MEASUREMENT OF CURRENCY RISK: Application of an Integrated Approach to Forest Products Industry

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Abstract

Measurement of Currency Risk:
Application of an Integrated Approach to Forest Products Industry

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This thesis is devoted to a critical evaluation of foreign exchange exposure. It extends the past work on the measurement of operating exposure by modelling the exchange risk of one specific industry - forest products - in Canada. We first build a model of the influence of exchange rate fluctuations on the cash flows of a Canadian forest products company. The effects of exchange rate changes on firm value are analyzed within a three country framework to account for exchange rate induced competitiveness. A home currency depreciation versus the U.S. dollar (and Scandinavian currencies appreciation) is expected to be bullish on Canadian forest products stocks. We then collect information to test our model using time series analysis over the last fifteen years for all publicly traded Canadian forest products companies. Some estimated exposure coefficients reveal an anomaly which is challenging to interpret; however, it is partly resolved by (a) incorporating the impact of currency changes on the Canadian market, and (b) accounting for the hedging activity of the firms under analysis.

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A mes parents
et à mon frère, Jean-François

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Symbols

Note: The subscripts j, i, t, and k, are respectively for country, company, month and firm characteristic. See *Appendix 2 & 3* for company variable names (the letter L means the values have been transformed).

Π: firm's profits (C$)

R: firm's export revenues

C: firm's total costs

X_1: C$/US$ exchange rate

p^u: U.S. dollar sales price

q: quantity sold (volume)

c: unit cost of production

e_D: elasticity of demand

S^c: Canadian net export supply

S^k: Swedish net export supply

S^u: U.S. net domestic supply

D^u: U.S. demand of forest products

P^j: price in country j

X_2: Swedish krona/U.S. dollar rate

$e_{P,Xj}$: elasticity of market price w.r.t. X_j

e_{Sj}: supply elasticity for country j

sj: market share (of the U.S. market)

$e_{D,Xj}$: elasticity of demand w.r.t. X_j

$e_{X1,X2}$: cross elasticity of exchange rates

$e_{Sc,Xj}$: elasticity of imports w.r.t. X_j

R_{it}: return on firm i's common stock

R_p: portfolio rate of return

ER_t: rate of change in exchange rate

γ_i: FX exposure of company i

γ_{1i}: exposure to fluctuations in X_1

γ_{2i}: exposure to fluctuations in X_2

β_i: exposure to market risk

R_{mt}: return to national stock market

r(C$/US$): inflation-adjusted rate

Δn(SK/US$): change in nominal X_2

CPI_j: consumer price index country j

RCD_t: monthly change in real X_1

NCD_t: monthly change in nominal X_1

RSK_t: monthly change in real X_2

NSK_t: monthly change in nominal X_2

TSE_t: changes in TSE 300 index

Z_{ki}: kth firm specific variable

Introduction

The contemporary business environment is characterized by high volatility in real and financial markets. Whereas the effects of changes in prices and interest rates are easily measured and managed, it is very difficult to measure the impact of fluctuations in exchange rates on the operations of a firm. Although attempts have been made to understand how exchange rate changes will affect the future cash flows of a firm, most studies have focused on more easily measured accounting and transaction exposures. Academics as well as managers, however, realize that the most important impact of volatility in currency markets is in the area of operating - or cash flows - exposure. The economic impact of a currency change is difficult to determine as it depends on a great number of industry specific variables, including the location of major markets and competitors, supply and demand elasticities, input substitutability and offsetting inflation (Shapiro [1991]).

The goal of this research is to improve our understanding of the effects of changes in exchange rates on the value of a firm. Strategic and tactical operating choices are at stake, such as siting, sourcing, and market position. There are implications for the management of foreign exchange (FX) risk, but also for the measurement of management performance.

The study first addresses the determinants of foreign exchange exposure *(Section 1)*. After reviewing the empirical evidence on recent FX experience, we develop the implications and explore the theory underlying corporate management of FX risk. These preliminaries underline the importance of a correct assessment of a firm's risk exposure, and thereby the relevance of the study. Moreover they suggest that, given the complexity of the international environment, it is helpful to concentrate on the risk profile of a mid-complex industry.

We therefore extend past work on the measurement of operating exposure by modelling the exchange risk of one specific case - the forest products industry, whose export business is dominated by Canada. As mentioned by Kenyon ([1991], p. 1), although "an understanding of the currency markets is a financial discipline, [...] those who manage currency risk need an intimate grasp of its commercial markets and its objectives in those markets." For this purpose we undertake an industry audit before developing a model of foreign exchange *(Section 2)*.

The work is then carried out in three stages. In the first stage, we build a model of how exchange rate fluctuations should influence the cash flows of a forest products company in Canada. The assumptions are derived from the aforementioned industry analysis. We begin by elaborating a two country model and then extend it to three countries to account for interactions between different exchange rate changes. Both mathematical and graphical analysis of the model are developed *(Section 3)*.

In the second stage, we collect information on specific companies to test our model. The hypotheses provided by our model are tested using time series analysis for all publicly traded Canadian forest products companies from December 1976 to January 1992 *(Section 4)*. In assessing the relevance of the different hypotheses, we are interested in competitive impacts, and particularly test whether a home currency depreciation is bullish on Canadian forest products stocks.

Finally, in order to explain how exposure may differ across firms in the same industry, we carry out a cross-sectional analysis of economic exposure. We expressly acknowledge the relevance of hedging activities and diversification of sample firms. (Actual FX management practices of the firms under analysis are taken into account using annual reports and questionnaire responses.) The estimated exchange risk coefficients are then discussed with respect to firm-specific variables to provide the sources of differences in exposure. The results give some insight on the measurement of FX exposure.

1. Determinants of Foreign Exchange Exposure

Since the breakdown of the Bretton Woods system of fixed exchange rates two decades ago, exchange rate volatility has increased markedly (up to 40% in a year and 5% in a single day in the mid-eighties, IMF [1993]). Differing degrees of financial, industrial, and political integration around the world are responsible for this new reality. After reviewing the recent foreign exchange experience and its implications for corporate risk management, we shall focus on the issue of exposure measurement.

1.1. Empirical evidence on recent FX experience

For many economists, exchange rates should be unstable only if fundamental economic variables are also unstable.[1] The most important aspects of the recent foreign exchange experience, however, have been reported by Abuaf & Schoess [1988] and may be summarized as follows. First of all, it appears that exchange rate volatility has been high compared to market fundamentals, and that this volatility has been increasing over time. Most exchange rate changes are unexpected (spot and forward rates tend to move together), and there is almost no correlation between

[1]Those fundamentals include mainly national monetary policies, economic growth rates, interest and inflation rate differentials and current account imbalances.

successive changes in exchange rates. Deviations from Purchasing Power Parity - that is changes in real exchange rates - persist for long periods, due to changes in central bank reactions for example. In the short run, deviations may be explained by exchange rates reacting faster to shocks than price levels, making real and nominal exchange risk close substitutes. Correlations with market fundamentals are unstable (and sometimes odd), and so are correlations between rates. Finally forward rates are biased predictors of future spot rates, which may be due to the risk characteristics of the underlying economies.

The implication to be drawn from the above is that exchange rates are very sensitive to news. However, the extent to which exchange rates behave like asset prices has not been examined carefully, and there is room for an "asset market" view of exchange rate determination.[2] The poor forecasting performance of technical or econometric models (especially in the long run for the former and in the short run for the latter), gives strong support to the efficient market hypothesis (EMH). According to EMH, financial asset prices fully reflect all information, or at least all publicly available information. The empirical evidence suggests that the best forecaster of future spot prices is the driftless random walk model (a corollary of the EMH). In other words, this means that the future spot rate of exchange is best

[2] New theories of exchange rates (such as monetary theory, the asset approach, and the portfolio-balance approach) are based on the stock supply and demand of a currency in contrast to the explanation based on the balance-of-payments account which emphasizes the flow demand and supply of a currency (to pay for exports and imports, respectively). See MacDonald & Taylor [1989] for an expository survey of exchange rate determination and De Grauwe et al [1993] for chaotic models of FX markets.

predicted by the current rate, a result which is rather unsatisfactory from a theoretical perspective.

Bearing all this in mind, especially the poor performance of forecasting, higher volatility in the foreign exchange markets has increased the levels of foreign exchange risk (Willet [1986], Lessard & Lightstone [1986]).[3,4] This volatility is more important than for interest or inflation rates, and it gives rise to various types of risks (described in detail below), which in efficient markets would not affect the value of a company. A number of market imperfections, however, require that firms estimate and manage risks arising from changes in exchange rates. For a company, currency fluctuations do translate into more variable operating margins, that is a greater currency exposure, and a more complex evaluation of foreign operations.

1.2. Reasons for corporate management of FX risk

The first argument against corporate management of foreign exchange risk is provided by the Purchasing Power Parity Theorem. According to PPP, exchange rate changes are offset by changes in price levels. In other words, in theory, there is

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[3] Recently, Franke [1992] and Serçu & Vanhulle [1992] challenged the conventional view by suggesting that, just like the value of a stock option, a firm's value may well increase with exchange rate volatility.

[4] There are several theories of exchange rate volatility. The condition for stability of the FX market is known as the Marshall-Lerner condition. Short run inelasticities of a country's import demand (cf. Magee [1978]) can cause a currency supply curve to slope downward explaining why FX markets may be unstable, no force pushing exchange rates towards equilibrium. Derived from the monetary approach, the Dornbush sticky-price theory implies that exchange rates may overshoot due to non-traded goods prices lagging behind money supply increase. Overshooting may also be due to speculative bubbles (Frankel & Froot [1981]), or to stock adjustments and flow fluctuations as described in the accelerator model (Dunn [1983]).

simply no exposure to foreign exchange risk.[5] In practice, however, there are deviations from parity, especially in the short run, as documented by Roll [1979] for example, or Adler & Lehman [1983]; besides, the relevant set of prices for a firm is rarely the general price level (relative-price risk). Assuming that exchange risk does exist, the Capital Asset Pricing Model indicates that the only risk of concern is systematic, and it makes no difference whether exchange risk is managed separately in foreign exchange markets, or passed along to the capital market. In other words, exchange risk does not need to be hedged. Yet, hedging does make a difference for example whenever default risk is significant since less default risk may increase a firm's debt capacity.[6] Assuming next that exchange risk needs to be hedged, the Modigliani-Miller theorem implies that investors can take care of it as well as the firm. In reality though managers are better informed than shareholders, and they are in a better position to get a low-cost hedge.

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[5]To show that ex-post violations of PPP are necessary for the presence of FX exposure, we can write the relative form of PPP as $X^*=(LP^*-FP^*)/(1+FP^*)$, where X denotes an exchange rate expressed in direct quote, LP and FP local and foreign price levels, stars standing for changes in variables. We also set an exporter's profit as $Y=(Xp-c)q$, where p is the foreign currency sales price, c is the unit cost of production in local currency, and q is the quantity of goods sold. We then assume the profit at the end of the year to be $Y(1+Y^*)=[Xp(1+X^*)(1+FP^*)-c(1+LP^*)]q$. Subtracting and manipulating terms gives the change in profit as $Y^*=[Xp(X^*(1+FP^*)+FP^*)-cLP^*]q/Y$. Now, for profits to grow (or decrease) after a local currency depreciation, we need to have $Xp[X^*(1+FP^*)+FP^*]-cLP^*>0$. If profits were initially zero, it becomes $Xp[X^*(1+FP^*)+FP^*-LP^*]>0$. Since both X and p are positive, the condition for profit to be systematically affected by exchange rates can be written as $X^*>(LP^*-FP^*)/(1+FP^*)$, which violates Purchasing Power Parity.

[6]A rigorous analysis for hedging under some circumstances is provided by Smith & Stulz [1985]. They demonstrate that a value-maximizing firm can hedge for three reasons: taxes, costs of financial distress, and managerial risk aversion (see also Shapiro [1984], Barnea, Haugen & Senbet [1985], and more recently Dobson & Soenen [1993]). Still Jorion [1991], whose empirical results do not suggest that exchange risk is priced in the U.S. stock market, notes that "active hedging policies by financial managers cannot affect the cost of capital and other reasons must explain why firms decide to hedge" (p. 363).

One may claim that the forward market is a fair bet, and that gains and losses cancel out over time. Unfortunately, this concept of self-insurance does not account for the risk aversion of economic agents. Similarly, the Efficient Market Hypothesis applied to foreign exchange markets infers that forward contracts are priced properly, and thus there are no excess returns from hedging. The objective of hedging, however, is to decrease variance, not to earn excess returns. Since future forward rates are as uncertain as future spot rates, one may say that hedging per se does not reduce uncertainty. This argument is not valid since hedging provides information on anticipated cash flows which can be useful for activities with the same horizon as the forward contract. It may be asserted too that a firm's exchange gains and losses could be used to hedge the consumption bundles of its shareholders. Nevertheless, shareholders are better off hedging their particular consumption bundle risk, while the firm hedges exchange risk. Finally, by considering market imperfections and divergent stakeholder perspective on risk, foreign exchange risk management is found to be relevant at the corporate level.[7]

The aim of FX risk management is to neutralize the impact of unexpected exchange rate changes on net cash flows. This can be done traditionally through hedging (e.g. currency options/futures) or through risk diversification (e.g. currency

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[7]Theoretical papers addressing the issue of relevance or otherwise of currency management are Shapiro & Rutenberg [1976], Giddy [1977], Logue & Oldfield [1977], Jacque [1981], Dufey & Srinivasulu [1983], Shapiro & Titman [1986], Cornell & Shapiro [1987] and Miller & Bromiley [1990].

baskets/cocktails; Soenen [1985], [1988]).[8] Even though financial hedging is an indispensable tool (Kaufold & Smirlock [1986]), it cannot create competitive advantage. The portfolio approach provides an inexpensive way to reduce foreign exchange risk without recourse to hedging; however, at the same time, the firm might diversify its competitive advantage away.[9] Empirical field studies on management practices and their factors will be of interest in *section 4*.

1.3. Definitions and measurement of FX exposures

The above statement on the relevance of foreign exchange management motivates the need for a correct assessment of a firm's risk exposure. Indeed, foreign exchange risk must be measured first in order to be managed.[10] But if in theory, currency exposure, or "the extent to which the value of a firm changes with a change in the exchange rate," is easy, "as a practical matter, it is much more difficult to find agreement on a definition and means to compute foreign exchange exposure" (Flood & Lessard [1986], p. 25).

Foreign exchange exposure is traditionally classified into three different

[8]The hedging effectiveness of various financial instruments has been investigated by Swanson & Caples [1987] for example.

[9]Joseph & Hewins [1991] note that the utilisation of portfolio models has yet not become an important feature of the foreign exchange exposure management process.

[10]To be accurate, FX *risk* is the variability of domestic currency values attributable to unanticipated changes in exchange rates, whereas FX *exposure* is what is at risk.

exposures, the so-called transaction, translation, and economic exposures.[11] Surveys found that the amount of attention paid to the different exposures has changed over time to the benefit of a longer term view. Whereas the dominant objective of foreign exchange risk management was to minimize translation losses (Rodriguez [1981]), and thereafter transaction exposure (Khoury & Chan [1988]), real operating exposure has been the subject of much of the recent academic work on exchange risk management (e.g. Kenyon [1991]). The latter exposure is caused by interactions between commercial and currency markets; it is the most challenging to measure and is the focus of this paper.

1.3.1. Transaction and translation exposures

Wihlborg [1980] defines transaction exposure as an uncertain domestic currency value of an open position in a foreign currency with respect to a known transaction. In other words, transaction exposure refers to the contractual cash flows involving an actual exchange transaction. It is the sensitivity of realized domestic currency values of assets or liabilities when those are liquidated, with respect to unexpected changes in exchange rates. Due to the consolidation of parent's and affiliates' balance sheets, translation exposure, in turn, is the uncertain domestic value of a net accounting position denominated in a foreign currency at a certain future date. It is thus the sensitivity of real domestic currency asset or liability values

[11]Early studies had classified the different exchange exposures with varying definitions (see Kenyon [1981] for review).

appearing in financial statements, with respect to unexpected changes in exchange rates. In simple terms, translation exposure relates to future foreign currency denominated stocks, whereas transaction exposure relates to future foreign currency denominated flows.

1.3.2. Economic exposure

Following Rodriguez & Carter [1984], economic exposure involves the discounting of future cash flows to a present value and measures exchange rate fluctuations on all operational cash flows regardless of whether an exchange transaction is required. Also called the sensitivity of operating income, operating exposure involves the effect of exchange rates on the current and future profitability of firms. Indeed, "under global competition, exchange rate fluctuations not only change the dollar value of the firm's foreign profits and foreign-currency denominated contractual assets and liabilities (such as accounts receivable and debt), they also alter the firm's competitive position and often call for changes in operating variables such as pricing, output, and sourcing" (Lessard [1986], p. 7). Operating exposures do not have fixed face values; they depend on such factors as "the elasticity of demand for imports or exports, the fraction of input prices that depend on exchange rates, the flexibility of production to respond to exchange rate induced changes in demand, and the reference currency for [computation]" (Levi [1990], p. 203). Put another way, economic currency risk is the risk that "a sustained real rise of a currency against the currency of competitors will adversely affect a company's competitive costs, and therefore its sales, profit margins and market share, which in turn will reduce the return on the capital and revenue investment previously sunk in its present commercial activity, and the present value of that investment" (Kenyon [1981], p. 11).

What emerges is that foreign exchange fluctuations can change a company's competitive position; this further means that the determinants of operating exposure depend upon the structure of the markets in which a company operates. We analyze the competitive environment of a particular industry after examining more general models of FX exposure developed in the literature.

1.4. Previous models of FX exposure

Early studies (Heckerman [1972], Dufey [1972], and Ankrom [1974]) acknowledge that fluctuating exchange rates would affect firms' operations, but a systematic analysis of the impact of exchange rate changes on the foreign subsidiary of a multinational corporation was first undertaken by Shapiro [1975]. He concludes that FX exposure is determined by the sector of the economy in which the subsidiary operates. Cornell [1980] and Wihlborg [1980] note that the fundamental source of risk is measured by real - i.e. deviations from Purchasing Power Parity - as opposed to nominal exchange rate changes (also Levi [1983]). Consequently, purely domestic firms are shown to be also exposed to currency risk (Eaker [1981], Hodder [1982]).

An important contribution was made by Hodder [1982] whose approach to measuring a firm's exposure depends on the stochastic relationship between its real rate of return and exchange rate movements. Using a simplified two-country model, exposure is shown to depend on the extent to which individual asset prices adjust with exchange rates, the distribution of such adjustments between countries, and the relationship between domestic inflation and exchange rate movements.

Flood & Lessard [1986], and Choi [1986] relate the firm's FX exposure to underlying market conditions for its outputs and inputs. Specifically, Choi [1986] develops a model of a firm's exchange exposure - a hypothetic U.S. firm based in two different countries - and its effect on market value. The model explicitly considers the firm's economic exposure in terms of output and input demand elasticities.[12] Its three components are respectively, the home economic effect, the foreign economic effect, and the accounting effect of foreign cash flows. A complete analysis, though, requires that the effects of the cost of capital be combined with the effect of accounting and economic exposures. The paper shows that the effects of exchange exposure on firm value are generally ambiguous, in contrast to the positive association between currency and stock values suggested in the monetary model.

More recently, Booth & Rotenberg [1990] develop a model which incorporate

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[12]The three variables which determine the foreign economic impact of exchange rate changes are the linkage between exchange rates and output/input prices, the market demand structure for the firm's output, and input supply conditions which determines the firm's own input demand elasticity.

the concepts of purchasing power parity and commodity arbitrage subject to transaction costs. Since "firms maximize their market value [...] subject to the constraint that the resulting product price must lie within the bounds imposed by commodity arbitrage" (p. 9), they conclude that foreign exchange exposure will vary both across firms and for one firm across time depending on whether or not the commodity arbitrage bounds are binding.

Finally, Bodnar and Gentry [1993] do not develop a formal model but they base their analysis on intuitive theoretical relations for effect variables. As a result, the effects of an appreciation of the home currency on the value of industries involved in different activities is anticipated to be positive for non-traded good producers, importers and users of internationally-priced inputs, and negative for exporters, import competitors and foreign investors. The results support the idea that FX exposure depends on industry characteristics.

The purpose in reviewing these studies was to show that many simple partial equilibrium models predict an increase in the value of a home country firm in response to a real drop in the value of the home currency. Similarly, the value of a foreign competitor is expected to decrease as a consequence of the same exchange rate movement. This leads to the perception that the firm whose home currency drops becomes more competitive. In other words, models of operating exposure to real exchange rate changes are consistent with the view that export-oriented firms, as well as import-competing firms, benefit from a real depreciation of the home currency.[13]

To conclude, this section highlights the importance and the necessity of measuring FX exposure. However, as Hekman [1983, p. 60] says, "the theoretical abstraction may simplify one's understanding of exposure, but at the same time, it apparently complicates its measurement." We realize that the economic impact of a currency change is difficult to determine as it depends on a great number of industry specific variables. This leads us to focus on one specific industry, such as the Canadian forest products industry. Its competitive environment, which will prove useful in constructing our model of FX exposure, is examined in detail in the next section.

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[13]E.g. Hekman [1985], Flood [1985], and Choi [1986].

2. Industry Characteristics

This study is an industry level analysis of foreign exchange exposure. We chose to focus on one specific mid-complex industry, namely the Canadian forest products industry. We argued in the previous section that assessing economic exposure to exchange rates cannot be based only on accounting information, and that it requires a detailed description of the industry competitive environment. Therefore, we shall now study the structure of the markets in which the Canadian forest products industry, and its competitors, operate.[14]

2.1. Forest products

A firm's FX exposure depends partially on the nature of the particular products it produces. Forest products may be classified into two broad categories: wood products and pulp & paper products. *Table 1* illustrates the growth of world production/ (exports) of forest products by major commodity group.

[14]Much of the description in this section is intended to provide a general background for the development of FX exposure model (it is thus not necessarily directly applied in the model).

Table 1
World production (exports) of forest products

	Wood products (1,000,000 cu m)		Paper products (1,000,000 t)	
	Roundwood	**Lumber**	**Wood pulp**	**Paper/board**
1961	2,051 (38)	344 (41)	62 (10)	77 (13)
1970	2,463 (96)	415 (57)	102 (17)	126 (23)
1980	2,934 (117)	450 (80)	126 (21)	170 (35)
1988	3,431 (126)	506 (100)	151 (26)	224 (51)

(*Source*: [4], Forestry Canada 1990, pp. 195-203)

Small product differentiation, easy transportability, and absence of trade barriers are important factors for arbitrage to take place. The geographical scope of markets of widely traded goods reflects barriers to transhipment such as transportation costs and tariffs, as well as differences in tastes. Consequently, forest products appear to be traded in global markets.

2.1.1. Lumber and wood products

Wood products that are traded include pulpwood, chips, logs, lumber, plywood, particle board, and a variety of veneers. Lumber is divided into softwood and hardwood. Softwood lumber is made from conifers (mostly pines), and is mainly used for building purposes. Hardwood lumber comes from deciduous trees (oak, maple, yellow poplar...) and is mainly used for furniture. In other words, although wood products have a wide range of applications, the construction sector is the end-use market for most of the industry's products.

The lumber industry has a ideal competitive market structure: large numbers of independent buyers face large numbers of independent sellers, so that price-taking behaviour is an accurate description of the reactions of market participants. We note that forward prices for lumber and plywood are quoted on the Chicago Mercantile Exchange.

2.1.2. Pulp and paper products

About two thirds of Canada's annual harvest goes into building products and the remainder goes into pulp and paper products.[15] Export business on a world scale is dominated by Canada, although the Scandinavian countries play an important role, with Finland and Sweden in second and third place, as shown below.

Table 2
Paper and paperboard (in million tons, 1988)

Top 5 producers		Top 5 exporters		Top 5 consumers	
U.S.	69.5	Canada	11.4	U.S.	76.4
Japan	24.6	Finland	7.2	Japan	25.0
Canada	16.6	Sweden	6.4	China	13.2
China	12.6	U.S.	4.3	Germany	12.4
USSR	10.8	Germany	3.8	USSR	10.0

(*Source*: The Economist, Book of Vital Statistics, 1990, p. 102)

The largest segments of the Canadian industry are newsprint, and wood pulp. We see that the U.S. is by far the world's largest producer and consumer of paper. North American markets for newsprint have traditionally been segmented between eastern and western regions with B.C. sending most of its exports to western U.S.

[15]Paper is made from pulp, which in turn is made from wood chips. (Pulp markets have a more competitive structure than newsprint.)

The larger eastern markets are served by mills in Ontario, Quebec, and the Atlantic provinces in competition with producers in southern U.S. Those mills also export to Western Europe in competition with Scandinavian suppliers.[16] We note that the key North American price is the New York contract price set by Canadian producers in U.S. dollars.

2.2. Canadian forest products industry

Forestry is a pillar of Canada's economy. It is the biggest manufacturing industry, contributing 8.5% of GDP and employing over one million people (8.1% of employment in Canada). Unlike the minerals sector for example, nearly all Canadian wood production is used for domestic manufacture of forest products. Exports in the industry, valued at $22.8 billion, represent 16.9% of total Canadian exports.

2.2.1. Timber supply

Forests cover nearly half of Canada's one billion hectares of land, half of which are considered to be productive. Canada's forests are about 10% of the world's total forest area. They range from mixed hardwoods and conifers in the East to pure coniferous stands in the West. They hold 24 billion m^3 of timber, and three quarters of this volume is softwood. Spruce, pine, balsam fir, and aspen/poplar are

[16] About half of Canadian sulphate pulp exports moves to the U.S. and about one-third moves to Europe.

the principal forest species.

Each year, about one million hectares of land are harvested, mostly by clear-cutting. This harvest yields approximately 190 million m^3 of timber (versus an Allowable Annual Cut of 230). Canada's timber volume rose 0.3% annually over the past decade as a result of tree growth in standing forests. Environmental concerns are expected to tighten the wood products market as harvesting is further restricted. In addition to government curbs on timber companies, public pressure may increase the proportion of publicly owned forest land in reserves not subject to timber harvesting. With supply restricted, the ability of the market to respond to increased wood products demand will be restricted.[17] (Fire, insects, and disease are also tremendously destructive, resulting in the loss of nearly as much timber as is harvested.)

In the medium term, there are "adequate levels of timber supplies to support the current level of industrial activity," according to a Forestry Canada study, although "in the long term, Canada's timber supply prospects are less clear" (*Source* [3], p. 122). The study notes that softwood harvesting is approaching a maximum level.[18] However, if supply is a constraint in this market, there is no global shortage

[17]Native Canadians' land claim could also affect the supply of forest products available for export.

[18]Sedjo [1987] stresses the importance of new technologies - genetically improved trees - in meeting future resource needs. For now, the best answer to future timber supply is manufactured wood products (e.g. MacMillan Bloedel's "engineered" wood).

of wood fibre on a world scale, as is explained later in the section. Consequently, Canadian foresters now worry that their exclusive role in supplying the U.S. lumber deficit will be questioned by foreign timber.

2.2.2. Industry structure

The Canadian forest industry is further characterized by its geographic concentration, corporate concentration, and ownership structure, respectively. The forest industry is concentrated in British Columbia, Quebec, and Ontario (86% of value-added). British Columbia, where nearly half of Canadian forest production is located, specializes in lumber. Interior sawmills produce mainly for the U.S. housing market, while plants along the coast produce more sophisticated products, mainly for Japan. Ontario and Quebec are the centres of the pulp and paper industry which counts about seventy companies operating more than 140 mill sites.

There is a high degree of corporate concentration in the Canadian forest industry (c.f. Wagner [1988]). Since the industry has a high degree of integration, manufacturing by the industry is highly concentrated. The development of large specialized mills have made the Canadian industry more efficient than the U.S. industry in producing large quantities of standard items such as softwood lumber. However, Simon notes that "mergers may be needed to create companies with the muscle to take on the world again" (*Source*: [6], p. 1).

Provincial Crown forests represent 80% of the productive forest land in Canada, leaving 11% under federal jurisdiction and 9% in private ownership. The provincial governments have traditionally managed the forests that were leased and harvested by the private sector, but recently forest regeneration and management duties have been transferred to the private sector. *Table 3* reports Canada's largest public forestry companies, excluding wholly owned subsidiaries of foreign companies and privately owned concerns.[19]

Table 3
Canada's main forestry companies (in C$, 1992)

	Sales	Earnings (Loss)
Noranda Forest*	4.5bn	(88.0m)
MacMillan Bloedel	3.0bn	(48.8m)
Domtar	1.9bn	(159.0m)
CP Forest Products	1.8bn	(248.0m)
Abitibi-Price	1.7bn	(219.0m)
Repap	1.1bn	(209.9m)
Canfor	0.9bn	(49.9m)
Fletcher Challenge Cda**	0.9bn	(43.5m)
Cascades	0.9bn	28.2m
Weldwood	0.7bn	17.5m

*Prior to February 1992 sale of 49% stake in MacMillan Bloedel. **Year ended June 30. (*Source*: [6], Financial Times, May 7, 1993, section IV, p. 3)

According to Statistics Canada, about 44% of Canada's pulp and paper industry was foreign owned in the late 1980's, which is similar to the foreign presence in other resource-based sectors. Many foreign held companies are wholly owned, so they do not have the same profile as the publicly-traded Canadian producers.

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[19]The biggest U.S. subsidiaries include Stone Consolidated, Kimberley-Clark, Boise Cascade and Weyerhaeuser.

2.2.3. An export-driven industry

FX exposure partially depends on the nature of business and its particular source/sell configurations. Canada has been the largest exporter world-wide of forest products for more than seventy years. (About three quarters of forest product output is exported.) *Table 4* ranks the major forest products exporting countries.

Table 4
Forest products exports by major exporting countries
(World exports $US85,009 million in 1988)

(1) Canada	17,441	(3) Finland	8,184
(2) U.S.	10,723	(4) Sweden	7,405

(*Source*: [4], FAO, 1990, pp. 295-6)

Canada accounts for 21% of the world total. Its main world market shares are softwood (50%), newsprint (55%), and woodpulp (33%), that is primarily commodities for which the value added by processing is low.[20] The single most important export market is the U.S. market as can be seen from *table 5*.

Table 5
Canadian forest products exports by destination ($US million, 1989)

U.S.	14,733	Europe	3,627 (34% U.K.)
Other	882	Asia	3,505 (73% Japan)

(*Source*: [4], Forestry Canada 1990, p. 97)

It is interesting to note that the flow of forest products from the U.S. to Canada is generally only about 10% of the flow from Canada to the U.S. For both

[20]In a study prepared for the government of Canada, M. E. Porter notes that "there is almost no export position in more sophisticated segments such as fine paper" (Canada at the Crossroads: The Reality of a New Competitive Environment, 1991, p. 16).

wood and pulp & paper products, the Canadian industry must rely primarily on export markets, whereas the demand of the U.S. domestic market exceeds the production of the U.S. industry. (About two thirds of the Canadian production of softwood and fifty percent of the pulp and paper production is exported to the U.S.)

The Japanese market - which is the second largest consumer of pulp and paper in the world - has been almost impossible to penetrate because producers and distributors have formed networks from the mills to the end users that are closed to foreign producers, notwithstanding Japanese government agreement to open up the market in the coming years.

2.2.4. Financial analysis

2.2.4.1. Current situation

A June 1992 Price Waterhouse study reported that the Canadian forest industry posted a record loss of $2.5 billion in 1991 (reduced to $1.6 billion in 1992), compared with just over break-even in 1990 and a $2.4 billion profit in 1989 (*Source*: [2], p. 28). Industry performance has been seriously affected by such factors as high interest rates, exchange rates, and weakening product demand. Compounding the problem was mandatory spending on recycling/pollution control projects, and a general recession in early nineties.[21]

[21]The Standard and Poor's paper & forest products index experienced a 59% decline in 1991.

These losses can be explained by a decrease in revenue from sales and by a consequent reduction in production. Total Canadian forest products sales dropped from $38.5 in 1989 to $31.9 billion in 1991. The collapse in industry profitability was due primarily to sharply lower profits for market pulp and newsprint operations. These markets had to deal with an unfavourable supply/demand balance, as stagnant demand coincided with overcapacity. Prices in the paper industry are very volatile and sensitive to capacity utilization rates.[22] The decline in woodpulp (pulp prices fell from US$803/ton to US$563/ton in 1991) was due to weak demand and competition from foreign pulp producers.

Canadian producers had the additional burden of the strengthening Canadian dollar. Compared with the U.S. dollar, Canadian currency was approximately 1.9% stronger in 1991 than a year earlier, averaging US$0.873. The higher Canadian dollar, according to Price Waterhouse, resulted in a $400 million reduction in forest industry revenues. This gives some insight on how the production levels, the price and thus the profits of the firms vary with the exchange rate.

Along with the nature of a firm's products, the firm's structure determines its sensitivity to changes in different macroeconomic variables. In other words, exposure also depends on the level of debt relative to equity (the industry debt ratio went from 0.67 in 1990 to 0.88 in 1991), and on capital intensity. It is useful here to make

[22]Capacity utilization rate was 88% in 1990, 85% in 1991, and 87% in 1992.

a distinction between the lumber and the pulp & paper industry. Indeed, unlike the former, the latter is very capital intensive.[23]

2.2.4.2. Prospects

The short term prospects for wood exports will be influenced by such factors as supply issues, environmental concerns, trade negotiations and foreign competition. The demand for softwood lumber will remain closely related to the growth of the U.S. housing market. Johnson, investment analyst for Richardson Greenshields, believes production reductions will bring price above costs again in 1994. The poor economic conditions, combined with the new domestic capacity should reduce shipments to Western Europe and Japan (20% of sales); however, that decrease will largely be compensated by increases in exports to North America and other markets (70% and 10% of sales).

To conclude, the increasing importance of high value-added forest products, and the emergence of low cost competitors within the Third World represent a major challenge to Canada's future success with its traditional production, marketing, and trade strategies.

2.3. Foreign competitors

[23]Since paper production is not labour intensive, Asian and Latin American competitors cannot take advantage of lower wage costs to the extent they have in some other industries.

The location of competitors is crucial for assessing exposure. Also of relevance are the degree of international competition in domestic and in export markets, as well as the degree to which production is concentrated in one country. The purpose of this section is to provide an overview of Canada's traditional and new low-cost competitors.

2.3.1. Traditional competitors

2.3.1.1. The United States

Like the Canadian forest industry, the U.S. forest industry is regionally concentrated; the South and West account for 90% of the wood pulp production, and they account for an even larger proportion of the softwood lumber production. The concentration of Northwest forests in public hands has made the region vulnerable to public policy debate on logging plans and will accelerate the industry's shift to the South. Expanding timber supply from Chile and New Zealand will compete with North American wood, although U.S. private timber supplies should expand in the next century as second growth stands come to maturity in the West.

It is important to understand policy impacts on the pattern of forest trade. Indeed, government policies on the use of commercial forests can have important implications for trade in forest products between the U.S. and Canada. Tax policies and subsidies may influence firms' production costs and thus their ability to compete in international markets; also, tariffs and other barriers to imports may limit the ability of foreign producers to compete in domestic markets.[24] The dependence of Canadian producers on the U.S. market combined with the fact that the U.S. has a very large domestic forest products industry are the basis for trade conflicts between the two countries. They have disagreed for years over whether the Canadian softwood lumber industry is subsidized; in 1986, Canada was forced to impose a federal tax (initially 15%) on its softwood lumber exports to the U.S. in order to avoid the imposition of a U.S. duty on these products.[25] The Canadian government withdrew from the agreement in October 1991. Since 1992, the U.S. International Trade Commission allowed the Commerce Department to impose a 6.51% duty. (However, Canadian trade minister Michael Wilson said Canada would appeal the ruling to a bi-national panel under the Free Trade Agreement.)

2.3.1.2. Europe

Europe is important for the Canadian industry both because it is a sizeable market, and also because several of the chief competitors of Canada are European companies. The E.C. is the largest producing block in Europe, manufacturing 39.8 million tons of pulp and paper in 1991.[26] In recent years, slower growth rates combined with excess supply from new capacity has brought severe pressure on prices

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[24]In recent years, some high value-added forest products have been subject to tariff barriers. Uhler et al [1991] state that "it is probably because of U.S. tariffs [...] that these segments of the Canadian industry failed to develop beyond simply supplying the domestic market."

[25]cf. M. B. Percy and C. Yoder, 1987, "The Softwood Lumber Dispute and Canada-U.S. Trade in Natural Resources."

[26]Germany and France account for 32% and 18% of that total respectively.

and profitability. Currently, much of the competition among many American paper companies is taking place in Europe. They have been able to purchase mills and are moving to create European-wide markets for their products. Europeans are responding by their own mergers and acquisitions.

Scandinavia finds itself in a period of restructuring and recession. Finland has suffered the most, as its domestic economy is still heavily influenced by that of the former Soviet Union. The country's pulp and paper producers have modernized their installations over the past few years, creating heavy debt. Sweden is facing high costs, depressed prices, overcapacity, and high interest rates. Pressure on prices will probably continue until supply and demand in the export markets of these countries is balanced.

Finally, Lyon & Sedjo [1991] conclude from their timber supply model that "the traditional producers of the Northern temperate climate regions, such as Canada, the Pacific Northwest, and the Nordic countries, will continue to be major forest producers, but at somewhat reduced production levels after their old-growth forests have been harvested."

2.3.2. New low-cost competitors

In the 1970's, consumers began to discover that faster growing trees in the U.S. South, Brazil and other temperate regions of the world could be turned into many of the same products provided by Canada at much lower costs. The quality is acceptable enough for Canadian suppliers to start being hurt by competition.[27]

The latest capacity survey from the Food and Agriculture Organization of the United Nations indicates that the largest growth in paper and paperboard capacity will come from Latin America and Asia (*Source*: [3], p. 372). Indeed, the emerging countries of the Southern hemisphere are becoming a major source of future wood supplies; moreover, they are going to have approximately the same access to the North American market as do Canada and the United States. Brazil is the dominant producer in Latin America, and its pulp exports are rising dramatically. Chile has an estimated 11.8 million hectares of land with productive capacity for forestry, which will make it one of the most important pulp suppliers in the 1990's.

2.4. Competitive analysis

Many forest products are traded internationally and, thus, are vulnerable to continuing changes in the global marketplace. While the maintenance of adequate supply is necessary for the health of the fo... industry, it is not sufficient. It is also fundamental to correctly assess product competitiveness. Traditional considerations of static comparative advantage among basic factors of production have been replaced by more sophisticated economic models (UNIDO [1986], Porter [1990]).

[27]Action groups are fighting to stop the importation of old-growth timber; however, the rain forests are principally located in Third World nations which are reluctant to slow the cutting of their forests while massive logging continues in the U.S. and Canada.

In the long run, competitive success is largely determined by the industry's productivity, input prices, and exchange rates. We now examine the above variables with a special emphasis on the effect of exchange rate changes on the comparative advantage of Canada and the U.S.

2.4.1. Productivity

Following an UN-FAO [1988] joint study, Oum & Tretheway [1991] measure the productivity of various forest product industries for major producing countries around the world. They show that the Canadian industry needs to improve its overall productivity for its survival.[28]

One of the significant weaknesses in the Canadian forest sector identified in Porter's report is the low level of research and development.[29] Low research intensity may represent a threat to the future productivity and competitiveness of the forest-based sector.[30] As an example, *table 6* compares the costs of producing newsprint in different countries in 1990.

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[28] T. H. Oum and M. W. Tretheway, 1991, "A Comparison of the Productivity Performance of the U.S. and Canadian Pulp and Paper Industries."

[29] "The Canadian pulp and paper industry spent the equivalent of 0.3% of sales in R & D in 1988, while the industry in Sweden, Japan and Finland spent between 0.3 and 1% of sales" (Porter [1991], p. 50).

[30] cf. P. J. Jakes and C. D. Risbrudt, 1988, "Evaluating the Impacts of Forestry Research."

Table 6

Comparative newsprint producing costs (in C$/ton, 1990)

	U.S. South	U.S. West	Canada	Sweden	Finland
Labour	71	88	136	87	72
Energy	85	98	95	114	108
Fibre	149	111	158	219	298
Others	116	138	118	111	80
Total	421	435	507	531	558

Depreciation, interest cost, HQ and sales expenses excluded.

(*Source*: [2], p. 8)

The cost of labour is higher in Canada because the production of one ton of newsprint requires 3.9 hours compared with 1.8 and 2.5 in Western and Southern U.S. respectively, and 2.2 hours in the Scandinavian countries. However, in spite of higher wages, the Canadian industry in general has been more efficient than the U.S. industry.

In a world of emerging trading blocks, access to export markets is as crucial as productivity. An historic step was taken by Canada on January 1, 1989 with the implementation of the Free Trade Agreement with the U.S. More than 75% in value of the forest products trade now passes between the U.S. and Canada duty free. Boyd et al [1991] study of the impact of the FTA on the forest industry indicates that both parties achieve maximum gains.[31] For Hansing & Wibe [1991], "more confidence should be placed in market forces and their capability to create equilibrium in the timber market."[32]

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[31] R. Boyd and K. Krutilla, 1991, "The Impact of the FTA on the U.S. Forestry Sector: A General Equilibrium Analysis."

[32] J. Hansing and S. Wibe, 1991, "Rationing the Supply of Timber: the Swedish Experience."

2.4.2. Price factors

A firm's exposure is not only determined by the structure of the markets in which it sells its products. It is also determined by the structure of the markets in which the company and its competitors purchase their inputs. The forest industry, though, faces the exchange risk only on the output - or the sales - side. (Since most production costs are in terms of local currency, exchange rate changes have no direct effect on total production costs.)

2.4.2.1. Supply and demand

"Like other resource industries, the lumber industry and its markets are responsive to both seasonal and cyclical economic factors. Worldwide economic shifts, currency exchange, interest and inflation rates and even weather related events can have a profound effect on the supply and demand for lumber" (Repap's annual report, [1992]). Environmental pressure, though, has an increasing influence on the industry and will likely result in higher wood prices. Prices are also on the rise because of the lumber dispute with Canada; this dispute effectively raises prices to American consumers, though protecting U.S. lumber companies.[33]

Although recovering demand should outdistance the annual capacity growth, the equilibrium is becoming more complex. World paper markets, for example, are

[33]The general U.S. producer price index rose to 116.5 in 1991, compared to 125 for lumber (1982 = 100, *source*: [1], p. B86). As a consequence, steel might probably take some market away from wood as suggested by the Financial Post (April 18, 1994, p. S1).

becoming increasingly integrated, and new mills in Brazil and Chile could limit any increases in market pulp prices. Although the rate of new production capacity declined, new suppliers, intent on gaining market share, have effectively cut prices (shift of inventories from consumers to producers). Recessions in Europe and Japan have slowed pulp demand at the same time that weak currencies in Canada and Sweden have reduced operating costs in those countries.

Canada historically has provided the U.S. with 99% of its lumber imports, or about 3% of its total needs. However, lumber company executives view themselves as "marginal" suppliers to the U.S. market, and as having only a small role in determining North American lumber prices. In the words of Mr Miller, forestry minister of B.C., "left with relatively small and outdated mills, the Canadian industry was gradually transformed from a price setter to a price taker" (*Source*: [6], p. 3). To see how a firm's profits change with the price level when the firms act as price takers, we can consider the following cases. If all producers were in the U.S. (all production costs in terms of US$), then an appreciation of the U.S. dollar would have no effect on the prices and quantities produced in the U.S. market. The only change would be an increase in the Canadian value of the Canadian firms' U.S. dollar profits. If there were only one Canadian company operating in Canada, then the increase in Canadian profits would be greater than above by the decrease in the U.S. dollar value of production costs. Finally, if all firms were located in Canada (and assuming constant marginal production costs), then the U.S. dollar appreciation would lead to a proportional fall in U.S. market price so that the Canadian firms' profits (C$) would be the same.

2.4.2.2. Costs

The management actions that may be available to improve a company's competitive position are to shift costs into a more competitive currency, or to increase the degree of differentiation of its competitive offering, so as to make it less price-sensitive. Because the bulk of the costs are capital investments and raw material, forest product firms cannot switch costs between currencies.[34] Their cash flows depend above all on the prices of the natural resources they sell, which can be assumed to be determined by a basket of currencies heavily weighted towards the U.S. dollar. The marginal pricing factor that reflects the relative importance of producer cost and demand considerations depends on a number of variables. Those variables include the structure of the industry, the price elasticity of demand, the range of complements and substitutes,[35] the relevant cross elasticities, and the structure of costs. The forest product industry is a commodity market, not a differentiated customer market; producer cost is of prime importance.[36]

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[34]Still, some overseas companies, notably Stora of Sweden have aggressively taken holdings in Chilean companies to guarantee long term fibre resources.

[35]In the case of monopolistic competition, the change in profits caused by an exchange rate shift would be independent of the degree of product substitutability.

[36]The Financial Times reports that Abitibi's chief executive predicts the over-riding question in the industry to be: "Where are you in the cost curve?". Domtar's chief executive is also stating its determination to rebuild the company's financial base with its most cost-competitive business (*Source*: [6], p. 5).

To conclude, Canadian forest companies deal with highly competitive low-margin products in which they are mainly price takers; their costs are dominated by raw materials and the capital cost of their plants. The commercial profile of the industry is dominated by the fact that the sales are priced in U.S. dollars, and that the main competitor has its costs in U.S. dollars. Moreover, sales tend to be from price lists, which does not allow to account of short term movements in exchange rates. (It is a price list business in which companies set price lists and grant discounts from them.)

2.4.3. Exchange rates

Most of Canada's forest products production is exported, and it is customarily priced in U.S. dollars. Consequently, in determining local prices for Canadian producers, exchange rates are as important as the supply/demand balance. We first focus on the recent fluctuations of the exchange rates that are of relevance to estimate exposure. This primary analysis will allow us, in the following section, to consider the currency habitat in order to understand the size of the price change resulting from a given exchange rate variation.

Currency fluctuations are very important for the industry. Under normal circumstances, the U.S. is by far the low cost paper producer in the world. Only Brazil's low cost labour and eucalyptus fibre can effectively compete. However, when the U.S. dollar rises far enough, it makes the Scandinavians much more competitive.

Recently, European currencies have been quite unstable. The important one for the paper industry is the Swedish Krona, which has been allowed to float freely. This effectively resulted in substantial devaluations of 20 to 40 per cent against the U.S. dollar in the second half of 1992. Prices collapsed as the Scandinavians suddenly became the low cost producers, and reduced prices to regain market share. (In the past, as the highest cost producers, Scandinavian mills absorbed supply imbalances, shutting down when prices fell.) These devaluations - which make Swedish paper more competitive in American markets and American paper less competitive in European markets - reduced Northern Europe's pulp prices to Canadian levels, reducing Canada's protection to world overcapacity.

The Canadian dollar has floated freely since the beginning of the 1970's. Traditionally, the country's strong links with the U.S. have kept their currencies strongly correlated. However, the Canadian dollar dropped from approximate parity with the U.S. Dollar in 1977 to below US$0.75 in 1985. This period was beneficial to Canadian producers who were paying their expenses in Canadian dollars but were being paid with the increasingly valuable U.S. dollar.[37] For example, while newsprint pricing rose 84% in U.S. dollars during the period, Canadian producers enjoyed a corresponding 147% increase in local currency. In the second half of the decade, though, the Canadian dollar went up again to nearly US$0.90 in 1991. Thus

[37]According to the Pulp & Paper 1993 North American Factbook, favourable exchange rates may have helped prolong the life of a number of mills, especially in British Columbia.

Canadian producers gained less from price increases than their U.S. counterparts, and eventually the strong Canadian dollar increased the impact of falling prices caused by capacity additions and weakness in the North American economies.[38] Since then, however, exchange rate trends reversed, again favouring Canadian exports. (The Canadian dollar also continues to decline against the Japanese Yen. This means that Japanese buyers, who prefer old-growth coastal lumber from B.C., see no increase in their own currency. In other words, the price increases have not yet turned buyers from the Canadian market.)

As previously mentioned in *section 1*, we should be concerned with a real exchange rate analysis in order to take account of offsetting changes in price levels. Indeed, because the rate of inflation has been higher in Canada than in the U.S., the advantage to Canada has been less than the differences in the nominal rate would imply. The distinction between the real and the nominal exchange rate is important because of their different implications for exchange risk. This aspect is discussed in the next section.

[38]Average newsprint prices in 1991 were roughly 7% higher than in 1986 in U.S. dollars, but they were about 12% lower in Canadian currency.

3. Foreign Exchange Exposure Model Development

In this section we build a model of how exchange rate fluctuations should influence the cash flows of a forest products company in Canada. The model will provide a theoretical basis for constructing testable hypotheses about the nature of the sensitivity of sample firms to currency changes.

3.1. Model foundations

First of all, we need to clarify the sources of currency risk. For traditional exposure analysis, currency risk comes from movements in nominal exchange rates causing a mismatch between the currency of a firm's costs and the currency in which it quotes prices to customers (trading risk). However, currency risk also comes from the appreciation in real terms of a currency in which a firm incurs substantial costs, against the currency of competitors (competitiveness risk).[39] In fact, only changes in real exchange rates will affect a company's international competitive position. Those changes alter its ability to compete and to make profitable sales. Indeed, a rise in the real exchange rate may decrease either margins, sales volume or both. Since currency movements affect firms in the forest industry much more in their

[39]Competitiveness risk does not concern the currency in which the business sells since the currency of denomination affects all competitors and thus should be considered as macroeconomic risk (cf. Kenyon, [1991]).

impact on selling volumes and prices than in how they affect particular contracts or combinations of assets and liabilities, the currency related risk is mainly economic.

We already acknowledged that the currency of invoice does not suffice to determine a firm's operating exposure, which actually depends on the market structure in which the firm operates.[40] The currency in which the price of a good tends to be more stable - the so-called currency habitat or currency of determination - will tell us if a price will move or remain stable when exchange rates move. The impact of an exchange rate change between the Canadian and the U.S. dollars on the price of lumber, for example, depends on the producers and consumers that dominate the market and on the demand and supply elasticities. Theoretically, if we assume there is perfect competition with a unified world price (that is LOP holds for lumber between the U.S. and Canada) and we further acknowledge that the market is U.S. based, then a Canadian dollar depreciation will not change the U.S. dollar price of lumber but will increase the Canadian price by the amount of the depreciation. To understand how the dollar price of the product changes with exchange rate shifts, linear models such as developed by Ungern-Sternberg & Weizsacker [1990] are useful. According to them, the coefficient indicating the extent to which a given price change affects the firm's per unit profits differs with the

[40]According to Flood & Lessard [1986], market structure is determined by the currency habitat of the price of goods as well as the quantities impacts - that is the extent to which unit sales respond to real exchange rate changes.

type of competition in the market.[41] This integration of the theories of finance and industrial organization is essential to the approach adopted in this paper.

3.2. Base case

We may consider first the consequence of a change in the C$/US$ exchange rate for a Canadian forest company that exports to the U.S. market and faces no foreign competition. The effects on the company's profits (in Canadian dollars terms) can be derived as follows. If we define Π as Canadian dollar profits, R as total export revenues, and C as total cost for this firm, we can write

$$\Pi = R - C = (X_1 p^u q) - (cq), \tag{1}$$

where X_1 is the exchange rate expressed in Canadian dollars per U.S. dollars, p^u is the US$ sales price, q is the quantity sold, and c is the unit cost of production.

First of all, we need to know the effect of a given currency change on prices and total revenues of the firm, in terms of the home currency. In order to determine p^u, the profit maximizing firm will equate marginal revenue and marginal cost, such that dR/dq = dC/dq. By differentiating (and assuming changes in production do not affect the exchange rate, that is $dX_1/dq = 0$), we get

[41]This coefficient may equal one (perfect competition), two (Cournot model), or more than two in the case of monopolistic competition.

$$X_1p^u+X_1q\frac{dp^u}{dq}=X_1p^u[1+(\frac{q}{p^u})(\frac{dp^u}{dq})]=c.$$

Introducing the elasticity of demand $e_D= -[(dq/q)\ (p^u/dp^u)]$, the equation becomes

$$X_1p^u[1-(1/e_D)]=c \rightarrow p^u=\frac{c}{X_1(1-1/e_D)}, \tag{2}$$

which tells our firm how much to charge its customers in U.S. dollars, according to the cost of production, the exchange rate, and the elasticity of demand.[42] Now we can differentiate equation (2) with respect to the exchange rate. Since e_D and c are constants, we obtain

$$\frac{dp^u}{dX_1}=\frac{-c}{X_1^2(1-1/e_D)}=-\frac{p^u}{X_1}.$$

p^u and X_1 are both positive, which implies that dp^u/dX_1 is negative. This means that an increase in X_1 (or a devaluation of the Canadian dollar) will lower the profit maximizing US$ price. This preliminary analysis enables us to determine the impact of currency changes on the firm's revenues, as follows

$$\frac{dR}{dX_1}=qp^u+X_1p^u(\frac{dq}{dp^u})(\frac{dp^u}{dX_1})+X_1q(\frac{dp^u}{dX_1})$$

$$\rightarrow \frac{dR}{dX_1}=qp^u+X_1q(1-e_D)(\frac{dp^u}{dX_1}),$$

and since we found $dp^u/dX_1 = -\ p^u/X_1$, we can write

[42]The relationship makes sense only when the elasticity is more than unity, that is where marginal revenue is positive (since marginal revenue equates marginal cost which is always positive).

$$\frac{dR}{dX_1} = qp^u - X_1 q(1-e_D)(\frac{p^u}{X_1}) = e_D q p^u. \tag{3}$$

e_D, p^u, and q are all positive, which implies that dR/dX_1 is also positive. In other words, an increase in X_1 (or a devaluation of the Canadian dollar) will increase the Canadian dollar revenues of our firm from sales to the U.S.

Similarly, the impact of currency changes on the firm's costs is derived as follows

$$\frac{dC}{dX_1} = c\frac{dq}{dX_1} = c(\frac{dq}{dp^u})(\frac{dp^u}{dX_1})$$

$$\Rightarrow \frac{dC}{dX_1} = -c(\frac{dq}{dp^u})(\frac{p^u}{X_1}) = \frac{e_D cq}{X_1}.$$

e_D, c, q, and X_1 are all positive, which implies that dC/dX_1 is also positive; a home currency devaluation will then raise the cost of production.

So far we found that a devaluation of the Canadian dollar will raise revenues and costs. We now need to go back and take the derivative of equation (1) with respect to the exchange rate to determine the impact on profits. Using the above results, this gives

$$\frac{d\Pi}{dX_1} = \frac{dR}{dX_1} - \frac{dC}{dX_1} = e_D q p^u - \frac{(cqe_D)}{X_1}$$

$$\rightarrow \frac{d\Pi}{dX_1} = e_D q[p^u - (\frac{c}{X_1})],$$

where the brackets represent the profit per unit in US$. Consequently, since this is positive if the company was profitable, a devaluation of the Canadian dollar does raise the C$ profits of our firm. We conclude that there is a positive systematic relationship between an increase in the value of a Canadian forest products company and an increase in the Canadian/U.S. dollar exchange rate.

3.3. Model development

To provide further expectations of the impacts of exchange rate changes on market prices and volumes, we consider the following three-country trade model, involving the U.S., Canada and Sweden. In line with the industry audit of *section 2*, production takes place in any of the countries, with all production costs in terms of local currency only. All producers are assumed to employ the same technology. Also, as an approximation, all the sales are considered to be made in the U.S. market, and the goods to be homogeneous. Following Adams, McCarl, and Homayounfarrokh [1986],[43] the model consists of Canadian and Swedish net export supplies, U.S. demand, U.S. net domestic supply (adjusted for exports), and the

[43]Adams et al [1986] examine the impacts of exchange rate on consumption, production, prices and bilateral trade flows in the Canadian-U.S. lumber market. Their econometric model is based on annual data for the 1950-1983 period. They find short-term elasticities with respect to exchange rate (C$/US$) of less than 0.1 for U.S. consumption, -0.3 for U.S. delivered price and 0.5 for import volume. (The elasticity of Canadian market share is in the range of 0.4 to 0.6.) They conclude that "exchange rate has been an important, but by no means the sole, factor in recent expansion of Canada's share in U.S. lumber markets."

identities below

$S^c = S^c(P^c)$ Canadian net export supply, (4)

$S^k = S^k(P^k)$ Swedish net export supply, (5)

$S^u = S^u(P^u)$ U.S. net domestic supply, (6)

$D^u = D^u(P^u)$ U.S. demand, (7)

$P^c = P^u X_1$ and $P^k = P^u X_2$ Price equilibrium, (8)

$D^u = S^c + S^k + S^u$ Market clearing, (9)

where P^c is price in Canada (C$), P^k is price in Sweden (SK), P^u is price in U.S. (US$), and X_1 and X_2 are the C$/US$ and the SK/US$ exchange rates, respectively.

In order to determine the impact of a shift in exchange rate on total U.S. demand and on the volume of Canadian imports, we first calculate its effect on the equilibrium U.S. market price.[44] From the assumptions above, we can deduce

$$D^u(P^u) = S^u(P^u) + S^c(X_1 P^u) + S^k(X_2 P^u). \qquad (10)$$

The elasticity of equilibrium U.S. market price with respect to the C$/US$ rate of exchange, $e_{P,X_1} = [(dP^u/dX_1)(X_1/P^u)]$, is found by taking the total derivative of (10). Manipulating terms, we get (see derivations in *appendix 1*)

$$e_{P,X_1} = \frac{(e_{S^c}.sc)}{e_{D^u}-(e_{S^u}.su)-(e_{S^c}.sc)-(e_{S^k}.sk)}.$$

This shows that e_{P,X_1} depends on the elasticities of supply of the three

[44] Price movements and quantity impacts describe the revenues, costs and profits of the firms.

countries ($e_{S_j}=(dS^j/dP^u)(P^u/S^j)$ for market j), the elasticity of U.S. demand ($e_{D_u}=(dD^u/dP^u)(P^u/D^u)$), and the U.S., Canadian and Swedish shares of the U.S. market ($sj=S^j/D^u$ for market j). Since supply elasticities and market shares are positive and the demand elasticity negative in the normal case, then the numerator and denominator of the equation have opposite signs, which means that e_{P,X_1} is always negative. Besides, since the absolute value of the denominator is greater than that of the numerator, the absolute value of e_{P,X_1} is less than unity.[45] This means that if the Canadian dollar depreciates by a certain percentage with respect to the U.S. dollar (that is if there is a positive change in X_1), then the U.S. market price may remain the same or decrease down to maximum the same percentage. Actually, the equation shows that the more elastic U.S. demand (or the flatter the U.S. demand curve on the graphs below), the less the price effect of a shift in exchange rate. Moreover, the more U.S. initial supply and the more elastic it is, the closer to zero will be the elasticity of price with respect to exchange rate; this supports the U.S. dollar as the currency habitat for forest products. (The price effect is also diminished by more elastic Swedish supply.)

Similarly, taking the total derivative of the U.S. demand equation (7) gives the effects of C$/US$ exchange rate on total U.S. market quantity, $e_{D,X_1}=[(dD^u/dX_1).(X_1/D^u)]$. Substituting the above results for price, we get $e_{D,X_1}= e_{D_u}.e_{P,X_1}$. (Similarly, we can show that $e_{D,X_2}= e_{D_u}.e_{P,X_2}$.) Since the elasticity of demand is

[45]Similarly, we can show that $-1 < e_{P,X2} < 0$.

negative in the normal case and e_{P,X_1} was also shown to be negative, the elasticity of equilibrium quantity with respect to exchange rate is positive. This means that U.S. demand for forest products will be higher as the U.S. dollar appreciates (so long as supply in exporting countries are not restricted, which would imply a lower market response). It follows that increasing demand or supply elasticities will increase the quantity impact of the exchange rate.

Finally, to get the effects of C$/US$ exchange rate on the volume of Canadian imports, $e_{Sc,X_1} = (dS^c/dX_1).(X_1/S^c)$, we take the total derivative of the Canadian export supply relation (4). Substituting results gives $e_{Sc,X_1} = e_{Sc}(1 + e_{P,X_1})$. Since the elasticity of Canadian supply is positive and the absolute value of e_{P,X_1} lies between zero and one, the elasticity of import quantity with respect to exchange rate will also be positive. Consequently, an increase in the Canadian supply elasticity, or any shift which reduces the price effect of the exchange rate, will increase the import quantity effect. In the appendix, we also prove the elasticity of Canadian imports with respect to SK/US$ exchange rate to be negative, as $e_{Sc,X_2} = e_{Sc,X_1}/e_{P,X_1}$. This means that the volume of U.S. forest products imports from Canada will be increased by a higher X_1 and a lower X_2. Assuming triangular arbitrage, this further implies that Canadian exporters will supply more as the Canadian dollar loses value against the Swedish krona, which could be the case even if the C$/US$ remains stable.

In order to visualize the impact of different exchange rate changes, we use a graphical representation showing the interrelation among the different markets. We recall that the framework includes one importer country and two exporter countries, for which domestic demand is regarded as irrelevant. We estimate that the importer country is large enough such that its currency is the currency of determination. We are concerned with the effects of a change in the currency of either exporter countries with respect to the currency of reference; and we are also concerned with the effects of a change in the currency of the importer country with respect to the other two. The price elasticities that matter are the demand in the importer country and the supplies in the exporter countries. Demand and supply in the importer country are assumed to be inelastic with respect to the foreign price of its currency. It is only the supplies in the exporter countries that will change with the foreign currency price of the reference currency.

Graphically, the three markets under analysis are linked together through the exchange rates, represented by the 45° lines (the units of measurement are defined so that the expected values of the exchange rates are unity). The effects of a Canadian dollar devaluation versus the U.S. dollar are simulated in *Figure 1*. After the devaluation of 30% (accompanied by a decrease in equilibrium market price), Canada doubles its exports to the U.S., and also gains market share.[46] (Since Canadian exports are low value added products, they are very price sensitive.)

[46]We recall that the devaluation increases the exporter's cash flows in Canadian dollar terms because of some combination of higher margin and U.S. demand increase, according to the degree of exchange rate pass-through. (Zero "pass-through" means that the exporter absorbs the entire change in the exchange rate.)

Simultaneously, although the Swedish krona does not change with respect to the U.S. dollar, Sweden's exports decline by one third due to a decrease in exchange rate-induced competitiveness.[47] The effects of an appreciation of the currency of the importer with respect to the currencies of the exporter countries are depicted in *Figure 3*. When the C$/SK rate remains unchanged but US$ changes, both Canada and Sweden benefit from the exchange rate change, but do not gain market share at each other's expense. Those impacts are dependent on the relevant supply and demand elasticities, as can easily be seen from the graphs. These results lead to the hypotheses stated below.

H1: Value of a Canadian forest products company will increase with an increase in the Canadian dollar/U.S. dollar exchange rate.

H2: Value of a Canadian forest products company will decrease with an increase in the Swedish krona/U.S. dollar exchange rate.

H3: Value of a Canadian forest products company will increase (decrease) with an appreciation (depreciation) of the U.S. currency versus the currencies of Canada and Sweden.

To recapitulate, the present analysis is based on the forest industry market structure. We recall from the previous section that this industry faces U.S. dollar denominated world product prices. Because Canadian producers are not the market leaders, world prices are not really affected by changes in the Canadian/U.S. dollar

[47] *Figure 2* shows the symmetric impact of a devaluation of the krona.

exchange rate. Indeed, the model shows that the market price is not very responsive to a change in the exchange rate whereas the volume of U.S. forest products imports from Canada is increased by a depreciation of the Canadian dollar and/or an appreciation of the krona. The implication of a home currency depreciation for Canadian producers is thus higher Canadian dollar profits. Consequently, since forest products are mainly sold at fixed U.S. prices under medium-term contracts, we expect a home currency depreciation (and Scandinavian currencies appreciation) to be bullish on Canadian forest products stocks.

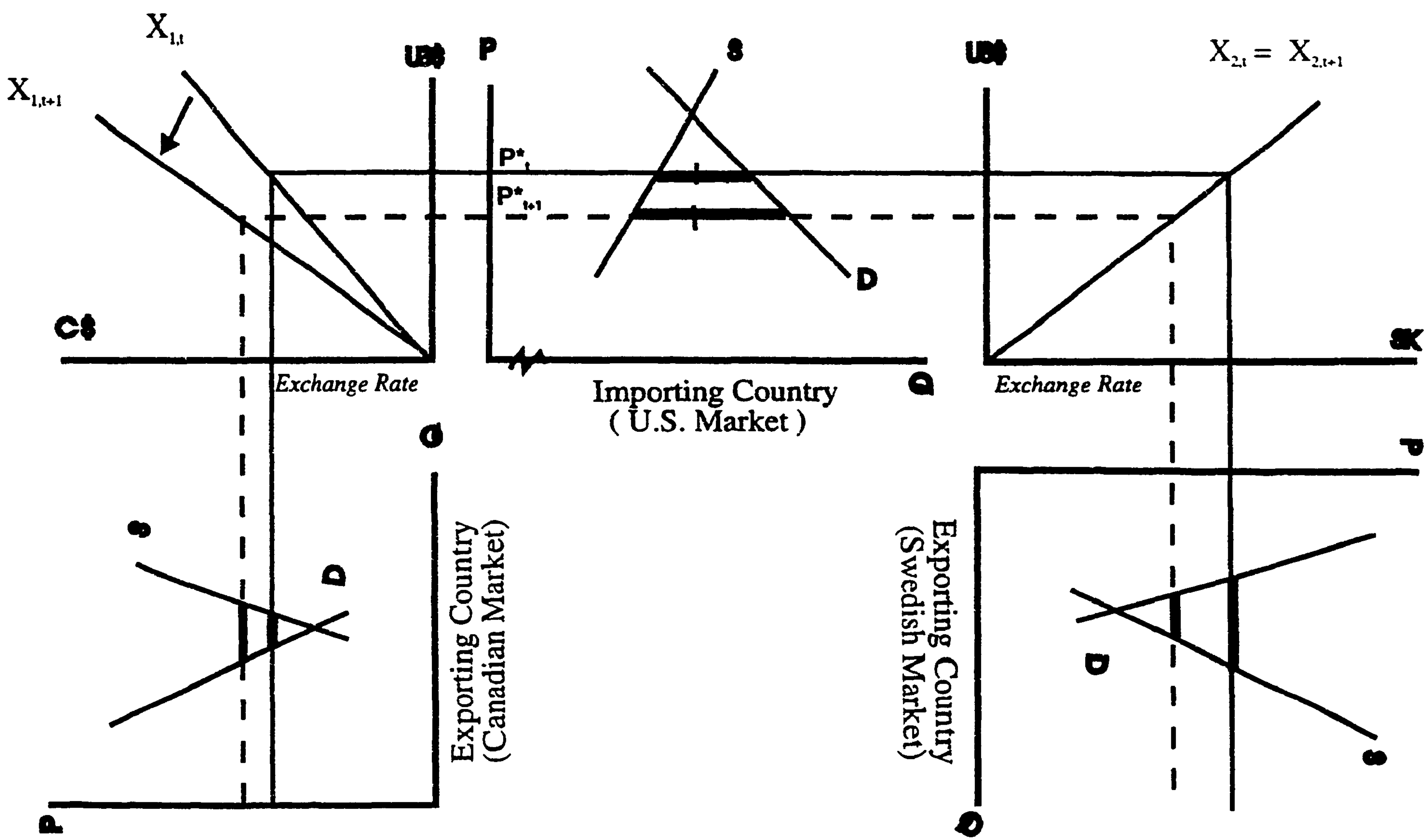

Figure 1: The Effects of a C$ Depreciation vs the US$

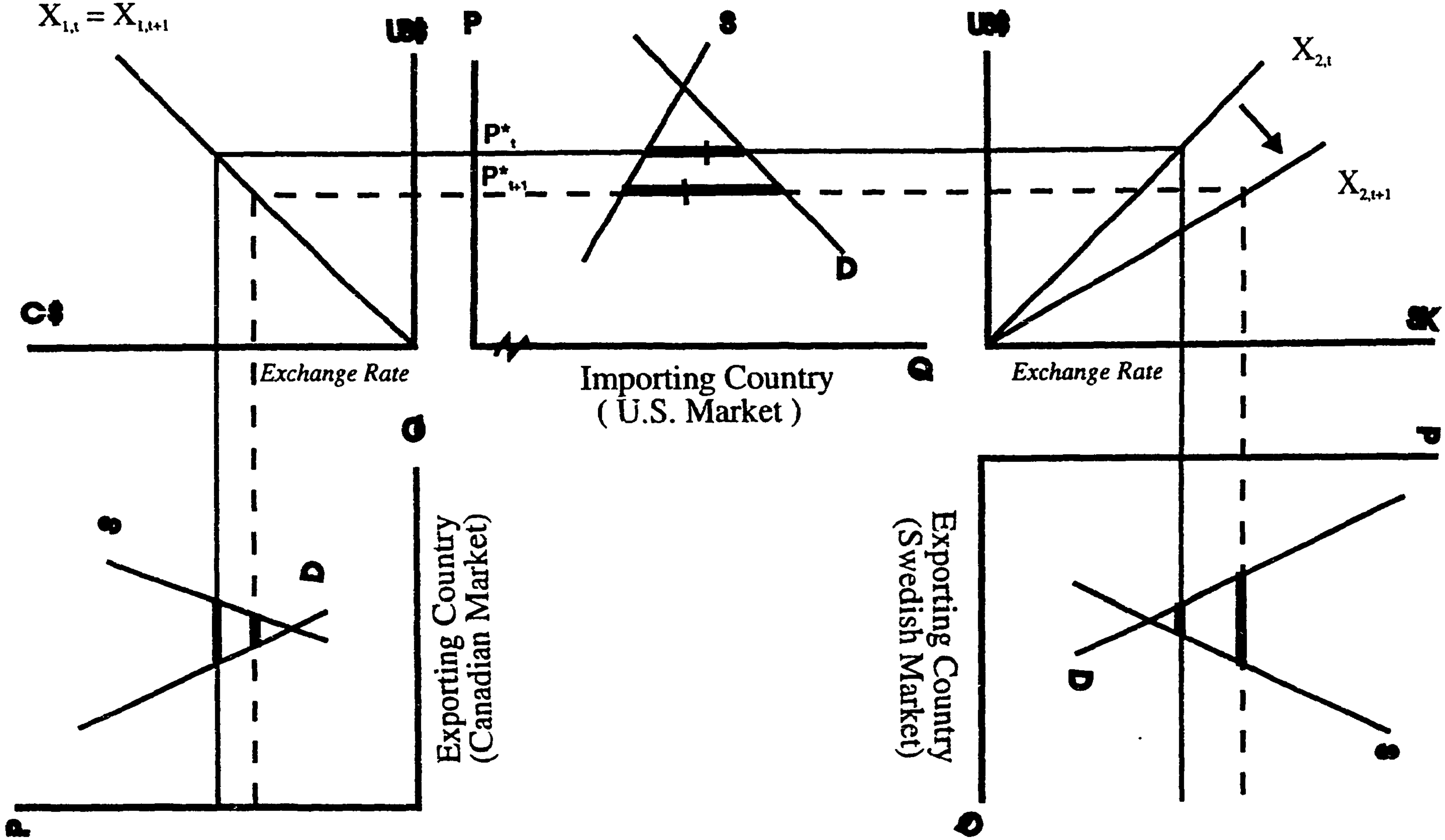

Figure 2: *The Effects of a SK Depreciation vs the US$*

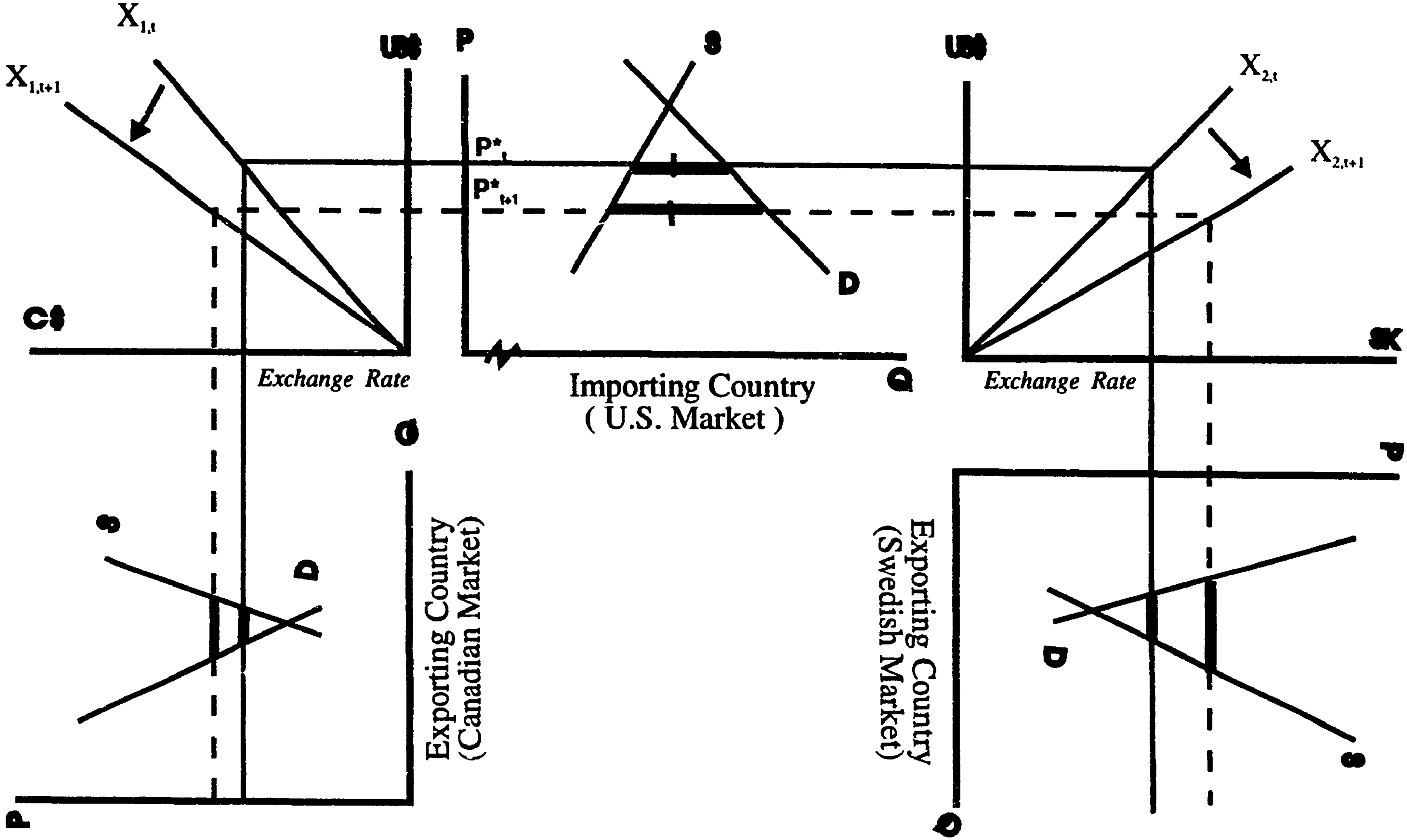

Figure 3: *The Effects of an Appreciation of the US$ with Respect to the Currencies of the Exporter Countries*

4. Empirical Implementation of the Exposure Model

The purpose of this section is to provide an empirical implementation of our model of exchange exposure. We are concerned with the effect of certain exchange rate changes on the market value of the firms under analysis. Methodology and data are described first.

4.1. Methodology

The estimation results are derived from time-series regression analyses. Several authors (Dumas [1978], Adler & Dumas [1980], and Hodder [1982]) define economic exposure to exchange rate movements as the regression coefficient of the real value of a firm on the exchange rate across states of nature. The application of the regression approach to measuring exposure is supported in the appendix of Adler & Dumas [1984] (also Garner & Shapiro [1984]).[48] They state that "exposure is best measured with statistical regression techniques, as the coefficient(s) of the purchasing power variable(s), (i.e., the exchange rates when domestic inflation is zero), in a multiple linear regression of an asset's future domestic-currency market price on (the set of) the contemporaneous foreign exchange rate(s)" (p. 43). This

[48]According to them, a reasonable measure of currency exposure should be an amount of currency, as well as a characteristic of any asset or liability that a given investor might own or owe, and it should be implementable for hedging purposes.

definition of exposure is appealing in that it separates the probability distribution of an asset's domestic currency price in the future into one part that is correlated with the exchange rates (the variability of which may be removed by financial hedging), and a second part that is independent of them.

FX exposure has largely been studied from the corporate point of view. Our approach also takes shareholder's perspective and is independent of accounting principles used to translate foreign accounting statements. In addition to being computationally simple, the regression coefficient concept of exposure provides us with "a single comprehensive measure that summarizes the sensitivity of the whole firm to all the various ways in which exchange rate changes can affect it." Indeed, "when and if hedging is a desirable corporate decision, it is exposure as a whole, not some part of it that should be protected" (*op. cit.*, p. 48). This approach focuses on the total effect of exchange rate changes since it takes into account changes in prices, costs, demand and production technology; foreign exchange risk seen as variability in a firm's cash flow includes volume as well as absolute and relative price effects, which are crucial for our exporting firms.

We use a stock measure of the value of the firm. This is consistent with our defining exposure in terms of market rather than book values. Financial markets, assuming they are efficient, immediately reflect the effect of an exchange rate change on the value of the securities issued by a firm, and hence, on the value of the firm.[49] Some papers (Eun & Resnick [1988], Ma & Kao [1990]) use aggregate stock price indices to show the empirical significance of systematic exchange rate risk; however, there have been few empirical studies that directly evaluate the impact of exchange rate risk on stock returns using the firm level data, especially when considering the amount of work on the impact of other macroeconomic risk factors.

Since share prices appear to follow a random walk, the variables to be incorporated in the model will be expressed as percentage rate of change.[50] As suggested earlier, the regression model to measure the effect of exchange exposure on stock returns is as follows

$$R_{it} = \alpha_i + \gamma_i ER_t + \varepsilon_{it} \quad (t = 1, ..., T), \qquad (i)$$

where R_{it} is the rate of return on the ith company's common stock in month t, and ER_t is the rate of change in the exchange rate measured as the Canadian dollar or Swedish krona price of the U.S. dollar (thus a positive value indicates a Canadian dollar or Swedish krona depreciation with respect to the U.S. dollar). The regression coefficient α_i is the constant in the equation, and represents the average change in

[49]As mentioned by Levi [1990], "because the effects on operating incomes show up in the future, the exposure of export-oriented and import-competing firms is different from the exposure on assets and liabilities, which shows up as gains or losses only at the time changes in exchange rates occur. Of course, market values of publicly-traded export-oriented [...] firms should change immediately, converting operating exposure into asset exposure" (p. 196).

[50]To be appropriate, we are concerned with unanticipated changes in exchange rates since markets compensate for changes that are anticipated. We could take the forward premium as the expected rate of change in the exchange rate, but as mentioned earlier the forward rate is actually a biased predictor of the future spot rate, which does not outperform the actual spot.

R_{it} when ER_t is zero. More important is γ_i which describes the sensitivity of the systematic relation between the dependent and the independent variables. The slope of the regression equation is a measure of foreign exchange exposure and can be written as γ_i = cov (R_{it}, ER_t) / var (ER_t), where cov (R_{it}, ER_t) is the covariance between stock returns and exchange rates changes, and var (ER_t) is the variance of unexpected changes in exchange rates.[51] In simple terms, the more R_{it} changes systematically with ER_t, the greater the exposure. Finally, ε_{it} is the residual error term for the return to company i in month t.

This single index model, however, does not account for non diversifiable risk. Consequently, in order to incorporate the market effect, we also use an more general two-index model as shown below

$$R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i ER_t + \varepsilon_{it} \quad (t = 1, ..., T), \qquad \text{(ii)}$$

wh're R_{mt} is the return to the national stock market in month t. We saw that the idea of exposure to exchange risk is analogous to that of exposure to market risk. In the familiar securities market line, the beta measures the firm's exposure to changes in the overall stock market index. Similarly, the exchange rate coefficient measures the firm's exposure to exchange rate fluctuations. Since changes in stock prices should reveal changes in current and expected conditions for profitability, we can add the change in the exchange rate to the market model to measure FX

[51]This is consistent with the hedging literature since the optimal hedge is what minimizes the variance of a portfolio's rate of return ($\sigma^2_{Rp} = \sigma_{Ri} + \gamma^2\sigma_{ER} + 2\gamma\sigma_{Ri,ER}$), such as $\gamma = \sigma_{Ri,ER} / \sigma^2_{ER}$.

exposure. Here, γ_i measures the firm's exposure to currency appreciation or depreciation independent of the overall market's exposure to currency appreciation or depreciation. A positive γ_i would indicate the forest products firm benefits from a home currency depreciation.

The previous formulation does not presume a causal relationship between exchange rates and stock prices; it is a statistical return-generating function rather than an equilibrium model (thus there is no need to explain the exchange rate term).[52] We assume the exchange rate to be exogenous to the value of the firms in our industry, with both variables simultaneously determined by underlying factors in the economy. The specification applies whatever the number of exchange rates that might be relevant. We differ from most studies on multinational corporations which use a multilateral exchange rate - that is a (trade) weighted basket of currencies for the exchange rate term - thus avoiding the problem of multicollinearity.

In the multi-factor model, as a matter of fact, the market returns and exchange rate changes may be influenced jointly by some external shocks, possibly translating to multicollinearity problems. To remedy them, we can use factor

[52]We are not testing whether exchange rate is a priced factor in the stock market since we look at the effect of exchange rate changes on ex-post stock price movements (that is on realized versus expected returns).

orthogonality.[53] To avoid the bias in the estimated coefficients entailed by this method, we could also construct estimates of the expected components of the alternative data series from an univariate autoregressive moving average ARIMA model. Choi, Elyasiani & Kopecky [1992] used it for bank stock returns for example. But, unlike their paper, we do not include interest rate risk; neither do we include commodity price risk. We are not interested in estimating financial price risk, or the proportion of currency risk with respect to other risks faced by the firm, but only in measuring the impact of fluctuation in exchange rates on the operations of a firm.[54]

The empirical equation is used to examine the null hypothesis that exchange rate fluctuations have zero impact on stock returns (H_0: $\gamma_i = 0$). More specifically, we test the hypotheses presented in the previous section, such as γ_1 being positive, or γ_2 being negative. We also test the stability of the exposure coefficients over time. Finally, we undertake a joint test of the significance of exchange rates in explaining returns for the forest products industry; and we test the hypothesis that all the exposures are equal (H_0: $\gamma_i = \gamma_j$) in order to establish cross-sectional variations in exposure across sample firms.

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[53] The regression model would then be written as $R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i ER'_t + \varepsilon_{it}$ $(t = 1, ..., T)$, where the exchange rate is orthogonal to the market factor (that is, $ER'_t = ER_t - \hat{e}$, with $\hat{e} = a_i + b_i R_{mt}$).

[54] Oxelheim & Wihlborg [1987] criticize the approach of analyzing specific uncertainties in isolation from other uncertainties. Their major objection is that the different kinds of risk faced by a firm are not independent from each other (see also Shapiro & Titman [1986], Smith et al [1990], Kenyon [1991]). However, keeping this in mind, the purpose of the present paper is not to study all financial uncertainties contributing to a firm's entire risk profile.

4.2. Time-series data

The data which consist of monthly time-series of stock prices for firms traded on the Toronto Stock Exchange, was extracted from the Ruban Laval data base maintained by Laval University. Sample firms are listed in *appendix 2*, along with selected recent stock prices and descriptive statistics on individual returns. The market factor is proxied by the TSE 300 Index. The monthly exchange rates are taken from the International Financial Statistics tapes published by the IMF (International Monetary Fund, [1993]). The rates are end-of-period market rates expressed in units of U.S. dollar for the Canadian dollar, and official rates expressed in units of U.S. dollar for the Swedish krona and the Finnish markka. The Swedish currency is conveniently used for the Scandinavian region, after computing the Pearson correlation coefficient for the krona and the markka against the U.S. dollar (0.895 for the sample period).[55] To conform with theory developments, real exchange rate changes are adjusted for inflation by subtracting the differential between the Canadian (Swedish) and the U.S. monthly Consumer Price Indices from changes in nominal rates, therefore $\Delta r(C\$/US\$)=\Delta n(C\$/US\$)-(\Delta CPI_c-\Delta CPI_u)$, as we may also write the real rate as $r(C\$/US\$)=n(C\$/US\$)(CPI_u/CPI_c)$. The sample periods fall between 1977 and 1991, when market conditions became more competitive; besides, before the late 1970's, the Canadian and the U.S. dollar were

[55]We note that after the Bretton Wood's system, the Nordic countries adopted a new measure for fixed exchange rates: a trade-weighted currency basket (the value of the Finnish markka was then related to 12 convertible key currencies, such as the Sterling pound (13.5%), the U.S. dollar (7.9%), and the Swedish krona (20.6%) - itself related to a trade weighted basket of 15 major currencies). It was then followed by an ECU-peg in 1991/92 and a float ever since (International Currency Review [1990], and Euromoney Guide to Currencies [1994]).

close to parity. (To illustrate, monthly C$/US$ exchange rates spanning from 1959 to 1976 have a mean of 1.03 with a range of 0.14.)

4.3. Estimation results

4.3.1. Regression analysis

The exchange rate sensitivities of each publicly-traded Canadian forest products company are estimated using ordinary least squares (OLS). Least squares estimates of currency exposures are provided in *appendix 3*. Specifically, the results from regressing equation (i) on changes in real C$/US$ rates for the whole period of 15 years are presented in *table A2*. What those results indicate is that most firms (85%) exhibit a negative exposure coefficient, among which about half are statistically significant at various levels. This suggests first of all that, unlike other studies based on U.S. MNCs, our sample firms are affected by currency changes in a significant way. However, the prevalent negative sign of the exposure coefficients entails that the firms experience a decrease in stock returns when the Canadian dollar depreciates with respect with the U.S. dollar. In other words, the results appear to fail to support the hypothesis that a home currency depreciation is bullish on Canadian forest products stocks. The regressions of an equally weighted portfolio of securities on the real and nominal exchange rates changes give the following results (t-values are given in parentheses)

$$R_{it} = \underset{(3.461)}{0.016} - \underset{(-2.953)}{1.050}\, RCD_{t}, \quad R^2 = 0.047 \quad F = 8.720$$

$$R_{it} = 0.017 - 1.198\ NCD_t, \quad R^2 = 0.055 \qquad F = 10.389$$
$$(3.607) \quad (-3.223)$$

with the variables RCD_t and NCD_t denoting real and nominal C$/US$ exchange rate changes, respectively.[56] It is interesting to realize from the above R^2 statistics that about five percent of the returns are explained by the exchange rate terms. (Indeed, the latter statistic determines the amount of attention to pay to managing FX exposure relative to managing the other risks faced by the firm.) The models prove to be overall significant according to the F-ratios, and this is the case because all parameters are significant at a level of 0.01. Even the regression constants, which are very small, are different from zero. Both real and nominal models lead to the same inferences, although the real currency effects imply slightly lower and less significant exposures. (This makes sense considering the monthly volatility of changes in inflation rates.) In fact, the coefficient of real exchange exposure indicate that a one percent depreciation of the Canadian dollar on average is associated with a 1.05% fall in value, that is approximately the same percentage change.

The assumptions of the models concerning normality, constancy of variance and autocorrelation of the residuals are validated next. Histograms of residuals and normal probability plots (not shown) were first examined before conducting Shapiro Wilks statistics for normality. The W_c-values are close to the critical value of 0.99

[56]Least squares estimates of double-log FX exposure are provided in the appendix (see *table A8*). Unless specified, we give linear estimates in the text for comparability with other studies (the results are very similar anyhow, since Log $(R_{it} + 1) = 0.014 - 1.067\ LRCD_t$, $R^2 = 0.05$).

(0.982 for n=100),[57] which means normality can be assumed for all variables but Consolidated Mercantile Corp. (We note in *appendix 2* that over the fifteen-year period, CMC has the highest monthly returns, as well as the highest volatility.) Since the returns are skewed to the right, the Wald test for normality via Skewness and Kurtosis is shown to be more restrictive.

The constancy of variance assumption is not rejected according to the Chi-squared values calculated in White's test for heteroscedasticity. Indeed, except for Abitibi Price Inc., all values are below the critical value of 5.99.[58] Similarly, the Durbin Watson statistic indicate absence of first order autocorrelation in the residuals since most DW-values, with the possible exception of Cascades Inc., are above the upper critical value of 1.69. Finally, the regression diagnostics analysis using Cook's distance and DFFITS shows the existence of a few outliers among which observation 130 (October 1987) is common to most regressions. However, no values were removed from the data set.

In order to assess the sensitivity of our sample firms to changes in the currency of cost of their Scandinavian competitors, we now regress the Canadian

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[57] W_c is the correlation between the ordered residuals and their expected values which provides the test for approximate linearity of the point in the normal probability plot.

[58] For this test, we write the squares of the residuals as a function of the Kronecker products of the independent variables; we then multiply the squared correlation coefficients from the regressions by the number of observations. After correcting for heteroscedasticity, the coefficient of exposure for Abitibi Price is still positive but it is of significant lower magnitude.

returns on Swedish krona changes. *Table A3* reports all the individual parameter estimates using both nominal and real exchange rate changes. As expected, most coefficients (67%) are negative. However, the magnitude of the exposures appears to be much less than in the previous equations, and so are the levels of significance. Indeed, 27% of companies with a negative exposure to the Swedish krona faced a significant exposure. (Interestingly, Green Forest Lumber Corp. shows a very different pattern with respect to all its counterparts with a 1% significant positive exposure of nearly 2.29.) A summary of the models are presented below

$$R_{it} = \underset{(3.385)}{0.016} - \underset{(-2.544)}{0.395}\ RSK_t, \quad R^2 = 0.035 \quad F = 6.472$$

$$R_{it} = \underset{(3.501)}{0.017} - \underset{(-2.253)}{0.355}\ NSK_t, \quad R^2 = 0.028 \quad F = 5.075$$

where the variables RSK_t and NSK_t denote real and nominal SK/US$ exchange rate changes, respectively.[59] The models are still overall significant, but it is not surprising that the exchange rate terms now explain only about 3% of the regressions. As before, results from the two equations are rather similar (although the nominal changes lead to a slightly bigger exposure), with both exchange rate terms significant at the 5% level.[60] As a result, from now on we will focus exclusively on real exposure to exchange rate changes. The coefficient of real exposure indicates that a one percent depreciation of the Swedish krona leads to a 0.39% fall in stock returns, witnessing the competitive impact of the currency change.

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[59]A regression of the stock returns on the real SK/C$ rate gives an exposure of -0.221 (p = 5%).

[60]Note that the correlation between nominal and real exchange rate changes is somewhat higher for the krona than the Canadian dollar.

In the methodology section, we develop a model which explicitly controls for market movements. The "augmented market model" consists of regressing the forest products stock returns on the TSE index returns as well as on the changes in exchange rates. *Table A4* shows the estimates for all the multiple regressions. Of course, the correlation coefficients are much higher than before, and the variables explain up to more than half of the changes in stock pric. On average, the betas are slightly above unity, and they are highly significant in 89% of cases. We know that firms in certain industries tend to have higher stock betas than those in other industries. In fact, stock prices of firms whose products are termed as necessities tend to respond less than the stock prices of most other firms when economic expectations are changing.[61] According to Rosenberg & Guy [1976, p. 66], a reasonable prior estimate of the market beta of a firm in the forest products industry is 1.16, which is consistent with our results. The models document that when incorporating the market effect, the regression constants are no longer significantly different from zero. More remarkable, exposure coefficients - evenly spread between positive and negative values - are actually not significant either, except for two specific companies with high positive exposures (namely Abitibi Price and Domtar). Those results suggest that the Canadian market as a whole is influenced by currency changes in a negative way. Regressing the market index on real changes in the C$/US$ rate proves the assertion with a (highly significant) gamma of minus 1.22

[61]Conversely, firms in luxuries tend to have high betas because they tend to have more variable earnings.

(R^2= 11%). Examining the following summary regression equation

$$R_{it} = 0.005 + 1.003\ TSE_t + 0.172\ RCD_t, \qquad R^2= 0.565 \quad F= 114.?79$$
$$(1.421)\ (14.524) \qquad (.675) \qquad (VIF= 1.122)$$

reveals that the market-adjusted coefficient of exposure is not highly correlated with the initial estimate, a result which differs from other U.S. studies like Jorion [1990].[62] The fact that beta is almost unity could reflect the importance of forest products stocks on the TSE 300; however, even though the index is more oriented towards companies in natural resources than the DJI in the U.S. for example, forest products stocks only represent about 2% of the index (mid-1985). Combining both exchange rates effects (see *table A5* for multi-currency exposures) and the market effect in the same regressions provides more insight on the sensitivity of the sample firms, as shown below

$$R_{it} = 0.016 - 0.927\ RCD_t - 0.330\ RSK_t, \qquad R^2= 0.071 \quad F= 6.719$$
$$(3.501)\ (-2.599) \qquad (-2.132) \qquad (VIF= 1.027)$$

$$R_{it} = 0.005 + 1.000\ TSE_t + 0.281\ RCD_t - 0.303\ RSK_t, \qquad \rho_{RCD,\,RSK}= 0.161.$$
$$(1.471)\ (14.777) \qquad (1.111) \qquad (-2.922)$$

As mentioned before, the multifactor models need to be tested for multicollinearity. For that purpose, variance inflation factors have been computed for all combinations of independent variables; since the factors are all below ten, we conclude that we do not need to use factor (market) orthogonality.

Clearly, whereas variable RSK is not affected by the introduction of the

[62]Jorion [1990] uses monthly returns from 1971 to 1987 for U.S. MNCs.

market proxy, RCD becomes statistically insignificant. As noted by Booth et al [1990] who assess FX exposure using Canadian data, "given the pervasive nature of exchange rate effects in the Canadian sample, it is natural to expect exchange rates to exert some common, market wide influence on equity valuation" (p. 20). Using monthly data for the period 1979 to 1983, they find prevalent exchange rate effects amongst their diversified Canadian sample since about two thirds of the regression coefficients are significant (5% level), with 97.5% of firms exhibiting a negative exposure.[63] It is also informative to compare these results with those of other studies involving Canadian data like Bodnar & Gentry [1993]. Their paper examine industry-level exposures for Canada, Japan and the U.S. using the (nominal) extended market model.[64] Interestingly, only four industries have significant exposures, among which the Paper & Forest products industry which has a negative exposure of -0.617; in the context of the article, this means that the industry is hurt by a home currency appreciation. (Lumber & Wood and Paper & Allied Products in the U.S. and Pulp & Paper in Japan are not significant.) Our results further suggest that investors view exposure to the Canadian dollar/U.S. dollar exchange rate as unsystematic; this makes sense considering that they can easily diversify their portfolios in the U.S. As international markets are becoming more integrated, we would expect the variable RSK to be less significant in more recent times. The

[63]Incorporating a January seasonal effect did not substantially modified the results.

[64]They use SUR (equivalent of GLS) for U.S. and Canada, and OLS for Japan, that they apply to monthly series from 1979 to 1988; they conclude that FX exposures are a linear function of industry characteristics.

following analysis will test the validity of this interpretation.

As we are aware of, the stability of exposure coefficient needs to be tested since exposure changes over time. (According to previous studies, we should test exposure over relatively narrow periods.) Consequently, we experiment multi-period exposure to assess the persistence of effects of past currency changes; the inter-temporal behaviour of exchange rate sensitivity is examined by segmenting the overall sample period into three sub-periods of five years (this should provide more accurate estimations of coefficients). *Table A6* provides the estimates for the periods 1977 to 1981, 1982 to 1986, and 1987 to 1991. A simple look at the coefficients suggest that at least some of them are changing over time. For example, a few companies experience a positive exposure in one period and a negative exposure in the subsequent one. Also, in general it seems that in the later period firms are more significantly affected by exchange rate fluctuations. (According to *table A7*, this period does not display higher volatility of exchange rate changes.) Formal stability tests based on ANOVA were conducted between sub-periods one and two, and two and three. The critical value for the Chow-test being equal to 3.07 for most regressions, we conclude that the exposures of ABI, CAS, CMC, DTC, RLD, and SPL are not stable over time (between the first two periods and the last one). This further suggests that it is better not to pool the data in one regression.

Since the loglinear specification does prove superior in terms of sum of square errors, as shown in *table A8*, we now choose to study only the more recent parameter estimates by taking the log of the variables plus the constant one, since some returns are negative (*tables A9 to A13*). Doing so enables us to consider all the forest products companies which were listed on the Canadian Exchange during the initial sample period. Least-squares estimates of double-log FX exposure for an equally weighted portfolio of Canadian forest products firms (1987-1991) are provided below

$$\underset{}{\text{Log }(R_{it} + 1)} = \underset{(-.349)}{-0.003} - \underset{(-2.496)}{1.692}\ LRCD_t + \underset{(.214)}{0.060}\ LRSK_t,$$

$$\text{Log }(R_{it} + 1) = \underset{(-1.159)}{-0.005} + \underset{(11.892)}{1.085}\ LTSE_t - \underset{(-.633)}{0.243}\ LRCD_t - \underset{(-.850)}{0.128}\ LRSK_t.$$

Table A11 shows that half the sample has a significant negative exposure to the C$/US$ exchange rate; in other words, in recent years many companies were actually hurt from their currency depreciating with respect to the U.S. dollar. Finally, it is worth comparing the t-values for variable RSK with the t-values from previous regressions (page 66) since, as we anticipated, Swedish krona exposure is no longer of concern to international investors.[65] To conclude we realize that, independent of the overall Canadian market's exposure, firms in our industry are not significantly exposed to currency changes.[66]

4.3.2. Interpretation of results

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[65]T-values for the log linear models are -2.773 and -2.855 compared to 0.214 and -0.850, respectively.

[66]The two notable exceptions are Scott Paper Ltd. for Canadian dollar fluctuations, and Green Forest Lumber Corp. for changes in the Swedish krona.

The empirical findings reveal a more (less) than proportional response of current economic value to changes in the C$/US$ (SK/US$) exchange rate. This result is not surprising; however, while we anticipated most Canadian forest products firms to be negatively affected by a depreciation of the krona, we did not expect them to be hurt by a depreciation of the Canadian dollar. Nevertheless, another paper involving Canadian data found negative regression coefficients for the Canadian resource base sector.[67] As suggested by the study, one explanation for negative exposures is that market views the firms as having cost exposure, "however, this explanation ignores the substantial proportion of Canadian firms that are dependent on the natural resource sector" (p. 15). This result which remains to be explained shows at least that FX exposure is a complex matter; since it is difficult to determine in advance, one may say that it is rather an empirical question. We next try to investigate the possible reasons why some of our empirical findings are conflicting with theory. They might stem from the restrictions in our model (assumptions do oversimplify reality), or from the ways to test for it.

4.3.2.1. Theoretical considerations

The discrepancy between model predictors and some of the results may be relaxed by considering less restrictive models of exposure. Indeed, it could be the case that the benefits of a home currency depreciation may be outweighed by the

[67]Assessing FX exposure for 156 Canadian firms using similar methodology (the single regression coefficient procedure), Booth & Rotenberg [1990] find that a one percent depreciation is associated with a 2.3% fall in firm value. (This is higher than for forest products firms but we should be careful in comparing estimates across studies.)

costs. A possible reason for a negative relationship between forest products stock returns and exchange rate changes could be an offsetting of the competitive edge of a home currency depreciation by opposite exposure on domestic operating incomes. For example, assuming that interest rate parity does not hold perfectly in the short run, if a Canadian dollar depreciation leads the Central bank to increase interest rates in a systematic way, then we would expect forest products stock prices to decline since the industry heavily relies on the construction sector, which is sensitive to interest rate levels. Similarly, we may be too restrictive in assuming a competitive structure for all of the industry's products, especially in pulp and paper. We can question the hypothesis that the exporter whose home currency drops becomes more valuable, by considering strategic effects arising from imperfect competition.[68] Allowing for demand side effects or recognizing the influence of exchange rate changes on the firms' cost of capital may also influence our expectations. Froot and Stein [1991] argue that the cost of capital for a home country firm rises when the home currency depreciates if there are costs associated with external financing. It is worth mentioning that, in those less restrictive contexts, theoretical considerations do not clearly predict the sign of a given firm's exchange rate exposure.

To go further, we might consider our results in light of the J-curve effect for

[68]Luerhman [1990] shows that "bimarket duopolists' reoptimization following an exchange rate shock has effects on firm value with ambiguous signs and amplitudes" (p. 620). In his framework, each equation contains three types of terms: revenues from abroad (base case), demand shift terms for each market (whatever competition type), and "strategic interaction" terms. The two first type of terms are the same as in Choi [1986]. The result that the base case exposure does not take account of strategic interactions is confirmed by the empirical work conducted on steel and automobile industries (Luerhman [1991]).

a country's balance of trade. The analogy at the level of a firm is of interest. Indeed, the J-curve describes a home currency depreciation temporary accompanied by the worsening of a country's balance of trade (as experienced for example in the U.S. in the second half of the 1980's). This is so because trade elasticities are smaller in the short run than in the long run.[69] The analysis by Manzur, Chen & Clements [1993] of the long-term effects on world trade of changes in competitiveness brought about by real changes in exchange rates is instructive. (They introduce a model to explain exports from the Group of Seven countries which highlights the role of real exchange rates.) Their empirical results indicate that "there have been large changes in real exchange rates and that the pattern of world trade responds to relative prices. Surprisingly, however, the impact of the observed changes in real exchange rates on trade is only relatively minor" (p. 124). The explanation for this result seems to be an "intriguing" systematic relationship between the price elasticities and relative price changes: indeed, exports from countries experiencing larger changes in competitiveness face more inelastic demand schedules.[70]

4.3.2.2. Empirical considerations

Our results may be due to the empirical implementation of the exposure model. The estimation of the regression coefficients for example might be improved

[69]We recall that our industry is characterized by medium-term contracts sales.

[70]Large changes in competitiveness would tend to be offset by low price elasticities, leading to only small quantity changes.

by accounting for the contemporaneous correlation of the error terms across firms. However, after comparing the coefficients of exposure estimated with OLS and SUR, Bodnar et al [1993] conclude that the system technique does not substantially influence the results.[71] Anyway, because of our incomplete data set we could not use this system approach over the fifteen year period, and the last sub-period would not provide enough time series observations compared to the number of companies under analysis. (Higher frequency observations would make it easier to use a shorter sample period - we recall that γ are not stable over time; however, this might bring other concerns like representativity and even synchronicity problems.)

More fundamentally, exposure is imprecisely estimated because our data consists of the firms' stock prices while our exposure model highlights the value of firm's operating cash flows. Indeed, using market assessment of firm value stresses how the market views FX exposure. This leads Booth et al [1990] to suggest the impact of a clientele effect to explain their results: "the sign of the coefficient [of primary resource firms] is counter intuitive and only makes sense once it is recognized that U.S. shareholder interest is focused on resource stocks" (p. 19). This is consistent with our interpretation of the impact of Swedish currency changes on sample firms' value. We realize that share prices do not only reflect operating cash flows; other cash flows influence the value of the firms. Companies may undertake

[71]Seemingly Unrelated Regressions can be estimated via Generalized Least Squares. We note that if the equations are actually unrelated, that is $\rho_{ij}=0$, there is no payoff to GLS. Besides, when the equations have similar explanatory variables, OLS and GLS are identical (Greene [1990], p. 512).

activities with offsetting exposures; specifically, hedging activities enclosed in stock prices may reduce the correlation between stock prices and exchange rates. As a consequence, a possible reason for unexpected estimates of exposure (or insignificant exposures in the augmented market model) is that firms may modify their exposure through hedging. In the words of Dobson & Soenen [1993], "given the existence of [...] agency problems, foreign exchange hedging does not merely impact firm risk. By smoothing cash flow streams, it also impacts directly firm value" (p. 35). The fact that financial hedging affects our measures of exposure is considered in the discussion below.

4.4. Discussion

For a more in-depth analysis, the determinants of exchange rate exposure are now discussed with a cross-sectional analysis of economic exposure. We intend to explain the exchange risk coefficients in terms of firm-specific variables. The analysis should help understand how exposure differs across firms, and provide the sources of these differences in exposure.

4.4.1. Cross-sectional variables

The first variables assumed to explain the level of foreign exchange exposure are those measuring foreign involvement (cf. Levi [1983]). A few studies have related cross-sectional variations in exchange exposures to the firm's foreign operating profits, sales, or assets. Most of them are based on U.S. multinational corporations. For example, for the period 1971-1987, Jorion [1990] reports significant cross sectional differences in the relationship between actual spot exchange rate changes and stock returns, which are then tested with regard to foreign sales ratios. If exposure coefficients reflect traditional financial analysis, we would expect that firms with higher proportions of foreign revenues (and/or foreign assets) would be more sensitive to exchange rate changes, and would benefit from a home currency depreciation. Also, firms with more foreign financing (which acts as a natural hedge) should have more negative exchange rate effects.[72]

However, those traditional variables fail to account for the hedging activities or diversification of sample firms. The problem is that we do not know the hedge of particular firms, since in practice, forward market transactions are not available for instance. As stated above, hedging (which does not affect cash flows from real operations) does create a cash flow that reduces the correlation between total cash flows and the exchange rate. Indeed, contractual cash flows associated with synthetic products can be used to offset the risk associated with a known series of the firm's operating cash flows. This analysis tries to incorporate those impacts on firm's exposures. The rationale is that other studies measuring exchange exposure, are in fact also measuring the competence of management. We do need to acknowledge the FX management practices in place to correctly measure exposure. Consequently,

[72]In general, natural hedges can be achieved by invoicing in domestic currency - or in a mixture of currencies - (thus shifting some of the risk to customers), as well as by buying inputs in the currency of exports (such as U.S. machines).

we collect information from companies' reports and questionnaires in order to proxy the missing variables. Focusing on the exchange risk of one specific industry is compatible with our aim.

4.4.2. FX management practices

Empirical field studies on the risk management practices in use find that (multinational) firms do manage their currency risk.[73] Transaction exposure is found to be the most relevant exposure, and forward contracting is the favoured technique to manage it. Economic exposure is explicitly dealt with by Aggarwal & Soenen [1989] who realize that long-term FX risk cannot be managed using the traditional hedging techniques. They assert that firms must use their marketing, production and financial strategies to prevent the effects of long-term changes in the exchange rates.[74] However, as mentioned recently by Batten et al [1993], "since few respondents (16.6%) measured economic exposure, most surveyed firms would be unable to develop [this] type of integrated approach."[75] Indeed, the way a company defines its risk determines how it manages it. This is consistent with our findings.

The information gathered at the firm level reveals that most firms export

[73] Among those studies are Rodriguez [1981], Mathur [1982], Drury & Errunza [1985], Collier & Davis [1985], Khoury & Chan [1988], Batten, Mellor &Wan [1993].

[74] This long-term approach is given three main strategic options in Soenen & Madura [1991], namely portfolio management, cash flow matching and operating policies adjustments.

[75] They examine the effects of a number of firm-specific variables on various management practice variables, and shows that among other firm characteristics, FX turnover has the most important effect.

about 70% of their sales. Therefore, foreign involvement measured this way does not help to differentiate among companies.[76] More interesting is to look at the diversification of sales across countries or better, at the diversification of foreign revenues across currencies (indeed, some companies which sell in many countries only invoice in U.S. dollars for instance). The length of time over which foreign sales contracts are fixed depends on the company, and is found to average four months. Surprisingly, only about half of the sample firms view themselves as "active" in hedging FX risk; besides, they mean transaction exposure, and rarely economic exposure (with a few exceptions like MacMillan Bloedel or Fletcher Challenge Canada). Hedging activity is carried out with forward contracts, options and currency swaps, but the use of U.S. dollar denominated debt is even more common. The amount of hedging measured by the percentage of forward contracts with respect to sales differs among companies; it is 50% on average, but most companies do not have a defined policy - unlike Abitibi Price - especially for non-US$ receipts.[77]

4.4.3. Exposure coefficient determination

The exposure coefficients do not tell us the determinants of the exposure. In order to model exposure as a function of firm's characteristics (such as the ones mentioned above), we can use the following multivariate regression

[76]However, some companies only have domestic operations, whereas others have foreign assets, mainly in the U.S.

[77]The information is not firm-specific because respondents view it as confidential.

$$\gamma_i = \delta_0 + \Sigma\, \delta_k . Z_{k,i}, \quad (k = 1, ..., n), \qquad \text{(iv)}$$

where $Z_{k,i}$ denotes the kth firm-specific variable for company i, and γ_i the exposure coefficient of company i calculated from the time series in *section 4.3.* However, this two-step estimation procedure presents a major problem related to the correlation of the error terms across companies, from equation (i). Indeed, because they are estimated over the same sample period, γ are not independent from each other. As a consequence, the standard error of the cross sectional variables in (iv) are biased, which discredits any statistical inferences. To overcome this problem, the literature suggests to model directly the structure of the error terms by using market-adjusted γ from equation (ii) in the model below

$$\text{Log}\ (R_{it} + 1) = \alpha_i + \beta_i\ \text{LTSE} + (\delta_0 + \Sigma\delta_k.Z_{k,i})\ \text{LRCD}_t + \eta_{it}.$$

Unfortunately, the coefficients of exposure defined in this way are statistically not different from zero (as shown in *table A10*).[78] The fact that firms do not exhibit cross sectional differences in their association with exchange rates strongly suggests that no statistical analysis be conducted. Given the number of firms however, we still provide some clues on possible relevant characteristics of exposure by use of *table A13*. As expected, none of the firm characteristics discussed previously provides a strong explanation for the exposures. We mentioned that, in this sample, the proportion of foreign sales is not a good measure of cross sectional differences. Moreover, dividing the sample according to the firms' predominant activity (lumber

[78]Except for one company, at the 10% level.

or pulp & paper products) does not help to explain the different exposures.[79] The length of average contract does not seem to be relevant, and the fact that some companies are cross-listed in the U.S. does not make a powerful distinction.[80] In fact, we find that the only variables of interest to explain the differences in exposure are the extent of hedging and the diversification of foreign revenues across currencies.

[79]Remarkably, this distinction is closely related to the companies' geographical location in Canada.

[80]ADI is also listed on the New York Stock Exchange, and CMC, MBL, RPP are listed on the Nasdaq.

Conclusion

This research is concerned with the influence of currency changes on firm value. It extends the past work on the measurement of operating exposure by modelling the exchange risk of a particular industry. Specifically, this paper builds a model of the influence of exchange rate fluctuations on the cash flows of forest products companies in Canada. The model is based on the industry competitive environment and recognizes the the currency habitat as the U.S. dollar. The price and quantity effects of currency changes on firm value are analyzed within a three country framework to account for exchange rate induced competitiveness. Both mathematical and graphical analysis of the model are developed.

Exchange rate exposure is then estimated as the correlation between changes in real asset values and changes in real exchange rates by using time series over the last fifteen years. The empirical results support the hypothesis that most sample firms are negatively affected by a competitive depreciation of the Swedish krona; however, they also suggest that the Canadian firms do not benefit from a home currency depreciation. This provides more evidence that "the stock market does not seem to react in the same way as financial analysis would imply" (Booth et al [1990, p. 13]). However, this paradox is partly resolved by (a) incorporating the impact of currency changes on the Canadian market, and (b) accounting for the hedging activity of the firms under analysis.

Suggestions for further research include assessing FX exposure using cash flow data at the level of the firm, or even looking at the influence of exchange rate changes on the companies' market shares instead of stock prices. To conclude, we refer to Miller [1992, p. 328] who argues that "more rigorous theory development is needed to elaborate the complementary role of financial and strategic responses to uncertainties."

Appendix 1

Derivation of the elasticity of equilibrium U.S. market price with respect to exchange rates in a three-country framework:

$$D^u(P^u) = S^u(P^u) + S^c(P^u X_1) + S^k(P^u X_2) \qquad (10)$$

$$dD^u = \left(\frac{dS^u}{dP^u}.dP^u\right) + \left(\frac{dS^c}{dP^u}.dP^u + \frac{dS^c}{dX_1}.dX_1\right) + \left(\frac{dS^k}{dP^u}.dP^u + \frac{dS^k}{dX_2}.dX_2\right)$$

$$\Rightarrow \frac{dD^u}{dP^u}.dP^u = \left(\frac{dS^u}{dP^u}.dP^u + \frac{dS^c}{dP^u}.dP^u + \frac{dS^k}{dP^u}.dP^u\right) + \left(\frac{dS^c}{dX_1}.dX_1 + \frac{dS^k}{dX_2}.dX_2\right)$$

$$\Rightarrow dP^u\left(\frac{dD^u}{dP^u} - \frac{dS^u}{dP^u} - \frac{dS^c}{dP^u} - \frac{dS^k}{dP^u}\right) = \frac{dS^c}{dX_1}.dX_1 + \frac{dS^k}{dX_2}.dX_2$$

$$\Rightarrow dP^u\left(\frac{dD^u}{dP^u} - \frac{dS^u}{dP^u} - \frac{dS^c}{dP^u} - \frac{dS^k}{dP^u}\right) = \frac{(dX_2.dS^c.dX_1) + (dX_1.dS^k.dX_2)}{dX_1.dX_2}.\frac{dX_1}{dX_1}$$

$$\Rightarrow \frac{dP^u}{dX_1} = \frac{\dfrac{dX_2.dS^c + dX_2.dS^k}{dX_1.dX_2}}{\dfrac{dD^u}{dP^u} - \dfrac{dS^u}{dP^u} - \dfrac{dS^c}{dP^u} - \dfrac{dS^k}{dP^u}}$$

$$\therefore \frac{dP^u}{dX_1}.\frac{X_1}{P^u} = \frac{X_1\left(\dfrac{dX_2.dS^c + dX_2.dS^k}{dX_1.dX_2}\right)}{P^u\left(\dfrac{dD^u}{dP^u} - \dfrac{dS^u}{dP^u} - \dfrac{dS^c}{dP^u} - \dfrac{dS^k}{dP^u}\right)}$$

$$\Rightarrow e_{P,X_1} = \frac{\dfrac{X_1.dX_2.dS^c}{dX_1.dX_2} + \left(\dfrac{X_1.dS^k.dX_2}{dX_1.dX_2}.\dfrac{X_2}{X_2}\right)}{\dfrac{dD^u}{dP^u}.P^u - \dfrac{dS^u}{dP^u}.P^u - \dfrac{dS^c}{dP^u}.P^u - \dfrac{dS^k}{dP^u}.P^u}$$

$$\Rightarrow e_{P,X_1} = \frac{(X_1 . \frac{dS^c}{dX_1} . \frac{dX_2}{dX_2}) + (X_2 . \frac{dS^k}{dX_2} . \frac{dX_2}{dX_1} . \frac{X_1}{X_2})}{(\frac{dD^u}{dP^u} . P^u) - (e_{S^u} . \frac{S^u}{P^u} . P^u) - (e_{S^c} . \frac{S^c}{P^u} . P^u) - (e_{S^k} . \frac{S^k}{P^u} . P^u)}$$

$$\because X_1(\frac{dS^c}{dX_1}) = X_1(\frac{dS^c}{dP^c} . \frac{dP^c}{dX_1}) = X_1(\frac{dS^c}{dP^c} . P^u) = X_1(\frac{dS^c}{dP^u} . \frac{1}{X_1} . P^u)$$

$$= \frac{dS^c}{dP^u} . P^u = \frac{dS^c}{dP^u} . \frac{P^u}{S^c} . S^c = e_{S^c} . S^c$$

$$\sim X_2(\frac{dS^k}{dX_2}) = X_2(\frac{dS^k}{dP^k} . \frac{dP^k}{dX_2}) = X_2(\frac{dS^k}{dP^k} . P^u) = X_2(\frac{dS^k}{dP^u} . \frac{1}{X_2} . P^u)$$

$$= \frac{dS^k}{dP^u} . P^u = \frac{dS^k}{dP^u} . \frac{P^u}{S^k} . S^k = e_{S^k} . S^k$$

$$\therefore e_{P,X_1} = \frac{(e_{S^c} . S^c) + (e_{S^k} . S^k)(\frac{dX_2}{dX_1} . \frac{X_1}{X_2})}{(\frac{dD^u}{dP^u} . P^u) - (e_{S^u} . S^u) - (e_{S^c} . S^c) - (e_{S^k} . S^k)}$$

$$\Rightarrow e_{P,X_1} = \frac{(e_{S^c} . S^c) + (e_{S^k} . S^k)(e_{X_2,X_1})}{(\frac{dD^u}{dP^u} . P^u) - (e_{S^u} . S^u) - (e_{S^c} . S^c) - (e_{S^k} . S^k)}$$

$$\Rightarrow e_{P,X_1} = \frac{D^u}{D^u} . \frac{(e_{S^c} . S^c)}{(\frac{dD^u}{dP^u} . P^u) - (e_{S^u} . S^u) - (e_{S^c} . S^c) - (e_{S^k} . S^k)}, \quad \text{with } e_{X_2,X_1} = 0.$$

$$\Rightarrow e_{P,X_1} = \frac{(e_{S^c} . sc)}{(e_{D^u}) - (e_{S^u} . su) - (e_{S^c} . sc) - (e_{S^k} . sk)}, \quad \text{with } sj = \frac{S^j}{D^u}.$$

__Nota__: $$e_{P,X_1} = \frac{(e_{S^c}.S^c)+(e_{S^k}.S^k)(\frac{1}{e_{X_1,X_2}})}{(\frac{dD^u}{dP^u}.P^u)-(e_{S^u}.S^u)-(e_{S^c}.S^c)-(e_{S^k}.S^k)}$$

$$\Rightarrow e_{P,X_1} = \frac{D^u}{D^u}.\frac{(e_{S^c}.S^c)+(\frac{e_{S^k}.S^k}{e_{X_1,X_2}})}{(\frac{dD^u}{dP^u}.P^u)-(e_{S^u}.S^u)-(e_{S^c}.S^c)-(e_{S^k}.S^k)}$$

$$\Rightarrow e_{P,X_1} = \frac{(e_{S^c}.sc)+(\frac{e_{S^k}.sk}{e_{X_1,X_2}})}{(e_{D^u})-(e_{S^u}.su)-(e_{S^c}.sc)-(e_{S^k}.sk)}, \quad with\ sj = \frac{S^j}{D^u}.$$

$$\because e_{X_1,X_2} = \frac{dX_1}{dX_2}.\frac{X_2}{X_1} = (\frac{dX_1}{dX_2}.\frac{X_2}{X_1})(\frac{P}{P}.\frac{dP}{dP}) = (\frac{dP}{dX_2}.\frac{X_2}{P})(\frac{dX_1}{dP}.\frac{P}{X_1}) = \frac{e_{P,X_2}}{e_{P,X_1}}$$

$$\therefore e_{P,X_1} = \frac{(e_{S^c}.sc)+(\frac{e_{S^k}.sk}{e_{P,X_2}})(e_{P,X_1})}{(e_{D^u})-(e_{S^u}.su)-(e_{S^c}.sc)-(e_{S^k}.sk)}$$

$$\Rightarrow e_{P,X_1}[(e_{D^u})-(e_{S^u}.su)-(e_{S^c}.sc)-(e_{S^k}.sk)-(\frac{e_{S^k}.sk}{e_{P,X_2}})] = e_{S^c}.sc$$

$$\Rightarrow e_{P,X_1} = \frac{(e_{S^c}.sc)}{(e_{D^u})-(e_{S^u}.su)-(e_{S^c}.sc)-(e_{S^k}.sk)-(\frac{e_{S^k}.sk}{e_{P,X_2}})}.$$

Effects of the C$/US$ rate on total U.S. market quantity:

$$e_{D^u,X_1} = \frac{dD^u}{dX_1}.\frac{X_1}{D^u} = \frac{dD^u}{dP^u}.dP^u(\frac{1}{dX_1}.\frac{X_1}{D^u})(\frac{P^u}{P^u}) = (\frac{dD^u}{dP^u}.\frac{P^u}{D^u})(\frac{dP^u}{dX_1}.\frac{X}{P^u}) = e_{D^u}.e_{P,X_1}$$

Effects of the C$/US$ rate on volume of Canadian imports:

$$e_{S^c,X_1} = \frac{dS^c}{dX_1}.\frac{X_1}{S^c} = [\frac{dS^c}{dP^u}.dP^u(\frac{1}{dX_1}.\frac{X_1}{S^c})(\frac{P^u}{P^u})]+[(\frac{dS^c}{dX_1}.dX_1)(\frac{1}{dX_1}.\frac{X_1}{S^c})$$

$$\because \frac{dS^c}{dX_1} = \frac{dS^c}{dP^c}.\frac{dP^c}{dX_1} = \frac{dS^c}{dP^c}.P^u = \frac{dS^c}{dP^u}.\frac{1}{X_1}.P^u$$

$$\therefore e_{S^c,X_1} = [(\frac{dS^c}{dP^u}.\frac{P^u}{S^c})(\frac{dP^u}{dX_1}.\frac{X_1}{P^u})]+[(\frac{dS^c}{dP^u}.\frac{1}{X_1}.P^u)(\frac{X_1}{S^c})]$$

$$\rightarrow e_{S^c,X_1} = (e_{S^c})(e_{P,X_1}) + e_{S^c} = e_{S^c}(1+e_{P,X_1})$$

Effects of the SK/US$ rate on volume of Canadian imports:

$$e_{S^c,X_1} = e_{S^c}(1+e_{P,X_1}), \quad e_{S^k,X_2} = e_{S^k}(1+e_{P,X_2})$$

$$\rightarrow e_{S^c,X_1}.e_{S^k,X_2} = e_{S^c}(1+e_{P,X_1}).e_{S^k}(1+e_{P,X_2})$$

$$\rightarrow (\frac{dS^c}{dX_1}.\frac{X_1}{S^c})(\frac{dS^k}{dX_2}.\frac{X_2}{S^k}) = e_{S^c}(1+e_{P,X_1})(\frac{dS^k}{dP^u}.\frac{P^u}{S^k})(1+e_{P,X_2})$$

$$\rightarrow (\frac{dS^c}{dX_2}.\frac{X_2}{S^c})(\frac{dS^k}{dX_1}.\frac{X_1}{S^k}) = e_{S^c,X_2}.e_{S^k,X_1} = e_{S^c}(1+e_{P,X_1})(\frac{dS^k}{dP^u}.\frac{P^u}{S^k})(1+e_{P,X_2})$$

$$\rightarrow e_{S^c,X_2} = e_{S^c}(1+e_{P,X_1})(1+e_{P,X_2})(\frac{dS^k}{dP^u}.\frac{P^u}{S^k})(\frac{dX_1}{dS^k}.\frac{S^k}{X_1})$$

$$\rightarrow e_{S^c,X_2} = e_{S^c}(1+e_{P,X_1})(1+e_{P,X_2})(\frac{1}{e_{P,X_1}}) = e_{S^c}(1+e_{P,X_1})(\frac{1}{e_{P,X_1}}+e_{X_1,X_2})$$

$$\rightarrow e_{S^c,X_2} = e_{S^c,X_1}(\frac{1}{e_{P,X_1}}+e_{X_1,X_2}) \rightarrow e_{S^c,X_2} = \frac{e_{S^c,X_1}}{e_{P,X_1}}, \quad \textit{with } e_{X_1,X_2} = 0.$$

Appendix 2

Nota: Stock symbols in parentheses may differ from the variables names.

Abitibi-Price Inc. (A) Eilen A. Mercier, Senior VP and CFO
Exchange Tower, 2 First Canadian Place, Suite 1300, Box No. 39, Toronto, Ontario M5X 1A9
Tel (416) 369-6700

Canfor Corp. (CFP) A.G. Armstrong, Senior VP Finance
2900-1055 Dunsmuir Street, P.O. Box 49420 Bentall Postal Station, Vancouver, B.C. V7X 1B5
Tel (604) 661-5241, Fax/Tel (604) 661-5273

Cascades Inc. (CAS) Andre Belzile, Directeur Corporatif Finances
404 Marie-Victorin Street, P.O. Box 30, Kingsey Falls, Quebec J0A 1B0
Tel (819) 363-2245, Fax (819) 363-2752

Consolidated Mercantile Corporation (CMC) Fred A. Litwin, President
106 Avenue Road, Toronto, Ontario M5R 2H3 Tel (416) 920-0500

Crestbrook Forest Industries Limited (CFI) John R. Croll, VP Finance and CFO
220 Cranbrook Street, Cranbrook, B.C. V1C 3R2 Tel (604) 426-6241, Fax/Tel (604) 426-3406

Doman Industries Limited (DOM.A) J.R. Abercrombie, VP Finance and Administration
435 Trunk Road, Duncan, B.C. V9L 2P9 Tel (604) 748-3711, Fax (604) 748-1600

Domtar Inc. (DTC) Robert G. Vaux, VP Finances et Expansion et Chef des Finances
395, boul. de Maisonneuve Ouest, Montreal, Quebec H3A 1L6
Tel (514) 848-5536 or 848-5400, Fax (514) 848-5187

Donohue Inc. (DHC.B) Richard Garneau, VP Finances
801, Chemin Saint-Louis, Quebec, Quebec G1S 4W3 Tel (418) 684-7700

Fletcher Challenge Canada Ltd. (FCC.A) Keith E. Winrow, Senior VP Finance and Secretary
9th Floor, 700 West Georgia Street P.O. Box 10058 Pacific Centre Vancouver, B.C. V7Y 1J7
Tel (604) 654-4000, Fax (604) 654-4118

Green Forest Lumber Corporation (GFT) Richard J. Smith, VP Finance and Administration
194 Merton Street, Toronto, Ontario M4S 3B5 Tel (416) 489-3336

International Forest Products Ltd. (IFP.A) G.J. Friesen, VP Finance and Secretary
P.O. Box 49114, Bentall Centre, Suite 3500, Bentall Tower Four, 1055 Dunsmuir Street, Vancouver, B.C. V7X 1H7 Tel (604) 689-6800 or 681-3221

MacMillan Bloedel Ltd. (MB) A.N. Grunder, Senior VP Finance and Administration
925 West Georgia St. Vancouver, B.C. V6C 3L2 Tel (604) 661-8000

Malette Inc. (MTI) R.L. Barette, Controller
C.P./P.O. Box 1100, Timmins, Ontario P4N 7H9 Tel (705) 268-1462, Fax (705) 268-5065

Merfin Hygienic Products (MIP) John McNicol, VP Finance and CFO
7979 Vantage Way, Delta, B.C. V4G 1A6 Tel (604) 946-0677

Noranda Forest Inc. (NF) Ian M. Young, Senior VP and CFO
Suite 4414, P.O. Box 7, Toronto Dominion Bank Tower, Toronto Dominion Centre, Toronto, Ontario M5K 1A1 Tel (416) 982-7444

Orenda Forest Products Ltd. (OFP) H.F. Foster, Executive VP and CFO
409-545 Clyde Avenue, West Vancouver, B.C. V7T 1C5 Tel (604) 926-4445, Fax (604) 926-7963

Canadian Pacific Forest Products Ltd. (PFP) David G. Toole, Premier VP et Chef des Finances
1155, rue Metcalfe, Montreal, Quebec H3B 2X1 Tel (514) 846-4811, Fax (514) 878-4850

Primex Forest Products Limited (PXF) Paul D. Rivers, VP Finance and Secretary
9924 River Road, Delta, B.C. V4G 1B5 Tel (604) 583-3665, Fax (604) 583-1217

Repap Enterprises Inc. (RPP) Ronald H. Sumner, Executive VP Finance
1250 boul. Rene-Levesque Ouest, Suite 3800, Montreal, Quebec H3B 4W8 Tel (514) 879-1316

Rolland Inc. (RL.A) Guy Duplessis, Tresorier
Bureau 1400, 2000 Avenue McGill College, Montreal, Quebec H3A 3H3
Tel (514) 289-1779, Fax (514) 285-4476

Scott Paper Ltd. (SPL) John M. Reid, Corporate VP Finance
1111 Melville Street, P.O. Box 3600, Vancouver, B.C. V6B 3Y7
Tel (604) 688-8131, Fax (604) 643-5543

Slocan Forest Products Limited (SFF) Ronald D. Price, Senior VP CFO and Secretary
#240-10451 Shellbridge Way, Richmond, B.C. V6X 2W8 Tel (604) 278-7311

Tembec Inc. (TBC.A) Thomas W. Laberge, VP Finances et Chef des Finances
800, boul. Rene-Levesque Ouest, Montreal, Quebec H3B 1X9 Tel (514) 871-0137

Weldwood of Canada Ltd. (WLW) Kent T. Williamson, VP and Controller
1055 West Hastings Street, P.O. Box 2179, Vancouver, B.C. V6B 3V8
Tel (604) 687-7366, Fax (604) 662-2798

West Fraser Timber Co. Ltd. (WFT) Martti Solin, VP Finance and CFO, Investor Contact
Suite 1000-1100 Melville Street, Vancouver, B.C. V6E 4A6
Tel (604) 681-8282, Fax (604) 681-6061

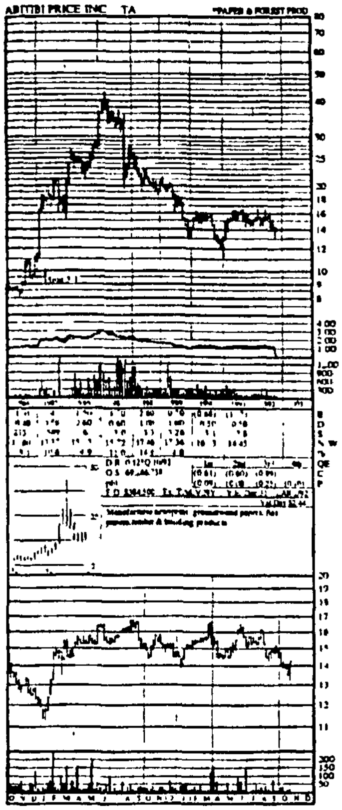
Westar Group Limited (WGL) Robert F. Chase, Senior VP Finance and CFO
1600-1055 West Hastings Street, Vancouver, B.C. V6E 2H2 Tel (604) 687-2600

Winpak Ltd. (WPK) J. Robert Lavery, President and CEO
100 Saulteaux Crescent, Winnipeg, Manitoba R3J 3T3 Tel (204) 889-1015, Fax (204) 832-7781

Some companies (such as Riverside Forest Products Ltd., or Quebec and Ontario Paper Corp.) were not taken into account because they were too recently introduced on the T.S.E.

Table A1	Number of cases	Descriptive statistics: stock returns variables				
		Minimum	*Maximum*	*Range*	*Mean*	*Std dev.*
TSE	180	-0.224	0.147	0.372	0.011	0.049
ABI	180	-0.270	0.441	0.711	0.016	0.089
CFP	99	-0.393	0.426	0.819	0.007	0.115
CAS	86	-0.266	0.389	0.655	0.018	0.124
CMC	176[a]	-0.613	1.414	2.026	0.027	0.220
CFI	180	-0.411	0.370	0.782	0.020	0.115
DOM	180	-0.333	0.639	0.972	0.016	0.146
DTC	180	-0.321	0.235	0.556	0.011	0.082
DHC	97	-0.203	0.188	0.391	0.013	0.081
FCC	180	-0.299	0.245	0.544	0.013	0.098
GFT	49	-0.500	0.500	1.000	-0.006	0.170
IFP	180	-0.419	0.541	0.960	0.018	0.140
MBL	180	-0.295	0.307	0.602	0.013	0.092
MTI	165	-0.380	0.563	0.943	0.012	0.122
MIP	24	-0.559	0.475	1.034	-0.014	0.219
NFP	53	-0.323	0.205	0.528	-0.009	0.092
OFP	23	-0.174	0.280	0.454	0.012	0.122
PFP	180	-0.244	0.321	0.565	0.012	0.083
PXF	50	-0.239	0.337	0.576	0.024	0.127
RPP	60	-0.427	0.268	0.694	-0.005	0.128
RLD	180	-0.185	0.301	0.486	0.015	0.086
SPL	180	-0.172	0.193	0.365	0.019	0.061
SFF	68	-0.341	0.370	0.711	0.014	0.120
TBC	86	-0.286	0.261	0.547	0.015	0.100
WLW	180	-0.237	0.349	0.586	0.013	0.089
WFT	67	-0.297	0.271	0.568	0.007	0.088
WGL	148	-0.231	0.393	0.624	-0.001	0.099
WPK	64	-0.183	0.147	0.329	0.007	0.073

[a]Four observations have been estimated.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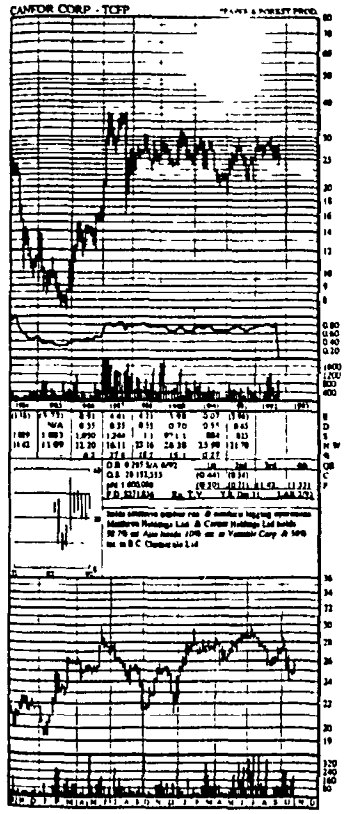
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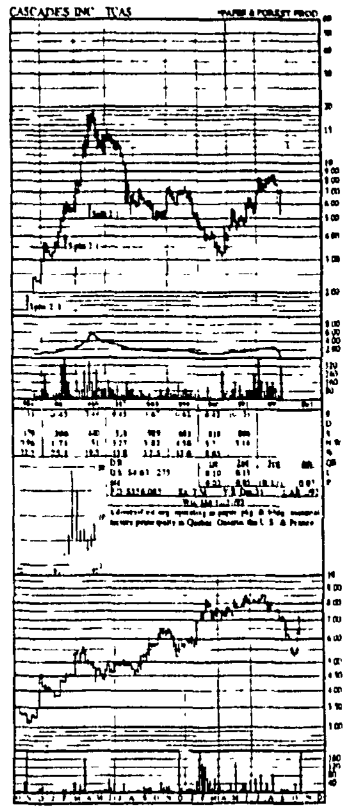
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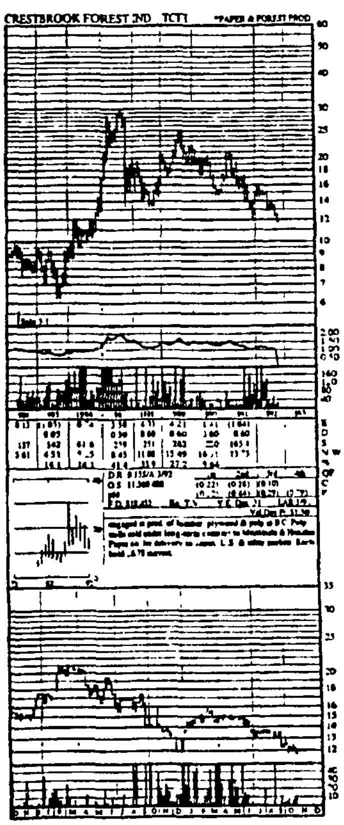
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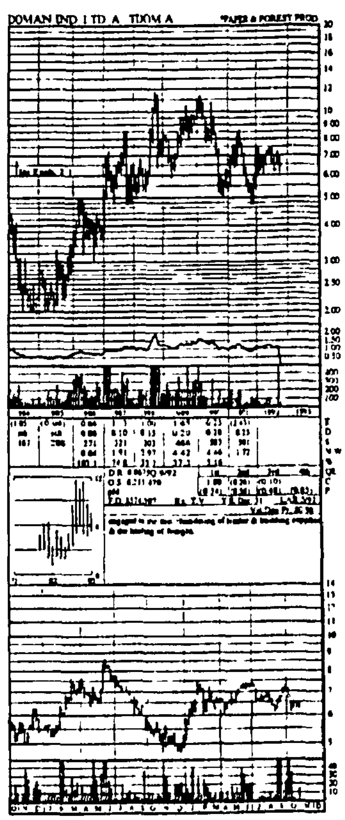
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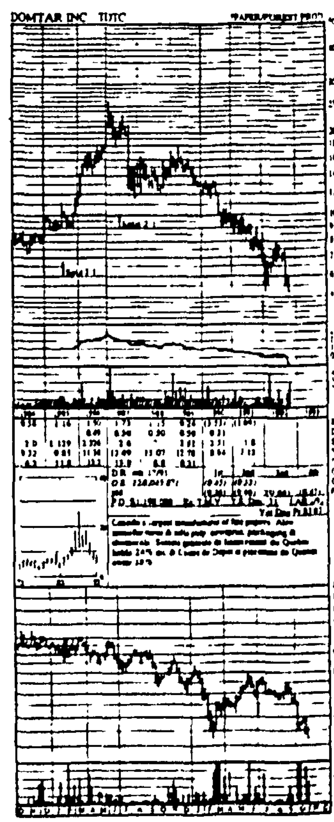
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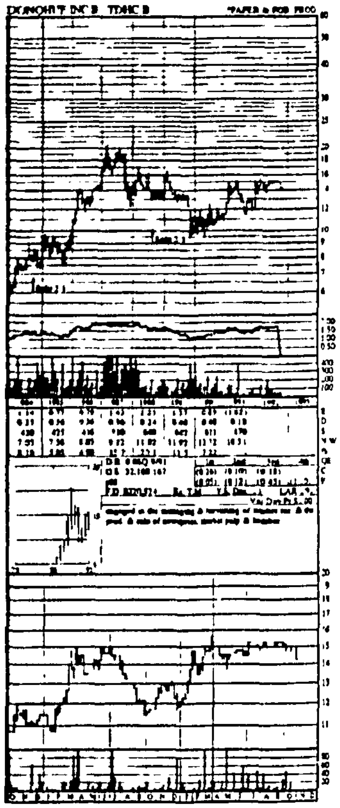

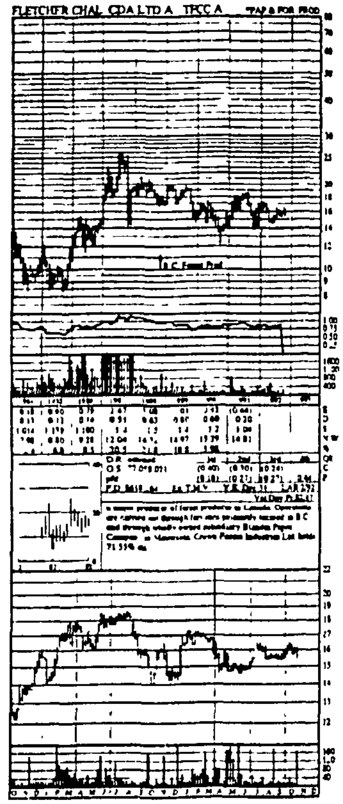
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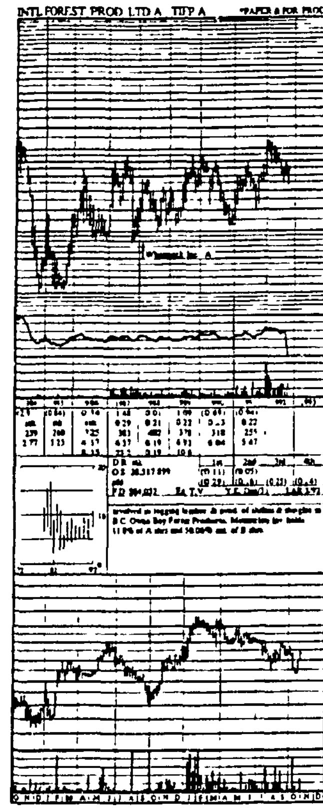
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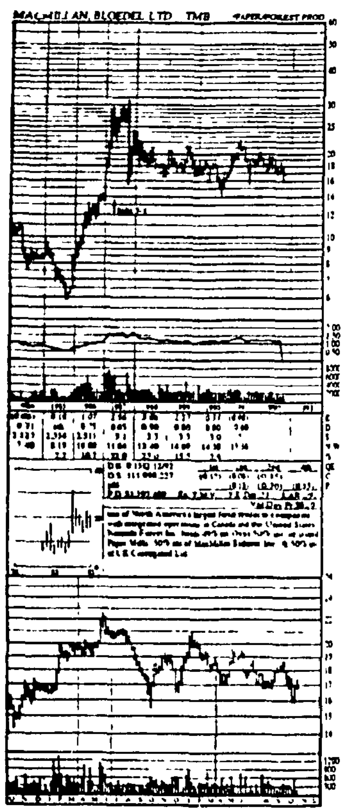
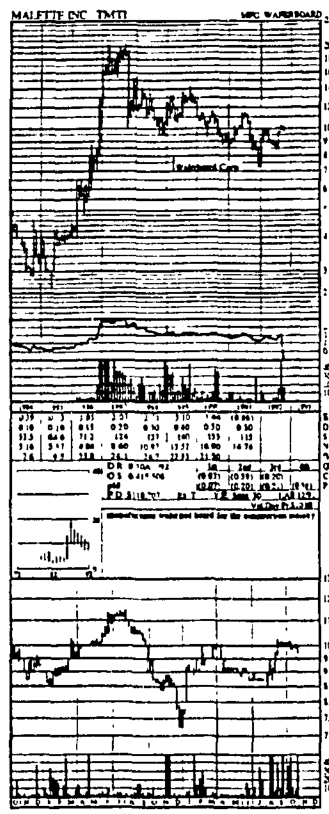

MACMILLAN BLOEDEL LTD MB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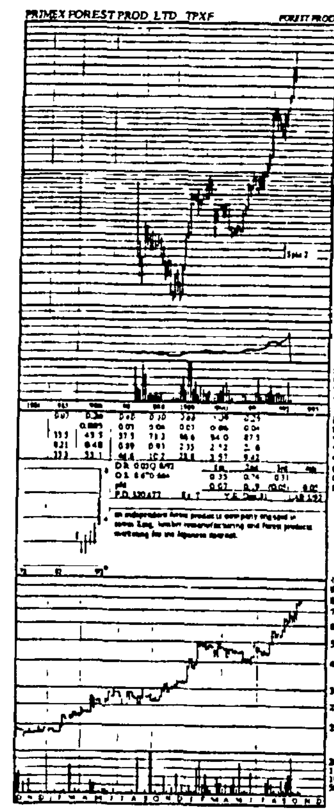
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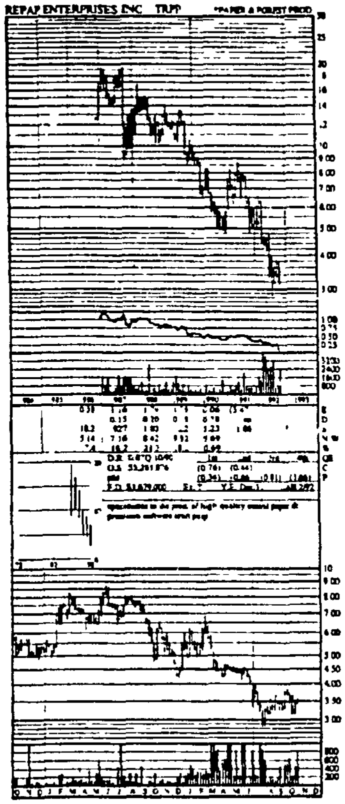
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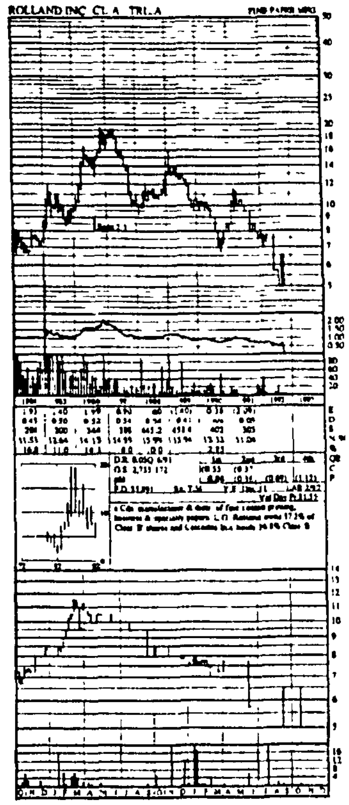
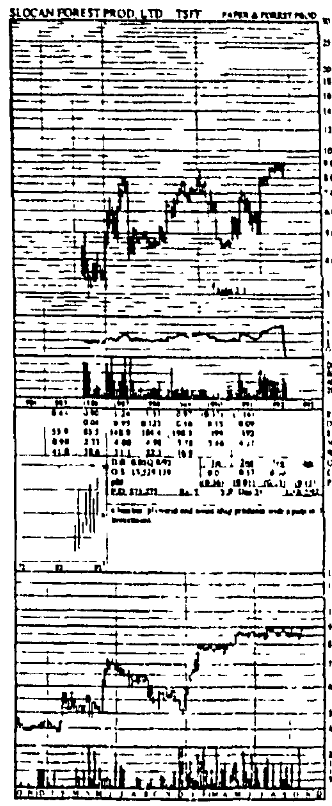
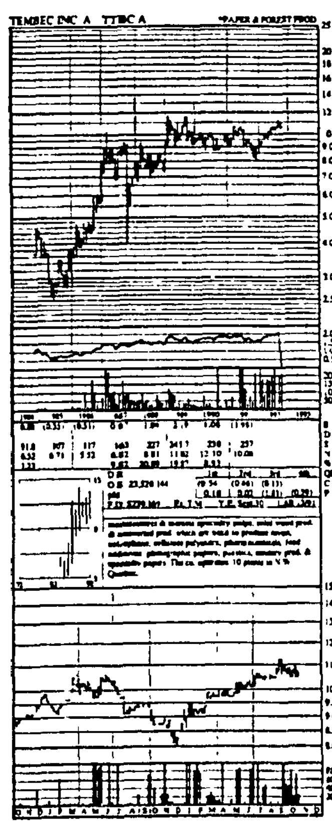

ROLLAND INC CL A TRL.A


SLOCAN FOREST PROD LTD TSFT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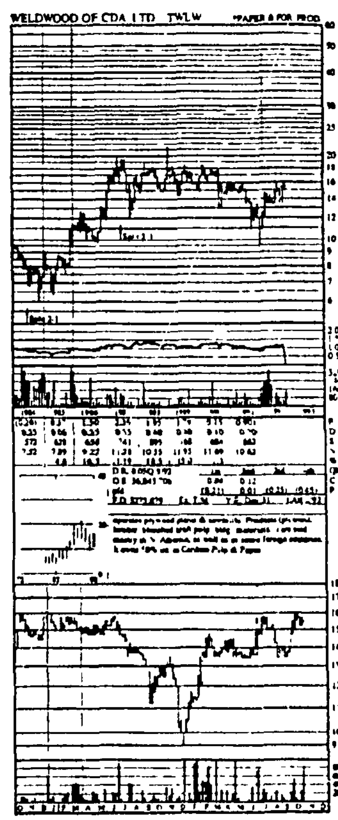
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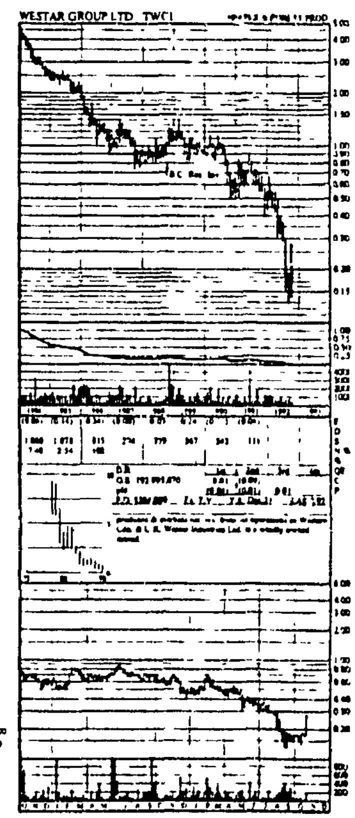
WESTAR GROUP LTD TWCI

Appendix 3

Table A2	$R_{it} = \alpha_i + \gamma_i RCD_t + \epsilon_{it}$								
	Analysis of variance		Autocorrelation[b]		Zresid[c]	White[d]	Parameter estimates		
Dep. variable	F-ratio	RSQ	DW	AR(1)	Wc	CHISQ	Constant	Exposure coeff.	t-value
TSE	21.731	0.109	1.876	0.060	0.972	2.718	0.012***	-1.218***	-4.662
ABI	1.380	0.008	1.818	0.087	0.971	20.736	0.016**	0.582	1.175
CFP	4.985	0.049	1.858	0.070	0.983	0.059	0.006	-2.134**	-2.233
CAS	0.184	0.002	1.617	0.190	0.929	1.359	0.017	-0.485	-0.429
CMC	0.024	0.000	1.914	0.041	0.838	1.386	0.027	-0.188	-0.154
CFI	3.142	0.017	1.911	0.043	0.956	2.106	0.021**	-1.137*	-1.772
DOM	2.287	0.013	1.684	0.153	0.965	2.430	0.016	-1.233	-1.512
DTC	0.230	0.001	2.090	-0.046	0.983	1.170	0.011*	-0.219	-0.480
DHC	2.503	0.026	2.158	-0.086	0.975	0.553	0.012	-1.079	-1.582
FCC	8.861	0.047	1.903	0.037	0.964	1.872	0.013*	-1.600***	-2.977
GFT	0.011	0.000	2.038	-0.027	0.885	0.377	-0.007	-0.222	-0.103
IFP	11.392	0.060	2.118	-0.063	0.974	2.538	0.019	-2.574***	-3.375
MBL	10.153	0.054	1.744	0.127	0.987	3.096	0.013	-1.592***	-3.186
MTI	4.478	0.027	2.170	-0.092	0.900	0.875	0.012	-1.483**	-2.116
MIP	0.088	0.004	2.694	-0.359	0.950	1.272	-0.014	1.252[a]	0.297
NFP	0.325	0.006	2.362	-0.200	0.972	1.145	-0.011	-0.656	-0.570
OFP	0.127	0.006	2.282	-0.187	0.961	2.422	0.013	0.970[a]	0.356
PFP	8.274	0.044	1.909	0.042	0.995	0.630	0.013**	-1.302***	-2.876
PXF	0.048	0.001	2.014	-0.048	0.968	4.830	0.025	0.351	0.219
RPP	2.759	0.045	2.259	-0.160	0.980	1.866	-0.011	-2.333	-1.661
RLD	1.750	0.010	1.538	0.230	0.962	0.396	0.015**	-0.639	-1.323
SPL	7.506	0.041	1.978	-0.008	0.973	1.044	0.020***	-0.912***	-2.740
SFF	2.932	0.043	1.970	0.005	0.970	1.462	0.008	-2.187*	-1.712
TBC	0.201	0.002	2.125	-0.091	0.985	0.318	0.015	-0.406	-0.449
WLW	13.858	0.072	1.889	0.054	0.984	1.422	0.014**	-1.789***	-3.723
WFT	6.505	0.091	1.896	0.038	0.957	0.482	0.001	-2.332**	-2.550
WGL	8.479	0.055	2.311	-0.165	0.971	2.338	-0.012	-1.755***	-2.912
WPK	4.691	0.070	2.144	-0.108	0.953	1.875	0.003	-1.701**	-2.166

Significant at the 10% level*, 5% level**, and 1% level***. [a]Not enough degrees of freedom. [b]Durbin Watson statistics and First order autoregressive disturbances. [c]Shapiro-Wilks statistics for Normality: $W_c = corr\{e_n, \Phi[(i-.375)+(n+.25)]\sqrt{MSE}\}$. [d]White's test for heteroscedasticity.

Table A2 bis	$R_{it} = \alpha_i + \gamma_i NCD_t + \epsilon_{it}$				
	Analysis of variance		**Parameter estimates**		
Dependent variable	**F-ratio**	**R^2-value**	**Intercept**	**Exposure coefficient**	**t-value**
TSE	23.958	0.119	0.012	-1.336***	-4.895
ABI	0.947	0.005	0.016	0.506	0.973
CFP	3.721	0.037	0.006	-1.910*	-1.929
CAS	0.080	0.001	0.017	-0.328	-0.283
CMC	0.109	0.001	0.028	-0.433	-0.330
CFI	3.252	0.018	0.021	-1.214*	-1.803
DOM	2.937	0.016	0.017	-1.464*	-1.714
DTC	0.465	0.003	0.011	-0.327	-0.682
DHC	2.039	0.021	0.012	-1.012	-1.438
FCC	11.232	0.059	0.014	-1.879***	-3.351
GFT	0.163	0.003	-0.009	-0.905	-0.404
IFP	13.708	0.072	0.021	-2.946***	-3.702
MBL	10.112	0.054	0.014	-1.668***	-3.180
MTI	3.463	0.021	0.012	-1.393*	-1.861
MIP	0.253	0.011	-0.013	2.315[a]	0.503
NFP	0.104	0.002	-0.010	-0.385	-0.322
OFP	0.000	0.000	0.012	-0.011[a]	-0.004
PFP	11.194	0.059	0.013	-1.578***	-3.346
PXF	0.073	0.002	0.025	0.451	0.270
RPP	2.103	0.035	-0.011	-2.084	-1.450
RLD	1.831	0.010	0.015	-0.686	-1.353
SPL	6.896	0.037	0.020	-0.919***	-2.626
SFF	3.447	0.050	0.008	-2.428*	-1.857
TBC	0.067	0.001	0.015	-0.240	-0.259
WLW	12.710	0.067	0.015	-1.804***	-3.656
WFT	5.207	0.074	0.001	-2.168**	-2.282
WGL	11.688	0.074	-0.011	-2.131***	-3.419
WPK	8.101	0.116	0.001	-2.229***	-2.846

Significant at the 10% level*, 5% level, and 1% level***. [a]Not enough degrees of freedom.**

Table A3	$R_{it} = \alpha_i + \gamma_i SK_t + \epsilon_{it}$									
	ANOVA (NSK)		ANOVA (RSK)		Parameter estimates (NSK)			Parameter estimates (RSK)		
Dep. var.	F-ratio	RSQ	F-ratio	RSQ	Cst.	Exposure coeff.	t-value	Cst.	Exposure coeff.	t-value
TSE	0.575	0.003	0.866	0.005	0.011	-0.092	-0.758	0.011	-0.112	-0.931
ABI	0.374	0.002	1.245	0.007	0.016	-0.133	-0.612	0.016	-0.240	-1.116
CFP	0.081	0.001	0.285	0.003	0.007	-0.124	-0.285	0.006	-0.227	-0.534
CAS	0.829	0.010	0.547	0.006	0.020	0.451	0.911	0.020	0.359	0.739
CMC	2.428	0.014	3.660	0.021	0.029	-0.847	-1.558	0.028	-1.024*	-1.913
CFI	0.549	0.003	0.148	0.001	0.021	-0.210	-0.741	0.020	-0.108	-0.384
DOM	5.069	0.028	5.651	0.031	0.017	-0.799***	-2.251	0.016	-0.834**	-2.377
DTC	0.355	0.002	0.667	0.004	0.011	-0.119	-0.596	0.011	-0.162	-0.817
DHC	1.785	0.018	1.067	0.011	0.014	0.405	1.336	0.015	0.309	1.033
FCC	3.631	0.020	3.909	0.021	0.014	-0.456*	-1.905	0.013	-0.468**	-1.977
GFT	10.572	0.184	8.527	0.154	-0.003	2 605***	3.251	0.002	2.289***	2.920
IFP	4.624	0.025	6.556	0.036	0.020	-0.733**	-2.150	0.019	-0.859**	-2.560
MBL	2.899	0.016	2.911	0.016	0.013	-0.381*	-1.703	0.013	-0.378*	-1.706
MTI	0.006	0.000	0.051	0.000	0.012	0.024	0.076	0.012	-0.071	-0.225
MIP	0.323	0.014	0.188	0.008	-0.017	-0.862^{a}	-0.568	-0.010	-0.634^{a}	-0.434
NFP	0.419	0.008	0.262	0.005	-0.009	0.296	0.647	-0.008	0.226	0.512
OFP	0.689	0.032	0.271	0.013	0.015	0.699^{a}	0.830	0.016	0.430^{a}	0.520
PFP	0.473	0.003	0.965	0.005	0.012	-0.140	-0.688	0.012	-0.197	-0.982
PXF	1.728	0.035	1.641	0.033	0.025	0.835	1.315	0.027	0.784	1.281
RPP	0.271	0.005	0.086	0.001	-0.004	0.319	0.520	-0.004	0.174	0.294
RLD	0.226	0.001	0.625	0.004	0.015	-0.101	-0.475	0.015	-0.166	-0.791
SPL	0.001	0.000	0.008	0.000	0.019	0.005	0.035	0.019	0.013	0.089
SFF	0.000	0.000	0.063	0.001	0.014	-0.007	-0.013	0.013	-0.132	-0.251
TBC	0.831	0.010	0.732	0.009	0.017	0.361	0.911	0.018	0.332	0.856
WLW	2.940	0.016	2.565	0.014	0.014	-0.372*	-1.715	0.013	-0.345	-1.602
WFT	0.028	0.000	0.001	0.000	0.007	0.069	0.168	0.007	-0.011	-0.027
WGL	0.384	0.003	0.758	0.005	-0.011	-0.167	-0.619	-0.011	-0.232	-0.871
WPK	0.335	0.005	0.136	0.002	0.007	-0.200	-0.579	0.007	-0.123	-0.368

Significant at the 10% level*, 5% level**, and 1% level***. ^{a}Not enough degrees of freedom.

Table A4	$R_{it} = \alpha_i + \beta_i TSE_t + \gamma_i RCD_t + \epsilon_{it}$				
	Analysis of variance		**Parameter estimates**		
Dependent variable	**F-ratio (proba)**	**R^2-value**	**Constant (t-value)**	**Mkt exp. (t-value)**	**FX exp. (t-value)**
ABI	33.964 (0.0001)	0.277	0.004 (0.735)	0.987*** (8.127)	1.785*** (3.977)
CFP	36.222 (0.0001)	0.430	-0.005 (-0.562)	1.674*** (8.013)	-0.657 (-0.857)
CAS	9.412 (0.0002)	0.185	0.008 (0.673)	1.272*** (4.313)	0.650 (0.612)
CMC	0.023 (0.978)	0.000	0.027 (1.560)	0.044 (0.124)	-0.163 (-0.123)
CFI	15.374 (0.0001)	0.148	0.010 (1.266)	0.895*** (5.210)	-0.047 (-0.073)
DOM	30.699 (0.0001)	0.258	-0.002 (-0.202)	1.553*** (7.640)	0.660 (0.878)
DTC	73.397 (0.0001)	0.453	-0.003 (-0.587)	1.176*** (12.099)	1.214*** (3.381)
DHC	16.171 (0.0001)	0.256	0.006 (0.843)	0.933*** (5.394)	-0.212 (-0.342)
FCC	70.967 (0.0001)	0.445	-0.002 (-0.375)	1.329*** (11.261)	0.019 (0.043)
GFT	1.026 (0.366)	0.043	-0.012 (-0.473)	1.052 (1.429)	0.693 (0.311)
IFP	40.701 (0.0001)	0.315	0.001 (0.167)	1.519*** (8.115)	-0.723 (-1.045)
MBL	77.437 (0.0001)	0.467	-0.002 (-0.314)	1.263*** (11.703)	-0.054 (-0.135)
MTI	9.738 (0.0001)	0.107	0.003 (0.364)	0.729*** (3.824)	-0.569 (-0.796
MIP	0.976 (0.393)	0.085	-0.011 (-0.255)	1.697 (1.364)	2.716* (0.636
NFP	35.853 (0.0001)	0.589	-0.009 (-1.087)	1.559*** (8.422)	0.944 (1.225
OFP	3.364 (0.055)	0.252	0.012 (0.514)	1.675** (2.563)	1.536* (0.632)
PFP	56.871 (0.0001)	0.391	0.0004 (0.082)	1.043*** (10.041)	-0.031 (-0.080)
PXF	6.173 (0.004)	0.208	0.017 (1.016)	1.740*** (3.505)	1.832 (1.218)
RPP	30.031 (0.0001)	0.513	-0.016 (-1.318)	1.963*** (7.399)	0.243 (0.227)

(continued)	F-ratio (proba)	R^2-value	Constant (t value)	Mkt exp. (t-value)	FX exp. (t-value)
RLD	24.856 (0.0001)	0.219	0.005 (0.820)	0.849*** (6.892)	0.396 (0.871)
SPL	21.124 (0.0001)	0.193	0.014*** (3.230)	0.507*** (5.777)	-0.294 (-0.906)
SFF	25.687 (0.0001)	0.441	0.004 (0.329)	1.753*** (6.814)	-0.074 (-0.071)
TBC	9.692 (0.0002)	0.189	0.008 (0.765)	1.029*** (4.375)	0.513 (0.605)
WLW	35.321 (0.0001)	0.285	0.004 (0.626)	0.881*** (7.263)	-0.715 (-1.597)
WFT	17.694 (0.0001)	0.356	-0.002 (-0.181)	1.042*** (5.133)	-1.066 (-1.310)
WGL	8.697 (0.0001)	0.107	-0.016** (-2.075)	0.477*** (2.912)	-0.999 (-1.555)
WPK	7.093 (0.002)	0.189	0.001 (0.153)	0.581*** (2.983)	-0.936 (-1.195)

Significant at the 10% level*, 5% level**, and 1% level***. ªNot enough degrees of freedom.

Table A5	$R_{it} = \alpha_i + \gamma_{i1} RCD_t + \gamma_{i2} RSK_t + \epsilon_{it}$				
	Analysis of variance		Parameter estimates		
Dependent variable	**F-ratio (p-value)**	**R^2-value**	**Constant (t-value)**	**C$/US$ exp. (t-value)**	**SK/US$ exp. (t-value)**
TSE	10.835 (0.000)	0.109	0.012*** (3.340)	-1.208*** (-4.551)	-0.027 (-0.234)
ABI	1.572 (0.211)	0.017	0.016** (2.403)	0.689 (1.376)	-0.288 (-1.326)
CFP	2.495 (0.088)	0.049	0.005 (0.437)	-2.103** (-2.167)	-0.098 (-0.232)
CAS	0.400 (0.671)	0.010	0.019 (1.384)	-0.580 (-0.509)	0.385 (0.786)
CMC	1.830 (0.163)	0.021	0.028* (1.669)	0.181 (0.144)	-1.037* (-1.905)
CFI	1.567 (0.211)	0.017	0.021** (2.433)	-1.126* (-1.728)	-0.029 (-0.103)
DOM	3.503 (0.032)	0.038	0.016 (1.507)	-0.948 (-1.159)	-0.768** (-2.161)
DTC	0.394 (0.675)	0.004	0.011* (1.803)	-0.163 (-0.352)	-0.151 (-0.747)
DHC	2.072 (0.132)	0.042	0.014* (1.666)	-1.200* (-1.747)	0.381 (1.274)

(continued)	F-ratio (p-value)	R^2-value	Constant (t-value)	C$/US$ exp. (t-value)	SK/US$ exp. (t-value)
FCC	5.667 (0.004)	0.060	0.013* (1.879)	-1.464*** (-2.699)	-0.365 (-1.550)
GFT	4.173 (0.022)	0.154	0.002 (0.079)	-0.003 (-0.002)	2.289*** (2.887)
IFP	8.002 (0.000)	0.083	0.019* (1.915)	-2.315*** (-3.024)	-0.697** (-2.096)
MBL	5.866 (0.003)	0.062	0.013** (1.974)	-1.491*** (-2.949)	-0.273 (-1.244)
MTI	2.237 (0.110)	0.027	0.012 (1.233)	-1.503** (-2.103)	0.049 (0.154)
MIP	0.112 (0.894)	0.011	-0.018 (-0.382)	0.926^{a} (0.211)	-0.570^{a} (-0.374)
NFP	0.280 (0.757)	0.011	-0.010 (-0.744)	-0.637 (-0.549)	0.219 (0.490)
OFP	0.219 (0.805)	0.021	0.017 (0.624)	1.181^{a} (0.423)	0.478^{a} (0.677)
PFP	4.269 (0.015)	0.046	0.013** (2.082)	-1.262*** (-2.745)	-0.109 (-0.544)
PXF	0.836 (0.440)	0.034	0.028 (1.507)	0.399 (0.250)	0.788 (1.274)
RPP	1.426 (0.249)	0.048	-0.010 (-0.589)	-2.354 (-1.662)	0.213 (0.366)
RLD	1.044 (0.354)	0.012	0.015** (2.291)	-0.592** (-1.209)	-0.125 (-0.586)
SPL	3.883 (0.022)	0.042	0.019*** (4.387)	-0.941*** (-2.785)	0.079 (0.538)
SFF	1.459 (0.240)	0.043	0.008 (0.521)	-2.176* (-1.689)	-0.090 (-0.172)
TBC	0.510 (0.603)	0.012	0.017 (1.501)	-0.493 (-0.541)	0.354 (0.905)
WLW	7.501 (0.001)	0.078	0.014** (2.176)	-1.705*** (-3.503)	-0.225 (-1.065)
WFT	3.205 (0.047)	0.091	0.001 (0.084)	-2.334** (-2.531)	0.025 (0.066)
WGL	4.258 (0.0016)	0.055	-0.012 (-1.549)	-1.717*** (-2.779)	-0.080 (-0.300)
WPK	2.351 (0.104)	0.072	0.002 (0.242)	-1.692** (-2.135)	-0.093 (-0.285)

Significant at the 10% level*, 5% level**, and 1% level***. ^{a}Not enough degrees of freedom.

Table A6	$R_{it} = \alpha_i + \gamma_i RCD_t + \epsilon_{it}$									
	(Un)restricted Sum of Squared Residuals					Chow tests[b]		Exposure Coefficients		
Periods	**77-81**	**82-86**	**77-86**	**87-91**	**82-91**	**F(1)**	**F(2)**	**1977-81**	**1982-86**	**1987-91**
TSE	0.149	0.112	0.263	0.118	0.234	0.444	1.009	-1.340***	-1.265***	-1.312**
ABI	0.408	0.507	0.946	0.370	0.982	1.965	6.944	0.245	2 404**	-1.626*
CFP	-	0.477	0.477	0.753	1.234	-	1.545	-	-1.898[a]	-2.129*
CAS	-	0.538	0.538	0.647	1.314	-	4.463	-	0.843[a]	-1.674
CMC	1.294	5.127	6.758	1.430	7.101	3.044	4.812	-1.182	-1.200	1.433
CFI	0.916	0.738	1.686	0.606	1.361	1.122	0.734	-0.674	-0.957	-2.818**
DOM	1.163	1.410	2.598	1.160	2.614	0.564	0.993	-0 876	-2.944*	0.199
DTC	0.416	0.316	0.739	0.398	0.762	0.555	3.899	0.412	-0.364	-1.661**
DHC	-	0.214	0.214	0.363	0.613	-	2.901	-	-0.154[a]	-2.102**
FCC	0.580	0.603	1.199	0.433	1.046	0.784	0.560	-1.341	-2.605**	-1.238
GFT	-	-	-	1.394	1.394	-	-	-	-	-0.222[a]
IFP	0.892	1.522	2.469	0.826	2.379	1.321	0.766	-1.942*	-4.426***	-1.791
MBL	0.546	0.340	0.890	0.525	0.869	0.262	0.268	-1.090	-1.937**	-2.128**
MTI	0.399	1.470	1.925	0.421	1.959	0.614	2.086	-0.277[a]	-2 079	-2.910***
MIP	-	-	-	1.095	1.095	-	-	-	-	1.252[a]
NFP	-	-	-	0.434	0.434	-	-	-	-	-0.656[a]
OFP	-	-	-	0.326	0.326	-	-	-	-	0.970[a]
PFP	0.448	0.353	0.806	0.338	0.701	0.362	0.839	-1.072	-1.602**	-1.872**
PXF	-	-	-	0.790	0.790	-	-	-	-	0.351[a]
RPP	-	-	-	0.929	0.929	-	-	-	-	-2.333
RLD	0.420	0.564	1.004	0.257	0.898	1.179	5.440	-0.122	-1.267	-1.487**
SPL	0.176	0.201	0.382	0.216	0.453	0.769	5.007	-0.958*	-0.370	-1.973***
SFF	-	0.067	0.067	0.836	0.917	-	0.496	-	1.811[a]	-2.310*
TBC	-	0.311	0.311	0.517	0.841	-	0.644	-	0.876[a]	-1.113
WLW	0.479	0.443	0.929	0.360	0.818	0.440	1.083	-2.319***	-1.276	-2.136**
WFT	-	0.023	0.023	0.437	0.462	-	0.137	-	-4.095[a]	-2.240**
WGL	0.234	0.402	0.637	0.710	1.117	0.019	0.261	-1.663[a]	-1.268	-2.366*
WPK	-	0.002	0.002	0.298	0.315	-	1.500	-	6.705[a]	-1.808**

Significant at the 10% level*, 5% level**, and 1% level***. [a]Missing data.

Table A7	Nominal Exchange Rate Changes (C$/US$)				Real Exchange Rate Changes[a] (C$/US$)			
Periods	77-81	82-86	87-91	77-91	77-81	82-86	87-91	77-91
Minimum	-0.028	-0.029	-0.030	-0.030	-0.030	-0.028	-0.028	-0.030
Maximum	0.041	0.042	0.024	0.042	0.045	0.041	0.026	0.045
Range	0.068	0.071	0.055	0.072	0.075	0.069	0.055	0.075
Mean	0.003	0.003	-0.003	0.001	0.003	0.001	-0.003	0.000
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Stand. deviation	0.014	0.012	0.012	0.013	0.015	0.013	0.012	0.013
Standard error	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.001
Skewness	0.166	0.812	0.320	0.438	0.203	0.656	0.476	0.479
Kurtosis	0.405	2.127	0.377	0.963	0.573	1.485	0.591	0.938
Sum	0.167	0.157	-0.174	0.150	0.161	0.066	-0.167	0.060
C.V.	4.949	4.649	-3.977	15.292	5.572	11.617	-4.206	40.28
Median	0.004	0.002	-0.004	-0.000	0.004	0.001	-0.004	-0.001

Table A7 bis	Nominal Exchange Rate Changes (SK/US$)				Real Exchange Rate Changes[b] (SK/US$)			
Periods	77-81	82-86	87-91	77-91	77-81	82-86	87-91	77-91
Minimum	-0.073	-0.064	-0.074	-0.074	-0.071	-0.061	-0.072	-0.072
Maximum	0.115	0.182	0.081	0.182	0.114	0.170	0.078	0.170
Range	0.187	0.245	0.155	0.256	0.185	0.230	0.150	0.242
Mean	0.005	0.004	-0.003	0.002	0.005	0.001	-0.005	0.000
Variance	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Stand. deviation	0.030	0.033	0.027	0.030	0.031	0.032	0.028	0.031
Standard error	0.004	0.004	0.004	0.002	0.004	0.004	0.004	0.002
Skewness	0.992	2.218	0.358	1.400	1.081	2.128	0.412	1.312
Kurtosis	2.787	11.660	0.935	6.965	2.490	10.516	0.692	5.483
Sum	0.327	0.234	-0.188	0.374	0.304	0.048	-0.315	0.038
C.V.	5.500	8.571	-8.783	14.666	6.079	40.424	-5.431	146.0
Median	-0.001	0.005	-0.004	-0.001	-0.001	0.001	-0.006	-0.002

[a]High leverage for Sep. 1978, Mar. 1980, Jun. 1982, and Feb. 1985. [b]High leverage for Mar. 1991.

Table A8	$\text{Log}(R_{it} + 1) = \alpha_i + \gamma_i \text{log}(RCD_t + 1) + \epsilon_{it}$							
	Analysis of variance		SSE w.r.t. specification		Zresids[b]	Parameter estimates		
Dependent variable	F-ratio	R^2-value	linear	loglinear	Wc	Intercept	Exposure coefficient	t-value
LTSE	21.573	0.108	0.389	0.401	0.953	0.010	-1.237***	-4.645
LABI	0.838	0.005	1.394	1.313	0.985	0.012	0.441	0.916
LCFP	5.182	0.051	1.234	1.265	0.974	-0.001	-2.207**	-2.276
LCAS	0.262	0.0031	1.314	1.183	0.956	0.009	-0.550	-0.512
LCMC	0.152	0.0009	8.495	6.852	0.920	0.007	-0.430	-0.390
LCFI	2.801	0.0155	2.339	2.328	0.947	0.014	-1.074*	-1.674
LDOM	2.359	0.013	3.781	3.468	0.989	0.006	-1.203	-1.536
LDTC	0.161	0.0009	1.188	1.202	0.973	0.007	-0.185	-0.401
LDHC	2.499	0.026	0.613	0.609	0.975	0.008	-1.072	-1.581
LFCC	9.839	0.052	1.643	1.612	0.974	0.008	-1.675***	-3.137
LGFT	0.006	0.0001	1.394	1.432	0.894	-0.020	0.169	0.077
LIFP	12.908	0.068	3.308	3.200	0.984	0.009	-2.704***	-3.593
LMBL	9.766	0.052	1.420	1.392	0.988	0.009	-1.551***	-3.125
LMTI	4.548	0.027	2.392	2.119	0.942	0.005	-1.411**	-2.133
LMIP	0.113	0.005	1.095	1.365	0.899	-0.040	1.589[a]	0.337
LNFP	0.366	0.007	0.434	0.482	0.943	-0.016	-0.734	-0.605
LOFP	0.199	0.009	0.326	0.311	0.971	0.007	1.187[a]	0.446
LPFP	8.477	0.046	1.166	1.157	0.992	0.009	-1.317***	-2.911
LPXF	0.147	0.003	0.790	0739	0.980	0.017	0.596	0.384
LRPF	2.211	0.037	0.929	1.038	0.945	-0.019	-2.206	-1.487
LRLD	1.970	0.011	1.325	1.242	0.977	0.011	-0.658	-1.403
LSPL	7.796	0.042	0.630	0.603	0.977	0.017	-0.912***	-2.792
LSFF	2.690	0.039	0.917	0.891	0.972	0.001	-2.063	-1.640
LTBC	0.181	0.002	0.841	0.838	0.982	0.009	-0.384	-0.425
LWLW	15.193	0.078	1.313	1.265	0.993	0.009	-1.844***	-3.898
LWFT	6.222	0.087	0.462	0.462	0.948	-0.003	-2.280**	-2.494
LWGL	8.724	0.056	1.352	1.322	0.986	-0.017	-1.766***	-2.954
LWPK	4.699	0.070	0.315	0.326	0.941	-0.000	-1.734**	-2.168

[a]Not enough degrees of freedom. [b]Shapiro-Wilks statistics for Normality.
Significant at the 10% level*, 5% level**, and 1% level***.

Table A9	$Log(R_{it} + 1) = \alpha_i + \gamma_i log(RCD_t + 1) + \epsilon_{it}$						
	ANOVA (1987-1991)			Parameter estimates			Outliers[a]
Dep. variable	**F-ratio**	**RSQ**	**DW**	**Cst.**	**Exposure**	**(t-value)**	**Obs. #**
LTSE	6.261	0.097	1.921	0.001	-1.317**	(-2.502)	130
LABI	3.097	0.051	1.829	-0.012	-1.571*	(-1.760)	121, 130
LCFP	2.568	0.042	1.896	0.003	-2.061	(-1.603)	122, 130
LCAS	2.056	0.034	1.749	-0.016	-1.653	(-1.434)	130, 145
LCMC	0.622	0.011	1.993	-0.034*	1.305	(0.789)	130
LCFI	5.687	0.089	1.612	-0.004	-2.678**	(-2.385)	130
LDOM	0.089	0.002	1.714	0.011	0.465	(0.298)	143
LDTC	2.931	0.048	2.224	-0.016	-1.641*	(-1.712)	130
LDHC	5.616	0.088	2.208	-0.007	-2.098**	(-2.370)	130, 155
LFCC	1.640	0.028	2.169	0.001	-1.252	(-1.281)	130
LGFT	0.006	0.000	2.212	-0.020	0.169	(0.077)	169
LIFP	1.601	0.027	1.888	0.007	-1.682	(-1.265)	130
LMBL	3.419	0.056	1.953	0.003	-1.957*	(-1.849)	130
LMTI	7.831	0.119	2.123	-0.014	-2.860***	(-2.798)	130
LMIP	0.113	0.005	2.675	-0.040	1.589	(0.739)	143, 168
LNFP	0.366	0.007	2.357	-0.016	-0.734	(-0.605)	130, 140, 147
LOFP	0.199	0.009	2.323	0.007	1.187	(0.446)	(b)
LPFP	4.716	0.075	2.256	-0.006	-1.853**	(-2.172)	130
LPXF	0.147	0.003	2.024	0.017	0.596	(0.384)	-
LRPP	2.211	0.037	2.249	-0.20	-2.206	(-1.487)	130
LRLD	4.166	0.067	1.654	-0.016*	-1.513**	(-2.041)	130, 170
LSPL	8.677	0.130	2.564	-0.001	-1.991***	(-2.946)	130
LSFF	2.726	0.045	1.796	0.005	-2.174	(-1.651)	130
LTBC	1.036	0.018	2.155	0.004	-1.070	(-1.018)	130
LWLW	6.068	0.095	2.314	-0.007	-2.178**	(-2.463)	165
LWFT	5.147	0.082	1.833	-0.002	-2.186**	(-2.269)	130, 140
LWGL	3.603	0.058	2.644	-0.018	-2.300*	(-2.898)	170
LWPK	5.119	0.081	2.171	-0.003	-1.836**	(-2.262)	137

Significant at the 10%*, 5%**, and 1% level***. [a]*Nota*: observation 130 is October 1987. [b]121, 124, 140, 143, 157, 180.

Table A10	$\text{Log}(R_{it} + 1) = \alpha_i + \beta_i \log(TSE_t + 1) + \gamma_i \log(RCD_t + 1) + \epsilon_{it}$				
	ANOVA (1987-91)		**Parameter estimates**		
Dependent variable	**F-value (proba)**	**RSQ**	**Intercept**	**Mkt exp. (t-value)**	**FX exp. (t-value)**
LABI	16.341 (0.000)	0.364	-0.013 (-1.507)	0.975*** (5.304)	-0.287 (-0.370)
LCFP	57.559 (0.000)	0.669	0.001 (0.116)	1.976*** (10.384)	0.542 (0.675)
LCAS	17.406 (0.000)	0.379	-0.017 (-1.528)	1.309*** (5.628)	0.071 (0.072)
LCMC	6.877 (0.002)	0.194	-0.032 (-1.772)	-1.354*** (-3.606)	-0.479 (-0.302)
LCFI	44.730 (0.000)	0.611	-0.006 (-0.689)	1.614*** (8.740)	-0.552 (-0.708)
LDOM	7.786 (0.001)	0.215	0.010 (0.577)	1.368*** (3.932)	2.267 (1.544)
LDTC	42.686 (0.000)	0.600	-0.018 (-2.330)	1.386*** (8.861)	0.185 (0.280)
LDHC	17.753 (0.000)	0.384	-0.008 (-0.878)	0.957*** (5.229)	-0.837 (-1.083)
LFCC	42.167 (0.000)	0.597	-0.001 (-0.115)	1.420*** (8.969)	0.619 (0.926)
LGFT	0.944 (0.396)	0.039	-0.024 (-0.961)	1.028 (1.372)	1.061 (0.469)
LIFP	26.200 (0.000)	0.479	0.005 (0.412)	1.721*** (7.033)	0.585 (0.567)
LMBL	47.907 (0.000)	0.627	0.001 (0.124)	1.564*** (9.344)	0.103 (1.146)
LMTI	51.100 (0.000)	0.642	-0.015* (-1.955)	1.496*** (9.125)	-0.890 (-1.286)
LMIP	0.502 (0.612)	0.046	-0.037 (-0.730)	1.333 (0.944)	2.774 (0.567)
LNFP	41.635 (0.000)	0.625	-0.012 (-1.389)	1.594*** (9.073)	0.941 (1.213)
LOFP	3.321 (0.057)	0.249	0.006 (0.282)	1.614** (2.528)	1.760 (0.738)
LPFP	30.687 (0.000)	0.518	-0.008 (-1.039)	1.122*** (7.244)	-0.375 (-0.573)
LPXF	6.780 (0.003)	0.224	0.011 (0.694)	1.746*** (3.657)	2.080 (1.443)
LRPP	37.187 (0.000)	0.566	-0.022 (-1.831)	2.089*** (8.340)	0.546 (0.516)

(continued)	F-value	RSQ	Intercept	Mkt exp.	FX exp.
LRLD	13.087 (0.000)	0.315	-0.016** (-2.142)	0.725*** (4.539)	-0.557 (-0.826)
LSPL	13.150 (0.000)	0.316	-0.002 (-0.298)	0.593*** (3.932)	-1.210* (-1.901)
LSFF	28.015 (0.000)	0.496	0.003 (0.237)	1.718*** (7.138)	0.090 (0.088)
LTBC	16.168 (0.000)	0.362	0.003 (0.296)	1.183*** (5.547)	0.488 (0.542)
LWLW	11.200 (0.000)	0.282	-0.008 (-0.798)	0.764*** (3.858)	-1.172 (-1.401)
LWFT	22.149 (0.000)	0.437	-0.003 (-0.334)	1.139*** (6.003)	-0.686 (-0.856)
LWGL	2.434 (0.097)	0.079	-0.019 (-1.277)	0.337 (1.117)	-1.856 (-1.459)
LWPK	8.071 (0.001)	0.221	-0.004 (-0.448)	0.601*** (3.195)	-1.045 (-1.316)

Significant at the 10% level*, 5% level**, and 1% level***.

Table A11	$\log(R_{it} + 1) = \alpha_i + \gamma_{1i}\log(RCD_t + 1) + \gamma_{2i}\log(RSK_t + 1) + \epsilon_{it}$						
	Analysis of variance (1987-1991)				**Coefficients of exposure**		
Dependent variable	**F-value (proba)**	**R^2**	**SSE**	**DW**	**α (t-value)**	**γ_1 (t-value)**	**γ_2 (t-value)**
LTSE	3.427 (0.039)	0.107	0.129	1.949	0.002 (0.324)	-1.334** (-2.525)	0.173 (0.795)
LABI	1.655 (0.200)	0.055	0.374	1.837	-0.011 (-1.021)	-1.589* (-1.768)	0.187 (0.504)
LCFP	1.335 (0.271)	0.045	0.778	1.880	0.004 (0.280)	-2.081 (-1.605)	0.200 (0.374)
LCAS	2.103 (0.131)	0.069	0.605	1.717	-0.012 (-0.854)	-1.722 (-1.506)	0.685 (1.453)
LCMC	1.777 (0.178)	0.059	1.227	1.874	-0.040* (-2.002)	1.419 (0.871)	-1.145* (-1.706)
LCFI	2.878 (0.064)	0.092	0.593	1.604	-0.003 (-0.237)	-2.696** (-2.381)	0.183 (0.391)
LDOM	0.106 (0.900)	0.004	1.144	1.702	0.010 (0.523)	0.488 (0.310)	-0.228 (-0.351)
LDTC	1.455 (0.242)	0.049	0.433	2.229	-0.016 (-1.319)	-1.648* (-1.703)	0.068 (0.171)

(continued)	F-value	R^2	SSE	DW	Intercept	RCD exp.	RSK exp.
LDHC	4.481 (0.016)	0.136	0.350	2.157	-0.003 (-0.302)	-2.161^{**} (-2.484)	0.635^{*} (1.772)
LFCC	0.807 (0.451)	0.028	0.450	2.169	0.001 (0.055)	-1.250 (-1.267)	-0.020 (-0.050)
LGFT	3.931 (0.027)	0.146	1.223	2.410	-0.011 (-0.439)	0.403 (0.197)	2.268^{***} (2.803)
LIFP	0.802 (0.453)	0.027	0.833	1.888	0.006 (0.387)	-1.673 (-1.247)	-0.095 (-0.173)
LMBL	1.687 (0.194)	0.056	0.528	1.953	0.003 (0.236)	-1.962^{*} (-1.836)	0.051 (0.116)
LMTI	4.129 (0.021)	0.127	0.488	2.155	-0.012 (-0.965)	-2.890^{***} (-2.813)	0.298 (0.703)
LMIP	0.224 (0.801)	0.021	1.343	2.620	-0.049 (-0.906)	1.009 (0.206)	-0.991 (-0.582)
LNFP	0.341 (0.712)	0.013	0.479	2.348	-0.014 (-1.014)	-0.709 (-0.581)	0.266 (0.567)
LOFP	0.301 (0.744)	0.029	0.304	2.367	0.011 (0.415)	1.432 (0.525)	0.532 (0.639)
LPFP	2.356 (0.104)	0.076	0.343	2.264	-0.066 (-0.566)	-1.862^{**} (-2.163)	0.095 (0.266)
LPXF	0.890 (0.418)	0.036	0.714	2.058	0.021 (1.177)	0.649 (0.421)	0.765 (1.277)
LRPP	1.264 (0.290)	0.042	1.032	2.264	-0.018 (-0.974)	-2.242 (-1.501)	0.360 (0.585)
LRLD	2.174 (0.123)	0.071	0.258	1.694	-0.015 (-1.629)	-1.528^{**} (-2.046)	0.150 (0.488)
LSPL	5.780 (0.005)	0.169	0.206	2.604	0.001 (0.114)	-2.035^{***} (-3.051)	0.446 (1.624)
LSFF	1.341 (0.270)	0.045	0.817	1.792	0.005 (0.281)	-2.170 (-1.633)	-0.033 (-0.061)
LTBC	0.524 (0.595)	0.018	0.521	2.148	0.005 (0.372)	-1.077 (-1.015)	0.075 (0.171)
LWLW	2.986 (0.058)	0.095	.369	2.313	-0.007 (-0.633)	-2.175^{**} (-2.437)	-0.030 (-0.082)
LWFT	2.536 (0.088)	0.082	0.438	1.833	-0.001 (-0.126)	-2.191^{**} (-2.252)	0.044 (0.110)
LWGL	1.775 (0.179)	0.059	0.692	2.640	-0.018 (-1.233)	-2.295^{*} (-1.877)	-0.046 (-0.090)
LWPK	2.565 (0.086)	0.083	0.310	2.171	-0.004 (-0.392)	-1.626^{**} (-2.230)	-0.102 (-0.304)

Significant at the 10% level*, 5% level**, and 1% level***. [a]Not enough degrees of freedom.

Table A12	$\text{Log}(R_{it} + 1) = \alpha_i + \gamma_i \log(RSK_t + 1) + \epsilon_{it}$					
	Analysis of variance (1987-91)			Parameter estimates		
Dependent variable	**F-ratio**	**R^2-value**	**SSE**	**Intercept**	**Exposure coefficient**	**(t-value)**
LTSE	0.438	0.007	0.144	0.006	0.151	(0.662)
LABI	0.180	0.003	0.394	-0.007	0.160	(0.424)
LCFP	0.092	0.002	0.813	0.010	0.165	(0.30[illegible]
LCAS	1.898	0.032	0.629	-0.007	0.655	(1.378)
LCMC	2.806	0.046	1.244	-0.044**	-1.121*	(-1.675)
LCFI	0.080	0.001	0.652	0.004	0.137	(0.283)
LDOM	0.117	0.002	1.146	0.009	-0.219	(-0.342)
LDTC	0.010	0.000	0.455	-0.011	0.040	(0.099)
LDHC	2.565	0.042	0.388	0.003	0.599	(1.601)
LFCC	0.010	0.000	0.463	0.004	-0.041	(-0.101)
LGFT	7.986	0.145	1.224	-0.012	2.262***	(2.826)
LIFP	0.050	0.001	0.855	0.011	-0.124	(-0.223)
LMBL	0.002	0.000	0.559	0.009	0.018	(0.039)
LMTI	0.309	0.005	0.556	-0.004	0.249	(0.556)
LMIP	0.425	0.019	1.346	-0.049	-1.062	(-0.652)
LNFP	0.350	0.007	0.482	-0.012	0.276	(0.592)
LOFP	0.338	0.016	0.309	0.009	0.471	(0.581)
LPFP	0.030	0.001	0.371	-0.001	0.063	(0.172)
LPXF	1.631	0.033	0.717	0.020	0.759	(1.277)
LRPP	0.268	0.005	1.072	-0.012	0.322	(0.518)
LRLD	0.155	0.003	0.277	-0.011	0.124	(0.393)
LSPL	1.968	0.033	0.239	0.007	0.412	(1.403)
LSFF	0.016	0.000	0.855	0.011	-0.070	(-0.126)
LTBC	0.017	0.000	0.530	0.008	0.057	(0.129)
LWLW	0.030	0.001	0.407	-0.001	-0.067	(-0.175)
LWFT	0.000	0.000	0.477	0.005	0.007	(0.017)
LWGL	0.027	0.000	0.735	-0.012	-0.084	(-0.134)
LWPK	0.146	0.003	0.337	0.001	-0.133	(-0.383)

Significant at the 10% level*, 5% level**, and 1% level***.

Table A13	$\text{Log}(R_{it}+1) = \alpha_i + \beta_i \log(TSE_t+1) + \gamma_{1i}\log(RCD_t+1) + \gamma_{2i}\log(RSK_t+1) + \epsilon_{it}$					
	ANOVA (1987-91)		**Parameter estimates**			
Dep. variable	**F-ratio**	**RSQ**	**Intercept**	**Mkt exp.**	**RCD exp.**	**RSK exp.**
LABI	10.705	0.364	-0.013	0.974***	-0.290	0.018
LCFP	37.905	0.670	0.000	1.985***	0.568	-0.144
LCAS	12.176	0.395	-0.015	1.280***	-0.014	0.463
LCMC	5.423	0.225	-0.037**	-1.296***	-0.310	-0.921
LCFI	29.383	0.612	-0.007	1.621***	-0.534	-0.098
LDOM	5.378	0.224	0.007	1.398***	2.353	-0.470
LDTC	28.326	0.603	-0.018**	1.397***	0.217	-0.174
LDHC	12.978	0.410	-0.005	0.927***	-0.924	0.475
LFCC	28.482	0.604	-0.002	1.437***	0.668	-0.269
LGFT	3.194	0.176	-0.014	0.894	1.171	2.197***
LIFP	17.771	0.488	0.003	1.746***	0.658	-0.398
LMBL	31.944	0.631	-0.000	1.578***	0.144	-0.222
LMTI	33.488	0.642	-0.015	1.493***	-0.897	0.039
LMIP	0.469	0.066	-0.047	1.407	2.183	-1.122
LNFP	27.448	0.627	-0.013	1.609***	0.942	-0.156
LOFP	2.246	0.262	0.010	1.592**	1.946	0.423
LPFP	20.203	0.520	-0.008	1.128***	-0.356	-0.101
LPXF	4.956	0.244	0.014	1.700***	2.082	0.599
LRPP	24.356	0.566	-0.022*	2.089***	0.546	-0.002
LRLD	8.576	0.315	-0.016	0.724***	-0.562	0.025
LSPL	9.565	0.339	-0.000	0.571***	-1.273**	0.348
LSFF	18.808	0.502	0.001	1.739***	0.151	-0.334
LTBC	10.660	0.363	0.002	1.191***	0.512	-0.131
LWLW	7.450	0.285	-0.008	0.775***	-1.142	-0.164
LWFT	14.648	0.440	-0.004	1.149***	-0.657	-0.155
LWGL	1.610	0.079	-0.019	0.344	-1.837	-0.105
LWPK	5.475	0.227	-0.005	0.614***	-1.007	-0.209

Significant at the 10% level*, 5% level**, and 1% level***.

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