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The impact of R&D intensity on the volatility of stock price

"A study of the Swedish Market during year 1997-2005"

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ABSTRACT

This thesis investigates the theoretical and empirical relationships between a firm's R&D investment intensity and the systematic risk of its common stock in Sweden. This is done by examining 38 Swedish firms between 1997 and 2005. An overlapping set of 5-year window is chosen to apply to calculate the variables of the samples.

In this thesis, three factors are introduced as a proxy of main constituents of systematic risk: intrinsic business risk, degree of financial leverage and degree of operating leverage. And we use these three constituents to analysis the relationship between R&D investment and systematic risk.

The results from Monte Carlos simulations and correlation analysis of our sample show that, in Sweden, firms with higher R&D intensity do face higher stock price volatility in the stock market. At the same time, we attempt to test the relationship among R&D and systematic risk's three constituents, but find that R&D intensive firms have more financial leverage which is opposite to our expect, which might due to the shortage of data and limitation of our sample selection, and R&D intensive firms do not have obvious relations directly with intrinsic business risk, degree of financial leverage or degree of operating leverage.

Key words:
R&D intensity; Systematic risk; Operating leverage; Financial leverage

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1. INTRODUCTION:

As an introduction, the background, main purpose, delimitation, brief statement of methodology, and preview of the thesis will be introduced.

Technology nowadays plays key role in current economy. The source of economic value and wealth is no longer the production of material goods but the creation and manipulation of intangible assets (Goldfinger 1997). Lev and Zarowin(1999) have documented a significant increase in the market to book ratio of US market, from a level of 0,81 in 1973 to a level of 1,69 in 1992, which means about 40% of the market value of companies is not recorded in the balance sheet. This is mainly because it is not easy to evaluate the intangible assets and obviously, investment in research and development (R&D) plays an important role.

As one important component in technology improvement, R&D's positive contribution to firms' competition and growth becomes more and more obvious and has received comprehensive attentions. The current phenomenon in most business world is that firms experience higher return with high volatility when they have higher R&D investment intensity, especially in such sectors as IT, Biochemistry and Chemistry, where the R&D investments are importance due to such sectors' business nature. Moreover, because of the consistent and long term R&D investments, Sweden is today regarded as one of the world's most knowledge-based economies. Sweden invests more in R&D as a proportion of GDP, 4.3 percent in 2003, than other OECD countries. After Japan and South Korea, Sweden accounted for the highest share of R&D expenditure by the business sector (72 percent) in relation to public funding[1].

Hence, the present study attempts to examine the relationship between firm's R&D intensity and the price volatility of its common stocks in the specific market, Sweden. The study focuses on investigating whether R&D investment affects firm's systematic

[1] Invest in Sweden Report, 2006/07, Invest in Sweden Agency

risk and whether the components of systematic risk is influenced by R&D investment at the same time, and our finding will also provide an insight in understanding the higher volatility of the return of the firms with business nature of high R&D intensive.

The method we adopt, to analyze the relationship between R&D intensity and systematic risk, is mainly based on the decomposition approach developed by Mandelker and Rhee (1984), which decomposed the systematic risk into three parts: intrinsic business risk, the degree of operating leverage and the degree of financial leverage. According to different intensity levels of R&D investments, we divided the selected data into two groups and a comparison was made between them.

The data we use as a sample are collected from the DataStream International. The main two parts of data were firms' annual R&D investment expenditures and their systematic risks during year 1997 to 2005. Then we applied an overlapping set of 5-year window approach[2] to calculate the variables of the samples.

The present study is divided into two major parts after the introduction. Part one is the *Theoretical Framework*, which includes two basic frameworks. First are the basic definition, types and major purposes of R&D investment, and the theoretical relationships among R&D, return and stock price. Second is about the systematic risk, including the traditional measuring method of it, the proxy approach we use in our study, and its three constituent components. Part two of our study is the *Empirical Analysis* which starts with the hypotheses development and models to compute R&D intensity, systematic risk and its three constituent components. Following contents are the data selection and descriptive statistics. Then we adopt the Monte Carlo Simulation and methods we list before to get the simulation results and correlation results. After these, we demonstrate the conclusion that derived from our study.

[2] i.e., the first 5-year window include year 1997-2001; the second 5-year window include year 1998-2002, and move on.

PART I
THEORETICAL FRAMEWORK

In this section, our aim is to give the readers a basic introduction on research and development (R&D) and systematic risk (β), including the definition, types, purpose of R&D expenditure, and traditional methods of β and also the proxy model we use, in order to let them understand the contents we involve later.

2. RESEARCH AND DEVELOPMENT (R&D) INVESTMENT

2.1 R&D definition

According to BARRON’S, Research and Development (R&D) means scientific and marketing evolution of a new product or service. Once such a product has been created in a laboratory or other research setting, marketing specialists attempt to define the market for the product. Then, steps are taken to manufacture the product to meet the needs of the market. Research and development expenditure is often listed as a separate item in a firm's financial statements. In some industries such as high-technology and pharmaceuticals, R&D expenditure is pretty high, since products are outdated quickly. Investors looking for firms in such fast-changing fields check on R&D expenditure as a percentage of sales because they consider this as an important indicator of the firm's prospects.

2.2 R&D types and purpose

It is easier to understand by dividing R&D into three types refer to the National Science Foundation (NSF) of United States: basic research, applied research, and development. Basic research is directed to understanding the subject, but not to applying it. Applied research is used to get knowledge or understand necessary for determining the means by which a recognized and specific need may be met. In industry, applied research includes investigations directed to the discovery of new knowledge having specific commercial objectives with respect to products, processes, or services. Development is the systematic utilization of the knowledge or understanding gained from research toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes. Research creates knowledge and development designs, and builds prototypes and proves their feasibility[3].

Prior researches find that firms which invest in R&D have two purposes: production improvement and innovation (Mowery, 1983). The success of R&D of innovation in nature will offer positive NPV (net present value) investment opportunity. As the price of stock can be decomposed into two parts: the value of the firm and the growth opportunity of the firms, it can be seen that the high R&D intensive industry with more opportunity of positive NPV investment projects will have high market value. As the book value only reflects the historical situation of firms, we can expect the high R&D intensive firms and high market to book value. We will talk more and clearer in the following section.

2.3 Relationships among R&D investment, return and stock price

We continue the two-part evaluation method of market value of a firm's equity in last paragraph, they can be calculated by: a) the discounted value of future cash flows expected to be generated from *existing assets* in place and, b) the net present value of *expected cash flows* from investment opportunities that are expected to be available to and undertaken by the firm in the future (Brealey and Meyer, 2003).

Schumpeter (1942) stated that innovation is a fundamental source of wealth[4]. R&D intensive firms usually attend to develop innovation (development of new ideas into marketable products) and therefore are expected to gain high growth opportunity (Titman and Wessels, 1988). The market value of R&D intensive firms contain a larger proportion of market value to be generated from future investment opportunities, compared with that of R&D low intensive firms.

[3] Encyclopedia of Small Business, by the Gale Group, Inc.
[4] Cañibano *et al.*, 2000

In an efficient market, positive market value effects of R&D expenditures that are consistent with a forward-looking perspective of stock market investors reported by Hirschey, Jose, Nichols, and Stevens, Lustgarten and Thomadakis. The changes in the stock price of firms reflect *the investors' expectation* of the discount present value of uncertain future cash flows (Ariel Pakes 1995). Chan et al (1990) documents the positive market reaction to the firms' announcement on R&D. However, market evaluation is complicated because of several factors as follow:

a) Uncertainty nature of R&D. The success probability of R&D is unpredictable, as the result of R&D is associated with the outcome of new untested technology in the technology-based firms. Highly differentiated research requires greater outlays with above-average intangible intensity than late-stage, applied research, such as process reengineering (Lev, 2001).

b) Accounting problem, or named asymmetric information problem. Under current U.S. GAAP (Generally Accepted Accounting Principles) standard, R&D expenditure is not reported in the firm's financial statement[5] and practically expensed when it is undertaken. Most Swedish firms also follow U.S. GAAP. The conservation accounting convention requiring expensing R&D expenditure incompletely estimates of the firm's current value and of its capability of creating future wealth (Cañibano *et al.* 2000). Investors find some yardsticks commonly used, such as price to earning ratio and market to book ratio, become less useful in value estimation of R&D intensive firms compared with low R&D intensive firms (Louis K.C. Chan 2001).

The non-financial measures nowadays become common practice among analysts (Mavrinac and Boyle 1996), and detail disclosure of information about value of R&D activity in accounting report could mitigate the forecast error. However, finding a practical measure applying to estimate benefit from innovative technology is impeded by its uncertainty prospects and firms' reluctance to release detail information on R&D

[5] The R&D expenditure is requested to be disclosed in the notes in the financial statement.

activities in accounting report aggregates the asymmetric information problem between firms and investors.

c) Outcome control, business matter. As the intangible asset nature, technology knowledge can spread through channels, such as new products imitation, licensing agreements, patent, research projects cooperation and even human resource flow. Know-how knowledge effects negatively influence pioneer firms' promised profitability and impacts on how long and how well they could enjoy the advantage competition position from their innovation. Whereas, knowledge spread also has impacts on firms within the same industry and firms in periphery upper/down stream industries. Empirical studies show that stock volatility is positively related to R&D and negatively related to intra industry spillovers (Michael K.Fung, 2006).

In conclusion[6], above matters complicate the market valuation, which in turn present by the high volatility of stock prices of high R&D intensive firms.

[6] Some other factors might be considered under special situations, such as R&D investment's Option-like feature, business cycle, matter of abnormal return and excess return.

3. MODEL USED IN THE PRESENT PAPER

Several researchers, such as Melicher (1974), Uri and Shalit (1975), try to adopt accounting variables to get the level of systematic risk. But most meet multicollinearity problems[7] among the variables that contribute to the level of systematic risk. Therefore, theoretical based studies used the approach that decomposes the systematic risk into several constituent components mathematically[8]. These theoretical models use various accounting variables to the systematic risk as a proxy to link firm's fundamental financing, investment and production decisions.

Since the variability of the firm's profits is a function of the firm's underlying cost structure, systematic risk depends on the fixed to total cost ratio. And this relationship can be got through gearing or leverage. Mandelker and Rhee (1984) demonstrate that operational risk and financial risk can be proxied through the respective use of the degree of operating leverage (DOL) and the degree of financial leverage (DFL). These two leverages and another important factor, intrinsic business risk (β0), determine the systematic risk (β). The present study follows their method to use the proxy to represent systematic risk (β) as

$$\beta = \beta_0 * DOL * DFL \qquad (1)$$

where:

β_0=intrinsic business risk of common stock

DOL=degree of operating leverage

DFL=degree of financial leverage

Cyclicality of a firm's sales revenue causes intrinsic business risk β0, according to Chung (1989), who defined cyclicality as the correlation coefficient between a firm's sales revenue and the general economic conditions. Through both theoretical and empirical

[7] It seems not easy to find some independent factors

[8] See Yew Kee Ho, Zhenyu Xu, Chee Meng Yap (2004)

test, Chung (1989) also justified that cyclicality of sales revenue, together with the degree of operating leverage and financial leverage, is the determinants of systematic risk.

3.1 Components of the model:

3.1.1 The systematic risk (β)

R&D investment makes the evaluation of the firms difficult for the investors and the the long term characteristic of the R&D investment even aggregates the problem. The changes of the stock prices of R&D firms reflect adjustment of the investors' expectation of the discount present value of uncertain future cash flows. The dynamic changes in the trading of the stocks cause the volatility, which is also defined as the stock risk.

Many previous researches document the positive relationship between the R&D intensity of the firms and the risk of their stocks. Stock risk contains both the systematic risk and specific risk. The system risk also named non-diversifiable or non-controllable risk, is simply a measure of a security's volatility relative to that of an average security. Markowitz (1952) developed Capital Assets Pricing Model (CAPM). In the CAPM, only systematic risk is relevant in determining an individual security's return. Non-systematic risk can be diversified away and only the systematic risk is left in the investors' portfolio. Systematic risk can be explained by:

$$\beta = \frac{COV(R_i, R_m)}{VAR(R_m)} \qquad (2)$$

where:

R_i = the expected (or required) return on an individual security (asset)

R_m = the expected return on the market portfolio (such as Standard & Poor's 500 Stock Composite Index or Dow Jones 30 Industrials)

COV (R_i, R_m) = the covariance between R_i and R_m

VAR (R_m) = the volatility of the market

Y.K.Ho *et al.*, (2004) examined the relationship between R&D investment and systematic risk of firms in US stock market and documented the positive relationship.

The present paper uses the popular market model to estimate the common stock β and the model is

$$R_{j,t} = \alpha_j + \beta_j R_{m,t} + \varepsilon_j \tag{3}$$

where:

$R_{j,t}$ = Return rate of stock j and time t

$R_{m,t}$= Return rate of OMXS index at time t

β_j= Systematic risk of stock j

ε_j =Well behaved disturbance term

The detail calculation of this variable is to be show in the section of Model Calculation.

3.1.2 The degree of DFL and DOL

Operating leverage measures of fixed costs in a company's operating structure. The fixed operating costs amplify the fluctuations in earnings before interest and taxes (EBIT). It can be measured through the following ratios: percentage change in EBIT to the percentage change in sales volume. The formula is as follows:

$$DOL = \frac{\text{Percentage Change in EBIT}}{\text{Percentage Change in Sales}} \tag{4}$$

Firms would like to finance part of their assets with securities to increase the income of the common shareholders. The variability in EBIT made by operating leverage will be enlarged by the financial leverage. According to Brigham in 1995, "The degree of financial leverage (DFL) is defined as the percentage change in earnings per share (EPS) that results from a given percentage change in earnings before interest and taxes (EBIT)." Then we calculate DFL, using the formula as follows:

$$\text{DFL} = \frac{\text{Percentage Change in EAT}}{\text{Percentage Change in EBIT}} \quad (5)$$

where:

EAT= Earnings after Taxes

EBIT= Earnings before interest and taxes

Therefore, the degree of operating leverage (DOL) is a measure of percentage change in EBIT arising from a percentage change in Sales, and the degree of financing leverage (DFL) is a measure of percentage change in EAT arising from a percentage change in EBIT. The influence of these two leverages on a firm's intrinsic business risk is summarized by a simplified two stage income statements by Y.K.Ho *et al.* (2004). Their first stage statement is based on cyclicality of a firm's sales revenue and fixed operating costs.

In a firm's Income statement,

$$\text{EBIT} = \text{Sales} - \text{Variable operating costs} - \text{Fixed Operating Costs} \quad (6)$$

Therefore the change of fixed operating costs will amplify EBIT, and then have impacts on the sensitivity of EBIT to changes of sales (Equation 4). At the same time, the sales revenue has impacts on the firm's intrinsic systematic risk. It is named first-stage leverage since the EBIT is a result just impacted by the former two factors.

Then, in the income statement,

$$\text{EAT} = \text{EBIT} - \text{Interest expense} - \text{Taxes} \quad (7)$$

So the interest expenses on debt financing alter the sensitivity of EAT to changes in EBIT (Equation 5), which is second-stage leverage in the formal income statement.

As been decomposed above, the systematic risk can be explained by three financial parts. Therefore, when we examine the relationship between the R&D intensity and systematic risk, we will also look at these three financial parts' relationship with R&D intensity. Follows the Mandelker and Rhee (1984)'s formula, Equation 2, Y.K.Ho *et al.* (2004) also developed a formal correlation framework that links the three constituent components of β to R&D investment to test the correlated relationship between R&D investment and systematic risk:

$$\rho(Ln\beta, LnR\&D) = \frac{\sigma_{Ln\beta_0}}{\sigma_{Ln\beta}} * \rho(Ln\beta_0, LnR\&D) + \frac{\sigma_{LnDOL}}{\sigma_{Ln\beta}} * \rho(LnDOL, LnR\&D) + \frac{\sigma_{LnDFL}}{\sigma_{Ln\beta}} * \rho(LnDFL, LnR\&D) \quad (8)$$

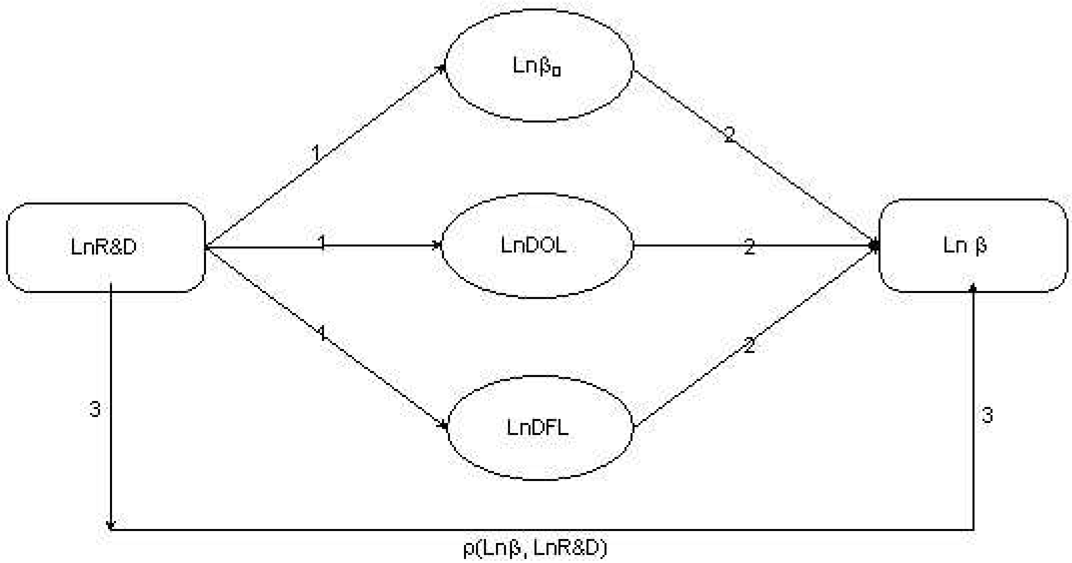
where

$\sigma_{Ln\beta_0}$, $\sigma_{Ln\beta}$, σ_{LnDOL} and σ_{LnDFL} are the standard deviations of the natural logarithm of β_0, β, DOL and DFL respectively.

This decomposition method allows us to test the relationship between R&D intensity and systematic risk through the relations between three constituent components of β and R&D. The correlation of the systematic risk with R&D investment is just the weighted sum of correlations between LnR&D and those constituent components through another two-stage model, which is shown in Figure 1 in the next page.

In the first step (shown in figure 1 as array No.1), we can find the relationship between LnR&D and each of these three constituent components, $Ln\beta_0$, LnDOL and LnDFL, through $\rho(LnR\&D, Ln\beta_0)$, ρ(LnR&D, LnDOL) and ρ(LnR&D, LnDFL) respectively. In the second step (shown in figure 1 as array No.2), the contribution that arises from the variability of each of these three different constituent components of β to the value of β are modeled.

Figure 1



Note: we can clearly find the mathematical relationship (shown as array No. 3) between LnR&D and Lnβ in this figure. For example, in the case of $Ln\beta_{0,}$ in step 1 (shown as array No. 1) , the correlation of LnR&D and $Ln\beta_0$ can be proxied by $\rho(LnR\&D, Ln\beta_0)$; then in step 2, correlation of $Ln\beta_0$ and Lnβ is $\frac{\sigma_{Ln\beta_0}}{\sigma_{Ln\beta}}$. We can use the same approach on LnDOL and LnDFL and then get the mathematical relationship as Equation (8).

Then we derive our testable hypotheses between systematic risk and R&D investment by their mathematical relationship.

PART II
EMPIRICAL ANALYSIS

In this section, we develop our hypotheses firstly and computation approaches of R&D intensity, systematic risk and other factors used in the analysis will be introduced. Then a sample selection approach is mentioned. The main underlying data for this section can be found inside and firms we analyzed can be found in the appendices. Further, descriptive statistics of the sample data are followed.

4. HYPOTHESES DEVELOPMENT

4.1 R&D investment and systematic risk

Prior studies, for example, Vhan *et al.*(2001), Lev and Sougiannis (1996) reported the subsequent gains in firms' earnings, growth opportunities and stock returns are positively associated to the R&D expenditure. The R&D with production improvement nature/cost saving, quality improvement nature will enhance firm competition, increase sales and realize profit. So firms with this kind of R&D will have good market position. As the R&D carried out in technology information and biochemistry is more with the first kind of nature, the market price of the firm will be higher than the traditional industry where the R&D is related to the second nature.

As the business nature of the two groups, the R&D intension will be higher in the high-tech sector compared with the tradition sector in which, although firms still carry R&D, the intensive is low, decided by the business nature. As we stated before in *1.3*, the market value of R&D intensive firms contain a larger proportion of market value to be generated from future investment opportunities, and the changes in the stock price of firms reflect the investors' expectation of the discount present value of uncertain future cash flows. Many researchers, such as Chan et al (1991), document the positive market reaction to the firm's announcements on R&D in United States.

Swedish business sector is based on the commodities that existed in the country and have been being turned into increasingly advanced products, laying the groundwork for a broad manufacturing sector that even today largely forms the foundation of the business sector and the economy. Moreover, Sweden's manufacturing sector is pretty internationalized[9]. Hence, we hypothesize that, in Swedish business world, R&D intensive firms also have greater systematic risk:

H1, R&D intensive firms have greater systematic risk

4.2 R&D investment and intrinsic business risk (β_0)

Optional feature[10] of R&D investment causes R&D intensive firms to be more sensitive to business cycle fluctuations than other types of firms. It makes sense to assume that managers prefer to exercise their options on the R&D investments to bring in innovations in an economic expansion period instead of in a recession period because R&D options can become worthless in a recession period (Y.K.Ho *et al.*, 2004). Furthermore, new or high-tech products are required more by consumers in an expansionary economic cycle, vice versa. Thus we believe it is reasonable to predict that sales incomes of R&D intensive firms are more sensitive to business cycle, thus R&D intensive firms face higher intrinsic business risk:

H2: Higher R&D Company has higher intrinsic business risk

9 Annual report of Sweden's Economy 2006, Swedish Government Offices

10 After investing in R&D, firm managers or others have the option to use the R&D results in production, or not. If managers decide to abandon R&D result because the economic condition is not good or due to some other reasons, the former R&D expenditure is wasted (a call option holder has the similar initial investment loss if the holder chooses to give up exercising); If managers decide to use the R&D result, then sales will be decided by the economic conditions and have a positive linear relationship with them, i.e. the better economic condition, the more benefit they will earn (Now consider a call option, if the holder chooses to exercise, the higher strike price means the higher benefit, which is similar to the R&D case). Then we say R&D investment has a call option feature.

Because we set up the relationship among systematic risk, intrinsic business risk (β_0), financial leverage (DFL), operating leverage (DOL) and operating risk (OR), we continue our hypotheses of other factors as follows.

4.3 R&D investment and degree of financial leverage (DFL)

Singh *et al.* (2005) observed a strong negative relationship between R&D intensity and DFL, using a sample of large United States (US) manufacturing firms. The reasons Y.K.Ho *et al.* (2004) stated for that situation make sense: a) the owner or manager of a firm with risky debt outstanding might under invest because all relative benefit from the projects will turn into debt holders' income. And due to this potentiality, R&D intensive firms will maintain lower debt level to ensure adequate investment than other firms; b) R&D investment usually produce intangible assets which are hard to value and will not be accepted easily as collateral. Thus R&D intensive firms will face higher cost if they use debt, rather than equity financing; c) R&D intensive firms usually face a higher financial distress risk, which means they should take lower financial leverage. Hence, we predict that R&D intensive firms also have a negative relationship with DFL in Swedish market:

H3: R&D intensive firms have lower degree of DFL

4.4 R&D investment and degree of operating leverage (DOL)

Usually, R&D investment expenditure in products innovations increase fixed cost and be moved into the firm's financial statement, but they do not influence the firm's variable costs directly. The R&D expenditure in process innovation, however, may reduce the variable costs because their main aim is to do so. Operating leverage reflects the ratio of fixed to variable operating cost, then no matter which part of costs R&D expenditure influence, they will increase the operating leverage.

So we predict that R&D intensive firms bear higher degree of operating leverage in the following hypothesis:

H4: R&D intensive firms have a higher DOL

4.5 R&D investment and operating risk (OR)

Operating risk is determined by beta0 and DOL and the formula is

$$OR_i = \beta_{0i} \times DOL_i \qquad (9)$$

where:

β_{0i}= Intrinsic business risk of common stock

DOL_i =Degree of operating leverage

Because we predict beta0 and DOL to be positively related to R&D investment, then it is reasonable to expect that R&D intensive firms' operating risk will be also greater due to their relationship. So we hypothesize that R&D intensive firms have greater OR:

H5: R&D intensive firms bear larger operating risk (OR)

5. MODEL CALCULATION

5.1 Computation of R&D intensity

The present paper uses R&D expenditure to total asset as proxy of R&D intensity. The R&D expenditure is the money amount had been expensed in the year in which it recorded.

This ratio rather than the ratio of R&D expenditure to sales is adopted by many researchers for the reason that how much to spend in R&D activities is as same as investment decision[11]. The amounts of total assets are relatively consistent in some period compared with the sales amount. This ratio will present more acute information on the R&D intensity than the ratio of R&D expenditure to sales, which is effected by the volatility of sales variable. Then a firm's five year average R&D expenditure to sales ratio is calculated using the sum of R&D expenditure in the five years divided by the sum of sales in the same period. This formula consists with the idea that R&D projects usually are long term investments. The five year window can reflect the firms R&D investment decision.

$$\text{Average}\frac{RD}{TA} = \frac{RD_{i,t-4} + RD_{i,t-3} + RD_{i,t-2} + RD_{i,t-1} + RD_{i,t}}{TA_{i,t-4} + TA_{i,t-3} + TA_{i,t-2} + TA_{i,t-1} + TA_{i,t}} \qquad (10)$$

where:

$RD_{i,t}$ =Research and Development expenditure of firm i in year t

$TA_{i,t}$ = Total assets of firm i in year t

[11] Many studies use different denominators, such as the sales amount, equity value, and so on. a) From the capital structure prospective, R&D expenditure is not relative to the structure. Using asset as denominator should be better than the market value of equity. b) R&D expenditure is the financial and business development strategy, is under management control independent from the market condition, Using asset as denominator should be better than the sale ratio.

When some firms with R&D expenses records less than 5 years, we calculate the ratio of the firms by using at least two years.

5.2 Computation of systematic risk (β)

The present paper uses the popular market model to estimate the common stock β as a proxy of β in the model of CAPM, which is generally used by empirical researchers and also used by Y.K.Ho *et al.*, (2004). The model is (Equation 3):

$$R_{j,t} = \alpha_j + \beta_j R_{m,t} + \varepsilon_j$$

where:

$R_{j,t}$ = Return rate of stock j and time t

$R_{m,t}$= Return rate of OMXS index at time t

β_j= Systematic risk of stock j

ε_j =Well behaved disturbance term

OMX Stockholm index (OMXS) is used as proxy for the monthly rate of return of the market. Each stock's systematic risk β is calculated by using the OMX Stockholm index (OMXS). If prices of stock i are available less than 5 years, 24 months (two years) data of prices is used.

5.3 Computation of DOL, DFL, β_0 and Operating risk (OR)

Variables of DOL, DFL are calculated by the cross section regression method (Mandelker and Rhee ,1984) with following formulas:

$$Ln(EBIT_{i,t}) = \alpha_t + \varphi_i Ln(SALE_{i,t}) + \delta_t \quad (11)$$

$$Ln(EAT_{i,t}) = \mu_i + \xi_i Ln(EBIT_{i,t}) + \nu_t \quad (12)$$

where:

$EBIT_{i,t}$ =Earnings before interest and taxes of firm i at time t

$SALE_{i,\,t}$= Sales of firm i at time t

$EAT_{i,t}$ =Earnings after taxes of firm i at time t

δ_t ,ν_t =Well behaved disturbance terms

Ln()= Natural logarithmic operator

The estimated regression coefficients Φ_i and $\xi_{i,}$ represent DOL and DFL of firm i.

When the firms reported negative EBIT or EAT in their balance sheets, we use the following steps to get an approximately estimate coefficients of Φ_i and $\xi_{i,}$.

$$EBIT_{i,\,t}=\alpha_t+\varphi_i SALE_{i,\,t}+\delta_t \quad (13)$$

$$EAT_{i,t}= \mu_i+\psi_i EBIT_{i,\,t}+\nu_t \quad (14)$$

First we run regression to get φ_i and ψ_i, then we estimate the DOL and DFL by φ_i ($*SALE_i$/ $*EBIT_i$) and ψ_i($*EBIT_i$/$*EAT_i$), where the $*SALE_i$, $*EBIT_i$ and $*EAT_i$ represent the 5 year average value of SALE, EBIT and EAT of each firm. When these variables of each firm available are less than 5 years, at least 2 years variable data are calculated.

The intrinsic business risk (β_0) and the operating risk (OR_i) are calculated as the follows:

$$\hat{\beta}_{0i}=\frac{\hat{\beta}_i}{DOL_i \text{ x } DFL_i} \quad (15)$$

$$OR_i=\hat{\beta}_i \Big/ DFL_i =\hat{\beta}_{0i} \text{ x } DOL_i \quad (16)$$

where ^ denotes estimated value.

6. SAMPLE AND DATA

Current study focus on examining the relationship between the return volatility and R&D intensity on Swedish firms listed on OMX - Stockholm Stock Exchange. Data used in the study come from DataStream. We choose data during the period from 1997 to 2005. An overlapping set of five-year window is chosen to apply to calculate the variables of the samples.

The R&D expenditures of Swedish firms are not reported directly in the balance sheet and it will present in the notes of balance sheet when incurred. Actually in Europe, the quantitative disclosure of R&D investments is compulsory only in the United Kingdom (Belcher, 1996), because the general accounting framework set by the European Fourth Directive did not require the disclosure of R&D expenditures. It only required a general description of research and development activities to be included in the annual report (Fourth Directive, art. 46, 1978), this not implying any indication as to the annual amount of R&D costs.

R&D expenditure in the DataStream specified with a variable with WS code of WC01201. Then we have to exclude other firms those do not have R&D data inside[12].
Before we process data, six sample sets applied to scream samples:

a) We pick up the Swedish firms categorized to the large capitalization sector of OMX - Stockholm Stock Exchange so that we can avoid the size factor affecting the excess rate of return, as the size is one of the three factors shown in the model of Fama and Franch(1992). When some companies have two stocks in the list, we choose the one that has a bigger volume quantity.

[12] Actually we tried to collect all annual reports of other firms which do not have relative R&D investment data in Datastream and found that the Datastream does not include these firms just because they do not have relative fixed number announcement in their annual report.

b) Swedish financial firms are excluded from our sample list. Empirical study carried out by Y. K. Ho et al (2004) on US stock documents that the relationship between R&D intensity and the components of systematic risk are stronger for manufacturing compared with non-manufacturing firms.

c) Only the firms with non-zero R&D expenses are included in. The zero R&D expenses firms are in two groups. One group include such firms as public facilities runners, real estate companies and telephone operating companies, which do not usually carry out R&D activities. The other group includes firms with high R&D intensive in nature, which do not choose to expense their R&D expenses and report it in the note of balance sheet, but amortize the R&D expenses as goodwill in the intangible assets instead. The firms in the second groups need further study. Thus, the samples included are under the same accounting circumstance. Amortizing rather than expensing the R&D expenditure will decrease the mispricing and improve the forecast capacity of estimating the return of return of R&D intensive capital, which need further study.

d) Only the firms with positive value of β, β_0, DOL and DFL are included so as to convert the variables into logarithmic transformation as required in formula. Selecting the firms with positive number of DOL and DFL make the current study biased toward to profitable firms.

The final number of firms we analyze can be seen in Table 1 and the original firms we attempt to analyze can be seen in Appendix.

Table 1
The number of samples going through screening in different period[1]

	1997-2001	1998-2002	1999-2003	2000-2004	2001-2005
Non-financial, large-Cap firms	29	33	36	38	38
Non-R&D expenditure announcement in Annual Financial report[2]	21	21	23	23	24
After taking out firms with negative variable value	7	10	9	9	14

Note: 1) as number of the sample is different in each year, we count the sample at least with two year data in each 5 year window, which is consistent with our calculation method that samples with as least two year data of variables can be used. 2) Non-R&D expenditure announcement does not mean they do not have R&D expenditures during this period, they just move this part into intangible asset or Goodwill in their relative financial statements.

7. DESCRIPTIVE STATISTICS OF THE SAMPLE DATA

Table 2 shows the cross section statistics of variables of the screened samples during the period from 1997 to 2005. Some pictures and tendency provided by the screened samples can be seen from the table.

R&D expenses fluctuate with total assets throughout the whole period, but vary in the larger range. The R&D intensity does not show a monotonic increase, however it shows same trend with the fluctuation with R&D expenses and total assets. These trends together with the trend of sales are in consistent with the business cycle of Swedish in the correspondent period. The mean of R&D intensity of the screened sample is not relative high, because some information technology and medicine companies with high R&D expenses not reporting the information in the notes of annual reports.

Mean of beta in each period presents a number less than 1, which tells that our portfolios are no riskier than the market risk. This may be explained by our selection condition that firms are selected from the large capitalization sector. The standard deviations of beta arrange from 0.149 to 0.68 throughout the examined whole period, which shows that the beta difference among the firms is less in some period whereas bigger in others. Means of DFL range from 1,203 to 1,530 and means of DOL change from 1,943 to 2,927. Standard deviations of DFL are in the range from 0,492 to 1,011, whereas, those of DOL are from 1,645 to 4,176, which shows the DOL vibrates much stronger than DFL in the different periods.

Each OR is less than Beta in different period and the standard deviations of OR is less than those of Beta expect for the period of 1997-2001.Total asset increases steady expect for second stage. R&D expense is on a decreasing side. As a result, the R&D intensity shows a declination. These reflect the situation after booming period of high technology business.

Table 2
Descriptive statistics of the sample firms

Test period Sample size	1997-2001 7	1998-2002 10	1999-2003 9	2000-2004 9	2001-2005 14
Total Asset (thSEK)					
Mean	43 661 526	50 254 633	28 285 233	54 289 978	59 073 141
Standard deviation	30 118 291	63 047 493	28 603 793	70 578 389	68 004 923
Minimum	17 793 280	4 494 629	2 276 600	2 494 400	3 022 800
Median	38 197 800	26 353 100	18 814 300	30 635 160	35 070 726
Maximum	85 261 800	215 744 200	98 517 800	231 007 600	242 286 000
R&D (thSEK)					
Mean	719 766	4 016 862	363 973	1 222 064	1 174 682
Standard deviation	548 430	11 160 831	270 623	1 876 182	1 677 625
Minimum	182 000	40 088	45 933	55 739	88 580
Median	735 600	482 800	325 580	567 400	507 100
Maximum	1 549 400	35 760 008	770 800	6 039 600	6 575 800
RD/TA					
Mean	0,016	0,030	0,019	0,023	0,020
Standard deviation	0,008	0,048	0,017	0,015	0,012
Minimum	0,009	0,005	0,005	0,009	0,005
Median	0,017	0,016	0,012	0,020	0,018
Maximum	0,031	0,166	0,061	0,060	0,054
SALES (thSEK)					
Mean	45 802 471	45 320 481	23 428 614	51 995 440	49 593 590
Standard deviation	38 387 174	61 358 998	23 000 648	60 991 801	54 924 812
Minimum	12 546 300	5 582 685	2 270 400	2 473 600	2 746 200
Median	38 904 200	19 129 600	18 269 800	22 381 400	26 012 136
Maximum	122 074 000	210 204 400	77 563 400	179 848 000	201 945 800
DOL					
Mean	2,076	2,909	2,268	1,943	2,927
Standard deviation	1,645	4,176	3,049	2,152	2,301
Minimum	0,238	0,154	0,340	0,044	0,294
Median	1,556	0,970	0,701	1,631	2,348
Maximum	5,036	13,129	9,424	6,580	8,891
DFL					
Mean	1,440	1,203	1,530	1,451	1,439
Standard deviation	0,606	0,492	0,772	1,011	0,721
Minimum	0,930	0,313	0,635	0,714	0,775
Median	1,169	1,274	1,236	1,223	1,191
Maximum	2,626	1,805	3,117	4,036	3,559
BETA					
Mean	0,696	0,792	0,530	0,589	0,808
Standard deviation	0,125	0,674	0,221	0,244	0,292
Minimum	0,504	0,423	0,287	0,227	0,364
Median	0,717	0,574	0,500	0,593	0,769
Maximum	0,849	2,660	0,983	1,045	1,548
BETA 0					
Mean	0,666	0,807	0,570	0,082	1,639
Standard deviation	0,673	0,659	0,412	0,075	1,603
Minimum	0,088	0,053	0,013	0,006	0,331
Median	0,251	0,681	0,614	0,063	1,283
Maximum	1,913	1,669	1,276	0,247	6,469

Table 2 (*continued*)

T*est* period Sample size	1997-2001 7	1998-2002 10	1999-2003 9	2000-2004 9	2001-2005 14
OR					
Mean	0,580	0,720	0,450	0,478	0,627
Standard deviation	0,222	0,451	0,215	0,200	0,199
Minimum	0,360	0,298	0,119	0,175	0,234
Median	0,472	0,503	0,422	0,451	0,638
Maximum	1,008	1,636	0,804	0,719	1,136

Note: This table provides descriptive statistics for the variables used in the present study. R&D is the 5-year average expenditure, RD/TA is the 5-year sum of R&D expenditure divided by 5-year sum of total assets, SALES is the 5-year average sales income, DOL is the degree of operating leverage, DFL is the degree of financial leverage, Beta is the systematic risk, Beta0 is intrinsic business risk and OR is operating risk.

8. RESULTS

8.1 Monte Carlo Simulation Results

According to the degree of R&D intensity, we divide screened firms into two portfolios. One portfolio contains firms with R&D intensity ratio lower than 0,010, and the other one contains firms with R&D intensity higher than 0,010. The average of the ratio of R&D against total assets of the lower R&D intensity portfolio is between 0,007 and 0,009 and the average of the ratio of the higher R&D intensity portfolio is between 0,019 and 0,040 throughout our study period. The t-test result shows the average systematic risk (β) of each component in the higher R&D intensity portfolio is significantly higher than that of the lower R&D intensity portfolio.

From the distribution characteristics of variables as shown in Table 3 in the next page, we observe the mean, minimum, median and maximum of each variable, which make it possible to simulate the population distribution of the variable by applying Monte Carlo simulation. We employ the Monte Carlo simulation to simulate all of them 1000 times. The advantage of the Monte Carlo simulation is that from the sample's distribution, a general population distribution can be attained. Further, with the lognormal transformed of the variables, the distribution simulated by Monte Carlo simulation will be preventative of the sample distribution. As the sample population after screened is relatively little, the simulated distribution of the sample could be improved by including more samples which should be examined in further study by considering the whole market.

Then we apply t-test to examine the difference between the means of variables of the two portfolios. Expect for the period of 2000-2004, the average betas of higher R&D intensity portfolio are significantly larger than those of lower R&D intensity portfolio in each of the 5 year window, which demonstrates that the firms of higher R&D intensity bear more systemic risk than the firms with lower R&D intensity, that means, the higher volatility of

Table 3

Properties of two portfolios formed on five-year average R&D expenditure to total asset

	Period	Low ratio [b]	High ratio [c]	(High – Low)[d]	ρ(High - Low)[e]
Average	1997-2001	0,009	0,019[-a]	0,010***	0,000
RD/TA	1998-2002	0,007[+a]	0,040[-a]	0,033***	0,000
	1999-2003	0,007	0,025[-a]	0,018***	0,000
	2000-2004	0,009	0,024[-a]	0,015***	0,000
	2001-2005	0,007[-a]	0,022[-a]	0,015***	0,000
Average	1997-2001	-0,521	-0,032[+a]	0,201***	0,000
LnBETA	1998-2002	-0,654	-0,307[-a]	0,347***	0,000
	1999-2003	-0,72	-0,702[+a]	0,019***	0,000
	2000-2004	-0,457	-0,637[+a]	-0,179***	0,000
	2001-2005	-0,321	-0,269	0,052	0,002
Average	1997-2001	-1,406	-0,674[+a]	0,733	0,000
LnBETA0	1998-2002	-0,66[-a]	-0,768[+a]	-0,100***	0,000
	1999-2003	-0,038[+a]	-1,461[+a]	-1,081	0,000
	2000-2004	-2,584	-3,057[+a]	-0,473***	0,000
	2001-2005	-0,67	0,337[-a]	1,007***	0,000
Average	1997-2001	0,688	0,262[+a]	-0,425***	0,000
LnDOL	1998-2002	0,066[-a]	0,285	0,219	0,000
	1999-2003	-0,275[-a]	0,316[-a]	0,591***	0,000
	2000-2004	0,546	-0,113[-a]	-0,659***	0,000
	2001-2005	1,853	0,54[+a]	-1,314***	0,000
Average	1997-2001	0,224	0,331[-a]	0,107	0,000
LnDFL	1998-2002	0,033[+a]	0,092[+a]	0,060	0,000
	1999-2003	0,024[+a]	0,473[-a]	0,449***	0,000
	2000-2004	-0,198	0,286[+a]	0,484***	0,000
	2001-2005	0,14	0,305[-a]	0,165***	0,000
Average	1997-2001	-0,758	-0,536[-a]	0,222	0,000
LnOR	1998-2002	-0,664[+a]	-0,421[-a]	0,243***	0,000
	1999-2003	-0,731[+a]	-1,025[+a]	-0,295***	0,000
	2000-2004	-0,33	-0,904[+a]	-0,574***	0,000
	2001-2005	-0,460	-0,531[+a]	-0,070***	0,000

Note: In each study period, beginning with the 1997-2001 period and terminating with the 2001-2005 period, all stocks are ranked by the R&D expenditure to total asset ratio and assigned to one of the four equally sized portfolios. The last second row presents the difference between high intensive ratio and low intensive ratio. Average denotes the cross-sectional average value, RD/TA denotes 5-year average R&D expenditure to total assets ratio, LnBETA denotes the natural logarithm of the systematic risk, LnBETA0 denotes the natural logarithm of the intrinsic risk, LnDOL denotes the natural logarithm of the operating leverage, LnDFL denotes the natural logarithm of the financial leverage, LnOR denotes the natural logarithm of the operating risk. a Sample mean is greater(smaller) than the theoretical mean at 1%. b Denotes the low R&D intensive ratio which is less than 0,010. c Denotes the high R&D intensive ratio which is more than 0,010. [d] (High – Low) denotes the difference between the average of the high ratio part and the low ratio part. ρ value for null hypothesis that the difference between the average of the high ratio part and the low ratio part is zero. *** 1% level of significance and ** 5% level of significance.

the higher R&D intensity firms. This result supports our hypothesis H1 that the higher R&D intensity of the firm, the higher volatility of the return of the firm's stock is. Because only one firm is left after sample screening procedure with R&D intensity less than 0,010 during the period of 2000-2004, the trend of this period can be improved by including more samples than current study.

Beta0, LnOR and LnDOL don't present consistent trends in the examined period, which means our hypothesis H2, H4 and H5 do not hold. However, LnDFL of higher R&D intensity portfolio is larger than that of lower one in each 5 year window. The persistent trend is interestingly opposite to our hypothesis H3 that the higher R&D intensity firms bear lower degree of financial level than do the lower R&D intensity firms, which means our high R&D intensity firms have higher financial leverage than the lower ones. This is not surprising if we find out most our sample firms are the large firms in the sectors, such as industry and consumer discretionary, which do not face the financial distress and difficulties in financing with fixed cost instruments.

8.2 Correlation Result

Our model tells that the R&D expenditures relationship with the risk of stock returns can be the yield of firm's intrinsic, operating and financial components. We examine the linkage as shown in the formula with correlations between variables.

Though the linkage as expressed in the formula is not obviously supported by the result data, some supportive and interesting evidences can be observed from the table 4. First, the results of correlation between R&D expenditure further strengthen our hypothesis of the relationship between R&D investment and stocks' systematic risk. Results in all the 5 year windows demonstrate positive relationship with significant at 95% confidence relationship observed in periods of 1997-2001, 1998-2002 and 1999-2003. When we calculate the correlation between R&D investment and stocks' systematic risk before the data being transformed into lognormal distribution, the results indicate positive relationships are significant at 95% confidence in each 5 year window.

Second, σLnBeta0/σLnBeta and σLnDOL/σLnBeta are larger than σLnDFL/σLnBeta in each period. As can be seen from the formula, these three ratios measure the weights of the contributions of the three components in the right side of the formula to the relationship between the R&D expenditure and the Beta in the left side of formula. Although, the correlations between LnBeta0, LnDOL and LnDFL with LnR&D show different kinds of relationship present in different period, the evidence that σLnBeta0/σLnBeta and σLnDOL/σLnBeta are always larger than σLnDFL/ σLnBeta suggests that the influences of the intrinsic business risk and the operating level on the systematic risk are larger than that of financial level. We can conclude that the intrinsic business risk and operating risk of Swedish large profit firms under the current study have much more influence than financial risk on the R&D intensity and systematic risk relationship.

9. CONCLUSION

This is a cross-sectional study to test the theoretical and empirical relations between R&D investment expenditures and systematic risk in the specific market, Sweden. Three factors are introduced as the main constituents of systematic risk: intrinsic business risk, degree of financial leverage and degree of operating leverage. And we use these three constituents to analysis the relation between R&D investment and systematic risk.

The main results show that, in Sweden: (i) our hypothesis H1, R&D intensive firms' stocks have greater systematic risk in the stock market, can be accepted according to the analysis of our sample of large-Cap firms, which means firms with higher R&D intensity do face higher stock price volatility in the stock market; (ii) R&D intensive firms have more financial leverage which is opposite to our expect, which might due to the shortage of data and limitation of our sample selection; (iii) R&D intensive firms do not have obvious relations directly with intrinsic business risk, degree of financial leverage or degree of operating leverage.

We should know that the above findings is biased to firms that are profitable, large in the market capitalization, more R&D intensive and have available R&D announcement data, compared to the rest of the population. The conclusion (ii) and (iii) mean our hypothesis H2, H4 and H5 do not hold, it might be better to involve more different types of firms to test these hypotheses in further studies.

Table 4

Correlations of 5-year average R&D expenditure to total asset with Beta and its constituents

Period	Number	(1) P(LnBeta ,LnR&D)	(2) σLnBETA0/ σLnBeta	(3) P(LnBeta0, LnR&D)	(4) (2)*(3)	(5) σLnDOL/ σLnBeta	(6) P(LnDOL, LnR&D)	(7) (5)*(6)	(8) σLnDFL/ σLnBeta	(9) P(Ln_DFL, LnR&D)	(10) (8)*(9)	(11) P(Ln_OR, LnR&D)
Expected Sign		+		+			+			-		+
1997-2001	14	0,615*	3.388	-0.180	-0.187	0.475	0.293	0.139	0.748	0.060	0.045	0.525
		(0.033)		(0.643)			(0.445)			(0.854)		(0.097)
1998-2002	15	0,606*	2.672	-0.298	-0.796	2.915	0.367	1.069	1.336	0.343	0.458	0.024
		(0.022)		(0.373)			(0.267)			(0.231)		(0.935)
1999-2003	15	0,634*	2.287	0.247	0.564	2.067	-0.443	-0.915	0.826	-0.382	-0.316	0,577*
		(0.015)		(0.492)			(0.200)			(0.187)		(0.031)
2000-2004	17	0.464	2.801	0,673*	1.884	2.783	-0.002	-0.006	0.807	0.059	0.047	-0.081
		(0.070)		(0.012)			(0.995)			(0.842)		(0.774)
2001-2005	19	0.431	2.181	0.153	0.335	1.723	-0,534*	-0.920	0.867	-0.017	-0.015	0.357
		(0.074)		(0.543)			(0.033)			(0.949)		(0.159)

Note: The Pearson Product-Moment Correlation coefficients are calculated for each of the five 5-year study periods. The results are arranged according to followed formula (Equation 8):

$$\rho(\mathrm{Ln}\beta, \mathrm{LnR\ \&\ D}) = \frac{\sigma_{\mathrm{Ln}\beta_0}}{\sigma_{\mathrm{Ln}\beta}} * \rho(\mathrm{Ln}\beta_0, \mathrm{LnR\ \&\ D}) + \frac{\sigma_{\mathrm{LnDOL}}}{\sigma_{\mathrm{Ln}\beta}} * \rho(\mathrm{LnDOL}, \mathrm{LnR\ \&\ D}) + \frac{\sigma_{\mathrm{LnDFL}}}{\sigma_{\mathrm{Ln}\beta}} * \rho(\mathrm{LnDFL}, \mathrm{LnR\ \&\ D})$$

Where ρ denotes the Pearson Product-Moment Correlation coefficients, σ denotes the standard deviation operator, Lnβ denotes the natural logarithm of the systematic risk, LnDOL denotes the natural logarithm of the degree of the operating leverage, Lnβ0 denotes the natural logarithm of the intrinsic business risk, LnDFL denotes the natural logarithm of the degree of the financial leverage, LnOR denotes the natural logarithm of the operating risk and LnR&D denotes the natural logarithm of the 5-year average R&D assets to total assets ratio. * Correlation is significant at the 0.05 level, 2-tailed. ** Correlation is significant at the 0.01 level, 2-tailed

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APPENDIX

All 38 large Cap firms involved in the present thesis.

Firms	Sector	Short name	ISIN in the Nordic List	Issuer
ABB Ltd	Industrials	ABB	CH0012221716	ABB
Alfa Laval AB	Industrials	ALFA	SE0000695876	ALFA
ASSA ABLOY AB ser. B	Industrials	ASSA B	SE0000255648	ASSA
AstraZeneca PLC	Health Care	AZN	GB0009895292	AZN
Autoliv Inc. SDB	Consumer Discretionary	ALIV SDB	SE0000382335	ALIV
Axfood AB	Consumer Staples	AXFO	SE0000635401	AXFO
Boliden AB	Materials	BOL	SE0000869646	BOL
Electrolux, AB ser. B	Consumer Discretionary	ELUX B	SE0000103814	ELUX
Elekta AB ser. B	Health Care	EKTA B	SE0000163628	EKTA
Ericsson, Telefonab. L M ser. B	Information Technology	ERIC B	SE0000108656	ERIC
Fabege AB	Financials	FABG	SE0000950636	FABG
Finland TIETOENATOR ORD				
Hennes & Mauritz AB, H & M ser. B	Consumer Discretionary	HM B	SE0000106270	HM
Hexagon AB ser. B	Industrials	HEXA B	SE0000103699	HEXA
Holmen AB ser. B	Materials	HOLM B	SE0000109290	HOLM
JM AB	Financials	JM	SE0000806994	JM
Kinnevik, Investment AB ser. B	Financials	KINV B	SE0000164626	KINV
Lundin Petroleum AB	Energy	LUPE	SE0000825820	LUPE
NCC AB ser. B	Industrials	NCC B	SE0000117970	NCC
Nobel Biocare Holding AG	Health Care	NOBE	CH0014030040	NOBE
Peab AB ser. B	Industrials	PEAB B	SE0000106205	PEAB
SAAB AB ser. B	Industrials	SAAB B	SE0000112385	SAAB
Sandvik AB	Industrials	SAND	SE0000667891	SAND

SAS AB	Industrials	SAS	SE0000805574	SAS
SCANIA AB ser. B	Industrials	SCV B	SE0000308280	SCV
Securitas AB ser. B	Industrials	SECU B	SE0000163594	SECU
Skanska AB ser. B	Industrials	SKA B	SE0000113250	SKA
SKF, AB ser. B	Industrials	SKF B	SE0000108227	SKF
SSAB Svenskt Stål AB ser. A	Materials	SSAB A	SE0000171100	SSAB
Stora Enso Oyj ser. R	Materials	STE R	FI0009007611	STE
Swedish Match AB	Consumer Staples	SWMA	SE0000310336	SWMA
Svenska Cellulosa AB SCA ser. B	Materials	SCA B	SE0000112724	SCA
Tele2 AB ser. A	Telecommunication Services	TEL2 A	SE0000314304	TEL2
Tele2 AB ser. B	Telecommunication Services	TEL2 B	SE0000314312	TEL2
TeliaSonera AB	Telecommunication Services	TLSN	SE0000667925	TLSN
Trelleborg AB ser. B	Industrials	TREL B	SE0000114837	TREL
Volvo, AB ser. B	Industrials	VOLV B	SE0000115446	VOLV
Vostok Nafta, Inv Ltd SDB	Energy	VOST SDB	SE0000367823	VOST