	1.000000	-0.080942
SPF	-0.331259	-0.101346	0.022987	0.031253	-0.080942	1.000000

SWEDEN

1988/02/15-1998/01/15

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	0.586707	-0.621512	-0.312105	-0.386470	0.700836
CPI	0.586707	1.000000	-0.836277	0.177329	-0.436278	0.691850
IR	-0.621512	-0.836277	1.000000	-0.027837	0.483143	-0.645160
EI	-0.312105	0.177329	-0.027837	1.000000	-0.129233	-0.010768
NBSK	-0.386470	-0.436278	0.483143	-0.129233	1.000000	-0.581949
SPF	0.700836	0.691850	-0.645160	-0.010768	-0.581949	1.000000

1998/02/15-2008/01/15

	FX	CPI	IR	EI	NBSK	SPF
FX	1.000000	-0.544424	0.347116	-0.601029	-0.515049	-0.341212
CPI	-0.544424	1.000000	-0.646581	0.868896	0.529422	-0.011599
IR	0.347116	-0.646581	1.000000	-0.390301	0.029279	0.022987
EI	-0.601029	0.868896	-0.390301	1.000000	0.724232	0.031253
NBSK	-0.515049	0.529422	0.029279	0.724232	1.000000	-0.080942
SPF	-0.341212	-0.011599	0.022987	0.031253	-0.080942	1.000000

Appendix 3: Futures Specification

CME Random Length Lumber Futures		
Sector of application: Rehabbing & construction		
Trade Unit	110,000 bd. ft. of random lengths 2x4s (8' to 20')	
Point Descriptions	1 point = $.10 per 1,000 bd. ft. = $11 per contract	
Contract Listing	Seven months of January, March, May, July, September, and November.	
Strike Price Interval	N/A	
Product Code	Clearing=LB Ticker=LB	
Trading Venue: Floor		
Hours	9:00 a.m.-1:05 p.m. LTD(12:05 p.m. If the LTD is on a day that the market closes early, then the time is 11:05 a.m.)^	
Listed	All listed months	
Strike	N/A	
Limits	$10.00 per thousand board feet above or below the previous day's settlement price. Expanded limits. See Rule 1702.D	
Minimum Fluctuation	Regular	0.10=$11.00

CME Wood Pulp Futures		
Trade Unit	20 metric tonnes times the FOEX Indexes Ltd.-PIX NBSKP Europe Index monthly average per tonne.	
Point Descriptions	1 point = 1.00 = $20.00	
Contract Listing	All calendar months (total listed 12)	
Strike Price Interval	N/A	
Product Code	Ticker=WP Clearing=WP	
Trading Venue: CME® Globex®		
Hours	Monday - Thursday 5:00pm - 4:00pm (next day) Sunday and holidays 5:00pm - 4:00pm (next day) Expiring contract closes 2:00am on Last Trading Day	
Listed	N/A	
Strike	N/A	
Limits	There shall be no trading at a price more than $50 per tonne above or below the previous day's settlement price, except that there shall be no daily price limits in the expiring contract during the spot month.	
Minimum Fluctuation	Regular	0.50= $10 USD

Source: www.cme.com
2008-05-06

Appendix 4: White's Test

Prob. Chi-Square < 0,05

	Obs*R-squared	Prob. Chi-Square	Heteroscedasticity
CANADA			
Abitibi cons	12.62665	0.9914	No
Abitibibowater Can es	17.17926	0.7002	No
American Wild Woodland	18.91184	0.5908	No
Arbec Forest Products	38.96742	0.0099	Yes
Asset Man	18.73658	0.6020	No
Canadian Os- Pack	10.87143	0.9652	No
Canfor	36.41581	0.0196	Yes
Cascades	13.19900	0.9015	No
Catalyst Paper	39.72028	0.0080	Yes
Cathay Forest	99.86659	0.0000	Yes
Ced Or (dead)	11.76390	0.9458	No
Doman Industries	50.25897	0.0003	Yes
Green Forest Lumber	19.98298	0.5223	No
Intl Absorbents	51.93115	0.0002	Yes
Intl Forest Products	15.22384	0.8116	No
Orenda Forest Products	15.91186	0.7746	No
Paxton	9.212360	0.9874	No
Riverside	34.74261	0.0301	Yes
SFK Pulp	13.44987	0.8921	No
Sino Forest	9.485756	0.9848	No
Slocan Forest	18.51246	0.6164	No
Tehcana	23.06920	0.3403	No
Tembec	13.82424	0.8770	No
Timberwest Forest	10.28132	0.9750	No
West coast Forest	12.81116	0.9151	No
West Fraser Timber	12.68700	0.9192	No
Weyerhaeuser	41.52164	0.0048	Yes
FINLAND			
M-Real	17.85707	0.6580	No
Metsae Tissue	25.29444	0.2346	No
StoraEnso	13.48757	0.8906	No
Strömsdal	15.95216	0.7723	No
UPM Kymmenä	39.31967	0.0090	Yes
SWEDEN			
Bergs Timber	144.9635	0.0000	Yes
Billerud	10.37332	0.9736	No
Bong Ljungdahl	124.8522	0.0000	Yes
Holmen	7.794217	0.9960	No
Klippan	11.99428	0.9398	No
Lundbergföretagen	155.8246	0.0000	Yes
Rottneros	23.00176	0.3439	No

Appendix 5: The Coefficient of Determination and the Durbin-Watson test

CANADA	R-squared	DW
ABITIBI-CONSOLIDATED	0.071313	2.111374
ABITIBIBOWATER CAN.ES.	0.017282	2.065448
AMER.WILD WDLD.GNG.	0.015881	2.152675
ARBEC FOR.PRDS.SUBD.VTG. SHS.'A'	0.056618	2.185698
ASSET MAN.SFTW.SYS.	0.021877	2.129046
CANADIAN OS.PACK.	0.015550	2.219209
CANFOR	0.161871	2.019378
CASCADES	0.061228	2.194599
CATALYST PAPER	0.067771	2.195541
CATHAY FOREST PRODUCTS	0.022939	2.139943
CED-OR	0.027833	2.002606
DOMAN INDUSTRIES	0.029826	2.624526
GREEN FOR.LUM.	0.077459	1.984459
INTL.ABSORBENTS	0.052363	2.373622
ORENDA FOR.PRODUCTS	0.151154	2.190501
PAXTON INTL.RES.	0.029600	2.121494
RIVERSIDE FOREST PRDS.	0.130324	1.920609
SFK PULP FD.	0.123579	1.881793
SINO FOREST	0.095414	1.946984
SLOCAN FOREST PRDS.	0.077472	2.245390
TECHCANA	0.074719	2.684238
TEMBEC 'A'	0.073147	1.774057
TIMBERWEST FOREST UNT.	0.204839	2.184581
WEST COAST FOREST PRDS.	0.042172	2.255613
WEST FRASER TIMBER	0.129669	2.214546
WEYERHAEUSER EXH.SHS.	0.088619	2.164508
FINLAND		
M-REAL 'B'	0.048673	1.934676
METSAE TISSUE	0.155705	2.022859
STORA ENSO 'R'	0.004118	2.173040
STROMSDAL 'B'	0.017486	1.895359
UPM-KYMMENE	0.074455	2.066177
SWEDEN		
BERGS TIMBER 'B'	0.071350	1.870613
BILLERUD	0.158277	2.034127
BONG LJUNGDAHL	0.041069	1.850533
HOLMEN 'B'	0.020865	1.935737
KLIPPAN	0.092929	1.971399
LUNDBERGFORETAGEN 'B'	0.071466	1.591276
ROTTNEROS	0.185136	2.242867

Appendix 6: Chow's Forecast Test

	Chow's Forecast Test:	
	F-statistics	**Prob. F**
CANADA		
Abitibi cons.	1.616281	0.0821
Abi can es	5.799352	0.0000*
American Wild Wdld	0.033633	1.0000
Arbec For prds	1.099645	0.3669
Asset Man Softwood	4.998437	0.0000*
Canadian Os. Pack	2.570772	0.0030*
Canfor	0.871766	0.5903
Cascades	1.684330	0.0715
Catalyst Paper	1.686417	0.0710
Cathay Forest	0.141709	0.9349
Ced or	1.543923	0.1056
Doman Industries	8.665124	0.0000*
Green For.Lumber	0.262536	0.9947
Intl Forest Prds	0.863988	0.5919
Intl. Absorbents	0.544268	0.7420
Orenda	1.500181	0.1366
Paxton Intl	0.447269	0.9497
Riverside	3.053555	0.0006*
SFK Pulp	4.115814	0.0208*
Sino Forest	1.018736	0.4367
Slocan Forest	1.495583	0.1229
Techcana	0.395507	0.9676
Tembec	4.683317	0.0000*
Timberwest Forest	1.876855	0.0430*
West Coast Forest	1.357724	0.1840
West Fraser Timber	0.940233	0.5121
Weyerhaeuser	0.530773	0.8987
FINLAND		
M-Real	0.699166	0.7630
Metsae Tissue	0.445105	0.9434
StoraEnso	0.257770	0.9960
Strömsdal	0.552631	0.8888
UPM Kymmene	0.420238	0.9612
SWEDEN		
Bergs Timber	2.108754	0.0150*
Billerud	0.737138	0.7192
Holmen	0.187890	0.9992
Kinnevik	4.490186	0.0000*
Klippan	7.947136	0.0000*
Lundbergsgruppen	0.669119	0.7920
Rottneros	0.658876	0.8009

** = Values that are significant on the 95% significant level*

Appendix 7: Number of Active Companies 1988-2007

Year	Canada	Finland	Sweden
1988	9		1
1989	12	1	2
1990	18	3	4
1991	18	4	4
1992	18	4	5
1993	19	4	5
1994	19	4	5
1995	19	4	6
1996	19	4	6
1997	19	4	6
1998	20	5	6
1999	23	5	6
2000	24	5	6
2001	24	5	6
2002	24	5	7
2003	24	5	7
2004	21	4	7
2005	17	4	7
2006	15	4	6
2007	14	4	6