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Economic geographical analysis of the Finnish paper industry

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KIITOKSET

Jokaisella tapahtumalla on aikansa ja paikkansa. Niin on myös tällä tutkimuksella ollut oikea-aikaisuutensa ajan saatossa. Aiemmin minulla on ollut etusijalla perhe ja yritykseni johtaminen, mutta lasten vartuttua aikuisiksi ja luovuttuani yrityksen omistajuudesta jäin minulle vapaa-aikaa, jonka halusin käyttää hyödyllisesti. Väitöskirja on aina ollut yhtenä tavoitteena ajatusteni sopukoissa. Nyt kun tämä tavoite on vihdoin toteutunut, voin todeta, että on ollut uskomattoman hienoa koota ja saattaa vaatimattomat ajatuksensa loogiseen ja systemaattiseen muotoon ja saada ne julkaistua rakentavan kritiikin jälkeen kansainvälisissä tieteellisissä julkaisuissa. Tutkimus ja tieteen tekeminen on viimekädessä itsenäistä pohdintaa ja sinnikästä puurtamista, mutta ympärille aina tarvitaan kannustavien ja opastavien asiantuntijoiden ryhmä, jota ilman ei aloitteleva tutkija tule toimeen. Minun tieteellisen urani ohjasi oikeille raiteilleen Turun yliopiston maantieteen professori Pentti Yli-Jokipii. Pentti kannusti minua tutkimaan erityisesti paperiteollisuutta, koska olin viettänyt sen parissa tiiviisti reilun vuosikymmenen. Pentin ohjauksessa sain aikoinaan valmiiksi maisterin tutkinnon ja nyt voin kirjoittaa näitä rivejä väitöskirjaani. Kiitos Pentti! Pentti valitsi minulle myös loistavan ohjaajan, professori Ulla Tapanisen, tutkimukseni aihealueelta, talousmaantieteen piiristä. Ullan kannustuksen, rohkaisun ja asiantuntevien palautteiden ansiosta tutkimukseni edistyi suunnitellusti. Ulla kannusti minua alusta alkaen kirjoittamaan artikkeleista koostuvan väitöskirjan ja kuinka oikeassa hän olikaan, vaikka se olikin välillä haastavaa. Ulla antoi minulle pysyvän tiekartan tieteelliseen maailmaan. Ulla, haluan osoittaa sinulle suuret kiitokset! Olit upea ohjaaja. Pentin jäätyä eläkkeelle maantieteen laitokselle tuli professoriksi Jussi Jauhiainen, joka valvojan roolissaan jaksoi kärsivällisesti ja suurella asiantuntemuksellaan opastaa minua ja kommentoida väitöskirjani sisältöä ja ohjata työtäni sen loppuun saattamiseksi. Jussille todella suuret kiitokset! Haluan myös kiittää maantieteen laitosta ja erityisesti professoreita Jukka Käyhköä ja Risto Kalliola kaikesta tuestanne ja lukuisista jatko-opiskelijoille järjestetyistä seminaareista ja keskusteluista, joiden aikana oman tutkimukseni sisältö tarkentui. Haluan osoittaa nöyrimmät kiitokseni työni tarkastajille professori Tommi Inkiselle ja professori Juha-Matti Lehtoselle. Teidän asiantuntevat palautteet ja rakentava kritiikki auttoi merkittävästi työni viimeistelyssä. Suuret kiitokset menevät myös Antti Vasaselle, maantieteen laitokselle, väitöskirjani ammattitaitoisesta taittamisesta.

Tämä tutkimus ei olisi ollut mahdollista ilman laadukasta tutkimusaineistoa. Käytössäni oli laaja empiirinen tehdasaineisto, johon perehtymällä saatoinkin tutkia Suomen paperiteollisuutta todella perusteellisesti ja useasta näkökulmasta. Todella isot kiitokset tästä menevät yhteistyötahoilleni, joiden ansiosta saatoinkin käyttää tällaista poikkeuksellisen laajaa aikasarja-aineistoa tutkimuksessani. Tehtaan edustajien kanssa minulla oli mahdollisuus käydä vuosikymmenen ajan todella mielenkiintoisia keskusteluja paperiteollisuuden tilasta ja sen tulevaisuudesta. Näiden ystävien kautta olen saanut olla etuoikeutetussa asemassa. Vuosien saatossa olen tavannut suuren määrän sekä paperin valmistuksen että laskennan asiantuntijoita, joiden kaikkien luetteleminen tässä olisi mahdotonta. Heille haluan osoittaa todella nöyrät kiitokseni. Haluan suuresti kiittää Metsäteho Oy:tä ja sen toimitusjohtajaa Heikki Pajuojaa, joka myönsi minulle apu-

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- II Hämäläinen, E. & U. Tapaninen (2010). Economics of a Nordic paper mill–case study, *Industrial management & Data Systems* 110(1), 5–23.
- III Hämäläinen, E. (2011). Cost efficiency of supply chain in a Nordic paper mill – A case study, *International Journal of Management* 28(3), 945–958.
- IV Hämäläinen, E. & U. Tapaninen (2011). Accuracy of the economic anticipating in a Nordic paper mill - A case study, *Int. J. Applied Management Science* 3(4) 368–384.
- V Hämäläinen, E. & U. Tapaninen (2011). Accuracy of forecasting in a Nordic paper mill's supply chain: A case study, *Norsk Geografisk Tidsskrift–Norwegian Journal of Geography* 65(2), 104–113.

In all five supporting articles, the first author was responsible for the selection of the theme, data mining and analyses, and the author took initiative to construct and compose the articles and made all the figures and tables in the articles. Professor Ulla Tapaninen gave structural advice and essential support regarding the content of the articles before they were submitted to the selected journals. All the articles were proofread by a native English translator.

In the first article, the distribution of design and work was Esa Hämäläinen 85% and Ulla Tapaninen 15 %.

In the second article, the distribution of design and work was Esa Hämäläinen 95 % and Ulla Tapaninen 5 %.

The third article was designed and constructed completely by Esa Hämäläinen (100 %).

In the fourth article, the distribution of work was Esa Hämäläinen 95 % and Ulla Tapaninen 5 %.

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ABSTRACT

The purpose of this academic economic geographical dissertation is to study and describe how competitiveness in the Finnish paper industry has developed during 2001–2008. During these years, the Finnish paper industry has faced economically challenging times. This dissertation attempts to fill the existing gap between theoretical and empirical discussions concerning economic geographical issues in the paper industry. The main research questions are: How have the supply chain costs and margins developed during 2001–2008? How do sales prices, transportation, and fixed and variable costs correlate with gross margins in a spatial context?

The research object for this case study is a typical large Finnish paper mill that exports over 90 % of its production. The economic longitudinal research data were obtained from the case mill's controlled economic system and, correlation (R^2) analysis was used as the main research method. The time series data cover monthly economic and manufacturing observations from the mill from 2001 to 2008.

The study reveals the development of prices, costs and transportation in the case mill, and it shows how economic variables correlate with the paper mills' gross margins in various markets in Europe. The research methods of economic geography offer perspectives that pay attention to the spatial (market) heterogeneity. This type of research has been quite scarce in the research tradition of Finnish economic geography and supply chain management. This case study gives new insight into the research tradition of Finnish economic geography and supply chain management and its applications.

As a concrete empirical result, this dissertation states that the competitive advantages of the Finnish paper industry were significantly weakened during 2001–2008 by low paper prices, costly manufacturing and expensive transportation. Statistical analysis exposed that, in several important markets, transport costs lower gross margins as much as decreasing paper prices, which was a new finding. Paper companies should continuously pay attention to lowering manufacturing and transporting costs to achieve more profitable economic performance. The location of a mill being far from markets clearly has an economic impact on paper manufacturing, as paper demand is decreasing and oversupply is pressuring paper prices down. Therefore, market and economic forecasting in the paper industry is advantageous at the country and product levels while simultaneously taking into account the economic geographically specific dimensions.

1 INTRODUCTION

1.1 Background

At present, the Finnish paper industry is facing particularly challenging times concerning its existence and operation (Hetemäki and Hänninen, 2009). During 2001–2008, the economic situation of the Finnish paper industry was adversely affected by the lowering paper demand in Europe and simultaneous rises in costs in Finland, especially of the main raw materials (Käär, 2009). The Nordic paper industry is mainly capital-intensive bulk-production, which must compete and live with the location and geographically based realities. The paper companies are working intensively to find solutions to enhance the profitability of the existing assets, mills and machine lines. The soaring costs together with decreasing demand have led to unprofitable production. The paper industry specific discussions have left out detailed empirical economic factors, like costs, time series, real logistics costs and profits in euro per paper ton by country and by customer (see e.g. Koskinen, 2009b and Lähtinen, 2007). Finnish professionals in the paper industry are currently discussing how the paper industry could maintain competitiveness in the future, being located far from the global market (e.g. Hetemäki, 2007 and Oinonen, 2008). Between 2001 and 2008, Finnish paper companies closed over 20 pulp, paper and board machine lines, even including some complete closures at large operating mills producing millions of tons of paper products (see e.g. Oinonen, 2008). As an example, in late 2008, UPM- Kymmene closed the Kajaani paper mill with three machine lines producing 640,000 tons of newsprint (UPM-Kymmene, 2008b). RISI (2009) estimates that the negative trend will continue due to lowering paper demand especially in Europe.

Hetemäki and Hänninen (2009) have estimated that, until 2020, Finnish paper production can drop dramatically, by up to 30 %, from 13 million tons (2009) to 9.4 million tons. If this scenario materializes, it would dramatically change the structure of the Finnish export industry. Losses in annual export income would be hundreds of millions of euro. RISI (2009) announced that printing paper grades are under severe price and demand pressures and that overcapacity had a negative impact even on the 2010 contract price negotiations. Koskinen (2009a) reveals that paper rolls remain in intermediate warehouses averagely 45 days, which makes just-in-time deliveries difficult. Long storage times also bind a lot of capital costs. Muckstadt et al. (2001) point out that the level of uncertainty in market economics and demand must be dealt with explicitly to determine whether negative impacts exist. Industries must take serious action to change their production methods, product mixture and even manufacturing locations to adapt to new economic situations in the market.

1.2 Main objective and research questions

There is a long-lasting research tradition in geography, which emphasizes that economic issues should be linked with the spatial context (see e.g. Martin, 1999; Storper et al., 2002; McCann, 2005 and Essletzbichler and Rigby, 2007) in order to obtain and to see

the heterogeneity in the microeconomics within the exporting industry. In addition to Krugman's (1991a,b and 1995) 'new economic geography', there is a growing interest among economic geographers to study and understand economics as an evolutionary process over space (Grabner, 1993; Martin, 2000; Scott, 2004; Boschma and Frenken, 2006 and Webber et al., 2007).

The purpose of this academic human economic geographical dissertation is to study and describe how competitiveness in the Finnish paper industry has developed during 2001–2008. The development of external transport costs (from the mill warehouse to customers,) paper prices and internal processes (variable and fixed costs of a paper mill) during the research period is analyzed.

During the research process, we examined how the different important economic variables in a paper mill correlate with the gross margins by country with monthly time series during 2001–2008 in 15 countries. There are four main research questions, which are as follows:

RQ 1–How do the total paper sales and product-specific sales correlate with the gross margins of the paper mill?

RQ 2–How do the total transportation costs and transportation costs of one important product from the mill to customers correlate with the gross margins of the paper mill?

RQ 3–How do the total variable costs and total product-specific variable costs correlate with the gross margins of the paper mill?

RQ 4–How do the total fixed costs and total product-specific fixed costs correlate with the gross margins of the paper mill?

The paper mills are fundamentally dependent on well-managed and well-functioning value-chain processes from the wood yard at the mill to foreign consignees. All physical transporting costs are estimated to stay high and even rise globally due to soaring oil prices, and this will have a strong influence on paper transports by ships and trucks all over Europe. Transport and other costs for the most bulk products are essentially dependent on location, either from the main raw material sources to the mill or from the mill to the end customers.

The Finnish paper industry is located at the periphery from the markets' perspective. As such it is essential to explore the export industry's geographical horizons and bring out how long distances from the main market affect the economics of a bulk industry. This study supports the theoretical and practical discussions on how the companies could better analyze the particularities in the foreign market and attempt to avoid the aggregated high level average values, which are usually presented in the economist mathematical and theoretical models (Martin, 1999). Each unique market area has its own economic factors, which are supposed to affect the result of a paper mill differently. The microeconomic and empirical research angles offer company level perspectives on the economic geographical discussion concerning the paper industry as a whole. This study endeavors to support the evolutionary economic geographical discussion concerning

the Nordic paper industry. Additionally, the topic of this dissertation is relevant from the viewpoint of exporting bulk industries that are operating far from the main market with minimal local demand.

The research process was divided into phases, which included five supporting articles and this study:

I phase: to study how paper prices, material costs and paper prices have been developed and how transportation costs in euro per ton increase, when paper delivery volumes decrease.

II phase: to examine the large variation in deliveries between customers and how the delivery volumes correlate with gross margins.

III phase: to reveal, with the main economic variables, how the production performance and efficiency per paper machine hour had developed.

IV phase: to examine, with two separate articles, how the case mill was able to forecast the development of the sales volumes, costs and margins in the selected markets. We also compared these anticipated values to the realized values.

V phase: to reveal how the economic variables (paper prices, transportation costs, variable and fixed costs) correlate with the gross margins.

These five research phases offered an extended possibility to examine the Finnish paper industry through one large case mill from different orientations. The essential topic was to combine and study the economic issues in a geographical context.

1.3 Research methods

The research methods used in this dissertation are descriptive case analysis and statistical correlation analysis that is based on the obtained mill's economic figures: prices, transportation costs and variable and fixed costs in euro per paper ton. The correlation analysis is used to illustrate how strong the statistical relationship was between gross margins and selected economic variables during the research period. The central topic is to make observations based on the quantitative time series data analysis in the economic geographical context. Earlier there have been limited possibilities to acquire reliable longitudinal mill data for academic studies due to reasons of confidentiality. The correlation analysis has been carried out separately for the fifteen different markets to reveal how the export markets differ from one another. This study includes the complete data from 14 important export markets and the domestic market. The correlation coefficients of the economic variables are calculated from the total exports to these markets as well as the total exports of the most important product, to examine if and how the lower aggregate level affects the statistical correlations. The statistical correlation analysis gives the possibility to see whether there is statistical significance in the studied economic variables, even if the correlations do not directly show possible causality between the examined variables.

There are five supporting articles, which were composed to explore and reveal the research topic from different points of view. The main objective, however, has been to look at the economics of a paper mill from the evolutionary perspective with spatial linkages. The supporting articles are:

Hämäläinen, E. & U. Tapaninen (2008). Spatial characteristics of the transports in the paper mill's supply chain, *Fennia* 186(2), 83–93.

Hämäläinen, E. & U. Tapaninen (2010). Economics of a Nordic paper mill—case study, *Industrial management & Data Systems* 110(1), 5–23.

Hämäläinen, E. (2011). Cost efficiency of supply chain in a Nordic paper mill - A case study, *International Journal of Management* 28(3), 945–958.

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1.4 Structure

The dissertation consists of the following sections: Section 2 describes the research subject, which is the paper industry from the Finnish perspective, and how the Finnish mills integrate demand, manufacturing and deliveries as a seamless process. The theory, constructs and the literature are presented in section 3, which focuses on the economic geographical theories as well as the supply chain, transportation and frictions in a spatial context. In the following section 4, some of the special considerations of the case study as a research method are discussed. Additionally, the empirical case data is described in section 4, namely how the economic data was obtained from the case mill's database. The used methodology, as well as the positioning of the supporting articles, is defined in the following section 5.

The empirical results are presented in section 6, starting with the supporting articles. Then, in the following sections, detailed results of the empirical findings are shown, especially in relation to how the selected economic variables correlate with the gross margins in fifteen countries. These empirical results are linked and enfolded on the theories used in section 7. The discussion and generalization and limitations based on the results are revealed in section 8. Finally, the conclusions highlighted through this thesis are presented in section 9 at the national level and the managerial level. In the end, there are some ideas for further research and the appendix, which shows the used correlations by country.

2 FINNISH PAPER INDUSTRY AS A RESEARCH OBJECT

2.1 Paper mills' demand and supply processes

In this section, the functioning of demand, deliveries and costs calculation is described, especially in a Finnish paper mill (Figure 1). Nordic mills are usually integrated production units (Figure 2), which include fiber lines, like PGW (pressure ground wood) and TMP (thermo-mechanical pulp) lines, and after these production phases, there are PMs (paper machine lines) (Diesen, 1998). The different machine lines and production departments have been organized to operate as an efficient value chain channel to deliver the paper grades to the market as flexibly and efficiently as possible.

The paper orders and deliveries should function in balance with the paper production in order to make the expensive production machinery operate as economically as possible through the value-added channel. The paper mills tend to make long-lasting delivery agreements with the main customers, and this way they attempt to forecast demand and supply more accurately (Fogelholm, 2000). For the Finnish paper mills, intermodal truck/train-short sea-truck transporting and the supply chain are the backbone of international trade. The existing paper industry in Finland was originally built for exporting purposes near the raw material and energy sources. Later, the Finnish mills were placed near the sea for logistics reasons. During the past years, large printing paper mills have been built near the market in Europe, and these are supported with inexpensive pulp transportations from South America. Additionally, some paper mills located near ports in the Nordic countries occasionally import inexpensive eucalyptus pulp from South America.

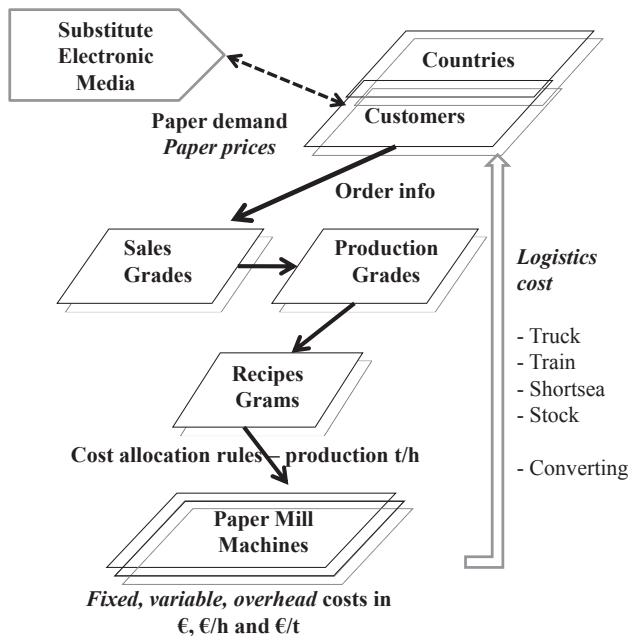


Figure 1 The paper mill's demand and value-added chain.

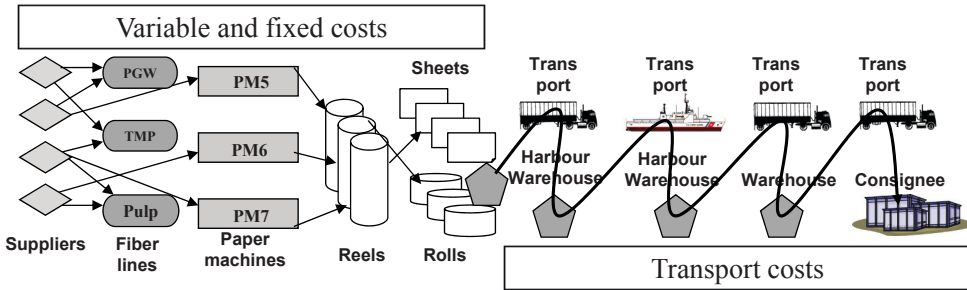


Figure 2 An example of the supply chain and transportation functions of a Nordic paper mill.

In Finland, export-intensive paper mills operate in a firm and highly demand-oriented manner and focus on the customers' needs, as Diesen (1998) and Lamberg and Ojala (2006) state. Paper grades are manufactured largely on a make-to-order basis, where jumbo reels are converted and packed to customer rolls according to specifications (Fogelholm and Hämäläinen, 2003). All paper qualities have different production tons per hour, required moisture, surface, gloss, base weight, density, color and pre-defined roll width for the printing machines. These differences in production also generate costs differences, which are calculated in euro (€), euro per paper ton (€/t) as well as in euro per machine hour (€/h). The wrapped and packaged rolls are transported from the mill by using different modes (truck/train–short sea–truck/train) to distribution centers, where consignees pick up the rolls. A majority of the end customers are located in different countries and markets in Europe over an extensive area and behind long transport routes.

The raw material suppliers deliver raw materials, like timber, pulp and chemicals, to a paper mill, which makes different paper grades based on the recipes that the customers demand. These customer packages are transported to customers in different countries through nodes by different intermodal means. Especially from Finland, these exporting transport and logistics nodes are complicated, time consuming and therefore costly processes. Other European paper mills have shorter truck transports, and even the volumes of intermediate warehousing can be remarkably lower, if they are needed at all. This gives real measurable advantages, both in costs and time, for the mills located closer to the market (Koskinen, 2009b).

The costs are calculated by summing up all the realized manufacturing costs (variable and fixed costs) and transportation costs of the sales on a monthly basis. The fixed costs are allocated to the grades by the production performance of the grades in tons per machine hour (Fogelholm, 2000). This value-added delivery process from the forest through manufacturing and transportation to the consignees can take several months. Even if bulky printing paper products differ to some extent from one another, the basic manufacturing processes are quite common in all paper mills.

2.2 Paper industry under changes

The North European paper industry developed because of many competitive advantages (see e.g. Diesen, 1998 and Dieter and Englert, 2007): the availability of reasonable

fiber; inexpensive hydroenergy; large, modern and efficient paper machines; skilled personnel; and growing demand in the main markets until the late 20th century. The economic environment around the paper industry changed dramatically in the beginning of the 21st century for many reasons, e.g. the oversupply of paper products, lowering demand and paper prices, soaring timber and oil prices, and the breakthrough of the Internet (Hetemäki, 2007). The Finnish paper producers have attempted to be competitive in international markets especially with large paper machines and improved and more expensive paper qualities from lower valued and bulky qualities (Lamberg and Ojala, 2006). The Finnish paper mills export over 90 percent of their production, and paper imports are very low. The Finnish, along with the Nordic, paper industry has responded to a long period of growing paper demand and need for virgin fiber especially in Europe (see e.g. Forestindustries, 2010). This industry is one of the cornerstones of the Finnish national economy. The value of the forest products was approximately half of the total exports in 1995, and in 2008, it is still around 20 %. In many rural areas of Finland, timber harvesting together with a local paper mill are still some of the most significant employers. The map shows that the mills are located mainly in the southern parts of Finland and inland, and they need multimodal transportation means to get paper products to the market. The EU market is fairly large and immensely concentrated. Nearly all of the largest printing houses and 250 million consumers can be reached within a day's transport from the paper mills in Central Europe, which is not possible from the Finnish mills. Access to the market from a North European mill consists of a complicated mix of transportation functions, which add to delivery time and costs. The distant Finnish paper mills are very dependent on a continuous, well-operating and agile delivery chain to overcome the problems caused by geographical heterogeneity. This phenomenon is worth studying in more detail with real mill time series data to reveal the impacts of the different markets for the mill.

Paper manufacturing in Finland has changed dramatically during the past years, and there has been big restructuring in the Finnish paper industry, including plenty of closures of paper and board machines, which are listed in Tables 1 and 2.

During 2002–2010, the closed paper machine capacity reached up to nearly 3,000,000 tons per year, which was almost 20 % of the total paper production capacity in Finland. Closed carton board capacity totalled to 410,000 tons per year during the same period. Already in the 1990s, there were some closures of very small machines, like two machine paper mills in Kotka in 1999 (Stora Enso, 2000). These tiny paper machine lines were closed because they were very ineffective and technologically out-of-date, and the production was moved to larger units in Finland. In 2007, Stora Enso (Stora Enso, 2008) closed the Summa mill with two machine lines. In 2010, M-real Corporation announced that it was going to close a special paper machine at the Simpele mill and move the production to the Gohrsmühle mill in Germany. During the summer 2011 a large global paper company, UPM-Kymmene, announced the shutdown of the Myllykoski paper mill, after taking over the whole Myllykoski paper company (UPM-Kymmene, 2011). The decision was justified by there being a large amount of overcapacity of the printing paper grades in Europe. So the mill closings seem to continue. These sites were situated mainly in rural areas, where they have operated as some of the most important industrial sector employers. All of the closed paper

Table 1 Closed paper machine (PM) lines during 2002–2010.

1.	UPM-Kymmene; Voikkaa paper mill, PM16, 2002, 75 000 t/a, MFS-paper (UPM-Kymmene, 2003)
2.	Myllykoski; Myllykoski paper mill, PM5, 2002, 70 000 t/a, SC-paper (Myllykoski Oy, 2003)
3.	Stora Enso; Summa paper mill, PM1, 2003, 120 000 t/a, newspaper (STORA ENSO, 2004)
4.	UPM-Kymmene; Voikkaa paper mill, PM17, 2004, 100 000 t/a, MFS-paper (UPM-KYMMENE, 2005)
5.	UPM-Kymmene; Kuusaansaari paper mill, PM1, 2005, 10 000 t/a, MG-paper (UPM-KYMMENE, 2006)
6.	UPM-Kymmene; Kuusaansaari paper mill, PM2, 2005, 10 000 t/a, MG-paper (UPM-KYMMENE, 2006)
7.	Stora Enso; Varkaus paper mill, PM1, 2006, 95 000 t/a, fine paper (STORA ENSO, 2007)
8.	UPM-Kymmene; Voikkaa paper mill, PM11, 2006, 150 000 t/a, MFC-paper (UPM-KYMMENE, 2007)
9.	UPM-Kymmene; Voikkaa paper mill, PM18, 2006, 250 000 t/a, LWC-paper (UPM-KYMMENE, 2007)
10.	UPM-Kymmene; Kymi paper mill, PM7, 2006, 150 000 t/a, fine paper (UPM-KYMMENE, 2007)
11.	UPM-Kymmene; Tervasaari paper mill, PM6, 2007, 118 000 t/a, bag paper (UPM-KYMMENE, 2008a)
12.	Stora Enso; Anjala paper mill, PM1, 2008, 120 000 t/a, MFS-paper (STORA ENSO, 2009)
13.	Stora Enso; Summa paper mill, PM2, 2008, 200 000 t/a, MF-paper (STORA ENSO, 2009)
14.	Stora Enso; Summa paper mill, PM3, 2008, 240 000 t/a, book paper (STORA ENSO, 2009)
15.	UPM-Kymmene; Kajaani paper mill, PM2, 2008, 170 000 t/a, SC-paper (UPM-KYMMENE, 2009)
16.	UPM-Kymmene; Kajaani paper mill, PM3, 2008, 245 000 t/a, MFS-paper (UPM-KYMMENE, 2009)
17.	UPM-Kymmene; Kajaani paper mill, PM4, 2008, 225 000 t/a, news paper (UPM-KYMMENE, 2009)
18.	Sappi; Kangas paper mill, PM2, 2008, 100 000 t/a, coated magazine paper (SAPPI, 2009)
19.	Georgia Pacific; Nokia paper mill, PM8, 2008, 25 000 t/a, tissue paper (GEORGIA SPACIFIC, 2009)
20.	Sappi; Kangas paper mill, PM1, 2009, 210 000 t/a, office paper (SAPPI, 2010)

Table 2 Closed board machine (BM) lines during 2002–2010.

1.	M-Real, Tako board mill, BM2, 2007, 70 000 t/a, 3-layer folding boxboard (M-REAL, 2008)
2.	Stora Enso Varkaus, BM5, 2008, 90 000 t/a, coreboard (STORA ENSO, 2009)
3.	Strömsdal, Juankoski board mill, BM1, 2008, 70 000 t/a, graphic board (STROMSDAL, 2009)
4.	Stora Enso, Kaukopää board mill, BM1, 2009, 180 000 t/a, liquid packaging board (STORA ENSO, 2010)

and board production units were very export-intensive. These mill closures generally mean worries for the local economy in regions that originally developed mainly as a result of timber processing and the paper industry. In the end, the closings and the reduction of industrial workforce also heavily affect the local service sectors' ability to run business economically.

The latest modern and large paper machines were built in Finland during 1996–1998: Sappi's (former M-Real) Kirkniemi PK3 (1996), UPM-Kymmene's Tervasaari PK8 (1996), Stora Enso's Oulu PK7 (1997) and UPM-Kymmene's Rauma PK4 (1998). These machines are expected to be competitive due to their scale of production (lower unit fixed costs), improved quality and their location close to the export harbor, besides Tervasaari PK8, which is a special paper machine (release paper).

The present supply-demand equilibrium is not in balance in the paper market, and paper mills have difficulties in acquiring good prices from buyers due to oversupply

(RISI, 2009). Paper producers try to push their paper products to markets by lowering sales prices to obtain more market share and to acquire a better competition situation. European paper suppliers are also occasionally complaining about cheap imports due to the weakness of the dollar against the euro. This also makes European exports to the USA unprofitable. Paper purchasers, mainly the printing and publishing houses in Europe, are not always willing to make long-lasting purchasing deals with the producers like earlier. Nordic paper mills normally produce high returns by economies of scale and integrated fiber production, and therefore the fixed costs and fiber costs in euro per paper ton are usually lower than the competitors' costs in the continent (Lamberg and Ojala, 2006). These integrated and productive manufacturing units have helped to overcome obligatory distance costs. The export transportation of forest products has become a top priority for today's executives of the forest products industry (Hölsä, 2005), which Hameri and Lehtonen (2001) have discussed earlier in their study. According to these conclusions, speedier transportation operation easily generates direct cost savings amounting to 2–5 % of annual turnover. Just-in-time (JIT) production systems in logistics tend to encourage certain suppliers to relocate plants closer to their customers in order to make more frequent deliveries in a timely manner (Lasserre, 2004). Some type of relocating process seems to be occurring in the Finnish paper industry, as the above closing lists present (Tables 1 and 2). During past years, Finnish engineering and economic researchers have been active in paper industry studies (see e.g. Eloranta et al., 1994; Lehtonen, 1999; Fogelholm and Hämäläinen, 2003; Haarla, 2003; Koskinen and Hilmola, 2008 and Koskinen, 2009b). The main research focus and message in these discussions have been both JIT (Just-In-Time) and inventory levels, which together cause the long and costly lead times of the supply chain. Fogelholm (2000), being somewhat different in his views, argues that a paper machine should be considered a bottleneck in the mill and stresses that the efficiency of a machine line is central and the only relevant research topic. As a conclusion, all these previous discussions state that the share of logistics costs is significant in the paper mill, and it must be taken into consideration.

3 THEORETICAL IDEAS AND FRAMEWORK

3.1 Some characteristics of economic geography and microeconomic research

In the following sections 3.1–3.4, the author goes through the theories, which comprise the theoretical settings for designing this dissertation. The main standpoints are on economic geographical and transport geographical theories, which together disclose revealing aspects when studying the exporting industry. The term “economic geography” refers to the study of economic activities, like trade, from the viewpoint of geography (Martin, 1999). In *Handbook of commercial geography* (Chisholm, 1889), which is the first economic geographical book originally written in English and published by Chisholm, trade was primarily geographical and commerce depended on differences in the producing conditions of the world. A hundred years later, Dicken and Lloyd (1990) consider that economic geographical research is spatial organization of economic systems: where the various elements of the system are located, how they are connected together in space, and the spatial impact of economic processes. World economy after the Second World War until end of the 80’s was rather stable, and changes in the economic processes were quite slow. After the 80’s economic liberations in Asia and in former Eastern Europe the global economy started to expand and integrate, and the role of Asia also started to increase remarkably. At that time, oil was relatively inexpensive, apart from some peaks in the mid seventies, so the low transportation costs did not represent a significant part of total costs in the exporting manufacturing firms.

According to Barnes (2009), economic geography is one of the most diverse sub-disciplines within human geography, and it is concerned with describing and explaining the varied places and spaces in which economic activities are carried out and circulate. Economic geographers attempt to analyze and forecast the changes in the organization of production (Grant, 2005). Webber (2005) considers that the large number of questions in economic geography center on the evolution of the world economy, like decision rules and economic practices between different places. It can be considered that the big change in world economy, which started especially in Asia but also in South America, is expected to continue. The Asian low-cost workforce has brought difficulties for Western economies, but also these rather rapidly expanding Asian economies produces great markets and possibilities for the Western companies. This economic evolution has induced that the location of the industries and manufacturing continuously changes the supply–demand balance, and therefore industries are relocated to find more affordable regions for business. This global economy operates through complex networks, both vertically and horizontally; these networks form production chains that take a different form in each industry (Dicken, 1998). These production chains and networks have, during recent years, been under a constant change and formed very sophisticated electronic networks integrating companies and markets. A particularly good example of these new networks is the global World Wide Web, which is expanding rapidly, forming social and economic networks. The fact is that the personal contacts, information and capital are moving from place to place in seconds looking for the best profit based

on the latest economic information. Economic geography has particular challenges, because it is considered to be a philosophically diverse discipline, employing and studying a variety of approaches, themes and phenomena, like location, transportation, production, competition and markets and economic growth (Barnes and Sheppard, 2005). However, these themes are integrated into each other very closely and can hardly be separated when studying economic processes. Thus, if an economic geography researcher aims to examine how a company may succeed in global competition, some of the previously mentioned themes should be included in the study. Competition is mostly understood to be economically beneficial, and competition is a hegemonic discourse in economic geographical thinking (Schoenberger, 1998). Additionally, Sheppard (2005) points out from the economic geographical angle that when there is competition between firms, competition also occurs between the different places in which the firms are located. It is thus important to consider whether place itself makes a significant contribution to competition. During past years, even large manufacturing companies have been forced to make quick decisions when looking for an affordable location to remain competitive in global markets. In an increasing number of cases new production locations are located outside Europe. This situation may change continuously in the future, particularly if oil prices start to soar, increasing transportation costs and forcing manufacturing companies to relocate.

Geographers are trying, mainly with empirical data, to describe and reveal how the impacts of geographical topics, like transportation, impact organizations (Nelson and Winter, 1982 and Maskell, 2001). Additionally, Martin (1999) and Scott (2004) note that one perspective in economic geographers' research should be to reveal phenomena of the real world with empirical studies and link together economic agents and geographical regions. Geographers are often inclined to focus on the empirical reality present in the world, and the geographic perspective brings the possibility to examine less analyzed spatial topics and development (Lee and Wills, 1997). These research views described above thus study a phenomenon, and, in some of them, development can be considered somewhat defensive and traditional, even old-fashioned. Among these traditional empiric objectives, there might be a need for more economic geographic examinations that study changes in the global economy and their impact on our lives.

Traditionally, economic geographers have put aside the sophisticated mathematical models, when compared to geographic economists, and focused more on analyzing and describing the development in the real world with empiric data collected with different methods and sources. However, many economic geographers attempt to discover heterogeneities and development over space and time by using modeling, which can be considered beneficial for the human geographic science. In this context, Johnston (1986) and Plummer (1996) encourage the utilization of mathematical analysis and models to reveal the spatial configuration of the economic landscape; this can be called the positivist conception of science. Later, Plummer (2005) considers that, because the geographical world is complex, we need to build relatively simple models to understand how these systems operate. Some geographers, like Martin (1999) and Scott (2004), have criticized this phenomenon, and they thus lift up the importance of transportation and location, which especially Weber studied widely. Additionally, Davis and Weinstein (2003) criticize that the mathematical models of economic geography are based on

mathematical assumptions and formulas, with some simplifications and restrictions. The results are normally as expected due to the developed model and theoretical values of the formula. According to Walz (1996) these mathematical models often leave out three essential spatial elements: transport costs, time series and factor mobility, which all are highly important topics when studying the real world. However, these mathematical models give us a possibility to build theoretical assumptions, which then can be tested with the empirical material.

Sheppard and Barnes (2005) consider that an institutional approach to economic geography emphasizes the evolution of the economic landscape. Economic activity is socially and institutionally situated; it is not possible to explain it by reference to atomistic individual motives alone. The role of systems of rules, procedures and conventions is the focus of an institutionalist approach to economic geography. The rational choice of perspective is to focus on the ways in which institutions serve to reduce costs and to increase economic performance (Eggertson, 1990 and North, 1990). Institutions are understood as the outcome of market behavior, constantly changing through the economic process in relation to time. During past years, especially the implications of finance institutions and banks have increased significantly and this has also changed the behavior of economic geography and economic environment. Even whole European nations have faced economic difficulties due to high public and private spending based on borrowed capital. This has led to uncontrollable price increases and, in the end, low economic performance in many countries.

Arbia (2001) considers that, until relatively recently, location and transport geographical characteristics have been regarded as irrelevant factors in many economic studies. Most economists have conducted their studies as if all economic agents were concentrated in one single, dimensionless point in space and as if transportation and communication costs were zero. Such topics as spatial location, interaction between firms, spatial pricing, etc. have typically been left to a small group of scholars (regional economists) and considered unimportant from a macro-dynamic point of view. However, this scenario is rapidly changing, and the rise of the so-called 'new economic geography', which is raising transportation issues to the center, has radically changed many economists' perspectives. An increasing number of economists now acknowledge that the geographical location of the manufacturing sites, because of transportation, matters more to the companies than other macro factors (Quah, 1996).

3.1.1 Characteristics of transportation geography, location and frictions

In this section, the author describes and highlights some noteworthy theories of economic geography–transportation and location, which can be considered to be inseparable. The optimal locations of industrial activities fall under the umbrella of the location theory, which is widely studied by geographers. These topics are essential concepts when we are discussing how geography impacts economic actions, like the location decisions of firms. Economic transport geography helps to understand the behavior of firms competing in space to manufacture, sell and deliver similar products to geographically scattered consumers (Sheppard, 2005). Sheppard (2005) reminds us that understanding the behavior of the firms competing in space to sell the same product to

geographically scattered consumers has been a defining problem in economic geography. Transportation and location together can be considered one of the most essential topics in economic geography.

Transportation and location examinations contain a large number of relevant contributions, especially from the so-called German location researchers. These theorists provide general location theories, including von Thünen's agricultural location theory, Weber's transport orientation and market (and purchasing) area theory, and Lösch's spatial designs. Von Thünen (1826) examined a single city surrounded by concentric rings of agricultural land, where the areas closest to the industrial center have the highest income and produce goods with the highest transport costs. However, Alfred Weber's work (1909, 1929) is considered to be the roots of the modern location theories. Particularly, Weber assumed that firms will choose a location that will help to minimize their costs. There are simplifications in his theories, especially location occurring in an isolated region (no external influences) composed of one market, space being isotropic (no variations in transport costs except a simple function of distance) and markets being located at specific centers. Respectively, Hotelling (1929), in his pioneering work, analyzed a situation in which two firms compete for consumers with respect to location and price in a linear market where consumers are uniformly distributed. However, in Hotelling's model, price equilibrium does not necessarily exist for the given locations of firms. Lösch (1954) produced the spatial organization of production centers, whose form is appealing, and this spatial pattern of economic activities offers several advantages. Lösch (1967) claimed with his model that the total distance between production points can be minimized by reducing the length of the transport routes, and Lösch's economic landscape minimizes aggregate transportation costs. Isard (1956) was concerned with the impact of concave transportation costs on the firm's location. Additionally, in Christaller's (1966) spatial model, friction of distance and hence transportation costs were the core. Later, location theory has been developed by several researchers, like Moses, 1958; Webber, 1972; Porter, 1990; Fujita et al., 1999; Stroper, 1997 and Behrens et al., 2009. Wu and Olson (2008) consider that transportation issues have become an important factor in the global trade. Porter (1990) states that, for many companies and industries, affordable location of the manufacturing site can give an essential competition advantage. Weber's model also assumes perfect competition, implying a high number of firms and customers, and a perfect knowledge of the market conditions, both for the buyers and the suppliers. According to Weber, three main factors influence industrial location: transport costs, labor costs and agglomeration economies. Location thus implies an optimal consideration of these factors. Weber explained that certain industrial activities are located where they are because of transportation costs; the costs of transporting various kinds of raw materials to the factory are connected to the costs of delivering finished products to the market.

Ever since Weber (1909, 1929), there has been a permanent interest in the transportation aspects of the location of the firm. However, Plummer and Sheppard (2006) argue that the impact of transportation costs on the industry's location has been neglected in research papers during the past years. They believe that the main reason for this has been inexpensive transporting, which was particularly based on very affordable oil prices (also Rietveld and Vickerman, 2004). Still, the transportation facilities are

considered a major location factor, and the minimization of the total transportation costs is regarded a basic objective. The Weberian production-location problems have been revised and extended by many authors, notably Bradfield, 1971; Emerson, 1973; Woodward, 1973 and Mai, 1981. Lindberg (1953) tested Weber's theories and made a detailed study of the Swedish paper industry. Lindberg revealed that, even if the industry was not oriented toward materials as commonly believed, the Swedish paper industry was certainly located so as to minimize the cost of transportation materials and products. Much of the weakness of the existing approaches to models on industrial location rises from a relatively narrow conception of the production process and its focus on isolated and single-plant models. Thus they fail to capture many important interdependencies of different production processes, which tie a plant or a firm to the rest of the space economy.

Weber's location theory explains well the location of heavy industries, particularly from the industrial revolution until the mid-twentieth century, which is the sector that Weber was examining. Activities having a high level of raw material use tend to be located near the supply sources; for example, aluminum factories will be located near energy sources (electricity) or port sites. As a result of his research, Weber developed a material index, which is simply the weight of the inputs divided by the weight of the final product (output). If the material index is higher than 1, the location tends to be closer to the material sources. If the index is less than 1, the location tends to be closer to the market. The reduction of transport costs and new economic sectors (high technology) have changed locational behavior substantially, as industries are located without much consideration of Weber's principles. This Weberian approach has affected the econometric calculations in which Aiura and Sato (2009) show that there are two types of equilibrium from the point of view of the customers. On one hand, the firms' locations are symmetric with respect to a raw material site to reduce the transport cost. On the other hand, firms try to differentiate themselves from one another geographically by locating separately to avoid price competition. These two incentives work equally for both firms in a symmetric equilibrium. Aiura and Sato (2008) emphasize that, at the location where population (thus demand) is great, a firm could obtain positive profits by setting a sufficiently high price to cover the transportation costs. It is understandable for all industries to attempt to cover transportation costs by setting reasonable prices to reach profitable economic results, but this is eminently dependent on the competition situation. Mills and Hamilton (1994) also support the Weberian ideas that economic activities with varying production costs across locations and relatively large transport costs are called production cost oriented. Among the transport cost oriented industries, if input transport is relatively expensive, the firms are materials oriented, and if delivery transport is relatively expensive, the firms are market oriented in their location decisions.

In addition to Weber and other German location and transportation scientists, Beckmann (1968) in the 1960s pointed out that space (i.e., distance, location and region) is important to consider because of transportation costs (for persons and goods) and neighborhood effects (i.e., spillovers or externalities). Transportation costs can no longer be subsumed under production costs, because companies must economize space to keep distances cost-efficient. This means that long transport routes are considered costs

producing, which lowers the margins indispensably. Edwards (1975) observed that industrial investment tends to be concentrated in particular areas. This is in spite of the fact that interregional wage differences would seem to be sufficient to compensate for the extra transport costs that are incurred by a firm located in a peripheral region. This refers, in particular, to the situation where there is perfect competition in the market, which determines the sales prices. Sheppard (2005) argues that economic geographers conceive of places as more than just a point on a map and claim that competition between places cannot be reduced to competition between firms. Webber (1971) discovered that firms do not occupy favored locations only because they have made the right choices, but that sometimes firms locate near customers or raw materials by chance. Porter (1985; 1990 and 1998) argues that locations can create competitive advantage and that the state can intervene to help identify the right places. Porter locates the distinctive competitive advantages of places in their particular values, culture, economic structures, institutions and histories.

According to Kilkenny (1998), the purely economist location theory has neglected some typical characteristics of transportation activity, like detailed market-based transport and freight costs. Behrens et al. (2009) noticed that, when geographic concentration and the industrial size and production volumes of the industry increase, imbalance in the direction of shipping may raise marginal cost in the transport sector, as carriers have to come back empty. A large industrial unit, like an integrated paper mill, can produce large volumes of products to export, but imports do not necessarily increase to the same extent. In that case, they would reduce freight rates in one direction and increase them in the other, thus segmenting transport markets. This in turn certainly influences the firms' location pattern. This is a real situation in the Finnish paper and bulk transportation, which is highly export-intensive. Container carriers often come to Finnish harbors empty or only partially loaded, putting pressure on increasing the export transport unit costs to cover the carrier's bunker and wage costs. Brakman and Garretsen (2005) argue that, due to the rising transportation costs, firms have to think more intensively about their location.

In addition, Hesse and Rodrigue (2004) stress that, due to the current lack of comprehensive understanding of freight, there is a need for empirical investigations. This has not been easy to execute due to the reliable transportation and other costs that are difficult to obtain from microeconomic databases for research purposes, mainly because of confidentiality. Behrens et al. (2009) argue relevantly that freight rates are still taken as exogenously given parameters, which amounts to assuming that the market for transport services is either perfectly competitive with a perfectly elastic supply, or fully regulated with freight rates set exogenously. The main challenge is that neither of these two extreme interpretations provides reasonable approximations of real-world transportation.

McCann (1996) believes that the existence of transport costs thus leads to a higher level of inventories held by the firm than would otherwise be the case. Koskinen (2009a,b) points out that, in the Finnish paper industry, distant deliveries can take up to one and a half months to proceed, which produces long inventory and costly times. McCann adds that firms shipping heavy or bulky goods that are costly to transport compared to their total value require greater falls relative to local wages with respect to

shipment distance in order to encourage relocation, compared to firms shipping goods that are less heavy or bulky. In a spatial economy, transport costs between distant locations drive wedges between local and foreign prices, since firms charge higher export prices in order to cover the costs of shipping their output (Laussel and Thierry, 2007). This implies that the more firms are located in a region, the lower the prices in that region are (the so-called price index effect; see, e.g., Fujita et al., 1999). Kilkenny and Thisse (1999) consider that transportation infrastructures have a major impact on the spatial distribution of economic activities. They note that companies selling their output outside the region where they are located are facing two opposing constraints:

1. They must set a price that is high enough to cover trade costs.
2. They must set a price that is low enough when compared to the one charged by local competitors.

According to Ottaviano et al. (2002), when trade costs are sufficiently low, these two constraints are always compatible for all industry distributions so that firms are able to export profitably to foreign regions. When trade costs are sufficiently high, Behrens (2004) has shown that these two constraints are always incompatible for all industry distributions so that firms do not export to foreign regions.

Behrens et al. (2009) present the transport sector that can describe the market structure of different transport modes (trucking, railroads, air freight and water transportation). Trucking may reasonably be approximated by perfect competition in the wake of the Motor Carrier Act of 1980, which abolished most entry barriers and fare controls in Europe (Ying, 1990). This transport segment is mostly characterized by small companies sharing the market and having little control over freight rates. In contrast, railroads and water transportation are characterized by a small number of players. The shipping industry is characterized by a high degree of collusion (Sjöström, 2004). Shipping conferences can, with internal agreements, share different shipping routes, set rates, and decide whether or not to accept new members by restricting entry. This sector is, therefore, clearly not competitive and would be more accurately described as a sector with restricted entry and significant economies of scale because of high fixed costs. The share of the imperfectly competitive segments of the transport sector account for slightly over 50% of ton-miles shipped in both cases, thus suggesting that a model including imperfect competition in transportation is warranted in modeling that sector in markets absent from their analysis (Behrens et al., 2009). Leite et al. (2009) study the effects of internal and external trade costs on the location of industrial activity. They argue that industrial activity in a region is enhanced, *ceteris paribus*, by lower internal trade costs and by higher costs of importing (lower costs of exporting). The fact that asymmetries in the external trade costs, like transportation, lead to relocation of economic activity is an understandable result. Trade costs are highly variable across countries. They are higher in landlocked countries than in coastal countries (Limão and Venables, 2001) and higher in developing countries than in industrialized countries (Anderson and Wincoop, 2004). Kilkenny (1998) argues that the classic location theory assumes perfectly competitive markets and homogeneous consumers and often abstracts from geographical differences and variations in demand and prices. When revenues are inde-

pendent of location, a firm maximizes profit by choosing the location that minimizes costs. The total costs include fixed costs, input costs, production costs, and the costs of delivering output to markets. Kilkenny (1998) notes that the input transport costs per unit of final good sold depend on the rate per unit as well as the units of input needed per unit of output. If it is cheaper to ship the input, the optimal location is at the market. If it is cheaper to ship the output than the input (per unit of output), the materials oriented industry is called weight-losing, like the paper industry. The optimal location of a weight-losing industry is at the input location. Shaw (2006) argues that, although time has received increasing attention among transport researchers, e.g., a recent renewed research interest in time geography and its applications to activity modeling (Miller, 2005), more efforts are needed. Therefore, it is important to ask “what about time in transportation geography?” and to encourage more transportation geographers to explicitly tackle the concepts of time and real-time and critically assess their implications to classical transport theories and models.

Dicken and Lloyd (1990) remind that geography is a spatial discipline, and one of its central concerns is distance, or the friction of distance. This means the impediment to movement that occurs because places, objects or people are geographically separate. The theme of friction is not generally found outside of transport geography. According to Rodrique et al. (2006), the comparative advantages between countries are disturbed by spatially based frictions, and thus geography hinders as well as borders the different countries. This is a central topic in many geographical considerations of economic processes. The present trend of increasing transport costs due to higher fuel prices will strengthen the possibilities of using sea transport in combination with fast modes to curtail the frictions (Henstra et al., 2007). Behrens et al. (2007) believe that geographical frictions between any two regions are likely to be different. The frictions could be understood as obstacles in transportations; difficulties in customs' functions; intermediate warehousing abroad due to low frequency and capacity of transport routes; long distances between producers and customers; etc. All of these particularly add to transport costs and increase delivery time, resulting in higher capital costs. Even the simplest firm location model accounts for the fact that access to several markets is the key issue faced by a firm making its locational choice (Beckmann and Thisse, 1986). Hall et al. (2006) point out that globally, the physical amount of freight increased during the last twenty years because of the lowering transportation unit costs, particularly due to inexpensive oil prices as well as the increasing size of container ships. This situation may change substantially in the coming years, because the demand of oil will increase in Asia. Space economy is a complex, non-linear, dynamic system, particularly because of geographical differences and obstacles and because of transportation costs not increasing linearly but in steps (Plummer and Sheppard, 2006). Geographical location matters, and e.g. sea transportation is far more inexpensive than truck and even train transports. Particularly from the geographical perspective, Hesse and Rodrique (2004) note that there is a need for empirical research; since distribution is closely related to value chain interdependencies with the production system, the networks and markets are relevant subjects of examination. There should be studies to examine the degree to which supply chain in principles as transportation costs are becoming decisive for the location decisions of such firms.

3.2 New economic geography vs. evolutionary economic geography

Economist Paul Krugman (1991a), the 2008 winner of the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel, presented new economic geography (NEG) as a theory that explains the emergence of a heterogeneous economic space. This sector of geographical economics has developed models to determine optimal and/or equilibrium patterns of industrial locations. Krugman (1980; 1991a; 1991b; 1993a; 1993b and 1995) led the research in this field and revealed, in recent decades, market potential and a significant theory and model on optimal locations of industrial activities within the discipline of economics. Krugman argues that, in a world characterized both by increasing returns and by transportation costs, there will be an incentive to centralize manufacturing near its largest market, even if there is some demand for the products elsewhere. The simple reason is that by centralizing production in one place, one can realize the scale economies, whereas by locating the production near the largest market, one minimizes transportation costs. Krugman (1999) claims that it is not surprising that 'geography turns out to be perhaps the most naturally 'nonlinear' area of economics'. As Krugman (1994, p. 31) defines it: '. . . when we say that a corporation is uncompetitive, we mean that its market position is . . . unsustainable ± that unless it improves its performance it will cease to exist'. Krugman particularly argues for the importance of transport costs and topics of distance in his mathematized geographic economist examinations.

A relationship between trade costs and the location of economic activity is one of the main theoretical findings of 'NEG' literature. If trade costs are high, economic activity is dispersed across regions, whereas if trade costs are low, then economic activity becomes concentrated in one region. Behrens and Thisse (2007) argue that economies of scale of any type can lead to the spatial concentration of activities. Average costs may decline because of the scale of an industry. Scale economies that are external to firms but internal to the industry within geographically delineated markets are called localization economies. Based on the theories of Weber, spatial competition leads to firms locating far apart to acquire a profitable new market where the transportation costs can be charged fully in sales prices due to lower competition.

Pires (2006) argues that, in NEG studies, the location in space of economic activity and the main features of this literature can be summarized as follows: monopolistic competition, iceberg trade costs, 'home market' and 'agglomeration' effects. The monopolistic competition is addressed by Dixit and Stiglitz (1977), who set models of monopolistic competition in space. This formulation sets the transport costs, and thus distance, as an external quasi-freight rate. The iceberg trade costs of Samuelson (1954) refer to space as exogenous to economic processes. A major part of the export costs are simply invisible; these include the warehouse and capital costs and losses during transportation. At that time, the warehousing and losses were not registered fully due to manual registering. The 'home market' effect is from the 'new' trade theory (see, for example, Krugman, 1980), which argues that, if a company's export volumes rise, its home market effects, e.g. deliveries to the home market, should also increase. Lanaspá and Sanz (1999) believe that Krugman's model does not solve all problems, but it may mark a path towards the potential construction of solid theoretical explanatory models.

In contrast, the Nordic paper industry has not developed and expanded due to local demand. Instead, the paper industry in Nordic countries has been built to deliver paper products to European customers. It seems that most trade theorists are still reluctant to the idea of assuming that different countries have a different level of access to one another. Instead, they keep working largely with settings where market accessibility does not really matter. However, empirical evidence shows that a good access to markets is a major determinant for the location of economic activity (Gallup et al., 1999). Behrens (2005) shows that accessibility matters crucially for predicting how local market size affects industrial location: only when accessibility is appropriately ‘filtered out’ of the data, one can assess the link between the regional market size and the structure of trade and location.

In their recent study, Behrens et al. (2009) present that the demand for transport services becomes less elastic as the degree of spatial agglomeration rises, which increases carriers’ market power and allows them to charge higher markups. More transport is generally needed from the agglomeration than back to the agglomeration. Krugman (1991) points out that geographical economic issues, like transportation, have been at the periphery of mainstream economics for a long time. According to Arbia (2001), location and economic geographical characteristics have been regarded as irrelevant factors in many purely theoretical economic studies. Most economists have, for a long time, behaved as if all economic agents were concentrated in one single, dimensionless point in space and as if there were no transportation costs or these costs were static and standardized (Martin, 1999).

A statistical methodology for spatial analysis is necessary to answer the many questions posed by the NEG. The market-based data obtained from the database of an export company can generally be understood to display a certain degree of statistical dependency, which may vary between geographical regions. These geographical regions must be chosen subjectively in practical circumstances. McCann (1996) and Porter (1990) remind that most firms manufacture products at a particular location (clusters, agglomerations) as a part of a production chain. The structure of the product chain may be described in terms of the value per ton of the products as is customary in the manufacturing industry.

Davis and Weinstein (1999) argue that Krugman’s geographical economic theory has not developed the economic geography model in sufficient generality to simultaneously deal with differences in the size of regions, distances, goods, and industries as well as to allow for differences in input composition and demand structure. Additionally, Martin and Sunley (2007) criticize that the economy is indeed a complex system, which is largely due to it being spatially distributed and spatially embedded. In this challenge, geography can contribute an empirical approach to complexity (Dopfer and Potts, 2004).

An important aspect concerning the NEG is that it has triggered a large number of empirical one-region investigations (Head and Mayer, 2004). The importance of these one-region cases can be questioned, because spatial heterogeneity is widely accepted. Therefore, if empirical discussions deal with many regions (and sectors), theory has focused almost exclusively on two regions (and sectors). Although such simple settings have proven to be valuable to our understanding of spatial phenomena, like transporta-

tion, they generally offer a fairly poor basis for deriving testable predictions of spatial behavior, like the impact of transport costs (Behrens, 2005). It is not always clear that we can extrapolate the predictions and results derived from the two-region models (e.g. Krugman, 1991a) to a multi-regional system. Quite the opposite: the answer is probably no, although this is not really recognized by economists.

The trade-off between fixed production costs, like wages, maintenance, rents and transportation costs, is central to the spatial organization of an economy (Kilkenny and Thisse, 1999). The higher fixed production costs and transportation costs are, the lower is the number of places where economic activities develop. A reduction in transportation costs allows a decline in the number of economic centers. In other words, an economy characterized by large investments and low transport costs, although endowments may be spatially homogeneous, is likely to experience uneven spatial development, with many activities concentrated in only a few places. Preferred locations are those with good access to the market and to the supply of manufacturing raw materials (see Krugman, 1991a and 1995).

Krugman's NEG is partly criticized by geographers and regional scientists due to its lack of empirical evidence and real world freight costs. Behrens et al. (2009) point out that, although transport costs are a key ingredient of the NEG, freight rates are taken in as parametric and are not set by the market. Neary (2001), Ottaviano (2003) and Head and Mayer (2004) note that, along with theoretical research, empirical studies are also needed in NEG. The real transport costs should be revealed alongside theoretical studies. Niebuhr (2006) considers that, in the NEG models, the agglomeration of economic activities and population is based on increasing returns to scale and transport costs. According to Essletzbichler and Rigby (2007), the economic performance of regions and countries varies because of differences in their characteristics. However, it is difficult to predict the divergence of regional fortunes as well as the future of a specific country. Regions and companies are not static entities, and their environment may change radically over time. Grabher (1993), Cooke and Morgan (1998) and Amin and Thrift (2000) argue that these types of processes should be considered as dynamic and evolutionary economic development and also studied empirically with mathematical models. It has been noted that economically based location theory is poorly suited for incorporating the realities of industrial location, especially the maximization of the quality of inputs rather than the minimization of transport and input costs. Economist geographers have rediscovered the insights of Weber (1929) on transportation and agglomeration effects in that firms are reducing transition costs to be competitive (Krugman, 1991a). Especially Martin and Sunley (2007) have condemned these modeling methods for being empirically crude, and geographers have revealed these location topics a long time ago (see e.g. Martin, 1999 and Scott, 2006). Martin (1999) argues that these highly restrictive mathematical models in the new location theories are abstract and, in many instances, they tend to substitute spatial units, which are independent of scale, for geographical places. NEG is considered by geographers like Martin (1999), Brakman (et al., 2001) and Scott (2004) mainly as reinventing the impacts of transport costs on the firm's location. Martin and Sunley (1996) argue that, while an exchange of ideas between Krugman's theory and the work in industrial geography would be mutually beneficial, both approaches are limited by their treatment of technological

externalities and the legacy of orthodox neoclassical economics. Dymski (1996) claims that Krugman's models are based on the rational choice of equilibria (derived from mathematical modeling), which depart from the neoclassical methodology by utilizing one of its assumptions, e.g. that of increasing returns (Plummer, 2005). Martin (1999) believes that, although the mathematical formulas of the new geographical economics may be considered sophisticated, the geographers do not consider them particularly novel, and their empirical applications are trivial. Additionally, Bullock and Cliff (2004) argue that the pure economics say little about geographical space and its relation to the adaptive behavior of businesses. Geographers have correctly criticized these ideas of NEG and Krugman, particularly of forgetting the empirical evidence and focusing practically on the mathematical theories, which often are far from real world realities and heterogeneities. Geographers often apply inductive case study research with an interdisciplinary approach, signaling the specificity of the real world (Boschma and Frenken, 2006). Martin (1999) and Martin and Sunley (2007) argue that spatially connected systems are complex, adaptive and non-deterministic. However, economic geographers have neglected to participate actively in theoretically and mathematically oriented discussions and the development of the models that focus on economic spatial research. In this research field, geographic economists like Krugman have shown their theoretical capability to develop and build new patterns to study location and transportation topics. Traditional geographers still argue that Krugman neglects the long tradition of geographic studies, which is focused on economic, labor and regional development issues (e.g. Massey, 1995; Hanson, 1998; Martin and Sunley, 1996; Peck, 1996 and Storper, 1997). Clearly it seems that economic geography research should particularly consider spatial heterogeneities by empirically exploring and revealing these selected issues in space.

3.3 Home market effect

In this section, the author describes some features of the concept of home market effect, which especially Krugman (1980) addresses. Laussel and Thierry (2007) note that the effects of country size differences have been a focus of attention for many years in the new trade literature (Krugman, 1980 and Helpman and Krugman, 1985). Crozet and Trionfetti (2008) discovered that models characterized by the presence of increasing returns to scale, monopolistic competition, and trade costs typically give rise to what is known as the home market effect. The home market effect explains the situation in which differentiated goods produced under increasing returns to scale incur transport costs, and the firms producing these goods tend to concentrate on the largest market to save on transport costs. In his trade theory, Krugman (1980) emphasizes the basis for the common argument that countries will tend to export those kinds of products for which they have relatively large domestic demand. This means that companies are able to export products that already have vast production capacity available due to domestic demand. However, Krugman's argument does not conform adequately to the Finnish paper industry because the Finnish mills have very small domestic markets. An extreme example is Stora Enso's two machine line mill located in Oulu, Finland, producing around one million tons of graphics paper and exporting over 95 % of its production. It can be noted that, without

exception, all Finnish mills have originally been built particularly to serve foreign customers with local affordable raw materials (Lamberg and Ojala, 2006).

The HME is mainly a macroeconomic model, and it is defined as a proportional relationship between a country's share of the world production of a good and its share of the world demand for the same good. Davis and Weinstein (1999 and 2003) note, in a novel approach, that the HME is closely associated with the presence of increasing returns to scale and monopolistic competition. Amiti (1998) explains in a theoretical paper how the pattern of specialization and trade varies according to country size when industries have different trade costs that are based on transportation, inventories and customs tariffs. These costs are generally considered logistics costs in the literature. Behrens (2005) argues that the main finding of the HME literature is the existence of a disproportionate causation from demand to supply. Disproportionate increases in the local market size increase the local industry size. This suggests that larger regions host a disproportionate share of the imperfectly competitive sectors and are net exporters of the goods they produce.

The HME's economic importance is limited, since it influences the specialization of a small number of countries. In the Nordic countries, the paper industry was, from the early 1900s, founded and developed attributable to comparative advantages, which explain trade by inherent differences between countries. Later, the increasing returns of the Nordic paper industry explain trade by economies of scale and advantages from specialization in higher valued paper grades to overcome the locational disadvantage. This is a significant and more topical issue than ever for the Nordic paper mills located far from the market.

3.4 Some considerations of supply chain efficiency: demand, costs and prices

This section presents in more detail the topics of supply chain from the point of view of the manufacturing industry, namely demand, manufacturing costs and product prices. Since the early 1980s, supply chain management (SCM) has become a general concept within management (see e.g. Schonberger, 1982; Monden, 1981; Christopher, 1992; La Londe, 1997; Drucker, 1998 and Hicks, 1999). One approach tends to view SCM as an extension to the logistics concept, while another approach sees SCM as an enhanced process management concept (Persson and Grønland, 2002). Larson et al. (2007) note that the underlying bond is the integration of processes throughout the supply chain with the goal of adding value to the customer. According to Kosior and Strong (2006) supply chains can be considered as "open-loop" systems, whereby goods are produced and distributed in the market according to historical or anticipated demand. Gripsund et al. (2006) distinguish between SCM and the supply chain itself, because the chain exists regardless of whether it is "managed or not". Robinson et al. (2005) stress that technology investment decisions require careful consideration of supply chain dynamics and cost structures. Ingalls (1998) notes that firms have reached under a SCM environment to satisfy a customer's various needs, but there have not been good research results, on account of many uncertain variables with stochastic properties in the supply

chain. Lee et al. (2002) believe that simulation has the capability of finding a local optimum value within each component throughout the entire supply chain. Lowering unit costs of export transportation is a top priority for today's executives of the forest products industry (Hölsä, 2005), but this supply chain has not been extensively studied with a holistic approach (De Palma et al., 1987 and Koskinen, 2009).

According to Wu and Olson (2008), well working supply chains have become an essential element in the world economy, and SC needs controlling of the overall costs of holdings, ordering, transportation and purchasing. Browne (2002) discovered that supply chain strategies, such as the concentration of production and storage locations and flexible production techniques, have become increasingly significant. Supply chain costs play a critical role in all theoretical explanations of the spatial concentration and location of economic activities (Brakman et al., 2001). According to Henstra et al. (2007), there have been 'waves' in logistics processes since the 1960s, and at this moment, the potential for internal reorganization appears to have been exploited to the fullest extent possible. It seems that new forms of collaborative networks are emerging in places where companies cooperate horizontally to share the costs of using logistics facilities and services. There is a growing need for flexible supply chain structures that aim at increasing costs and asset efficiency. Consolidation and collaboration (horizontal as well as vertical cooperation between chain partners) are the most logical ways to generate lower costs per unit freight. Also, Groothedde (2005) argues that collaboration and the synchronization of logistics activities creates affordable deliveries. Iskanius (2006) emphasizes the ability of a supply chain to rapidly respond to changes in market and customer demands.

Eloranta et al. (1994) perceive that logistics and JIT (Just in Time) does not support the desired improvements in the paper industry, because inventories are increasing instead of decreasing. Gallis (1997) believes that there is room for the forest industry to improve its logistic management in order to decrease the added interest rate cost due to capital cost during inventories. Lehtonen and Holmström (1998) note that simulation applications specific to the paper industry's logistics are scarce. According to Fogelholm and Hämäläinen (2003), smaller lots in paper manufacturing increase costs and lower margins by scaling up grade change waste, recycling and lost production time. More frequent shipping may decrease warehousing costs but raise both production unit costs and shipping unit costs in euro per ton. In the research papers of supply chain management, the paper industry is often studied without detailed transportation and supply chain costs (see e.g. Lähtinen, 2007 and Koskinen, 2009b). This may be caused by the lack of valid empirical data or the distance and location having been perceived as somewhat irrelevant. This means that the geographic diversities, transport distances and freight costs have been put aside, and SCM is mostly being studied as a purely theoretical process. There are no studies available where SC costs are named and calculated in detail utilizing time series data so that they reveal how they affect the gross margins in different markets. Location remains all-important as time/space relationships collapse differentially (Knowles, 2006). Lasserre (2004) also notes that geographical differences matter and transportation remains crucial. SCM theories and studies without geographical aspects automatically leave out important spatial elements, like market characteristics, which should be considered more actively in the coming years.

According to Pesonen (2001), any management system is sensitive to product volume and price fluctuations as well as unpredictable changes in the business context. Literature on logistics and supply management provides ample evidence for SCM enhancing business performance (see e.g. Mentzer et al., 2001; Shang and Marlow, 2005 and Schramm-Klein and Morschett, 2006). However, Töyli et al. (2008) note that surprisingly little empirical affirmation has been presented on the relationship between financial and logistics performance. Transport costs are put aside or neglected in the discussions, which makes the evaluation of the impact of transportation costs difficult.

The warehousing and inventory carrying and handling component of total logistics costs alone typically accounts for some 30 % of the total production costs (Sayer, 1986). The total logistics costs have consequently been estimated to account for over 65 % of the total industrial 'overhead' costs, which themselves typically account for up to 80 % of the production's added value at any one stage (Miller and Vollmann, 1985). However, in these discussions, these costs are not mentioned in detail. There are only references to the cost being an important topic.

Niebuhr (2006) notes that the spatial pattern of the market potential resembles the accessibility measures and peripherality indices calculated by Keeble et al. (1982) or Schürmann and Talaat (2000). A total of 13 regions marked by low market potential are located geographically far from the market, comprising, in particular, Finland, Greece, Portugal, the south of Spain and Italy. Malik and Temple (2008) find that, from the perspective of a small open economy, changes in world prices are exogenous. However, the impact of world price variation on a given economy depends on its import and export structures, and these are clearly endogenous in the long run. In contrast, high accessibility and market potential are estimated for regions in the north-west of Europe, covering large parts of the Netherlands, Belgium, Germany and the north of France. Bergin and Glick (2007) stress that peripheral countries experienced a much greater decline in price dispersion in the early 1990s and a much weaker increase in dispersion with core countries since the adoption of the euro. Most firms are essentially atomistic, in the sense of having no market power, and they will continuously change their relations with other firms (McCann et al., 2002). Kilkenny and Thisse (1999) believe that the choice of spatial price policy also influences the location of firms. Firms that cannot charge prices that would profitably cover transport costs do not serve as large a market as firms that can. Delivered pricing occurs when a firm offers to sell a good to customers as well as to provide delivery for a single bundled price. Delivered pricing tends to be found in markets where the ratio of transportation cost to the total price paid by customers is high, firms have transportation cost advantages compared to customers, and firms compete oligopolistically. This has been observed in many markets in the United States and Europe, including those for cement, sugar, plywood, fertilizer, steel, and plasterboard (Haddock, 1982 and Philips, 1983). Delivered pricing is also a prevalent pricing pattern for non-commodity products. Greenhut (1981) studied the spatial pricing patterns of U.S. firms with significant transportation costs, where the delivered cost to customers included at least 5 % freight cost. Kilkenny and Thisse (1999) note that location and production decisions are often interdependent. Similarly, the choice of location matters in the firm's choice of price, and vice versa. If firms make these decisions independently, it may lead to substantial losses in the firms' profits. This

is why facility location analysis would probably gain relevance if pricing and strategic competition was integrated into the operational models.

3.5 Summary of the main theoretical ideas and frameworks used in this thesis

In this chapter, the author summarizes the theoretical ideas that had the strongest contribution and most effect on this study and that encouraged to compose this doctoral thesis. The economic geography formed a relevant umbrella to study the Finnish paper industry, and this research utilizes the ideas and theories of economic geography as well as notions of supply chain management widely. Crystallization of this could, firstly, be made in how Webber (2005) expresses the theme; economic geography examines the evolution of the world economy, and secondly, that economic geography employs and studies a variety themes, like location, transportation, production, competition and markets (Barnes and Sheppard, 2005). All these important themes are in use more or less in this study. According to Martin (1999) and Scott (2004), economic geographical research should reveal phenomena of the real world with empirical studies and link together economic agents. Until relatively recently, location and transport geographical characteristics have been regarded as irrelevant factors in many economic studies, as Arbia (2001) reminds. This study tries to remove this absence.

However, particularly transportation geography, especially Alfred Weber's ideas (1909, 1929), were the most stimulating and ruling theoretical elements and stand-points in this thesis. Weber is considered to be the constructor and the roots of the modern location theories. Weber assumed that firms will choose a location that will help to minimize their costs and that certain industrial activities are located where they are because of transportation costs. Especially interesting was the argument on how his location theory explains the location of heavy industries, because in our study the research object is a heavy bulky industry, the paper industry. Weber explained that activities having a high level of raw material use tend to be located near the supply sources, like the paper industry near to timber resources. Weber's theories explain a major part of the existing locations of the Finnish paper mills. But the past years' development in the transportation costs has showed that Weber's theories should be examined and tested more closely with real mill data.

For the author, Krugman (1999) also proved to be an interesting theorist from the location and transportation points of view. He had restarted the discussions on those originally Weberian location topics, which had been somewhat neglected during the past years. Krugman, who was one of the main developers of NEG, reminds of the importance of transport costs and topics of distance, which he studied with his geographic economist and mathematically sophisticated examinations. Krugman (1991) explains in his theoretical models that by locating the production near the largest market, one simply minimizes transportation costs. However, along with these theoretical studies, the real world transport costs should also be revealed in NEG, according to Neary, 2001; Ottaviano, 2003 and Head and Mayer, 2004. Additionally, Krugman (1980) emphasizes the basis for the common argument that countries will tend to export those kinds of products for which they have relatively large domestic demand. This means that companies are able to export products that already have vast production capacity

available due to domestic demand. Kilkenny (1998) considers that detailed market-based transport and freight costs should be used more in examinations.

In the area of supply chain management, the author considered particularly important what Wu and Olson (2008) remind us of: that supply chains are in the center of the global economy, because of the increased exchange between countries. Supply chain strategies have become particularly significant (Browne, 2002), which shows that top management should be more actively involved in this topic. Pesonen's (2001) interesting argument is that any management system is sensitive to unpredictable changes in the business context, which has really been the existing status for the past 10 years in the Finnish paper industry. Finally, Töyli et al. (2008) consider that very little empirical verification has been displayed between financial and logistics performance. Especially real world transport costs are missing in the discussions, which makes the evaluation of the impact of transportation costs difficult. Especially the ideas obtained from transportation and supply chain theories have been central when composing this thesis.

4 CASE STUDY AS RESEARCH METHOD

4.1 Using case study as research method in paper industry

There are several different definitions of case study presented by MacDonald and Walker, 1975; Merriam, 1988; Stake, 1995; Simons, 2009; Gerring, 2009 and Yin, 2009. A case study can be defined as an empirical inquiry that investigates an empirical topic (Yin, 1989; 2003 and 2009). A case study can be considered a real world based examination, which aims to reveal some phenomenon, occurrence or function. Yin (2009) reminds that there is a distinctive need for conducting case-study research, because there is inquisitiveness to understand complex phenomena. The complexity evidently refers to something which is otherwise difficult or impossible to understand. Case studies are preferred in studying contemporary events where relevant behavior cannot be manipulated (Yin, 2009). Therefore the results can be considered reliable and generalized in some scale, but not as statistical samples. The case study is beneficial to use, when a researcher wants to know “how” and “why” something occurs (Yin, 2009). Gerring (2009) notes that case study research can be either quantitative or qualitative, or some combination of both. This means that the research material can be either pure numeric data or otherwise systematically classified qualitative data with no numeric values. These research methods can naturally be utilized in the same case study to some extent. Stake (2000) reminds that case studies are often done for a specific audience, whose knowledge and understanding of the phenomena the study aims to increase. This is a natural and relevant observation, because all sciences usually have their own audiences and journals, where studies are published. Eisenhardt (1989, p. 534) defines a case study as “a research strategy which focuses on understanding the dynamics present within single settings. This refers to the situation where things are under constant change and a case study offers a possibility to examine impacts of the change.” Case studies offer the possibility of exploring specific defined problems, which otherwise could be even difficult to examine (Easton, 2010). Simons (2009) defines the case study as an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular policy, institution or system in a ‘real life’ context. Because the case study is not a sample in the statistical sense, the expression of uniqueness is important to understand. Generalization is not easy to make. The researcher should be aware of which type of a case the objective of the study is: critical, typical, unique, revealing, future-oriented, extreme case or longitudinal case (Gomm et al., 2000; Flyvberg, 2001 and Yin, 2003).

Flyvbjerg (2006) emphasizes that case study methods are well suited to produce context-dependent knowledge when the objective is to acquire the greatest possible amount of information on a selected phenomenon. According to Gomm et al. (2000), the decision reached regarding a single case may be generalized to future cases. Case study research can provide specific discoveries that are not possible to acquire through other methods, like a random sample (McCutcheon and Meredith, 1993). Laine and Peltonen (2007) thus argue that a case always has one factual connection in the empirical context. The case can contain one or more analytical objects. The case study method is different from all other methods, because its evidence is drawn from a single case

and it attempts to illuminate features from a broader set of cases (Gerring, 2009). The number of observations employed by a case study may be either small or large, and they are consequently evaluated with a qualitative or quantitative method.

McCutcheon and Meredith (1993) argue that case study research is often used for developing new theories or for examining unfamiliar situations. They add that case study research is one empirical approach to develop understanding of a real world phenomenon and for generating a large amount of data on which to base a theory. Case studies offer a potentially effective and efficient means for comparing complex and disparate operation settings (Lewis, 1998).

Case studies can be single or multiple-case designs; they differ in that a multiple design must follow a replication rather than the sampling logic. When no other cases are available for replication, the researcher is limited to a single-case design. Gerring (2009) considers that a case denotes a spatially delimited phenomenon (a unit) observed as a single point in time or over some period of time. Gerring adds that each case may provide a single observation or multiple (within-case) observations. A case study may be understood as the intensive study of a single case, where the purpose of that study is to reveal phenomena of a larger class of population. Gerring (2009) stresses that the fewer cases there are, and the more intensively they are studied, the more the work merits the appellation of "case study". A single-case design is often not only appropriate, but also unavoidable (see also Easton, 1995). These single cases, when viewed as experiments, are valuable in testing and developing a theory (Yin, 2003). Yin (1993 and 2009) considers that case studies are generalizable to theoretical propositions and not to populations or universes. When conducting a case study, the goal is to generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization). The case is not a sampling unit, and statistical generalizations should not be chosen for this reason (Yin, 2009). Analytic generalization can be used regardless of whether the case study involves one or several cases. Goldstone (1997, s. 108) claims that case studies are "aimed at providing explanations for particular cases, or groups of similar cases, rather than providing general hypothesis than apply uniformly to all cases in a suspected case universe". The case selection is an important methodological decision for revealing poorly known phenomena (Dubois and Araujo, 2007).

The selected case mill includes essential embedded detailed cases from the point of view of export in the form of 15 countries representing around 80 % of the mill's deliveries to different markets in Europe. These 15 embedded cases represent multiple observations on different export markets and how these markets behave by increasing and simultaneously revealing the variation in the results. Additionally, this dissertation uses time as a research angle to add dynamics to the examination. Eisenhardt (1991) argues that there should be 4–10 cases, because it is difficult to generate a theory from fewer than 4 cases. This argument, from the point of view of the paper industry oriented case study, is somewhat of an overreaction in data collection and data volumes. It is more important, according to Yin (1989), to understand how the cases are approached than how many there are. It is generally recognized that cases are not selected randomly. The case amount should be adjusted to the phenomena explored and the case used in the research rather than just counting the cases. The increase of cases adds diversity, as Dubois and Araujo (2007) note, and a single case with multiple embedded

sub-cases also adds variation to the detailed data. In this dissertation, the mill and the research countries make a seamless composition, which strengthens the case's reliability but also shows particularities and variations between the different embedded cases. The idea of this case study is that comparisons are based on replication of the research logic between countries (embedded cases) (Yin, 2009), within-case observations (Gerring, 2009) as well as large sampling and statistical representativeness with selected economic factors. Yin states that each case must be selected so that it either

1. predicts similar results for predictable reasons (i.e. literal replication) or
2. produces contrary results for predictable reasons (i.e. theoretical replication); Yin, 1989.

Stake (2000) presents that exploring and learning from a particular case inevitably reflects the researchers' values and perspectives in the (re)construction of the case knowledge. Issues such as comparison, triangulation, description versus interpretation, and generalization are often perceived as typical challenges in its implementation. The general objective of the dissertation has been to reveal the development in the paper industry with the used research angles, which have been selected by the author himself. Naturally, this has had an obvious influence on the research perspectives and construction of this case study, particularly on the utilization of the advantages of triangulation (Patton, 2002): quantitative data analysis, interviews of the experts and literature discussions. According to Patton (2002), there are four types of triangulation in doing case evaluations: data, investigator, theory and methodological triangulations. Iterative triangulation employs systematic iterations between literary review, interviews, case evidence, and intuition (Lewis, 1998).

The case study allows for contextual longitudinal data analysis of various actions and meanings that take place and are constructed within specific organizational contexts (Hartley, 1994). Special research topics concerning specific sectors, like the paper industry, are somewhat impossible or extremely difficult to examine closer without valid empirical secondary time series data from the paper mill. Additionally, the necessary effects of the economic geographical heterogeneities are not possible to explore or reveal without relevant and valid case data from the exporting industry. The various forms of empirical investigation derive their strength from focusing the research on recent and actual conditions. However, investigating ongoing business operations does not allow conditions to be controlled or variables to be manipulated during the research phase (Benbasat et al., 1987). According to Eisenhardt (1989), the researcher should constantly compare theory and data, iterating towards theory that closely fits the data. For case studies, results can be tested and extended by replication through the investigation of other cases, where results should be comparable. The case study can be considered an empirical research method, which can utilize different types of data sources, and the case study also offers a possibility to reveal a certain single and complicated phenomenon in detail. Case studies are widely used especially in social sciences, when studying, for example, the social behavior of a particular group. However, for economic geographic researchers, a case study offers a relevant study instrument along with the other methods to examine and reveal some specific economic function in detail.

4.2 Some limitations and constrains of case studies

In this section, the author reflects on the limitations and constrains that are considered to be present in case studies. Gerring (2009) reminds us that, in a case study, the sample is small, consisting of a single case or a handful of cases, which the researcher examines in detail. In case studies, the term 'sample' is not understood as a statistical definition rather as the immediate subject of a study. Gerring (2009) argues that if a single case is observed at a single point in time without the addition of within-case observations, such a study offers no evidence whatsoever of causal proposition. The results of case studies are difficult to generalize because of their inherent subjectivity and because of them often being based on qualitative subjective data and therefore only being generalizable in a particular context.

Yin (2009) has discovered that case studies have been viewed as a less desirable form of inquiry than experiments, but this constraint can be mitigated by having the case study investigator report all evidence fairly. Yin (2009) also notes that a common concern in case studies is that they provide little basis for scientific generalizations, as Kennedy (1976) stresses: how can we make generalizations from a single case? Kennedy argues that it does not help to add data points to a single case, because the data is still based on one case. Kennedy claims that the data of a single case can offer confirming or disconfirming evidence but never conclusive evidence. Also, Lincoln and Guba (2000) argue that generalizations of case study results are not possible. Miles (1979) suggested that the case study's usefulness is limited to an exploratory phase in a hierarchically arranged research program. Yin (2009) reminds that case studies are generalizable to theoretical propositions and not to populations. Therefore, the design of the case study is important, and the theory should be selected carefully. Otherwise analytical generalizations can be difficult to make.

One weakness of a case study is that statistical generalizations as a method do not allow for the generalization of the results of the case study (Yin, 2009). This is because the cases are not sampling units, and therefore the generalization should be done as analytic generalization. Case studies are not the best method for assessing the prevalence of phenomena. Eisenhardt (1989) considers that there is no ideal number of cases, but these should be more than three cases in use in order for the cases to work out well. Easton (2010) reminds that this statement is based on Eisenhardt's experience with case research and is implicitly about increasing the number of cases as a way of finding the same results in each case. Also, Yin (2009) notes that multiple-case designs may be preferred over single-case designs, in order to avoid putting "all eggs in one basket". Therefore, when doing single-case research, the choice of the case must be justified strongly.

Walker (1986) stresses that case study research can describe the way matters are at that particular moment, because usually the case is locked in time. However, the organization(s) and especially the surrounding world have moved on, which limits generalizations. The subjectivity of the researcher is an inevitable part of the study, and this personal involvement can be seen as a problem (Simons, 2009). According to Leino (2007) absolute generalization cannot be found, but there can be relative generalization, which should be considered. These generalizations of case studies are linked only to the contexts, the time and the place when the study was accomplished.

4.3 Empirical longitudinal paper mill data

The author had the possibility to select one large exporting mill as a case mill and to obtain unique longitudinal research data from the mill's database. The case mill is a typical bulky printing paper mill, which exports 90 % of its production and is located quite close to the export port. The case mill is a good example of the Finnish printing paper industry. The cost structure of the paper industry in the bulk mills is very similar; a ton of paper needs around a ton of fiber as well as some chemicals, energy and additives. These costs components are very similar in all printing paper mills, and product differentiation is quite difficult, if impossible. This study does not examine the internal functions of the paper mill, only its economic variables. Case selection can be made in an information-oriented manner, where the case is selected on the basis of expectations about its information content (Flyvbjerg, 2006). For this case study, the theory is based firstly on transport geographical factors, which originate mainly from German location geographers (especially the Weberian approach) and secondly on the supply chain theories, where demand, supply chain costs and product prices conduct (e.g. Christopher, 1992).

The case mill, an integrated multi-line printing paper mill, is located in Southern Finland. Integration means that the mill has its own fiber lines to lower the raw material costs, and therefore the use of more expensively purchased pulp is quite minimal. The mill acquires the majority of its raw materials, like timber, from within around 200 kilometers. The mill gets some of its energy from its own hydropower station as well as from its own heating power plant. The case mill was built to operate near raw material sources, like most of the Nordic mills originally were. It exports over 90 % of its production (Figure 3) in paper rolls, and is thus a good representation of a typical Finnish paper mill (Lamberg and Ojala, 2006; Koskinen, 2009a and Käär, 2009).

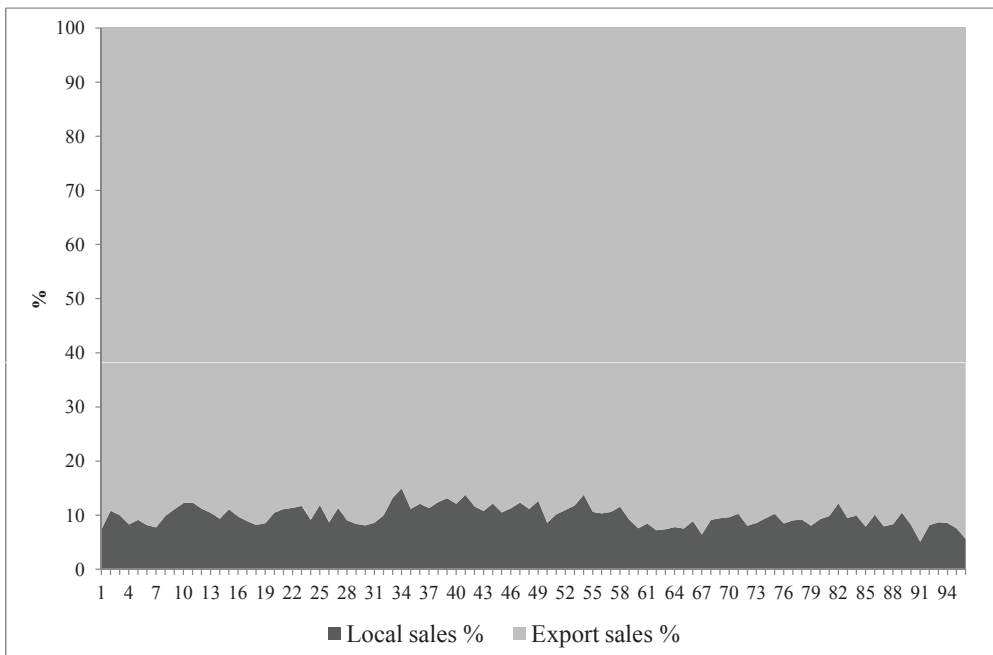


Figure 3 Percentage values of the home market and export markets monthly 2001-2008.

Finnish paper mills are built, without exceptions, to serve mainly European but also other foreign countries, because local demand is minimal. Although there can be several restrictions in case studies, the paper companies and single mills have a lot of common production features and logistics functions, which naturally may differ slightly from mill to mill. The objective in providing holistic descriptions of the contemporary paper industry business, to learn about their nature, management and evolution, often makes a single-case study the only option. Moreover, the context's specificity and the study of paper mill processes complicate the case study in all its phases. The case mill was selected as a research object because it represents a typical Nordic printing paper mill very well.

The research data was obtained from the case mill's cost-management (CM) SQL-database (Figure 4), where it was readily available. Usually this type of secondary data have been stored and later collected from organizations for other purposes than the research situation at hand (Lehmann, 1989 and Parasuraman, 1986). For reporting purposes, the case mill has used a modern cost management system, which was originally developed for continuous process environments (see e.g. Reeve, 1991). This extensive quantitative economic database holds the mill's past, present and estimated costs and sales information, and the data are affirmed by the mill's economic controllers and then reviewed by the chartered surveyors. The figures are reported in the mill's annual economic reviews monthly. The actual figures are based on monthly material consumption, manufacturing costs and customer sales prices gathered from different sub-databases. The longitudinal data cover a time series between 1/2001–12/2008 (a total of 96 months). Yin (2009) calls this type of a case a longitudinal case: studying the same case at two or more different points of time. The mill is kept anonymous to protect the real case, which has also been stressed by Yin (2009). Ruefli and Wilson (1987) note that the time series is especially appropriate and suitable for industry and competitiveness analysis along multiple dimensions and perspectives of performance over periods of time. Longitudinal data, ordinal time series analysis allows the making of performance measures from real world. Time series analysis gives the possibility to trace events and phenomena in detail and with precision, and statistical tests can be used to analyze the data (Yin, 2009).

The longitudinal data from the mill have been given out only for the research purposes of this dissertation. The spatial issues are found by querying the production and sales data separately regarding 14 different European countries (around 80 % of all sales) and the home market (around 10 % of all sales), totaling 90 % of all sales. The product-based figures are calculated from the most sold product of the mill. The idea is to examine whether the lower product-specific level behaves differently in the regression spatial analysis when comparing them with total mill values.

The author determined the relevant research variables and features, which fit best when studying the gross margins. As a result, the empirical time series are grouped to independent microeconomic variables: paper sales, transportation costs, variable costs, fixed costs, and the dependent research variable—gross margin.

These economic values have been transformed into several large data matrices. Within these data sheets, the processed figures are proportionate, valid and fully intercomparable. The final data are transferred into Excel spreadsheets and into Stat 4.1 for the

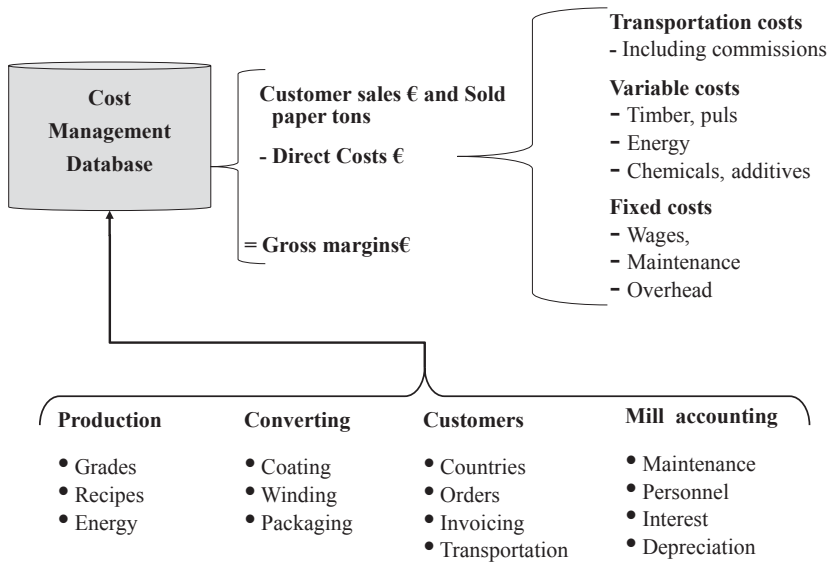


Figure 4 The origin of the research data: the case mill's basic data sources, the mill CM database (cost allocations) and calculations in euro per ton.

statistical correlation analysis. All the research variables were calculated in euro. The results of the calculations are presented as correlations to maintain business confidentiality. The total data cover production and economic information to the main markets in Europe, tens of different paper grades, which consist of millions of delivered paper tons during the research period.

The author carried out a number of discussions with the financial managers of the case mill and additionally with the mill personnel in other local mills and one foreign mill. These discussions enhanced the author's ideas on the topics to focus on during the research process. However, the dissertation, the data analysis, the results and conclusions are based on the relevant quantitative longitudinal data. These discussions are mainly used as background descriptions and in general illustrations of paper industry specific features; they are not used as research material in the data analysis in non casu at all. The empirical case data of this dissertation give the extraordinary possibility to contribute to the very scanty research tradition in economic geography examinations concerning the Nordic paper industry. The mill data cover the behavior and events as well as the embedded units of the case, and the data have been examined with statistical analysis.

4.4 Reliability of the data

This dissertation is a quantitative case study, which explores the phenomenon – the Finnish paper industry – with vast longitudinal data from one large paper mill. Kirk and Miller (1986, p. 41–42) present three types of reliability referred to in quantitative research, which relate to: (1) the degree to which a measurement, given repeatedly, remains the same; (2) the stability of a measurement over time; and (3) the similarity of measurements within a given time period. In the case of a large amount of relevant

data, the statistical analyses would show insignificant variations from analysis to analysis. The statistical methods for such applications are largely universal and very useful.

The research data were obtained from the mill's official economic database, where it is stored monthly and calculated from primary data by using production, sales and supply chain data, which are audited by the mill's controllers and external auditors. In this dissertation, the large economic historical database was used to evaluate and reveal the relationship of the sales, costs and margins spatially. To minimize the effects of single customers and the differences on the detailed grade-based values, the monthly data were collected by country. Thus the data include all customer deliveries per country in question.

The data only contain purely quantitative economic figures, which are allocated by country during the whole time series with the economic database system. The data are based on monthly invoices, materials and production and fixed costs, which are transferred from these specific sub-systems to the cost management system. The invoices are obtained from the sales system electronically and transferred into the costing system. Similarly, the materials are obtained from the material database, which shows how much the mill has consumed in variable costs of production during that month. The production volumes are obtained from the mill system. The invoices contain sales grade and country information, which are linked with production grades and volumes. Raw materials and their costs are allocated to the grades and customers by the proper paper recipes and their sub-recipes, like coating and pressure ground wood. Transport costs are obtained from customer invoices, and therefore these can be considered reliable.

The data are based on one paper mill with all its machine lines. From the paper production perspective, longitudinal data only present a small percentage of the whole paper production in Finland. The costs components in the secondary data are calculated by the controllers and checked by external auditors, and if there are any inaccuracies, it is very difficult, if not impossible, for the researcher to highlight them.

Production-based difficulties, like stoppages and breaks, which increase material and labor costs and may decrease the machines' hourly margins through lost production time, are not allocated to the grades in question. These waste volumes are allocated evenly to all grades made during the month in question. Thus, variable costs from the grades that are more difficult to manufacture and normally cause more breaks are allocated to all paper grades made in that machine line. The reason for this deficiency is that there are no real time measuring devices or cost calculation applications to allocate break and grade change based waste and losses to the grades to which they belong.

The transport costs, which are obtained from the invoice data, can, in some unique cases, be based on historical or anticipated values, because the realized transport routes were very different from the planned and normal routes. Additionally, detailed transportation times between dispatch date from the mill's warehouse and delivery date to the consignees, when they receive the products, are missing from this data. This would have been helpful in analyzing how the transport costs accumulate in more detail, especially because of the storage time in the intermediate warehousing. The research data are also missing some export countries in Europe as well as all the export countries outside Europe. The reason for this is that the European market covers 90 % of the sales. Additionally, the author wanted to use pure and solid 96-month data from the selected

target countries. However, the chosen export countries represent 80 % of total sales during the whole time series. The data that were left out represent a very fragmented part of the whole data and are mainly exports to distant overseas countries and to very small European countries, which do not have a significant impact on the mill. In addition, the data to these distant countries include a small amount of deliveries now and then, so the data were not complete from the point of view of monthly longitudinal data.

The data have been copied and pasted as it is into statistical software to avoid manual errors in making correlation coefficients. The export countries could have a strong influence on one another concerning paper sales and deliveries, and this could bring out sales and delivery variations. The autocorrelation was assumed to be very low, and this was largely dependent on the oversupply of paper products in the market during the whole time series. This can especially be noted in the lowering sales prices, which illustrates the tough competition in the market (see e.g. RISI, 2009). The case mill delivered paper to the markets where it could sell, so the research countries had relatively minimal reciprocal effects and dependency on the paper deliveries.

4.5 Validity

When conducting a case study, or any form of research, it is important to consider its validity. Yin (2003) describes that internal validity concerns changing or influencing factors in the object(s) under study that may impact the results. Joppe (2000, p. 1) provides the following explanation to what validity is in quantitative research: "Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull's eye" of your research object?" Internal validity means that the researcher has to be clear that event *x* did lead to event *y*, which can be illustrated with, for example, how transport costs affect the margins. The economic personnel of the mill allocated and calculated the original figures, which are used in this dissertation. The values under analysis are calculated similarly during the whole time series and regarding every export country. This gives the possibility of comparing the countries with one another during the whole research period. In this dissertation, internal validity means that the increase of sales prices causes, with statistical significance, higher gross margins or even net profit. Correspondingly, the increase of the costs lowers the margins and profits with statistical probability. These significance relations are tested by using regression analysis.

Yin (2003) points out that external validity regards whether the results of one study can be generalized outside the context of that study. High external validity gives the possibility of generalizing the findings to situations where replications are a difficult task. From the perspective of transportation costs, this dissertation only uses time series data from one mill, so the results can be generalized only restrictedly to cover other than mills far from the main market and with low local demand. The generalization of the case study must be based on analytic generalization.

Researchers using data collected from multiple countries can control unmatched factors, increase validity, rule out alternative explanations (Malhotra et al., 1996; Sin et

al., 1999 and Berry, 1980), and, in turn, enhance the generalizability of the findings. The data of this dissertation contain so-called embedded cases, i.e. exports to 14 European countries. This gives the possibility to analyze the heterogeneity of the export markets, which cannot be discovered just by using one country as a case or average or theoretical values from the mill to the market. Van Bruggen et al. (2002) note that using embedded sources improves the quality of response data and thereby the validity of reported relationships in organizational research. In this study, the different export countries reveal better the economic geographical phenomenon and their changes than if only mill level average values were used. Dubois and Araujo (2007) point out that a single case with multiple embedded sub-cases also adds variation as detailed data. In this dissertation, multiple sub-cases add understandable variety, because all the 14 export countries differ from one another by size, location and economical status as well as paper demand.

Schwab (1980, p. 5) has defined construct validity as “representing the correspondence between a construct conceptual definition of a variable and the operational procedure to measure or manipulate that construct”. Construct validity is a multistep process for assessing the adequacy of measures and “construct validation is an essential and major element in the research process” (Schwab, 1980, p. 33). The author, when composing articles 1–5, made an extensive literary search putting effort into both the existing discussions focusing on economic issues in the paper industry and the economic geographical theories. These gave a frame and a conception and were useful to revise the problem definition and to build relevant methodological and theoretical background for the study. The problem arose that it was not possible to compare the results with other paper mills or similar studies with a comparable analytic and data frame. There are very limited possibilities to explore many paper mills simultaneously with the same type of economic and supply chain data.

The content validity is related to how well the information received fulfills the core of the phenomenon to be investigated. The total number of target countries, or sub-cases, was 15 including the domestic market. The complete time series could be used from all these countries. Additionally, as a sample, the author obtained sales data of the most sold product from the same countries to explore how the statistical significances differ at the product level from the aggregated total values. These 15 countries can be considered embedded cases describing data heterogeneity inside the case, and these countries represents 90 % of the mill’s total sales and manufacturing. The product-based values can be considered a representative sample of the total deliveries.

Yin (2009) and Peltola (2007) remind that, in a case study, the empirical boundaries and criteria are very important to define properly. Malmsten (2007) notes that the selection of geographical area is critical and an important phase in the case study, because different geographical boundaries can change the content and results of the study remarkably. It is essential that the research area is adequate for the research problem, especially when studying such a highly export-dependent industry like the Nordic paper industry. In this study, the geographical area was restricted to Europe, which is definitely the main market for the case mill, as for the Finnish paper industry as a whole (Forestindustries, 2010). Therefore, this gives some possibility to generalize the results to other European paper mills located far from the market. The data from all these

European export countries included the complete monthly sales values of 96 months without zero months. Distant overseas exports from the mill are generally a few hundred tons monthly. These exports to several distant countries are somewhat occasional, and there can be long periods, even years, when there have been no deliveries at all. Therefore, comparable analysis from such a time series was not reasonable to make. Additionally, the economic impact of the overseas countries for the mill is not significant. However, exports to these distant locations can be profitable, because of the low local competition and inexpensive sea transportation. The logistics costs to distance overseas markets have been explored briefly in Article 3.

The country-specific monthly figures always include several customer orders, so there are some variations between delivery volumes and transportation costs, even within countries. Thus the overall conclusions are not highly dependent on the choice of any specific individual customer or delivery but are averages of all these country-specific deliveries. In Articles 1–5 there is, however, documented analysis of the customer level deliveries to illustrate how the logistics costs and sales volumes behave at the low aggregate level.

5 METHODOLOGY

5.1 Aim of the research

Theoretical discussion from the recent firm strategy perspective suggested how firms in industrial districts benefit from strategic resources, systemic organizational routines and collective learning (Cohen and Morrison Paul, 2005). The theoretical section showed that the time series and economic geography topics are missing from the discussions of exploration of Finnish paper mills (Lähtinen, 2007 and Koskinen, 2009b). This dissertation tries to remove this absence and describe how the Finnish paper industry managed economically in foreign markets during 2001–2008. The economically oriented transport geography focuses on exploring mainly theoretically the static situation in two areas and between two economic agents (Krugman, 1991a). Empirically and spatially linked examinations are needed to study the effects proven by effects of distance (Martin, 1999). This dissertation studies, from the economic geographical perspective, the development of the paper exports from a peripherally located mill to 14 countries and the home market. In addition to the sales prices and the manufacturing costs, the paper mill's transportation costs add inseparable linkages with time series and location aspects in the spatial context. Market-specific longitudinal case data give the essential possibility to examine the historical development and spatial variations of the Finnish paper industry, which are otherwise somewhat impossible to highlight. These historical and empirical studies help to understand the present situation of the paper industry. When exploring the dynamics in the value chain of a paper mill, cost, space and time all together contribute to the results.

In this dissertation, transportation (including commissions) is understood as a process in which the packed paper rolls are transmitted from the mill's warehouse to the distribution centers with common transportation means. The objective is to look closer at how the research variables behave in the example export countries during 2001–2008. The objective of the dissertation can be crystallized as follows:

The objective of this study is to examine how the different important economic variables in a paper mill correlate with the gross margins at the country-level with monthly time series during 2001–2008 to 15 countries.

The multidisciplinary approaches are: economic time series; supply chain management, correlation coefficient analysis; and the economic geographical perspective. Research questions are placed to examine the statistical significance of the main economic components in relation to gross margins. With these questions, the study brings a new angle to the paper industry research and generally to the research context concerning the exporting bulk industry with minimal local demand.

RQ 1—How do the total paper sales and product-specific sales correlate with the gross margins of the paper mill?

RQ 2—How do the total and product-specific transportation costs from the mill to customers correlate with the gross margins of the paper mill?

RQ 3—How do the total variable costs and total product-specific variable costs correlate with the gross margins of the paper mill?

RQ 4—How do the total fixed costs and total product-specific fixed costs correlate with the gross margins of the paper mill?

The answers to the research questions reveal a meaningful picture of the markets of the Finnish paper industry using spatially oriented case research. In the empirical sections, large analysis calculations with the real mill data are presented. The conclusion sections contain analyses of the results, which give the possibility to make conclusions from the point of view of export topics. The following section describes how the author carried out the research process to make the data analysis out of the vast empirical time series.

5.2 Building a research method and data analysis

The basic research methods used in this dissertation are descriptive case analysis and statistical correlation analysis, which are based on figures obtained from the studied mill. These correlations are used to visualize how the selected research variables behave in relation to the gross margins. The research objectives were based on the economic and real facts of the mill, and these factors are selected to present the existing phenomena and especially the changes during the time in space. The central topic in the dissertation is to make quantitative observations from the economic geographical point of view. These observations have been verified during the research work, which helps to find the significance between the factors in the explored data and how the variables behave in relation to the different market areas. The constructed analyzing method particularly supports the research issues concerning the paper industry in the economic geographical context. The designed method is a systematic way to connect the economic time series and spatial issues more distinctly to each other. The method shows how the margins are dependent on all other cost components, like fixed and manufacturing costs.

There are three phases to obtain the research data and present results out of the mill data and, at the end of the section, a detailed list of the research analysis is introduced:

1. Research variables for the economic analysis
2. Statistical correlation analysis
3. The economic geographical empirical correlation analysis

1. Research variables for the economic analysis

The detailed empirical data have been obtained from the mill's database by country. Data are selected monthly from the database by country during 2001–2008, which totals 96 months. The data cover economic values from the paper prices down to gross margins, and these are presented in the following Table 3.

Table 3 Descriptions of the research variables and how they were calculated.

Independent research variables	How the variables have been sorted in different levels.
Sales in euro—total sales and product specific sales. - Based on the paper sales prices.	Country-based monthly values based on the total values of the customer deliveries in euro; total sales and product-specific total sales by country.
Transport costs in euro. - The transportation costs from the mill inventory to the customers in the research countries separately.	Country-based values of total transportation costs and commissions, based on the customer deliveries in euro and product-specific transportation costs by country monthly.
Variable costs in euro. - Raw materials – pulp, pressure ground wood, thermo mechanical pulp, energy, chemicals, packing materials and additives. These costs are calculated by the customer based sales grades, which consist of specific paper recipes.	Country-based total values of the raw material costs of the customer and product-specific deliveries in euro by country monthly.
Fixed costs in euro. - Wages, maintenance and overheads, in a case paper mill the wages are classified as fixed costs, not as variable costs.	Country-based average values of the fixed costs and product-based values allocated to the machine-specific production grades, which are delivered to the customers monthly. The fixed costs are allocated by the production time in tons per hour for the paper grades.
Dependent research variable	
Gross margins in euro. - Price–Transport costs–Variable costs–Fixed costs = Gross margins.	Paper sales–transportation costs minus variable and fixed costs.

Table 3 presents the data retrieving and the research values for the basis of the analysis as well as how the raw data have been processed for research purposes. At the mill, there are several machine lines, which produce different volumes in tons. All these machines produce production grades (unique paper recipes and production tons per hour in paper machine) that all belong in different sales grades. The sales grade is an upper level for the production grade in hierarchy. Different customers purchase certain sales grades needed in their printing processes. The mill's cost management software has made all the cost calculations and allocations at the mill and machine levels as well as the product and country levels. All the economic values are calculated in euro, which makes the figures harmonized and fully comparable. The country-specific values are summed up from customer-based values.

2. Statistical regression analysis

Harrington et al. (2000) define that the clarification of relationships among variables is a fundamental task of data analysis. Regression analysis can be used to discover new features in data that might otherwise be overlooked. Regression analysis also has a potential application as an exploratory visualization tool. Regression analysis extracts phase information and measures correlations as a function of frequency from the multi-analysis and multi-channel measurements that are made over time. This phase information may be important for economic analysis, where multiple analyses vary with respect to sample location or date. Ketokivi (2009) considers regression analysis a statistical analysis, in which one variable (*y*-variable) is explained with one or several variables (*x*-

Table 4 Explanatory and dependent variables and the time lines.

Time series	Explanatory variable	Dependent variable	Statistical significance r^2 ($P < 0.05$)
<ul style="list-style-type: none"> - 14 export countries in Europe (80 % of the mill exports) and the home market during 2001–2008. - Total values by country (separately 12 months and all 96 months). - Total product-based values by country (separately 12 months and all 96 months). - All the data by country (= sub-case) and all the data by product. - Sample size: separately 12 and 96 months (data of the sub-cases). 	Sales €	Gross Margin	Significant
	Transport costs €, including Commissions	Gross Margin	Significant
	Variable costs €	Gross Margin	Significant
	Fixed costs €	Gross Margin	Significant

variable). With regression analysis, the researcher attempts to examine and explain the variance of the y-variable and make conclusions, in which the x-variables statistically explain the variations of the values of y-variables in the sample. The correlation analysis explains the dependency of the variables, but really not causality.

Statistical regression analysis is a generally used method in different fields of science to explore the relationship of the relevant research variables (Table 4). The variables are placed in the correlation matrix, and these factors are calculated with the statistical regression method to see how the variables correlate with e.g. how the sales prices explain the gross margins or how the higher transportation costs explain the lower margins. The used statistical method was the square of the Pearson's correlation coefficient (r^2) and the formula is given by:

$$r^2 = \frac{(\sum xy - n\bar{x}\bar{y})^2}{(\sum x^2 - n\bar{x}^2)(\sum y^2 - n\bar{y}^2)}$$

When one variable (y-variable) is explained with one variable at time (x-variable) then the regression coefficient of determination is square of the correlation coefficient (Ketokivi, 2009).

3. The economic geographic empirical correlation analysis

When studying the export industry without geographically based specifications, many of the economic impacts might remain unclear and scanty. Much valuable information would be missing if the results of the analysis were presented only with the purely average figures and forgetting the spatial dimensions, which have apparent effects on all the export functions. This was addressed in the theoretical sections. The economic figures are informative at the country or the market level. The export industry is worth studying with statistical correlation analysis, and the research results should be presented country-specifically, and the geographical research approach should be capitalized as a supporting and informative method. The countries selected for this study differ greatly

from one another in relation to location. More detailed country-specific research would have been used, but the research data were only available at the country-level. However, the research data give the advantage of presenting market heterogeneity and leaving out purely average values based on the mill level results. There is no need to rely on purely theoretical and mathematical presumptions, as real and reliable values can be used to describe detailed variations in the spatial context. This geographically oriented study makes it possible to compare specific economic factors between the countries and finally analyze how geography impacts the mill's results. This gives detailed information for the researcher on how the different analyzed economic factors behave in the main market.

In the following list, detailed phases are presented on how the economic data was converted to suit our research purposes. In the longitudinal data, one month was considered a proper period at the annual level to make relevant actual and forecast calculations:

1. Data were stored in a time series based database.
2. All the costs and prices were allocated to single products at the mill level, so that the raw materials used by each product and manufacturing phase in the process were stored correctly in the database for that specific product. The product-based cost allocations were made comparable by using detailed grade recipes within each product and machine line.
3. The customer invoice information covered paper sales prices and the locations of the customers as well as all the geographical issues and transportation costs to foreign delivery centers.
4. The total raw material costs were balanced by the cost management systems and made comparable with the accounting system monthly.
5. The change of the products' stock values was calculated geographically by locations.
6. In the Pearsons' correlation analysis, comparable euro per paper ton values of sales and costs were used in the time series by country or by country/product. The values were transferred automatically from the cost management systems to the Excel sheet.
7. From the Excel sheet, the data were transferred into statistical tools (Stat). The statistical tool calculated the correlation coefficients for every country separately but in a similar way. The correlation coefficients were calculated for all research countries in twelve month periods and for the whole research period of 96 months. These calculated correlations were construed and placed in the tables presented in appendix 1–8.

As a synthesis, the practical issue was first to input into the analysis tool both the actual and the forecasted economic values as basic sources of analysis. The regression analysis between forecasted and realized time series was carried out, and these calculations were linked to the spatial context to present the results geographically.

5.3 Background of the articles

In this section, there are descriptions of the five supporting articles (Table 5). All of these articles focus on different economic geographical aspects of the paper mill from single customers to total mills values. These articles explore and reveal the Finnish paper industry's development during past turbulent years. However, all the research papers are based on the same empirical mill database as well as the data of this research. The only aberration in the data is that the time series in the first three articles are from 2001 to 2008 and in the two last articles the longitudinal case data presents years from 2002 to 2008 monthly. The reason for this was that the forecast data were from 2002 to 2008.

In general, all five articles have the same basic research focus, namely the economic time series and correlation analysis in a spatial context. This is a novel approach in studying the paper industry, and it brings out a diverse research angle on the Finnish paper industry. The theoretical sections, from 3.1 to 3.4, provided the result that the paper industry, economic geography and time series are not widely presented together within economic geographical literature. This discovered absence in discussions has been an incentive and stimulus to begin to design and make this case study as well as the five supporting articles. The market-specific costs and margins and their relationships and connections with spatial and market issues bring new knowledge when explored through empirical longitudinal time series.

In article 1, empirical longitudinal data from 2001–2007 was used. The objective in the first article was to explore the development of the cost components between 2001 and 2007. The article shows how the transportation costs increase in spatial contexts and how the costs have developed in different markets. In addition, the correlation between transportation costs and order volumes was studied. This subject has not been discussed in literature with this accuracy earlier. The ideas of transportation geography and logistics were utilized as theoretical background.

When studying different process and business systems, it was noticed that variation and fluctuation bring out challenges in making the supply chain smooth and lean. Especially Shewhart (1936) and Deming (1988) have pointed out that variations should be understood profoundly if one wants to understand the economic processes. Additionally, the geographically based differences between countries in physical distances (see e.g. Rodrigue, 2006) bring out variety in logistics, transportation, deliveries and raw material acquiring, which are fundamental issues for the industry located far from the markets. From these points of view, article 2 explores how the economic components vary in the real world. The main topic was to study monthly sales at the customer and country levels and, from this angle, to look at whether and how deliveries behave during the time series. The objective was to find ideas and reasons that could partly explain the high intermediate inventory levels in different markets that e.g. Koskinen (2009a,b) has recently studied. Additionally, the idea was to study the correlations between different logistic variables, like sales volumes, transportation costs and net profits. Article 2 also shows how paper prices and transportation costs have developed during the research period. None the above-mentioned research topics, concerning the paper industry, have been widely considered within discussions in relevant academic journals.

Table 5 Articles and the methods and research questions.

Article	Data and methods	Research questions
<p>Article 1 Hämäläinen, E. and Tapaninen, U. (2008). <i>Spatial characteristics of the transports in the paper mill's supply chain.</i> Fennia 186(2), 83–93.</p>	<p>Time series 2001–2007 - Descriptive figures - Statistical correlation analysis</p>	<p>How have transportation costs developed during the study period concerning the exports to the market? How have the supply chain costs developed during the study period? Do order size and transportation costs have any causality in euro per paper ton? Has the productivity of the older paper machines increased in ton per hour?</p>
<p>Article 2 Hämäläinen, E and Tapaninen, U. (2010). <i>Economics of a Nordic paper mill: case study,</i> Industrial Management & Data Systems 110(1), 5–23.</p>	<p>Time series 2001–2007 - Descriptive figures - Statistical correlation analysis</p>	<p>What was the economic geographical development of the paper mill during the past seven years? How were demand and sales behaving in a paper mill at the country and customer levels? What was the correlation between sales tons, logistics costs and nets profits? What was the correlation between the logistics costs vs. gross margins?</p>
<p>Article 3 Hämäläinen, E. (2011). <i>Cost efficiency of supply chain in a Nordic paper mill - A case study.</i> International Journal of Management 28(3), Part 2, 945–958.</p>	<p>Time series 2001–2008 - Descriptive figures - Statistical correlation analysis</p>	<p>Has the mill been able to anticipate development of cost-efficiency accurately? Could the mill make any improvements in economic efficiency during the research period? Have the machine lines and grades deviated in hourly cost-efficiency? How can efficiency be observed in revenues by grade?</p>
<p>Article 4 Hämäläinen, E. and Tapaninen U. (2011). <i>Accuracy of the economic anticipating in a Nordic paper mill - A case study.</i> International Journal of Applied Management Science 3(4), 368–384.</p>	<p>Time series 2002–2008 in comparable analysis with forecasting and actual figures. - Statistical correlation analysis to 15 countries</p>	<p>How accurately has the case mill been able to anticipate the supply chain economic variables during the research period in fifteen different markets? What are the differences between markets? The economic variables are sales tons, sales prices, transportation, variable costs and gross margins.</p>
<p>Article 5 Hämäläinen, E. and Tapaninen, U. (2011). <i>Accuracy of forecasting in a Nordic paper mill's supply chain: A case study.</i> Norsk Geografisk Tidsskrift–Norwegian Journal of Geography 65(2), 104–113.</p>	<p>Time series 2002–2008 in comparable analysis with forecasting and actual figures. - Statistical correlation analysis two countries</p>	<p>How accurately has the case mill been able to forecast the supply chain economic variables during the research period in two different and important markets? The economic variables are sales tons, sales prices, transportation, variable costs and gross margins</p>

Article 3 focuses on examining the cost-efficiency of a Nordic paper mill, and the economic efficiency per machine hour can be considered an essential research angle from the perspective of the productivity of the supply chain and markets. This topic has been examined very little in previous scientific journals and discussions. The purpose was to examine whether the development of economic efficiency could give some clarification to why there were so many mill closures in Finland between 2001 and 2008. The research data consist of the forecasted and actual machine hours, variable and fixed costs and contribution margins, and the data cover the years between 2002 and 2008. The study reveals results on how the economic efficiency of the supply chain has developed during the research period. Our findings demonstrate that cost-efficiency per machine hour has been under serious pressure and lowered in the case mill during past years. Paper prices per machine hour have lowered demonstrating that the paper machines have produced less turnover and income. These results endorse the vast closures of machine lines, and even some mills, during past years.

Articles 4 and 5 examine the accuracy of the relationship between anticipated and actual figures. Article 4 explores how the mill has managed to forecast paper demand together with prices and costs in the market and even margins in fifteen different markets. Article 5 presents the accuracy of forecasting to two important export countries in Europe in more detail. The results of these articles show that the economic environment has changed dramatically due to lower paper demand at the market and especially increased material and energy costs. The subject of articles 4 and 5 is also novel, and hardly any relevant discussions about the paper industry from this point of view could be found in the literature. The theoretical ideas are derived from the supply chain and economic literature, especially forecasting in supply chain.

Table 5 presents how the supporting articles integrate into the general research question of this dissertation: how the Finnish paper industry has developed during 2001–2008 mainly at the firm level and from a geographical point of view. Economic geography with interdisciplinary methods fits well for the purposes of this study, where the target is to study how an exporting industrial site functions both spatially and economically. The theories of the articles are based on supply chain management, economic geography and transportation, combined with statistical correlation analysis.

6 RESULTS

6.1 Research questions revisited

The purpose of this study is to examine and describe how the competitiveness of the Finnish paper industry has devolved during 2001–2008. During this period, the Finnish paper industry has faced economically challenging times. We examined how the mill succeeded economically in different European markets and whether this could give some clarification to why there were so many machine and even mill closures in Finland between 2001 and 2008. The research questions were placed to reveal the relationships of the economic variables with gross margins from the research data and time series. The important issue was to look at the data from the perspective of the whole mill and its geographical context. The selected economic research variables are important and axiomatic issues in economically based studies. The principal objective was to study whether heterogeneities exist in the selected economic variables for geographic reasons. For the research questions, the dissertation conceived the answers with statistical correlation analysis calculated in different export markets. The economic geographical research tradition provides scanty answers to how spatial issues impact the Finnish paper industry.

Tables 12 and 13 present a summary of the calculated correlations concerning the research questions. These are collected from tables 7–10 by country presenting the empirical circumstances. Generally, the economic correlations vary and have different significances on the margins over space. The dependencies calculated from the total values (8 years; 96 months / country) show that all the variables have a significant impact on the gross margins. There were a total of 120 research years, which we examined in this study (15 countries and eight years per country) Transportation has a low economic significance in domestic deliveries, but in export sales, transportations have a greater dependency on the gains. This kind of empirical information could be valuable for the mill's management, when they analyze the export market differences and determine how to remain as competitive as possible. In the following paragraphs, the author has revised the research questions against the results based on the data.

RQ 1—How do the total paper sales and product-specific sales correlate with the gross margins of the mill?

The selling prices are the most important issue for the economic success of a paper mill producing paper products in the periphery. The study clearly revealed that, when paper prices are low, the mill profits are low or even loss-making, because the decreasing of the manufacturing and transport costs has not been successful. At the country level, apart from 2004, sales prices have had a high significance on the gross margins. When examining the whole data at the country and product levels, there is a strong relationship between paper prices and margins. Nearly 80 % of the examined 8 years based on the selected 15 countries (96 research years of total mill values and 97 research years of product-based values, which totals 120 research years) show that prices have a high

statistical significance (with $p < 0.05$) on margins. This issue is so important that the mills must adapt economically to low paper prices in all examined markets. The study showed that economic geographical heterogeneity exists “in the real world”, and this should be given serious attention by the paper companies. There are differences between countries in the mill profits, and these changes should be examined continuously from year to year and from country to country. Article 1 showed that paper prices correlate significantly with profits. Articles 4 and 5 presented the issue that the demand forecasting and the actual results showed that the mill was not always able to anticipate the future reliably. Paper mills should actively examine these changes at the country and product levels to acquire correct information from the market for the decision-makers.

RQ 2—How do the total and product-specific transportation costs from the mill to customers correlate with the gross margins of the paper mill?

The Finnish mills usually need to transport paper products through long inter-nodal truck–sea–truck routes from the mill to the customers. The European market is very heterogeneous from the logistics point of view, and thus many well-planned and functioning transport means are required. Transportation costs are a significant part of the total costs for distant companies. This obligatory costly logistics phase takes time and binds a lot of capital. Particularly for a mill located far from large markets, site is a crucial issue, and this impact of location from the costs perspective has been studied in this dissertation. The time series data based on the whole mill data show that transportation costs correlate significantly with gross margins. Transport costs can have as high an impact on the gross margins as paper prices in many countries, which is a new finding when studying the Finnish paper industry. Article 2 shows that transportation costs can lower gross margins significantly, provided that the paper prices are under heavy competition and manufacturing costs have been difficult to decrease. Article 1 presented that, in small customer orders, transport unit costs can become threefold compared to the normal average level. In some inland countries situated far from import harbors, transportation costs can have a very high significance on gross margins. The study clarified that for the mill, the transport costs have, together with paper prices, an essential dependency on the development of gross margins. The statistical time series analysis shows that, during half of the examined research years (in 61 research years from the total of 120 research years), there was high correlation between transport costs and gross margins. This topic became more important during 2006–2008 at the product level. During 2006–2008, due to soaring oil prices, transportation costs had a greater influence on the gross margins. There are, however, geographical differences. When the mill exports to inland countries and countries with longer transportation distances from import harbors, the transportation seems to have a greater significance on the gross margins than when exporting to seaside markets. When studying paper mills and their logistics, the economic geographical angle brings out new views, because these spatially based issues have become very topical again. The reason for this is the particularly fierce competition in the paper sector as well as the effect of the rising oil prices on the transportation costs. It is relevant to stress that the spatial perspective should be taken more seriously when developing transportation and logistics functions, especially in the peripheral bulk industries.

RQ 3—How do the total variable costs and total product-specific variable costs correlate with the gross margins?

Variable costs cover all the manufacturing costs, including timber, fiber, chemicals, energy and wrapping materials. Making one ton of paper takes a certain amount of material, and these volumes and costs are very difficult to lower. The Finnish mills also traditionally make fiber mechanically at the site, which requires a lot of energy. The variable costs represent 35–50 % of the total costs, depending on paper type. Our research showed that, in the whole time series data, there is a strong dependency between variable costs and gross margins, both at the country level and in the product-based values. There is high correspondence in the product-based values, (89 significant research years from the total of 120 research years), which indicates that the correlation analysis gives better detailed responses. The whole data and product-based data show high correlations in 2005. The reason for this result was the industrial block out and actions, which stopped paper production for several weeks. Paper sales dropped but manufacturing costs remained due to materials purchasing remaining quite high. In the total values, there is great variety from no dependency to up to around 80 % when explaining lower gross margins with variable costs. For the mill, the variable costs are a central topic, because these costs are so-called direct costs. Article 1 shows that variable costs have not lowered even though paper prices have decreased. The variable costs are very difficult to lower due to the characteristics of paper manufacturing.

These costs are not directly linked to the case mill's peripheral location, but Finnish mills are usually located in a raw material oriented manner or near export harbors. Our study pointed out that the case mill has not succeeded in decreasing variable costs at all during 2001–2008. The inexpensive fiber produced in South America will probably help some of the Finnish paper manufacturers, but it also helps the European competitors. This can bring new challenges to Finnish paper producers. The role of variable costs has increased in the case mill, especially at the product level. When a mill attempts to increase profits, variable costs must be under continuous surveillance and in tight control by the mill's management.

RQ 4—How do the total fixed costs and total product-specific fixed costs correlate with the gross margins?

The fixed costs are not directly linked with production volumes, cover salaries, wages, maintenance and overhead. The paper companies naturally attempt to minimize these costs, but our study highlighted that the case mill was not able to decrease them to the same extent as sales prices were lowered. The fixed costs have high correlations with gross margins, especially when calculated from the whole time series. The research data show that, in the country-based total, there are 80 research years (67 %) and in the product based values 93 years (78 %) out of 120 years that are statistically significant. This suggests that also these less-paper-grade-dependent costs have high dependency on the gross margins in lowering them. Especially at the product level, fixed costs have strong correlation with gross margins and, in some of the countries, also with paper prices. In 2005, the fixed costs had high correlations with margins, and the reason for

this was the strikes that lowered total sales. Due to the decreasing paper prices, the significance of the fixed costs has remained high. The present low paper prices do not allow for any cost increases. For the mill, the fixed costs seem to be difficult to decrease, even though these costs are so-called indirect costs and not paper grade dependent. Article 1 indicates that fixed costs have not lowered even though paper sales prices have decreased. These costs are not related to the mill's location, but the paper workers' union has historically had a strong negotiating position at the Finnish mills regarding salaries and work conditions due to the importance of the sector. In the Finnish paper companies, wages, maintenance and overheads are at a high level. To compensate these high fixed unit costs, the paper companies have attempted to decrease unit costs with the scale of production and economics, producing higher paper qualities with larger and faster machines. Unfortunately, this road is expected to end due to decreasing paper demand (see e.g. RISI, 2009; Hetemäki and Hänninen, 2009). The costs structure should be balanced with paper prices, like decreasing paper supply to meet the lowering demand in the market. Similarly to other cost-reducing methods, it is very difficult to achieve higher margins among the mills located far from market.

6.1.1 Findings of the supporting articles

Article 1: Spatial characteristics in the Nordic paper mill's supply chain – a case study

The article claims that the bulky paper products, production methods and the supply chain process are rather similar in every printing paper mill. The empirical time series data (2001–2007) show that the productivity (in paper tons per machine hour) of the older paper machine lines (pm 9, pm 8 and pm 7) has barely increased. The study stresses that the total supply chain costs (from wood yard to customers) have remained at a very high level in a paper mill located far from the markets, both absolutely and relatively, when comparing them with the paper price development. This also demonstrates explicitly that the costs per manufactured paper ton have not decreased during the same period. This gives strong indication that if the costs do not follow the decreasing paper prices, these older mills far from the markets will soon be facing serious economic problems.

The transport costs from the mill to the European market vary a lot and increase as a function of transport distance, especially in multi-modal sea-truck-based transportations. The research data show that there is big significance between the order volumes and the transportation costs. The customer order data covered different sizes of orders in volumes (tons), 2,386 in total to one case country. The orders were delivered during 84 months to the consignees, on average 28 orders per month. According to the research material, the transportation costs of the small customer orders, such as a few tons or some hundred kilos of packed paper rolls, are up to twice as high as the larger deliveries to an example country. Supplying smaller amounts from the mill to the consignees does not seem to bring the expected lower logistics costs for the case mill.

The transportation costs together with the sales costs (15–17 % of the whole supply chain costs) are a considerable part of the costs in a paper mill. In a small single order, the transportation costs can be up to 30 % of the total costs, depending on the custom-

er's location in relation to the mill. There are many logistical changes to the customers from the mill that are located inland, which increases load and unload phases and warehousing during transportation. The paper companies located in Finland are working intensively to adapt to this challenging economic and demand situation, mainly by closing unprofitable machine lines and mills.

We argue that transportation costs are worth looking at through customer-based sales material, because, at the mill level, the average costs figures completely leave out costs related to geographical diversity. Delivering small order volumes should be avoided when it is possible. Additionally, variety in the order volumes should be decreased, but this is based on the customer orders and therefore it is difficult to change. An alarming issue is that, during the past years, investments on the machinery have decreased, presumably mainly because of the tight economy. The paper companies are understandably cautious in making investments in mills where manufacturing costs are high and transport distance to the market long, slow and costly.

Article 2: Economics of a Nordic Paper Industry – a case study

In the second article, we studied the variations in sales and the relationship between logistics costs, sales volumes and net profits. The results showed that variation in production is minimal at the paper machine level, but in paper sales, there are great fluctuations. Monthly sales variations were large, even up to 800 % between months at the customer level. It is a challenge to decrease storage time in the inventories in distant locations if the supply and demand variations are so big and sometimes quite unpredictable. The fundamental reasons for these irregularities were beyond the scope of the study. In any case, these sales fluctuations should be taken into account more carefully in logistics and economic planning. It is demanding to make proper financial estimations, particularly with the existing anticipatory methods, due to significant variations in demand.

We explored the gross margins and logistics costs components through the sales price. We found large fluctuations in the paper deliveries in tons and also in the gross margins. There is a strong positive correlation between the sales prices and the gross margins ($R^2 = 0.6306$). In this case, the sales prices explain over 60 % of the gross margins. The empirical data show that there is also some causality between net profits and logistics costs. About 34 percent of the increased net profits in €/t can be explained with the lower logistics costs. A paper mill's monthly logistics volumes to the market are enormous, and the annual sales from our case mill are hundreds of thousands of tons of packed paper rolls in total. From this point of view, there is weak statistical positive correlation (0.11) between the sales volumes in tons and the net profits €/t. Therefore, the more tons are delivered, the better margins the mill achieves in these deliveries. When the volumes of the case mill's customer orders increase, the logistics unit costs decrease (-0.3385), which supports higher net profits in euro per ton. When the paper prices lower because of oversupply and manufacturing costs remaining high, the logistics costs become more crucial for the existence of paper mills. The paper sales prices correlate heavily with gross margins, so the paper companies should remove the oversupply from the market by closing unprofitable mills. The Finnish paper compa-

nies have already closed a lot of pulp, board and paper capacity during past years to lower the paper supply.

The main findings of article 2 can be summarized as follows: Firstly, variation in the supply chain process grows substantially from the mill to the consignees. Secondly, if the mill was able to lower logistics costs, this could bring out the possibility to acquire higher margins. Thirdly, the paper prices have a strong relationship with net profits. Fourthly, bigger customer deliveries in paper tons raise gross margins to some extent, because the logistics unit costs lower to some extent.

As a conclusion, it can be stated that it is worth studying the supply chain and logistics costs in the Finnish paper industry concurrently with statistical analysis and transport geography. This perspective helps to examine how the long transporting distance increases storage times and costs and therefore lowers the gross margins.

Article 3: Cost efficiency of supply chain in a Nordic paper mill – a case study

The purpose of this study was to explore how cost-efficiency per machine hour had developed during past years (2002–2008). The results indicate that the case mill had problems in improving cost-efficiency in the machine lines. The mill has been able to estimate fairly adequately the efficiency of variable and fixed costs per machine hour. Total costs per machine hour have clearly increased, and it is alarming that the margins per machine hour have decreased, lowering margins. Elmuti (2002) argues that there is little empirical research that investigates SCM's impact on the firm as a whole, and thus this study sheds some light on the issue. The empirical results disclose some mill level managerial implications, which show that the mill should concentrate on improving the economic efficiency of the machine lines. Energy efficiency should be the main focus during the coming years. Mills should take serious actions to lower raw material and energy costs. The management of the paper companies should continuously explore efficient machine line and paper quality combinations to maximize the income, which is what they are obviously doing already.

There are several supply chain researchers (see e.g. Christopher, 1992; see also Fogelholm, 2000; Pesonen, 2001; Koskinen, 2009a and Töyli et al. 2008) who argue for the importance of economic efficiency in the supply chain. However, they have neglected to verify the cost-efficiency per machine hour in the manufacturing industries, especially in the paper industry. This study aims to fill in the existing gap between the theoretical discussions and the current situation in the paper industry regarding efficiency topics. However, we should be cautious when generalizing the results from one mill, even a large one, and we should especially consider the location of the case mill when comparing results to those of other similar mills.

Printing paper mills must actively explore ways to solve the problem of increasing manufacturing costs and decreasing paper demand-oversupply imbalance as well as obvious challenges in economic efficiency. There is currently a real risk that Nordic mills will lose a part of their low-profit paper markets to local European competitors permanently.

Article 4: Accuracy of the economic anticipating in a Nordic paper mill – a case study

The results of this study are based on research on the economic variables in one paper mill. We studied how the anticipated and realized supply chain variables correlated with each other in fifteen countries. We examined whether the anticipated sales and actual sales tons had any correlation and could the mill thus forecast future demand. The examination period, 2002–2008, was economically challenging for the case mill as for the whole paper industry. Our mill material highlights that the paper mill should focus more on accurate economic planning in the future, as Fogelholm (2000) points out in his doctoral dissertation. This perspective could bring positive outcomes if the mill is able to anticipate paper prices, manufacturing costs and paper demand more reliably. The article shows that soaring variable costs, together with decreasing paper prices, have made it extremely difficult to anticipate margins accurately. Several supply chain researchers, like Helo (2004) and Kosior and Strong (2006), argue that, in supply chains, goods are produced and distributed according to purely historical or anticipated demand. This examination demonstrated that the reliability of the anticipatory process varies greatly from market to market. The mills should refrain from all types of disturbing issues, which occurred during 2005 and which can significantly harm production, sales and especially margins.

Sales estimations should be explored at the detailed market level, because competition is different in every location, and therefore it is useful to integrate these geographical aspects closely with supply chain studies.

Youngdahl (2000) argues that planning and making are necessary components in any supply chain. Elmuti (2002) points out that there is little empirical research that investigates SCM's impact on the firm as a whole. This study shows that both of these claims are relevant, and an empirical study can give new insight that can reflect on the industry in question. This study revealed that volatility in different paper markets is large, and there seem to be heavy fluctuations in paper demand and even costs and prices. Incorrectly anticipated paper demand can lead to inaccurate production and material planning at the paper machine level and increase the inventory values resulting in higher overall logistics costs. Even the logistics and supply management literature provide evidence that SC enhances business performance; this study shows that, especially from the viewpoint of margin estimation, there is much to gain. Finnish paper mills must actively explore ways to make the anticipatory functions more accurate in all markets, which could support profitability in the business.

Article 5: Accuracy of forecasting in a Nordic paper mill's supply chain – a case study

The purpose of this case study is to empirically examine the accuracy of forecasted and actual supply chain (SC) variables from the viewpoint of a Nordic paper mill's deliveries to two example countries in Europe. In this study, we combine correlation analysis with economic geographical approaches. We examine how the mill has succeeded in forecasting the development of paper prices, manufacturing costs and paper demand in two different and very important markets. Our research is based on longitudinal data, which include paper deliveries from the large integrated printing mill on a monthly basis during 2002–2008.

The empirical research material is based on data from one large integrated paper mill in southern Finland exporting 90 % of its total production. The main empirical findings show that supply chain factors should be studied in detail at the country and customer levels. Statistical correlation analysis based on the time period demonstrates that estimated and actual values vary a great deal monthly. The detailed mill material highlights that paper companies should focus more on result forecasting instead of actual reporting.

Our empirical examination shows that the differences between ex-ante and ex-post supply chain costs can be quite considerable at the country level, and this has obvious effects, particularly by complicating the overall economic direction. The empirical results have some mill level managerial implications, like that the gross margin level should be the focus of economic forecasting in paper mills. The results of the forecasting processes should be continuously reflected on in the chosen paper markets. The reliability of the forecasted market data in the budgeting process should be a focal requirement. The supply–demand relationship should be in balance and a priority for the paper companies to enable sales prices that cover the supply chain costs, which would be conducive to sound business.

In conclusion, a comparison between anticipatory economic planning systems should always rely on accurate price and cost data calculated applying the same criteria. When examining paper sales estimations at the detailed market level it is possible to reveal how the mill has been able to interpret signals from the markets. Additionally, studying forecasting gives the opportunity to explore the development of supply and competition between locations. The study shows that geographical aspects should be closely integrated with the supply chain development process.

6.2 Economic geographical correlation analysis during 2001–2008

As background to the correlation analysis, the costs structures of the variables used in the research data are presented in figures 5 and 6. Figure 5 shows percentage values of the development of the main costs components and sales prices from the wood yard at the mill to customers in 15 countries. These countries are the same as are used in the correlation analysis later in the empirical sections. On average, paper prices have decreased between 2001 and 2008 around ten percent. Similarly, the manufacturing costs have increased during the research period, and together with the price development, the situation has been very challenging and unhealthy for the paper industry.

Figure 6 shows that transportation forms a great part of the total costs, and this distance cost is difficult to avoid in a mill located far from markets. Figures 5 and 6 highlight the Finnish paper industry only had unfavourable choices from which to select, because the costs and prices were unbalanced. The case mill is completely dependent on the export market, like all Finnish paper mills. RISI (2009) estimated that the development of sales prices in paper products will not be satisfactory in the future because of oversupply and lowered demand in the main markets in Western Europe and the USA. Correspondingly, in the whole of Asia, paper demand is growing, but the long transportation times limit paper deliveries from Europe. Additionally, production capacity has increased steadily in Asia.

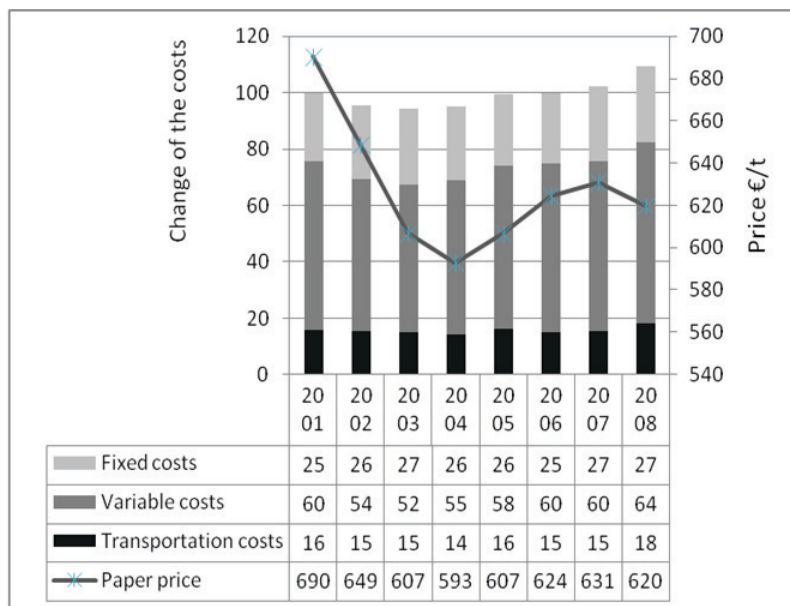


Figure 5 Development of the cost components in % in one Finnish paper mill (2001=100) and paper price development in €/t 2001 – 2008.

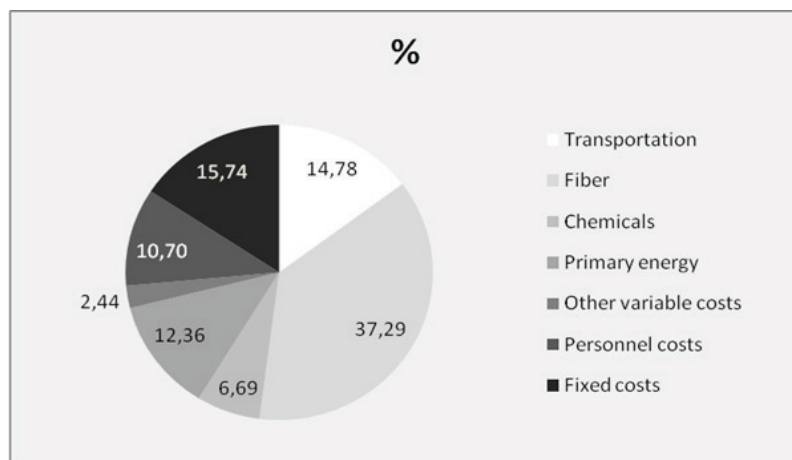


Figure 6 The average cost structure in percentage values in a Finnish mill in 2008.

Figure 7 illustrates how the transportation costs increase absolutely in relation to distance, and thus a distant location is a challenge for a bulk company in Finland. The variety between export countries can be extensive, depending on how many intermodal routes are needed to deliver products from the mill to its customers. Domestic transportation costs are insignificant when compared to the export logistics. The differences in this research context appear to be the transportation costs, because the manufacturing costs of the delivered tons only differ from one another marginally. Transportation to the European main market is costly, and to inland markets, the costs can be even 150 €/paper ton from the Finnish mill.

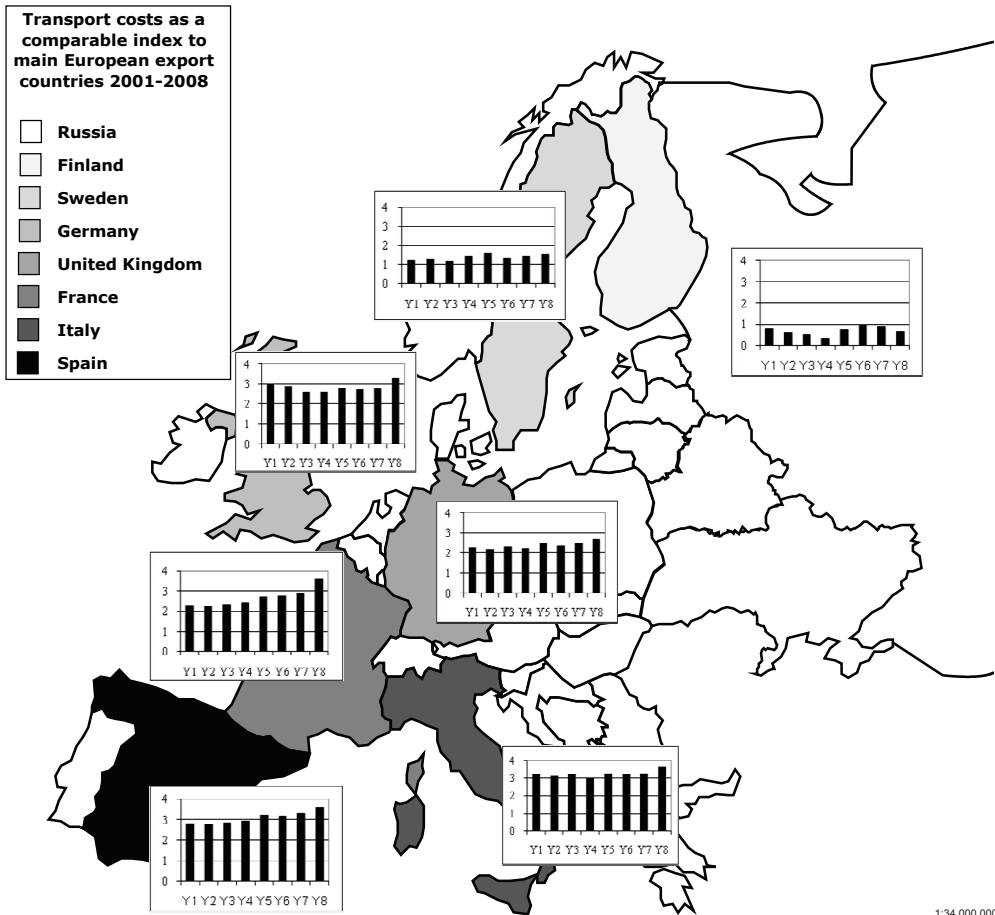


Figure 7 Development of the average transport costs (€/paper ton) calculated as a comparable index to main example export countries 2001–2008 from the case mill.

Strikes in 2005 increased transportation and warehousing costs. The Finnish mills produced beforehand a certain amount of so-called stock orders, which were delivered to the European distribution centers before the block-out period. These were later sold to the customers.

In the following sections (6.2.1–6.2.4), the empirical economic time series are examined with correlation analysis in the spatial context. These findings are not presented in the articles. The basic idea of the correlation analysis is to study whether the economic variables have a relationship with gross margins by country. The correlations are calculated with the total euro values and additionally with the product-based euro values separately to 15 countries annually (12 months), covering all 96 months in total (Table 6). The correlation analysis serves the major study objectives of this dissertation when testing the economic geographical method: Which cost variables correlate significantly with the gross margins and what kind of spatial characteristics exist in these costs factors? How are the statistical dependencies of variable costs and gross margins developed during the time series, and do the market types thus differ by country? The objective

Table 6 Correlations by country and by product.

Country-specific Pearson correlation coefficients are calculated from the total export values to 15 countries. Significance level, r^2 and marked (bold) correlations are significant at $p < 0.05$.	The correlations are calculated from all the total euro values of 15 countries.	Product-specific Pearson correlation coefficients are calculated from the most selling product to 15 countries. Significance level, r^2 and marked (bold) correlations are significant at $p < 0.05$.	The country/product based correl. are calculated from total euro values.												
In the following sections, in the correlation sum up tables, these columns are presented in the analysis.															
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1. N = Amount of the countries in calculations.															
2. Year, 12 months (cases) and in the last row the column 01–08 shows the correlation analysis, which is calculated from the 96 months both by country by country/product as well as from the summed data from the 15 countries.															
3. Amount of the statistically significant countries; summed up.															
4. Total amount of the significant values, summed up from the country values and from all country/product values.															
5. Percentage values of the total significant correlations.															
6. The percentage values summed up = 100 %.															
7. Correlation coefficients, all the economic data of 15 countries are summed up, and correlations are calculated from annual monthly values and from total time series.															
8. P-value, significance level.															

of this method is to link the microeconomic mill data, presented in the time series, within the geographic regions. The method is a new way to approach the export industry, especially the Finnish paper industry. In the appendix, the origins of the used basic correlation values by country are presented, and the following analysis tables have been summed up from them. Additionally, when the author is referring to the spatial issues, these detailed results are presented in the appendix.

6.2.1 Correlations between paper prices and gross margins

Table 7 presents the correlations between total sales, product-based sales and gross margins and the development of these variables during 2001–2008. The study shows that paper prices correlate strongly with gross margins concerning the whole data throughout the time series. The higher the significance values and thus sales prices are, the higher are the gross margins. This can especially be seen in the lesser amount of total values in 2005 and product-based values during 2004 and 2005. The differences during the time series are not very big but still noticeable. Those cases, where there is no statistical dependency between sales prices and gross margins, are quite specific in some sense, and they should be studied in more detail in future studies.

Both the complete country-based data ($R^2 = 0.63$) and the product-based data ($R^2 = 0.67$) respectively show very high correlations when the values were calculated from the total time series (96 months) covering all sales to examined countries. When calculated

Table 7 Correlations between sales in euro and gross margins total sales and product-based sales to 15 countries.

Sales in euro total values						Sales in euro product based values					
Country-wise correlations				All 15 countries together		Country-wise correlations				All 15 countries together	
N	Year	Stat. signif.	%	r ²	p	N	Year	Stat. signif.	%	r ²	p
15	2001	15	16	.299115	.065741	15	2001	15	15	.386828	.030823
15	2002	12	13	.069366	.408179	15	2002	14	14	.192298	.153864
15	2003	13	14	.024357	.628130	15	2003	10	10	.076357	.384619
15	2004	9	9	.039632	.535062	15	2004	14	14	.546343	.006018
15	2005	11	11	.587911	.003619	15	2005	9	9	.577905	.004107
15	2006	14	15	.173976	.177342	15	2006	10	10	.004369	.838284
15	2007	11	11	.356365	.040431	15	2007	15	15	.765337	.000195
15	2008	11 96	11 100	.613773	.002574	15	2008	10 97	10 100	.760322	.000218
96	- 01 -08	15		.630227	.000000	96	- 01 -08	15		.666993	.000000

separately, the country-based correlations show clear statistical significance between paper prices and higher gross margins. Values vary in the 15 countries from 27 to around 77 percent. There were strikes during 2005, and the paper mills stopped paper production for several weeks, which can be noted from the correlations. Paper prices have, during the past years, become a highly important issue for the paper industry. This can be seen when studying the time series. Paper prices have declined significantly from 2001 to 2008 due to lowering demand. At the same time, the mill has not contrived to make sufficient cost reductions, and thus the costs have not yielded like they should have.

During 2007 and 2008, the paper market highlights the influence of lowering demand and drop in the sales prices. The study shows that margins are strongly dependent on the price level. The total sales values and product-based sales values both have close to the same number of months when there is statistical significance between prices and margins, namely during 96/97 research years out of the total 120 research years. When we calculated correlations by country, the results show that paper prices have high statistical dependency with prices throughout the period. When exploring the results of a single product/country, the main indication is that the paper prices, without exception, have higher statistical dependency with the gross margins than with total country-based numbers.

Clear spatial variations exist, but during the research period, the overall data shows that the sales prices have had a strong correlation coefficient with the gross margins. At the country level, analyzing with both total and product-based values, the paper prices are evidently one of the most important factors that explain the margins. The case mill's major market is Europe, and the results of the empirical data support the argument that the price competition was heavy, especially in 2007–2008. Particularly on the largest sales markets, like Germany, United Kingdom, France, Spain and Italy, prices correlate significantly with gross margins during the time series. The Finnish mill must be able to sell paper products to these countries profitably, or the profitable operating of the mill becomes very challenging. These observations concerning the significance of paper prices can be generalized particularly to cover other printing paper mills in Finland.

6.2.2 Correlations between transport costs and gross margins

Table 8 presents how the transport costs correlate with the gross margins at the country level. The higher the correlation value is, the more the transport costs lower the gross margins. When the correlation coefficient is low or insignificant, the analysis does not find any statistical dependency between transportation costs and gross margins for that country and year. The table shows that variations are understandably very different from country to country. In the whole data, the relationship of the transport costs with margins is relatively low. However, the transport costs have an essential economic impact on the paper mills and understandably the locations of the customers heavily affect these costs. Therefore, the time series are valuable to examine by country, which gives the possibility of sorting out and comparing the spatial characteristics.

The total values in this study show that, to some inland and larger countries with long road and/or train transportations, statistical dependency between transportation costs and lower margins is greater than to small seaside countries. From the point of view of the annual variations, it is noticeable that, during 2001–2003 and from 2006 onwards, transport costs lowered gross margins in more countries than during the other years. During 2004 and 2005, there were lower paper prices, and thus during these years, prices may explain most of the lower margins. The analysis shows averagely quite a low correlation between transportation costs and gross margins. Still, both geographical heterogeneities and time-based differences can be found in the research data. This phenomenon should be taken particularly seriously in the supply chain development processes and budgeting calculations. To sum up, transportation does not have a great significance until 2008, when statistical p-values start to lower. There is a clear increase in the values by country and by year and their correlations during 2006–2008.

The total correlations are calculated from two different angles. Firstly, the country-based total data show relatively low correlation ($R^2 = 0.21$). Secondly, the product-based correlation coefficient is at a slightly higher level ($R^2 = 0.26$). In both cases, values were calculated from the total time series (96 research months) covering all deliveries to researched countries). Product-based calculations show very high statistical significance during 2007 and 2008 ($R^2 = 0.63$ and $R^2 = 0.80$). Separately calculated country-based correlations show clear statistical significance between higher gross margins and transportation costs. The correlations vary in the 15 countries in total values from a high 77 percent to *no significance*, and in product sales from 76 percent to *no significance*. These correlations show that transportation costs can have as high a dependency on gross margins as paper prices. Additionally, low correlation especially demonstrates that, in local markets, the transportation costs have no statistical significance to gross margins. Such countries are e.g. Finland and Belgium. The former is the domestic market and the latter has its own import harbor and a direct short sea route as well as a short truck delivery to customers from the harbor. France is a country where transportation costs have no statistical significance with gross margins in total values. In comparison, product-based time series shows that, in Finland as the home market and in Belgium as a small seaside country, transportation has low statistical correlation with gross margins. Therefore, geography clearly matters in economic topics in many ways, but the effect of the distance is not always clear. Sea transport gives some possibilities for lowering

Table 8 Correlations between transport costs in euro and gross margins total sales and product-based sales to 15 countries.

Transport costs total values						Transp. costs product based values					
All 15 countries						All 15 countries					
Country-wise correlations						Country-wise correlations					
together						together					
N	Year	Stat. signif.	%	r ²	p	N	Year	Stat. signif.	%	r ²	p
15	2001	9	15	.068649	.410701	15	2001	12	15	.001801	.895808
15	2002	5	8	.124836	.259907	15	2002	10	12	.151798	.210596
15	2003	12	20	.207775	.136415	15	2003	10	12	.207584	.136618
15	2004	2	3	.002150	.886223	15	2004	8	10	.224963	.119258
15	2005	3	5	.123644	.262355	15	2005	7	9	.104362	.305731
15	2006	11	18	.226571	.117761	15	2006	11	14	.016449	.691198
15	2007	11	18	.137772	.234876	15	2007	14	17	.627293	.002136
15	2008	8 61	13 100	.261929	.088960	15	2008	9 81	11 100	.798735	.000089
96 - 01 - 08						96 - 01 - 08					
13						13					
.210919						.000003					
						.259781					
						.000000					

export transport costs from the Finnish mills, but the inland truck transporting in the European continent easily eats away these advantages.

The product-based values show that, when the correlation coefficient is calculated at the lower and more detailed aggregate level, the significance appears more often than with the higher level of total values. This economic geographical research method explains correlations between variables better at the product and more detailed level. The data at the country level and at the country/product levels show how the soaring oil prices (see e.g. WTGR, 2010) have a strong influence on the transport costs by lowering gross margins during 2006–2008. This can be noted especially at the product level. The data show a novel issue; the purely mill-based average economic figures are quite misleading and hardly help in detailed logistics planning at all. Classified data are particularly needed and are collected from different geographical markets data, and these values certainly elicit more information on the total target market. Our study shows that the higher the aggregate level is (from the product level upwards), the lower the correlations are annually. This can be seen clearly in the product-based transport costs correlations, when comparing the total summary values with the country-based values. The used product was the only one exported during the whole time series, as it was not possible to use other products.

6.2.3 Correlations between variable costs and gross margins

Table 9 demonstrates the statistical dependencies between variable (raw material) costs and the gross margins of the paper deliveries in different countries and market areas. The higher the statistical significance value is, the more the variable costs lower the gross margins.

In the whole research data (96 months), the impact of the variable costs is relatively low, but during the same period in every research country, the variable costs had significant effects on the margins. The variations in the correlations indicate that the paper grades differ slightly from one another with regard to raw materials and packages when delivering paper rolls to different markets and customers. The variable costs, which consist mainly of direct manufacturing costs, have become less important after 2001, but during 2007–2008, the impact on the margin has increased, pointing out that the

Table 9 Correlations between variable costs in euro and gross margins total sales and product-based sales to 15 countries.

Variable costs total values						Variable costs product based values					
All 15 countries together						All 15 countries together					
Country-wise correlations						Country-wise correlations					
N	Year	Stat. signif.	%	r ²	p	N	Year	Stat. signif.	%	r ²	p
15	2001	13	17	.034511	.563225	15	2001	13	15	.113504	.284235
15	2002	11	15	.041671	.524521	15	2002	13	15	.115967	.278740
15	2003	12	16	.000014	.990764	15	2003	9	10	.004215	.841127
15	2004	5	7	.021085	.652513	15	2004	13	15	.415648	.023613
15	2005	8	11	.457485	.015728	15	2005	7	8	.350972	.042378
15	2006	9	12	.023254	.636121	15	2006	9	10	.001859	.894155
15	2007	9	12	.136107	.237947	15	2007	14	16	.616964	.002465
15	2008	8 75	11 100	.409650	.024981	15	2008	11 89	12 100	.648280	.001578
96 -01 -08 15						96 -01 -08 15					
						.230747 .000001 .334374 .000000					

material costs have not lowered. The significance of the variable costs in the total values decreased from 2001 to 2005. At the country level, the whole time series shows that the variable costs have a clear but relatively low impact on the gross margins.

The correlations are also calculated from two different angles. Firstly, the total country-based data show a significant relationship ($R^2 = 0.23$). Secondly, the product-based values show a higher dependency level ($R^2 = 0.33$). The whole time series (96 months) is used in these calculations. The separately calculated country-based correlations show clear statistical dependency between gross margins and variable costs in most countries. Among the fifteen countries, the values vary from 69 percent to *no significance* and in product-based values from the very high dependency of 79 percent to 12 percent. The correlation shows that the variable costs have a clear dependency on gross margins, although these differ from market to market. The product-based correlations have presented a stronger relationship during the past years. The increase of the impact on variable unit costs during the research period can be seen in Table 9. The amount of the significance in the product-based figures was low during 2005. The costs rises during the economic boom in 2007–2008 were distinctly the main reason for the higher correlations between variable costs and margins. The mill-based values show that strikes during 2005 had an effect on the gross margins, especially at the mill level. During 2005, there were lower sales due to strikes and more production stops. However, the mill purchased raw materials for material preparation in advance. Therefore, at the mill level, the variable costs have a high significance on the margins. Similarly to sales prices and transportation costs, when the aggregate level rises, the impact on the correlation decreases. However, the impact of the material costs really matters on the margins by markets in the paper industry, and it cannot be ignored in economic planning.

6.2.4 Correlations between fixed costs and gross margins

As could be seen with the variable costs, the fixed costs (wages, maintenance and overhead) also have a relatively low correlation with the margins when looking at the whole research data (Table 10). The higher the significance figure is, the more the fixed costs explain the lower gross margins. When analyzing the correlations annually and with product-based values, the data show that, in the past years, the significance between

Table 10 Correlations between fixed costs in euro and gross margins total sales and product-based sales to 15 countries.

Fixed costs total values						Fixed costs product based values							
Country-wise correlations						Country-wise correlations							
All 15 countries together						All 15 countries together							
N	Year	Stat.	signif	%	r ²	p	N	Year	Stat.	signif.	%	r ²	p
15	2001	14		18	.251462	.096723	15	2001	14		15	.331207	.050235
15	2002	9		11	.000004	.994913	15	2002	14		15	.023797	.632162
15	2003	12		15	.049275	.488059	15	2003	10		11	.061071	.438717
15	2004	6		8	.000576	.940961	15	2004	14		15	.501234	.009986
15	2005	11		14	.580233	.003989	15	2005	8		9	.630249	.002049
15	2006	10		13	.002085	.887930	15	2006	9		10	.006710	.800206
15	2007	9		11	.163241	.192716	15	2007	14		15	.663735	.001249
15	2008	9	80	11	.533464	.006985	15	2008	10	93	11	.661835	.001286
96	-01-08	15			.290655	.000000	96	-01-08	15			.290321	.000000

the fixed costs and the margins has increased. Together with the variable costs (direct manufacturing costs), the costs have become an important issue for the mills located far from the main markets after 2004 (see also Fig. 5).

For the part of the fixed costs, the correlation calculations are made in two ways, like in previous calculations with other variables. Both the country-based and the product-based data show statistical relationships ($R^2 = 0.29$). Country level longitudinal and total time series (96 months) are used in both these calculations. Next, the country-based correlations are calculated to show statistical significance between gross margins and fixed costs. Values vary among the 15 countries from a high correlation of 61 percent to a low significance of 15 percent in the total values by country. In product-based values, the dependency varies from a moderate 29 percent to a low 9 percent. These calculations show that the fixed costs have some dependency on gross margins, although variation is great from market to market.

The fixed costs are quite constant in paper mills, and these costs are usually not directly dependent on paper production and the paper markets. A mill can decrease the impacts of the fixed costs mainly by the scale of economics, putting the effort in paper grades that run faster through a paper machine line and minimizing converting costs like sheeting and cutting. The machine line binds a lot of fixed costs. Therefore, more efficient production in time units (tons per machine hour) should be the focus if a mill plans to decrease its fixed unit costs per paper ton. This depends centrally on the paper machine (width & speed) and grade type. In Finland, the wage level is high in the paper industry, mainly because of the capital intensiveness and the industry's strong influence on the Finnish export sector historically.

6.3 Summary of correlations

In the following Table 11, the amounts of the country-based annual correlations are summed up. They help to analyze how the dependencies of the different economic variables have developed during the time series. The data show prominently that the economic research variables explain gross margins differently both geographically and from year to year. This shows that forecasting should be done at the country or re-

Table 11 Sum up table representing the variables and the amount of the correlations during the research years .

Year	Total country based correlations				Year	Country/product - based correlations			
	Sales amount of correl.	Transp. amount of correl.	Variabl. amount of correl.	Fixed amount of correl.		Sales amount of correl.	Transp. amount of correl.	Variabl. amount of correl.	Fixed amount of correl.
2001	15	9	13	14	2001	15	12	13	14
2002	12	5	11	9	2002	14	10	13	14
2003	13	12	12	12	2003	10	10	9	10
2004	9	2	5	6	2004	14	8	13	14
2005	11	3	8	11	2005	9	7	7	8
2006	14	11	9	10	2006	10	11	9	9
2007	11	11	9	9	2007	15	14	14	14
2008	11	8	8	9	2008	10	9	11	10
Total	96	61	75	80	Total	97	81	89	93
% /120	80	51	63	67	% /120	81	68	74	78
- 01 -08	15	13	15	15	- 01 -08	15	13	15	15

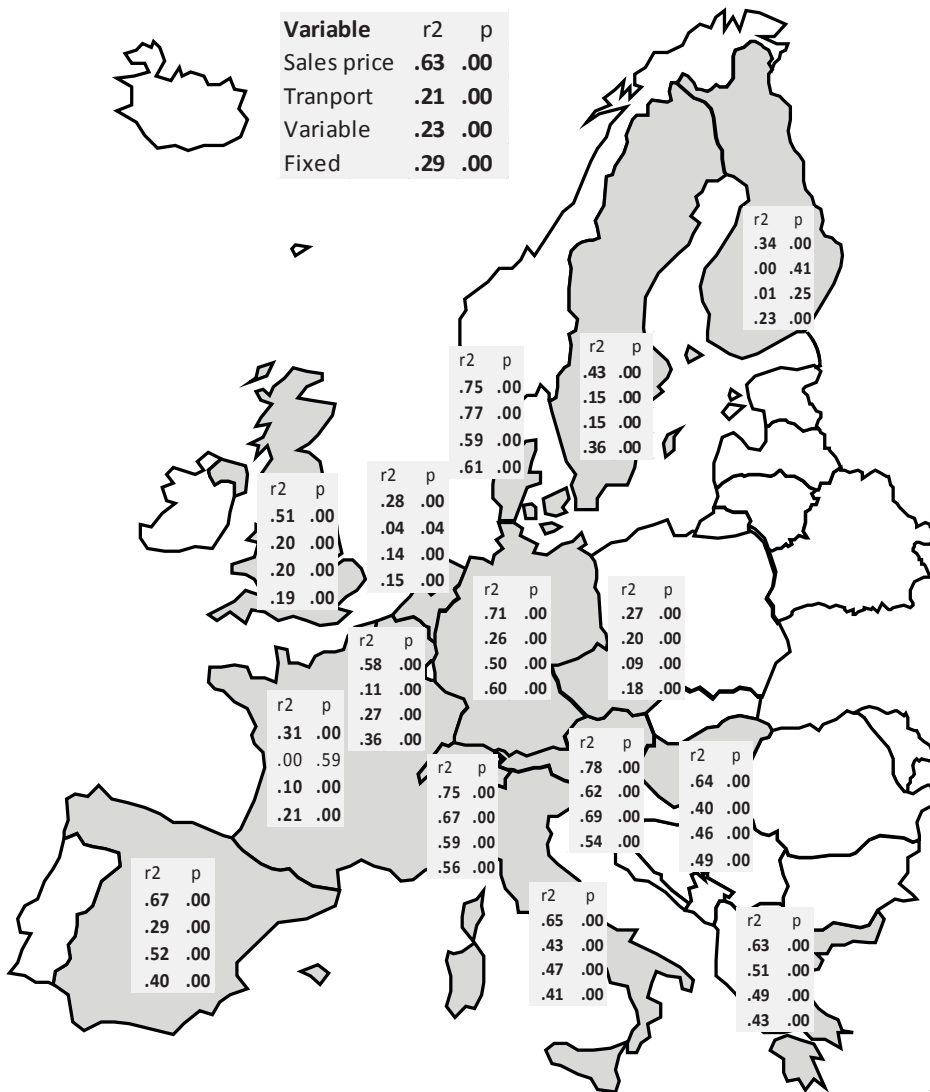
gional level when possible. The impacts of the economic variables vary from country to country (Appendices 1–8). In Europe, on average, the impact of the transportation costs rises when distance increases. This is revealed on the European map. The transportation costs have no real significance on the gross margins in the home market, but transportation costs to countries that do not have their own harbor have a big impact on the gains at the country level. In its economic forecasting, a mill should definitely use the product, customer and country specific information and avoid the average mill level figures. The supply chain factors from the timber yard at the mill to the foreign customers should be explored separately by country to get detailed facts of the market and delivery circumstances.

The evident fact is that the paper prices have the highest importance when a paper mill attempts to stay profitable. The research data show that the cost reductions have not been sufficient and, obviously, reductions are difficult to get through. The paper prices correlate significantly with gross margins in around 80 % of the so-called embedded cases. As Figure 5 shows, the paper prices have lowered and thus the other variables, like transport costs, have clearly gained importance. Table 11 shows the amount of those correlations that are statistically dependent on both the total (Figure 8) and the product country/levels (Figure 9). The table presents how the impact of the different variables has developed during the research years from the perspectives of the whole mill and a single product in the 15 countries. The paper prices have an impact on the gross margins from the perspective of the total and the product research. The transport costs clearly have a higher impact on the gross margins when calculated by product. Additionally, variable (raw material) costs show a clearly higher impact on the gross margins at the product level. Overall, the product-based correlations seem to have higher explanatory accuracy and sensitivity than the total values. This indicates that, on the higher aggregate stage, the correlation analysis loses some of its ability to explain the relationship between different economic variables. When the aggregate level mounts from the product-based to the country level, the average information becomes more central.

The correlations calculated with product-based economic time series clearly give higher explanatory values when calculated annually by country. Figures 8 and 9 present the map correlations for both total and product values from the whole 96 months of time series. These empirical results show that the research data at the low and detailed level give important insight into the research object.

Marked correlations are significant at $p < .05000$
 N=96 (Case wise deletion of missing data)

Correlations in whole mill data 2001-2008



1:28 000 000

Figure 8 Correlations of total mill based sales prices (€), transportation (€), variable and fixed costs (€) with gross margins (€), monthly 2001–2008.

Marked correlations are significant at $p < .05000$
 N=96 (Case wise deletion of missing data)

Correlations in product based data 2001-2008

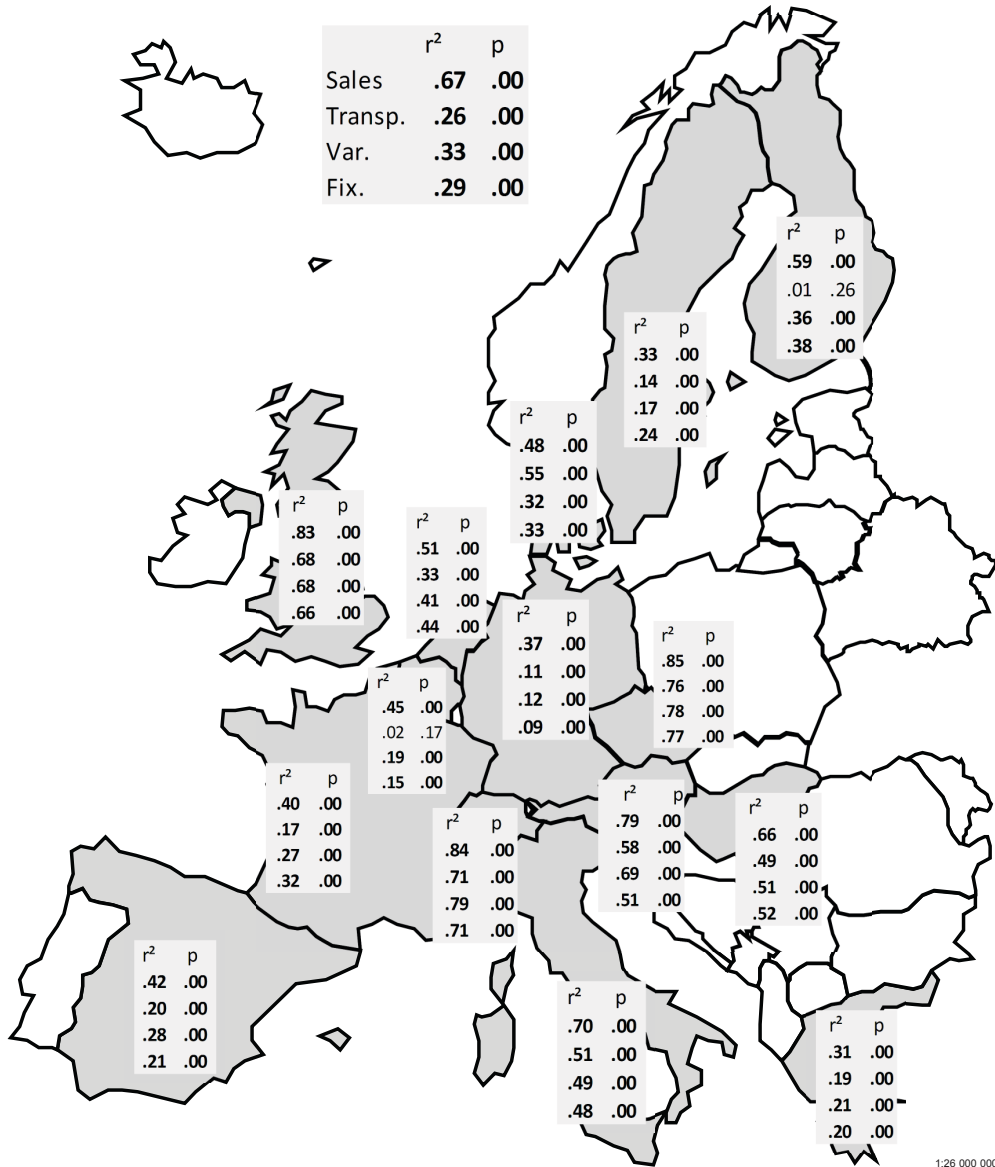


Figure 9 Correlations of product-based total sales prices (€), transportation (€), variable and fixed costs (€) with gross margins (€), monthly 2001–2008.

7 ENFOLDING THEORIES AND EMPIRICAL RESULTS

7.1 Micro-economy of paper industry in spatial context

The Finnish economic geographers have studied the Finnish paper industry with empirically based economic data very scantily earlier. The paper industry has mainly been studied by Finnish geographers from the environmental perspective as well as the industry sector's development of the local community and economy (see e.g. Kortelainen, 1991, 1993; 1994). Additionally, Tykkyläinen (see e.g. 2005) studies the spatial restructuring of rural Finland between the 1960s and the 1990s, when the paper industry has been considered an important export industry. This has been and still is an essential economic driver in rural regions. These articles do not describe paper mills as an economic geographical object, and this case study aims to remove this absence. Arbia (2001) notes irreproachably that location and economic geographical characteristics have been regarded as irrelevant factors in many economic theoretical studies.

From the economic geography angle, when there is competition between firms, particularly location itself makes a significant contribution to competition (Sheppard, 2005). From this perspective, this case study indicates that, for the case mill, the existing location does not always support receiving high margins, particularly because of high transport costs and increased manufacturing costs. Plummer (2005) points out that we need to construct relatively simple models and analyses to understand how systems operate. In the articles as well as this study, we have mainly used statistical correlation analysis but also trends graphs when explaining the dependencies of different variables. Schoenberger (1998) reminds us that competition is mostly understood to be economically beneficial, but our study shows that the Finnish paper mills have had difficulties in succeeding economically in these existing competition circumstances. Location clearly matters, especially when oil prices are high.

Geographers are inclined to focus their studies on the empirical reality in the world, and there is a general interest for empirical economic studies alongside the purely theoretical ones, according to Martin (1999), Sheppard et al. (1998) and Scott (2004). This dissertation supports, with interdisciplinary and empirical methods, the economic geographical tradition by combining the economic results with the spatial context. The results of this study strongly support the view that economic issues, like transportation costs, paper prices and demand, differ from country to country and that they are generally very specific in nature. Our study supports the earlier discussions stating that geographically based economic data give the possibility to reveal the differences between countries in this sense. This study promotes economic studies and market-based analysis that focuses on the exporting industries.

According to Davis and Weinstein (2003), the comparative advantage theory explains economy and trade by inherent differences between countries. Certain countries, like Finland and Sweden, have had particular advantages to make e.g. paper products and export them even to distant markets. This study gave an indication that some comparative advantages that were very important earlier (such as inexpensive raw materials together with hydro energy and highly productive paper machines) in the Finnish pa-

per industry do not exist anymore, as vital as they were before. There are several particular reasons for this, as the difficult demand circumstances in Europe as well as the long transport distances bring out an extra significant cost factor along with lowering paper prices. These costs are not easy to overcome with the present paper prices, which do not support paper mills to remain in Finland.

This dissertation found strong couplings and linkages between empirical microeconomic data and spatial differentiations, which, according to Behren (2009), are missing at present in economic literature. The econometric models are based on mathematical assumptions, which are generally far from the empirical spatially heterogeneous realities. Additionally, the empirical evidence often remains rather confusing, because there is a lack of relevant and valid microeconomic data. Many researchers are complaining of this absence of the real world connection. One of the original purposes to design and make this study was to remove this absence and take actively part in the discussion, mainly through published articles and the findings and analysis based on the empirical mill data.

7.2 Enfolding transportation costs in empirical spatial contexts

There are plenty of researchers who find that the impact of transportation costs on the location of the industry has been somewhat ignored recently. This is particularly a result of the availability of inexpensive transport, which is mainly based on cheap oil “death of distance” (see Rietveld and Vickerman, 2004 and Plummer and Shepard, 2006). As has already been mentioned, the Finnish paper industry has developed strongly during the high paper demand in Europe from the 1950s to end of the 1990s when transportation was relatively inexpensive. Considering this topic, Brakman and Garretsen (2005) argue that due to the rising transportation costs, firms have to think more intensively about their location. The empirical results of this study support the issue that transportation costs will become more topical than ever, especially in the paper industry, which uses common transport means. The case study supports the view of Wu and Olson (2008) that transportation issues have become a major element in the global economy.

Hesse and Rodrigue (2004) consider that there is a need for empirical investigations, which seem to be challenging to execute in economic literature. Earlier, there was little real scientific evidence on the impacts of the transportation costs to margins in the paper industry. The main argument and central problems are the absence of reliable transportation and other cost data, which was explained to be difficult to obtain from the mill sources even for research purposes. Behrens et al. (2009) argue that freight rates are taken as exogenously given parameters, which assumes that the market for transport services is either perfectly competitive or fully regulated. The transportation costs for this study are obtained from the mill and therefore they are formed under constant and international competition and show the real market freight prices. This gives real novelty value for the economic geographical discussion.

MaCann (2002) claims that, in the existing competition situation, the manufacturing firms require greater flexibility in relation to local wages. This case study gives the opposite empirical outcome regarding Finland. Regardless of the costly transportation

or low paper prices in the mill, the proportion of the fixed costs (wages, maintenance and overhead) has not been flexible, and they have hardly decreased at all during 2001–2008. Additionally, the statistical relationship of the fixed costs with the lower gross margins is significant. Kilkenny and Thisse (1999) remind that these firms, selling their output outside the region they are located in, are facing two opposing constraints:

1. They must set a price that is high enough to cover trade costs, including all logistics costs from the mill to markets.
2. They must set a price that is low when compared to the one charged by local competitors.

These obviously competence-linked decisions are not possible to achieve without compromising the returns, according to the mill data. The existing paper market can be considered to be almost under perfect competition due to decreasing paper demand and vast oversupply. The paper prices are set by the market, and the imperative transportation costs to the market from the Finnish mill cannot be charged fully. Instead, the mill must calculate the total costs case by case and estimate whether the deliveries are profitable or not. To some extent, the mill can deliver unprofitable orders to remain in business, but this market share oriented function can only work for short periods.

In the paper industry, competitive ability and circumstances should also be gained with other methods than with price competition. These include scale in production and purchasing raw material as affordably as possible to gain cost-effectiveness. Paper prices have lowered due to oversupply, and overall costs have increased. This combination has led to the result that the competitive advantages have clearly lowered in the Finnish paper industry. Ottaviano et al. (2002) point out that firms profitably export to a foreign region when trade costs are sufficiently low. When trade costs are sufficiently high, these above presented two constraints (A and B) are always incompatible for all industry distributions (Behrens, 2004), and firms do not export to foreign regions. In this study, the economic factors strongly indicate that relocations of some mills and paper production will take place in the Finnish paper industry in the future if the paper market will not become balanced with demand in Europe (see e.g. M-Real, 2010). The paper prices should be high enough and the transport and material costs low enough in order for the exports to be profitable from the Finnish mills to the Euro area. Like Behrens et al. (2009) state, in the transport sector, especially shipping has imperfectly competitive segments. This note worsens the optimism in Finland for easily decreasing the mandatory short sea transportation to Europe. Another reason is that the bulk ships arrive back to Finland only partially loaded or even empty due to low imports, so the ships charge more from the Finnish export industry. The empirical data highlighted that the transportation costs fluctuate and increase significantly across the countries when physical distance grows. This results in the higher significance of lowering gross margins in landlocked countries compared to coastal countries (Limão and Venables, 2001). The transport unit costs are understandably much higher to inland regions in Europe than to the seaside regions. The Finnish paper industry functions like Kilkenny (1998) and Isard (1956) argue; it is cheaper to ship the output (paper rolls) than the input (timber in tons per unit paper rolls). The material-oriented industry, like the pa-

per industry, is called weight-losing (Weber, 1929), and the optimal location for such an industry is considered to be at the input location. The empirical results indicate that the future can be challenging, because the transportation costs correlate significantly with the returns. Transportation costs are difficult to decrease, and therefore the paper companies must rethink carefully where to locate new paper machines in the future, and that place might not be Finland. Dicken and Lloyd (1990) emphasize that one of the central concerns of geography is the friction of distance, which refers to the impediment to movement that occurs when places are geographically separate. This study showed that the export locations and transportation to them brings out heterogeneous results from the point of view of the case mill. Rodrique et al. (2006) reminds that originally geographically based advantages (energy and inexpensive timber in the paper industry) are currently affected by spatial frictions like distance (transportation costs to market in the paper industry). Additionally, Rodrique et al. (2006) stress that the comparative advantages between countries are disturbed by the frictions of space and this is central to many geographical considerations of economic processes. This dissertation presents empirically that the impacts of the frictions (transport and warehousing costs) can be seen best from the amount of significance to margins. This significance (frictions) varies by country, and the correlations are different between countries. The results of this study support the views of Behrens et al. (2007), who noted that spatial frictions between any two regions are likely to be different. The access to several markets is the key issue faced by a firm making its location choice (Beckmann and Thisse, 1986). The present trend of increasing transport costs due to higher fuel prices will strengthen the possibilities for using sea transport in combination with fast modes to curtail the frictions (Henstra et al., 2007). For the Finnish export paper industry, the intermodal truck/train-short sea-truck transporting is the backbone of international trade. This obligatory and costly friction has been eliminated decades ago by scale in production, like faster and wider paper machines. Hall et al. (2006) note that the physical amount of freight has increased during the past twenty years because of lower costs. This situation may change in the coming years due to soaring oil prices, as Plummer and Sheppard (2006) remind. The empirical material supports these above-noted views that high transportation costs form frictions, which have become more decisive for the location decisions of the Finnish paper mills and other comparable bulky industries.

7.3 Evolutionary economic geography vs. NEG and paper industry

The empirical results of this study show in the form of correlations that the economic performance of regions varies because of the differences in their characteristics, as Esletzbichler and Rigby (2007) argue. This phenomenon is especially true in transportation costs, which the Finnish paper mills have confronted since the mills have been built. The present situation is more profound due to paper demand and costs developments. The empirical results indicate that there are several obvious issues that dictate how the industry will develop in Finland. It is possible that the evolution that happened in Finland during 2001–2008 will continue, because paper demand is estimated to lower slowly in the European market. The environment of the Finnish paper industry may also transform radically in the future due to it being heavily export-dependent.

As evolutionary economic geographers stress, all companies depend on demand development and changes in consumer behaviors. The paper demand has lowered in Europe due to digital media having increased (see e.g. Hetemäki and Nilsson, 2005 and RISI, 2009). This process should be understood more as dynamic evolutionary economic development based on the institutional turns and perspectives and studied empirically rather than just as path-dependent, static and analyzed with theoretic mathematical models (see e.g. Grabher, 1993; Cooke and Morgan, 1998 and Amin, 1999).

Krugman (1999) considered geography the most natural and non-linear area of economics. The empirical research of this dissertation combined with the findings of the articles supports Krugman's arguments that there is no such matter as a homogenous economic space from the point of view of the exporting industry. Instead, the spatial dimension of the economic issues is very heterogeneous from the perspective of the export industry. There are clear variation and changes from the geographical perspective in the time series. This examination shows that the different economic variables, like paper prices, transportation costs and other economic variables, behave differently in different times and markets from the point of view of geography.

Krugman (1991a) notes that, because of the high transportation costs, firms will relocate manufacturing near its largest market, thus minimizing transportation costs. This is evident in the Finnish paper industry. Our empirical findings show that the geographical distance is no longer an irrelevant issue for the Finnish paper industry. This fact has been explored by economic geographers long before Krugman's discussions, starting from German researchers like Weber, Lösch and Christaller (e.g. Martin, 1999 and Scott, 2004). Martin and Sunley (2007) criticize that the economy is a complex system, which is largely due to it being spatially distributed. This study has shown that geography contributes to the complexity of this challenge as it can increase the awareness and openness of a specific industry and economy with empirical studies (see e.g. Dopfer and Potts, 2004).

Martin (1999) criticizes that Krugman (1991a) fails to approximate 'real places' or to incorporate the spatial scale of the empirical world. This dissertation attempts to especially incorporate the spatial scale. There are several researchers (Neary, 2001; Ottaviano, 2003 and Head and Mayer, 2004) who note that there is need for such empirical research on the NEG. Behrens et al. (2009) consider that researchers should examine transport costs simultaneously with differences in the size of regions. In this dissertation, all the freight rates are set by the market. The unit rates in euro per paper ton are collected from the customer invoices by country and summed up monthly. Davis and Weinstein (1999) also claim that Krugman's theory has not developed the economic geographical model with sufficient generality to simultaneously deal with differences in the size of regions, goods and industries as well as to allow for differences in input composition and demand structure. This dissertation demonstrates strongly how sales to 15 European countries of different sizes behave differently from the perspective of a paper mill's economics. The country-specific longitudinal data resulted in big differences in the correlation analysis. Especially Lanaspá and Sanz (1999) emphasize that Krugman's model does not solve all problems; it just marks a path towards the potential construction of solid explanatory models. The most economically oriented trade theorists are still reluctant to the idea of assuming that different countries have different lev-

els of access to one another. Instead, they keep working largely in settings where market accessibility does not really matter. This study clearly shows that market accessibility with transport costs really matters. Transportation has a different and, in some inland countries, a very high impact on the gains of the exporting company between countries over the time series.

Behrens et al. (2007) consider that economies of scale of any type can lead to the spatial concentration of activities. Average costs may decline because of the scale of an industry. This study demonstrated an opposite development in the Finnish paper industry, the scale of economics has lost a lot of its strength because of high transportation and manufacturing costs or simply location of the sites. These increases in costs pressure the margins, because the paper prices have lowered during the same time (Figure 5). Additionally, this study shows that, between 2006 and 2008, the investments have decreased significantly compared to the earlier years. Oversupply of paper products and the ensuing fierce price competition in Europe leads to paper companies locating new paper mills with modern and larger production units far apart to other continents, like Asia, where demand is growing. Even Krugman (1991a) demonstrated with his NEG models that, when firms do not compete strategically, they concentrate when transport costs are low enough. This type of concentration was clear earlier in the Nordic paper industries because of comparative advantages like production economics in scale and low transportation costs based on inexpensive oil. In Finland, the process of mill closures started widely in 2001, and the aim was to close unprofitable production units and at the same time lower the paper supply. This process probably suggests that the paper industry will relocate in some scale away from Finland (see e.g. Hetemäki and Hänninen, 2009), following, in a way, the principles of the evolutionary economic geographical theories. These theories emphasize that, when the role of the transportation or manufacturing costs increases, production moves nearer to the market. This economic theory based on the industry location is revealed and researched already in Weber's discussions nearly 100 years ago. The trade-off between fixed production costs and transportation costs is central to the spatial organization of an economy (Kilkenny and Thisse, 1999). Higher fixed production costs constrain the number of places where economic activities can develop. A reduction in transportation costs allows for a decline in the number of economic centers. An industry characterized by large investments and low transport costs, even though endowments may be spatially homogeneous, is likely to experience uneven spatial development with many activities concentrated in only a few places.

In the Finnish paper industry, the development was previously typically as mentioned above, and production was thus concentrated on the large integrated units. However, this study shows that the development in the Finnish paper industry is menaced by low sales in euro, high manufacturing costs and transportation unit costs that can be up to five or six times higher than those of its European competitors. The Finnish companies are not able to restore cost advantages together with price increases in an oversupply situation. The evolutionary economic geography gives new insight when researching the paper industry with empirical data. The economist theoretical models put aside spatially based heterogeneities and emphasize the mathematically oriented point-to-point theories.

7.4 Home market effect and empirical results

Crozet and Trionfetti (2008) note that models characterized by the presence of increasing returns to scale, monopolistic competition and trade costs typically give rise to what has become known as the home market effect (HME) after Krugman (1980) and Helpman and Krugman (1985). They argue that when differentiated and specialized goods are produced under increasing returns to scale incurring transport costs, firms producing these goods tend to concentrate on the largest market in order to save on transport costs. The firms are attempting to increase the margins by locating nearer to larger markets, because differentiated products must be transported individually. Krugman (1980) notes that HME can be formulated so that high local demand could lead to a good being exported. If high demand increases exporting, home production must be more than the demand.

The Finnish paper industry (like the case mill) exports over 90 percent of its production, mainly to Europe. The home market has an extremely minor effect on the mill's economic result. There is practically no room for increasing supply to the home market. In the Nordic countries, from the early 1900s, the paper industry was founded and developed attributable to the absolute advantages, which can explain trade by inherent differences between countries. Later in the 1900s, the increasing returns of the Finnish paper industry explain trade by economies of scale with bigger paper machines and advantages from specialization in higher valued paper grades. This is a significant, important and topical issue for the Finnish paper mills located far from their markets. This study disclosed that the international competition has a crucial impact on Finnish paper mills, and, at present, companies are facing higher economic risks. Home markets are not able to compensate these negative international effects.

7.5 Some paper mill features of supply chain: demand, costs and prices

In the supporting articles 1–3, the paper mills' supply chain is explored from the perspective of geography to find out whether there are any relevant linkages between the supply chain and spatial issues. These three articles reveal how transportation costs affect the mill's profitability. As background, it can be stated that the paper process from the timber yard to the customers is a complicated value-adding process in which the supply chain consists of "open-loop" systems. Goods are produced and distributed in the marketplace according to historical or anticipated demand (see e.g. Diesen, 1998 and Kosior and Strong, 2006). The empirical mill data (articles 4 and 5) showed that differences between the actual and the estimated demand can be very high. The anticipatory forecasting methods should be 'calibrated to be market-specific' to give more reliable demand information already at the customer level. Articles 4 and 5 also showed that there were problems in estimating the paper prices and respectively the variable (material) costs. The forecasted values of supply chain costs were, in some periods, highly different from the actual ones. The most worrying issue was the low correlation coefficient between estimated and realized margins, which suggests that the economic steering can be difficult. Especially Pesonen (2001) attributes that any management system is sensitive to product volume and price fluctuations as well as unpredictable changes in the business context.

The logistics and supply management literature provide much evidence that SCM enhances business performance (see e.g. Mentzer et al., 2001; Shang and Marlow, 2005 and Schramm-Klein and Morschett, 2006). However, Töyli et al. (2008) note that surprisingly little empirical affirmation has been presented of a relationship between financial and logistics performance. Article 3 shows that supply chain efficiency has lowered, and margins per machine hour have lowered clearly. This dissertation also considers business performance by showing that the economic variables affect the returns geographically differently, particularly at the country level. The influence of the economic variables varies depending on the country and year. This type of a research perspective should be engaged in supply chain studies more actively.

The warehousing and inventory carrying and handling component of total logistics costs alone typically accounts for some 30 % of total production costs (Sayer, 1986). The empirical data show similar figures at the highest when comparing the transport costs with the variable and fixed costs. At their highest, the transport costs can reach up to 150 €/ton and the manufacturing costs of the same paper grade can be around 550 €/paper ton.

The paper mill's supply chain management is mainly studied without detailed transportation and value-adding costs (Koskinen, 2009a,b). Previously the distance and location have been seen probably as somewhat irrelevant. The economic geographical diversities and transport distances are put aside, and SCM is mostly studied as a purely theoretical process. This dissertation and the supporting articles 1–3 endorse the market location from the point of view of a Finnish mill. This study states that location-based SCM studies can bring out more detailed and exact market focused ideas of the phenomenon in question.

RISI (2009) have forecasted that expectations and pressures on the lowering of paper prices in the long term will continue. The time series 2001–2008 (Figure 5) showed that this process has continued during the past years and has hit the Finnish paper companies seriously. The spatial pattern of the market potential resembles the accessibility measures and peripheral indices calculated by e.g. Keeble et al. (1982), who consider that there are a total of 13 regions marked by low market potentials in Europe, and one of these areas is Finland. Correspondingly, Malik and Temple (2008) point out that, from the perspective of a small open economy, changes in world prices are exogenous.

Our empirical discoveries support what Bergin and Glick (2007) stress; the peripheral countries have experienced a much greater decline in price dispersion since the adoption of the euro. Another finding that is parallel to that of McCann et al. (2002) is that firms are essentially atomistic in the sense of having no market power. Single paper companies and mills like the case mill have no real chances to increase prices by themselves during the present competitive situation. Kilkenney and Thisse (1999) argue that companies that cannot charge prices to cover transport costs do not serve profitably as large a market as firms that can. This can be detected when exploring the empirical data, because the paper deliveries e.g. from Finland to North America are not as profitable as the European ones. Delivery pricing tends to be found in the markets and high transportation costs are not possible to invoice from customers due to the severe competition.

Kilkenny and Thisse (1999) point out that location and production decisions are often interdependent, and the choice of location also matters in the firm's choice of price, and vice versa. If firms make these decisions independently, it may lead to substantial losses in the firms' profits and competitiveness. This is why facility location analysis would probably gain in relevance if pricing and strategic competition were integrated into the operational models. Originally the Finnish mills were grounded on the locations where paper production was expected to be most profitable. This dissertation shows that these location-based matters have a very important role in the international competition. The costs are highly location-dependent and therefore quite difficult to replace without completely relocating the mill or its production. The empirical findings show that the supply chain management has not been able to offer clear economic benefits for the case mill to increase economic efficiency of the transportations. The dependency of oil prices is remarkable. When calculating statistical relationships between different economic variables, this study encourages the calculation of these correlations in a geographical context to acquire better market-based information on the basics of decision-making. This study states that these operational models, suggested by Kilkenny and Thisse (1999) should be integrated with the geographic context. This spatial point of view should be considered more seriously in the paper industry. It would help to better understand the economic geographically based changes in the market, which seem to affect the peripheral mills more and more seriously.

8 DISCUSSION

8.1 Generalization of results in this case study

The results of this examination can be extrapolated to a certain extent outside of their context. There are continuous discussions on if and how the results of case studies can be generalized. Eisenhardt (1989) argues that the researcher should utilize multiple-case analysis that allows the researcher to draw more generally held theoretical conclusions. The opposite opinion is stated by Yin (2009), who claims that, in case studies, there should be linkages between the analytical generalization and theory and not statistical generalization. According to Dyer and Wilkins (1991, p. 615), single case studies can reach a deeper level of contextual insight, whereas multiple case studies are “likely to provide a rather distorted picture or no picture at all, of the underlying dynamics of the case”. For this study, there was only one mill available that could be used as a research object. This study shows that the embedded cases, namely 15 different markets, give a clear, but fragmented picture of the paper exports. These kinds of findings are addressed by Dubois and Gadde (2002) and Halinen and Törnroos (2005), who emphasize that the essence of single case studies lies not in their ability to generate generally held theories but in their capacity to understand a particular phenomenon. This dissertation reveals that, when there is a need to understand the multiple, economically based facets of reality, we can crystallize different aspects of reality even in a single case study with vast quantitative time series data. As Yin (2009) pointed out, the generalization of results from either single or multiple designs is made to theory and not to populations. However, the results of this case can be generalized somewhat reliably to other printing paper mills or other bulk industries of the same type, which have a similar costs structure, and in which especially the transportation costs create a great part of the total costs. The origin and theory of this dissertation is heavily based on the thoughts of location and transport researchers like Weber (1909, 1929) and later Krugman (1991b), who argued that location and distance from the market has influence on and relevance with the industry competence and location through the economic results.

In this study, the time series secondary data are based on eight years, covering a million tons of manufactured and delivered paper rolls mainly to Europe. Based on this valid data, this study gives a good opportunity to understand the economic development of the paper industry especially in Finland but also in other Nordic countries. Our study gives possibilities to reveal and analyze the reasons for past years' (2001–2008) development and exceptionally difficult economic times. Therefore, it helps to identify better why paper companies have closed machine lines and mills in Finland. Easton (2010) points out that the low statistical representativeness of a single case is one of its key constraints. This constraint has been minimized by using statistical correlations alongside the total mill summary values as well as separately of the embedded cases based on the fifteen countries to reveal heterogeneities in the longitudinal data.

A serious question inevitably rises of whether these results could be generalized and if so, in what sense and how extensively? In January 2010, there are 24 paper mills in operation in Finland, and most of them produce mainly bulky paper products, which are delivered

to the European market (Forestindustry, 2010). Even though we only cover one case mill, we have a significant amount of observations that have been examined in detail. This type of research has been quite rare in previous scientific journals and discussions. From this angle, this case study increases the knowledge on the Finnish paper industry. This study also removes, for its part, an absence that has existed in the research tradition of Finnish economic geography and supply chain management. The results are possible to extrapolate to cover examinations made during the same time line focusing on bulk paper producers.

All the Finnish mills as well as many of the other Nordic mills are located far from the European market and their local demand is very low. Therefore, particularly transportation issues are quite comparable from mill to mill in the Nordic region. On the other hand, the case mill is not a good representative of a typical European mill located in Central Europe. The impacts of transportation costs are very similar in Nordic mills but not in sites nearer to the market in Europe. The results on how the transportation costs impact the case mill can obviously be generalized to some extent on the Nordic paper industry. The transportation costs to the market from the mills located in Europe can be less than a fifth of the costs generated from our case mill. Therefore, the influence of physical transportation is quite different on the profitability of these mills.

Out of other main costs, the fixed unit costs depend mainly on the productivity of the machine lines in paper tons. Therefore, with the same size of paper machines, these unit costs have quite a similar effect on the margins. The fixed costs have some impact on the margins, but the foreign mills may have different costs structures, and therefore generalization of this research is not possible to the foreign mills. The variable costs contain direct material consumption and costs. These may differ from mill to mill due to many reasons. The paper mills located in Europe usually make paper from purchased fiber, whereas the Nordic mills are mainly integrated units. Additionally, the European mills use a lot of recycled fiber, and the Swedish mills have the advantages of being able to purchase materials in Swedish crown and sell paper in Euro, which may occasionally bring some cost benefits to them. Thus the generalizations of the impacts of the variable costs can be difficult in the Swedish mills. The variable costs may affect the margins in the same way in the same types of large printing paper mills using virgin fiber and delivering only packed paper rolls to customers.

As paper prices are under heavy competition, the results of their effects should be considered comparable with other mills in Europe. In Europe, the paper prices are mainly at the same level in similar printing paper grades. As the data covered one mill in Finland, the results can, to some extent, be compared to mills whose production is located far from the market with little demand in the home market. The transportation costs show high correlation with lower margins in many markets as the paper prices correlate with lower margins, and the results vary from country to country.

The location theories state that the distance and thus physical transport costs from a mill to market, dictates the location of the manufacturing industry particularly in the bulky sector, especially in cases where the general costs structure is somewhat comparable in all markets. The desire or compulsion to increase competitiveness forces the paper mills to continuously think of their location, as paper demand is lowering mainly because of the new expanding digital media. This process cannot be avoided in the European paper markets.

8.2 Limitations and further research

There are scanty theoretical discussions and scientific papers that highlight the transportation costs and their impacts on the gross margins of a mill. Empirical mill data give a good opportunity to take a closer look at a paper mill in a real context and reveal these impacts. Transportation is regarded as one of the most important parameters when conducting economic geographical research. The impacts of the transportation costs were noted to be relatively similar in all distant and inland Nordic bulk mills. However, the impacts of these costs are difficult to generalize with European mills located near the market. These mills and their cost structure should be examined with similar methods as those used in this dissertation. Due to the data covering deliveries in Europe, the results can hardly be generalized to mills delivering paper overseas, because the transport costs and therefore the cost structure is quite different. In this study, we did not examine and reveal the following subjects:

- paper exports to Finland
- special paper and board mills
- warehousing and transportation times = lead times from order to delivery
- the Finnish paper industry generally
- manufacturing processes in detail
- used transport routes and transport means in exports in detail
- cutting and packing methods and their influence on export costs

All these topics listed above were left out and we focused on examining the exports volumes, paper prices, manufacturing costs and margins in detail at both the customer and country levels, which have not been discussed widely in scientific publications previously.

A realistic method based on the economical parameters is required in the analysis of costs. The method used in this study takes into consideration the prices, costs and margins. The transportation cost of a unit of cargo per route length is generally accepted as an indicator of economics, but in the paper industry, the correct value is euro per paper ton from the mill to the market.

The case mill is not a sample (Yin, 2009) of the Finnish paper industry, but it can still be seen as a relevant and typical representative of the Finnish paper industry. Because the data include one case, the generalizations could be considered naturally fitting between cases that are close the case mill (see e.g. Gomm et al., 2000). Stuart et al. (2002) recognize that extrapolating from a case to another instance can be dangerous if the context conditions are not carefully considered. For instance, the board and packing mills operate in a different market and their costs structure in manufacturing is different, and thus the results can be generalized only for the part of transportation costs due the costs per ton being very similar in all paper and board industries. Additionally, one essential limitation in a one case situation is that the variation apparently remains lower between observations at the mill level than if there were more observations from other mills. It is not wise to generalize the sub-cases, namely the 15 different markets, because differences between markets should be investigated more closely to determine

what really produces the differences in the economic dependencies with the gross margins. Examining other mills could have increased variety and differences in the findings when investigating the economic variables as well as produced wider in-depth knowledge. However, the results highlighted that one case offers a relevant method to exploring the paper industry in detail, but generalizations should be made very critically and comparing the results tentatively with bulky mills located far from their markets.

Finally, we have not studied the development of the paper industry in Finland and in Europe in general, but we have focused our efforts on examining the paper industry from the perspective of a single mill. Additionally, we have left out special paper manufacturers as well as board mills.

An important matter is to look at the other constraint of this case research from the cost perspective. The fixed costs depend mainly on the productivity of the machine lines and, as the paper machines are the same size, these costs affect the margins with the same force. The variable costs based on the material consumption may differ from mill to mill, and in the continent, mills usually make paper from purchased fiber, contrary to the Nordic mills. The effects of the variable costs on the gross margins can be considered important, but the results can only be generalized reliably with similar large printing paper mills delivering only packed paper rolls to customers without in-house converting. One big limitation in the results is that the case mill is located far from the market in the country, although it has a long tradition and good knowledge in paper making. Another deficiency is that it was not possible to conduct a comparable study with other paper mills, especially one near the markets in Central Europe.

The Nordic mills are not really able to allocate sales between exports and local deliveries efficiently, and therefore the results of this examination are limited to describing only the circumstances of these export intensive paper mills. Future research should focus on covering several case mills to get a wider picture of the Nordic or European paper industry. Additionally, the different packaging methods and how they affect the transport costs should also be taken into account, because there are differences between ways of packaging, e.g. sheets and rolls.

An important question to be placed and discussed is whether the results of this case can be generalized to other business areas, especially similar bulk industries, like the steel industry. The paper industry, as a continuing process industry, has its own style of producing bulky products, which differs from other businesses, such as printing companies. The steel industry in particular is a sector that produces steel coils in Finland, and this industry could be considered heavy bulk manufacturing. Bulky steel industry located far from the market could be presumed to behave in quite a similar way to the paper industry, and the distance-based transportation costs are probably an essential part of the total costs. The used research method can be utilized in the bulky industries to reveal how the economic variables affect the gross margins in different margins.

The time series data are based on quite a short period of time if we think of the hundred year long history of the paper industry in Finland. The research data especially describe the period during which paper demand has lowered in Europe and paper prices have decreased. During the past years, the digital media in the form of the Internet has replaced much of the printed media due to delivering information in real time, and this process will probably speed up. During the past years, the peak in oil price affected the

transportation costs heavily, resulting in lowering margins. The costs of transportation will remain challenging, as oil demand is estimated to increase.

The case data lack a paper grade oriented research approach within the countries, which could have given a more diverse picture of how the transportation costs vary between grades as well as inside the countries. This topic, logistics, should be explored in more detail in the coming years from the perspectives of several mills and from the perspectives of the customers and paper grades to reveal and anticipate how this important industry for the Nordic countries will develop in the coming years.

9 CONCLUSIONS

9.1 Results in light of economic geography

In this dissertation, four research questions were placed to explore how the paper sales and the costs factors correlate with the gross margins. The calculations based on these research questions are done by country and by product, covering separately the selected 15 countries, as well as with the total summed up mill values. The result showed that the paper prices and transportation, variable and fixed costs have different statistical significance and correlations with the lowering total gross margins geographically and during the time series. Tables 12 and 13 present how the different variables impact the margins. Table 13 shows that, in certain European markets, transportation has as high a statistical dependency with margin as paper prices.

When correlations are calculated at the product level, transportation has an even higher statistical dependency with margins than prices. At the country level, the product-based analysis with different economic variables shows higher statistical correlation with margins than with the mill-based values. The results by country also show that there is great heterogeneity in the results, as the economic geographical theories indicate. This suggests that the economic correlation analysis is worth conducting by country and by product to reveal diversity and variety in the market, as economic geographical theories argue. The linear mathematical models based on the theoretical point-to-point numbers used in the economist models certainly need empirical economic geographic studies alongside them to reveal the real picture of the spatial world. The results show that these spatially based behaviors should be taken into account in economic planning. The study was carried out with a research method that can be used

Table 12 Correlations of both total and product-based values with gross margins during 2001–2008 (96 months).

Variables / 15 countries	Correlations of total sales	Total sales p-value	Correlations of product sales	Product p-value
Sales €	0,63	0,000	0,67	0,000
Transportation €	0,21	0,000	0,26	0,000
Variable costs €	0,23	0,025	0,33	0,002
Fixed costs €	0,29	0,000	0,29	0,000

Table 13 Highest and lowest correlation values from the country-based values and product-based values with gross margins during 2001–2008 (96 months).

Variables / country-based	Correlations of total sales highest	Correlations of total sales lowest	Correlations of product sales highest	Correlations of product sales lowest
Sales €	0,78	0,27	0,85	0,31
Transportation €	0,77	No significance	0,76	No significance
Variable costs €	0,69	No significance	0,79	0,12
Fixed costs €	0,61	0,15	0,77	0,09

as a tool to analyze how the different economic factors behave spatially. It can be considered that the method is suitable for economic analysis of bulk industries located in the periphery. Another finding can be formulated as follows:

It is advantageous to conduct market and economic research focusing on the paper industry by country and by product with a statistical research method, which also takes into account manufacturing location issues. The relationship between costs and margins from the perspective of the manufacturing unit is unique in every geographical market, which the managers should be aware of in decision-making.

The sales prices have decreased during 2001–2008 due to oversupply in the market and costs not having decreased. This disadvantageous combination does not offer a durable surface in the real world. This might be one reason for the closures of over 25 pulp, board and paper machine lines and even whole mills in Finland after 2001. By closing mills and decreasing paper supply, the Finnish paper companies have made difficult decisions to lower paper supply and to get paper manufacturing profitable again. This process is estimated to continue over the coming years to extract the oversupply in Europe, and this topic also remains important in the future. Especially small customer deliveries can cost even two to three times more in euro per ton than average deliveries. Inland transportation from a port to the customers increases the total costs remarkably. The existing customer prices do not cover these soaring transportation costs. The case mill had problems in improving cost-efficiency per machine hour in the machine lines. The empirical findings support the standpoint of past years that Finnish paper mills have lost some of their absolute and comparative advantages, mainly due to high transport costs compared to their competitors. This case study highlights, from the Weberian angle, that the high and obligatory logistics functions affect margins heavily, and the results show that these costs are difficult to overcome with production speed and existing outputs. Additionally, the high variable and fixed unit costs have removed the economic advantages produced by efficient machinery. The European monetary union, with high valued euro, also makes it difficult to export paper products to the USA. The Swedish competitors get clear advantages by the occasional devaluation of the Swedish crown against euro. RISI (2009) estimates that paper demand in Europe will remain weak and, on the other hand, if oil prices go up, these matters together do not encourage paper companies to invest in Finland. The results of the dissertation can be crystallized as follows:

The ability to compete in an economically healthy manner with other paper producing countries has decreased in the Finnish paper industry, and some cost benefits have even disappeared during the years 2001–2008. Paper prices lowered and, at the same time, costs have even increased. Correlation analysis shows that the transport costs lower the gross margins in some markets statistically as much as the lowered paper prices do. Additionally, the case mill had difficulties in forecasting the gross margins properly, which suggests that price and cost estimation was very challenging during the research years (2002–2008). Gains were lower than estimated.

This study revealed that the demand varies significantly by customer from month to month, indicating that the distribution centers as warehouses balance the demand. At present, a paper machine still plays a central role in paper manufacturing, and the process is kept as uniform as possible to prevent unnecessary grade changes and stoppages, which increase the direct manufacturing costs. The analysis in article 2 showed that the logistics costs and even delivery volumes in tons correlate significantly with the net profits, which indicates that there is lot to gain in the logistics costs.

9.2 National level considerations for paper mills located far from their market

The printing paper mills make their paper grades from rather similar basic raw materials all over Europe. Additionally, the cost structure of the direct variable costs (raw materials) is very similar in all mills, where the mill is making the most of its own pulp. Greater differences can be found in transporting and fixed costs. The transporting costs are naturally affected by the mill's location, and the fixed unit costs are dependent on the scale of production in the mill and its machine lines and calculated in euro/paper ton.

The results of this study indicate, at the Finnish national level, that there are several issues that are essential for the success of the paper industry operating in Nordic distant locations.

These factors at the national level can be listed as follows:

Paper prices / lowering demand

Demand / supply should be balanced as soon as possible to stop the lowering prices. The forecasted paper demand and price level does not support profitable business. Distant mills, like the ones in Finland, are under deeper surveillance in the multinational paper companies if the paper prices continue to lower and will remain at low level.

Distance and location

In the coming years, transportation costs should not increase in the Finnish paper mills, because the competitors nearer to the market are able to deliver paper products, with same prices, much faster and certainly with lower delivery costs.

Variable and fixed costs

The manufacturing and fixed costs are extremely difficult to lower in the Finnish mills. The variable costs are quite constant, because the amount of materials and chemicals is relatively similar in the comparable paper grades manufactured in different mills. The fixed costs are dependent on the productivity of the paper machines. Here the Finnish mills have succeeded well historically due to larger and faster machines, but at present the scale in production is not sufficient.

What should be done in the paper industry in order for Finland to remain an affordable and optimal place even for investing in new paper machines? The findings of the dissertation support the following considerations:

- Oversupply should be removed by lowering the supply in order to stop sales prices from decreasing.
- Production flexibility should be increased in the paper mills, nonetheless taking into account the possible increase of costly grade changes, waste, recycling and warehousing.
- The different markets and their expected demand should be continuously investigated in detail to receive reliable information on how these markets develop.
- Raw material purchasing should be performed as economically as possible.
- The logistics from a mill to its market must be as lean as possible.

The paper industry is still a very important sector for the Finnish national economy. The coming years will show whether the paper companies succeed in turning the negative development to positive and how this will affect the Finnish mills located far from the market. Table 14 summarizes the considerations this dissertation brought out, illustrating the change in the Finnish paper industry over the research time and space.

In the Finnish paper companies, there are certainly ongoing discussions on where to locate future production units in order to stay competitive. The change in the Finnish paper industry has been very rapid during 2001–2008. Expected uncertainty in the paper market generates continuous experimentation and intensive search for new advantages. For Finland, this development has been negative from the point of view of evolutionary economic geography, especially in the Finnish rural regions, due to decreasing competitive advantages in relation to the European competitors in the lowering paper market.

Table 14 Short summary of the transformation in the Finnish paper industry during 2001–2008 and some reasons for that evolution.

Main catalysts and reasons for transformation in paper industry 2001–2008	Some national impacts in Finland during 2001–2008
<ul style="list-style-type: none"> • Finland joins the European (2002) monetary union, and devaluation of currency against other currencies (USD/SWE Crown) is not possible in the competitive sense. • Paper demand continues to decrease in the saturated European market. • Economic forecasting is challenging due to lowering paper demand. • Paper prices lower and do not rise. • The overall unit cost at the mills remains high, personnel, material and energy costs increase. • Transportation e.g. shipping costs rise due to oil prices. • Distance matters in transportation more and more. • Machine hourly based cost-efficiency slowly decreases. • Huge variation in delivery volumes presumably increases capital costs. 	<ul style="list-style-type: none"> • Paper companies start to close unproductive machine lines and later to shut down even whole integrated mills with several large machine lines, which produced bulk paper grades (closings of over 20 paper machine lines and 4 board machine lines during 2001–2009). No new machine lines are built in Finland. • The Finnish paper companies’ investments in North America proved to be a mistake economically. In the future, major paper machine investments are made in China and pulp mills in South America. • The existing paper mills and machines are expected to run as far as it is economically for the companies. • The paper machine closures may continue due to oversupply in printing paper qualities in Europe.

9.3 Practical and managerial implications

This dissertation provides a method for the economic reporting system that could contain ready-made algorithms with spatial linkages. This system can be utilized in quick market economic analysis. The method shows the significance of the decisions made by the company's managers from the geographical perspective. The limits and confines of this spatially linked reporting are in the material and production database, where the original data are stored and obtained. The database should be defined so that it creates economic reports at the appropriate geographical level. This research method constructs analysis tools that can be used in the mill's examinations as well as in other industries, especially if the source data fill the required validity and reliability objectives in the spatial context.

The results showed that, when the aggregate level of the correlation analysis moves from the product to the mill level, the amount of significant values decreases, indicating that the research method is better suited for the product level in the economic calculations. In the present market situation, the Finnish mills are in a difficult position because of the transport and other costs that are eating up their profits. The price increases are very challenging to get through in the current oversupply situation.

In their empirical study, Morgan and Strong (2003) point out that a firm that emphasizes the analysis of the market, is defensive of their market position and has futurity as their strategic orientation is likely to have better business performance. Our study showed that the correlations between estimated and actual paper demand vary greatly from country to country. The reliable demand analysis of the main target market has a central role, and it is one key to profitable business.

The managerial and practical recommendations of this case study can be summarized as follows:

- Mill logistics and supply chain managers should attempt to develop adaptive and market-specific supply processes from the mill to the consignees. This can help to lower storage times in delivery centers.
- The paper mills should start to increase passing from mill to customers, because those actions offer significant possibilities to get higher profits.
- The Finnish paper companies should focus on those paper qualities, which give some pricing capabilities to the mill and avoid those grades which have clear oversupply in the European market.
- Paper mills should transport as big customer deliveries as possible, because this supports higher margins, to some extent, due to the decreasing unit logistics costs.
- Mills should use reliable market-specific economic and logistic anticipatory methods and advanced cost and production planning systems to estimate especially margins as correctly as possible.

Older paper machines situated far from markets will face more tightening competition from the mills closer to the market in Europe. Many large paper companies, owning paper mills in several locations, deliver substitute paper products from the mill closest

to the customer to lower the transport time and costs. In such a situation, the Finnish mills are not in an affordable position. There are indications that the paper industry is transforming, to some extent, more into an industry that will build new mills in Central Europe. This is supported by the availability of inexpensive market pulp from South America, which is also transported to the European mills. The mill management should look carefully at the total supply chain costs by country and even by customer. The whole supply chain (from the wood yard at the site to the end customers) has become as crucial as sales prices in the Finnish paper industry. There are not many relevant means to lower the intermodal transportation costs in a paper mill due to the type of industry. In the future, the fuel costs and the environmental issues will possibly put more pressure on the truck and even short sea transport costs.

Economic geography, as a field of study considered as evolutionary, has put aside active participation in discussions concerning the paper industry. The main reason might be the lack of valid empirical longitudinal research data on paper mills. This dissertation reveals the central topics of economic geography, like heterogeneity and variation from the point of view of a single paper mill. Economic geography gives useful insight into the SC research discussion, which, especially in the Finnish paper industry located far from the European markets, should be exploited more actively.

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Appendix 1.

Product based correlation calculations									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales		Transport costs		Variable costs		Fixed costs	
Austria		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.890586	.000004	.639483	.001795	.790745	.000109	.822894	.000046
12	2002	.764959	.000197	.437109	.019230	.717947	.000503	.638589	.001819
12	2003	.027275	.607992	.093632	.333403	.014873	.705753	.020064	.660570
12	2004	.520449	.008090	.179033	.170531	.432021	.020201	.517044	.008402
12	2005	.042826	.518704	.008199	.779585	.005053	.826236	.003158	.862284
12	2006	.285844	.073310	.474499	.013232	.182729	.165716	.080328	.372023
12	2007	.369942	.035869	.276808	.078903	.232509	.112387	.256909	.092609
12	2008	.850449	.000020	.832195	.000035	.820262	.000050	.831172	.000036
96	- 01 -08	.790106	0.000000	.577891	.000000	.693733	.000000	.509802	.000000
Belgium									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.735297	.000363	.376264	.033902	.493680	.010827	.567305	.004683
12	2002	.913823	.000001	.731290	.000392	.896517	.000003	.853569	.000018
12	2003	.675764	.001034	.666501	.001197	.650745	.001521	.693463	.000773
12	2004	.587669	.003630	.305354	.062431	.433646	.019886	.452522	.016527
12	2005	.037676	.545520	.034604	.562685	.009652	.761315	.061542	.436901
12	2006	.370832	.035586	.373707	.034686	.303576	.063359	.262785	.088352
12	2007	.682957	.000920	.488936	.011384	.555573	.005396	.594062	.003343
12	2008	.311919	.059108	.106380	.300832	.160486	.196874	.178442	.171312
96	- 01 -08	.446110	.000000	.019564	.174088	.187655	.000010	.148710	.000104
Czech									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
9	2001	.952252	.000007	.883259	.000166	.923052	.000038	.950043	.000008
12	2002	.967096	.000000	.909894	.000002	.963215	.000000	.963128	.000000
12	2003	.779020	.000144	.730912	.000395	.753313	.000252	.796448	.000094
12	2004	.612144	.002632	.440670	.018574	.487154	.011600	.464525	.014651
8	2005	.802191	.002623	.567705	.030877	.729353	.006950	.851296	.001091
8	2006	.940272	.000068	.915836	.000193	.912046	.000220	.895411	.000372
11	2007	.995047	.000000	.994021	.000000	.991393	.000000	.995687	.000000
6	2008	.970206	.000336	.972288	.000291	.951338	.000903	.971459	.000308
78	- 01 -08	.851976	0.000000	.756181	.000000	.780356	.000000	.768983	.000000
Denmark									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.640120	.001779	.391266	.029603	.419558	.022757	.606596	.002835
12	2002	.688932	.000834	.396004	.028347	.644119	.001678	.667248	.001183
12	2003	.186442	.161015	.564437	.004849	.002007	.890032	.125288	.258985
12	2004	.445734	.017675	.125089	.259392	.380138	.032743	.387384	.030668
11	2005	.351375	.054619	.137888	.260854	.298488	.082053	.317206	.071212
10	2006	.810938	.000379	.753946	.001119	.804308	.000437	.738828	.001432
11	2007	.945976	.000001	.581952	.006318	.942836	.000001	.931287	.000002
9	2008	.057262	.535180	.089209	.434973	.070948	.488441	.072438	.483736
89	- 01 -08	.479483	.000000	.554159	.000000	.321802	.000000	.332807	.000000

Appendix 2.

Product based correlation calculations									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales		Transport costs		Variable costs		Fixed costs	
Finland		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.625576	.002188	.149960	.213623	.189697	.157001	.595639	.003276
12	2002	.667701	.001174	.452976	.016452	.632413	.001987	.591970	.003435
12	2003	.528102	.007424	.360486	.038996	.463503	.014803	.517374	.008371
12	2004	.622331	.002289	.005541	.818166	.477090	.012883	.537422	.006675
12	2005	.380317	.032691	.217562	.126379	.317850	.056243	.381481	.032350
12	2006	.284706	.073995	.309536	.060296	.144323	.223191	.102690	.309862
12	2007	.810839	.000065	.863983	.000012	.704564	.000639	.714035	.000540
12	2008	.488278	.011464	.341663	.045933	.345151	.044572	.365557	.037291
96	-01-08	.588503	.000000	.013208	.264854	.355790	.000000	.379843	.000000
France									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.827072	.000041	.589854	.003530	.711132	.000569	.818630	.000052
12	2002	.723480	.000454	.351663	.042125	.607654	.002795	.472515	.013505
12	2003	.492573	.010955	.505419	.009544	.026075	.616112	.478673	.012674
12	2004	.404569	.026191	.184739	.163155	.304068	.063101	.349320	.042991
12	2005	.787388	.000118	.434032	.019812	.722501	.000462	.801052	.000084
12	2006	.672878	.001082	.712282	.000557	.592846	.003397	.502407	.009861
12	2007	.783446	.000130	.632745	.001978	.716410	.000517	.735378	.000362
12	2008	.659249	.001338	.645540	.001643	.589256	.003557	.582123	.003895
96	-01-08	.404047	.000000	.174167	.000023	.271464	.000000	.319262	.000000
Germany									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.859623	.000014	.110826	.290351	.194201	.151607	.197307	.147993
12	2002	.566113	.004751	.242623	.103757	.529313	.007323	.450316	.016893
12	2003	.786415	.000121	.835073	.000032	.751658	.000261	.768987	.000180
12	2004	.861065	.000014	.687882	.000848	.849614	.000020	.857049	.000016
12	2005	.296954	.066924	.140409	.230096	.266335	.085867	.182289	.166282
12	2006	.637812	.001839	.622386	.002287	.383364	.031805	.572382	.004399
12	2007	.884399	.000005	.774829	.000158	.805253	.000075	.863570	.000012
12	2008	.631942	.002000	.554994	.005433	.530974	.007186	.589319	.003554
96	-01-08	.369277	.000000	.106897	.001149	.119950	.000547	.089865	.003005
Great Britain									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.680663	.000955	.066535	.418264	.359751	.039249	.666787	.001191
12	2002	.194219	.151587	.035482	.557685	.045383	.506197	.002166	.885797
12	2003	.126342	.256851	.136627	.236985	.069326	.408317	.104626	.305086
12	2004	.826331	.000042	.679958	.000966	.767138	.000188	.766801	.000189
12	2005	.200358	.144524	.038981	.538508	.578071	.004099	.222077	.121989
12	2006	.133690	.242483	.060435	.441190	.015428	.700533	.005060	.826127
12	2007	.732459	.000383	.570257	.004516	.578398	.004082	.609032	.002744
12	2008	.030693	.586023	.003253	.860243	.054909	.463524	.030185	.589186
96	-01-08	.827109	0.000000	.681403	.000000	.682051	.000000	.662312	.000000

Appendix 3.

Product based correlation calculations									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales		Transport costs		Variable costs		Fixed costs	
		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
Greece									
12	2001	.870879	.000009	.542158	.006319	.809091	.000068	.793153	.000102
11	2002	.717064	.001007	.434702	.027325	.692667	.001481	.663047	.002278
10	2003	.041893	.570557	.095569	.384757	.024759	.664192	.047177	.546655
11	2004	.748989	.000578	.688894	.001568	.714522	.001050	.701486	.001293
11	2005	.225332	.140119	.065680	.446845	.129119	.277777	.264761	.105348
11	2006	.718458	.000984	.666102	.002183	.667498	.002141	.568883	.007319
11	2007	.952571	.000000	.941889	.000001	.931587	.000002	.930324	.000002
11	2008	.425536	.029599	.276465	.096666	.393961	.038687	.389130	.040267
88	- 01 -08	.311689	.000000	.185983	.000027	.209501	.000007	.201956	.000011
Holland									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.824352	.000045	.410051	.024887	.702012	.000668	.794298	.000100
12	2002	.773046	.000165	.284757	.073963	.710494	.000575	.641865	.001734
12	2003	.449541	.017023	.506288	.009455	.365578	.037284	.360448	.039009
12	2004	.894006	.000003	.706354	.000619	.873212	.000009	.881279	.000006
12	2005	.587244	.003650	.351749	.042093	.578380	.004083	.587878	.003621
12	2006	.133365	.243100	.150874	.212112	.102818	.309543	.064765	.424742
12	2007	.694945	.000754	.470454	.013793	.607793	.002790	.575131	.004252
12	2008	.327887	.051672	.000493	.945397	.117492	.275398	.166776	.187511
96	- 01 -08	.507980	.000000	.331250	.000000	.408852	.000000	.435556	.000000
Hungary									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.967785	.000000	.900418	.000003	.942913	.000000	.963366	.000000
12	2002	.966526	.000000	.911499	.000001	.963244	.000000	.925346	.000001
12	2003	.847320	.000022	.839325	.000028	.801821	.000082	.823567	.000046
12	2004	.927503	.000001	.879768	.000007	.915724	.000001	.918295	.000001
11	2005	.791477	.000245	.778055	.000327	.724710	.000887	.833073	.000088
11	2006	.871604	.000027	.843496	.000066	.823920	.000113	.811474	.000154
12	2007	.934620	.000000	.925065	.000001	.889558	.000004	.917377	.000001
10	2008	.988507	.000000	.991427	.000000	.982044	.000000	.988222	.000000
92	- 01 -08	.657373	.000000	.486547	.000000	.507021	.000000	.521893	.000000
Italy									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
11	2001	.916597	.000004	.817456	.000133	.836679	.000080	.883446	.000017
12	2002	.893740	.000003	.709999	.000580	.868116	.000010	.792740	.000104
12	2003	.751780	.000261	.745760	.000295	.550566	.005726	.731753	.000388
12	2004	.830723	.000037	.716355	.000518	.786946	.000119	.778526	.000145
11	2005	.715297	.001037	.599174	.005172	.633603	.003380	.743764	.000636
12	2006	.627764	.002122	.653988	.001449	.558821	.005190	.484757	.011896
12	2007	.763293	.000204	.754383	.000247	.669311	.001145	.742774	.000313
12	2008	.768733	.000181	.741835	.000319	.722645	.000461	.712651	.000553
94	- 01 -08	.695494	.000000	.513004	.000000	.492069	.000000	.477605	.000000

Appendix 4.

Product based correlation calculations									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales		Transport costs		Variable costs		Fixed costs	
		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
Schweiz									
12	2001	.802317	.000081	.442544	.018237	.594760	.003313	.742269	.000316
12	2002	.374131	.034555	.201638	.143093	.227448	.116953	.184958	.162878
12	2003	.596399	.003243	.583437	.003831	.597507	.003197	.589473	.003547
12	2004	.542781	.006273	.216089	.127843	.454657	.016179	.505922	.009492
12	2005	.888162	.000005	.805390	.000075	.596733	.003229	.882634	.000006
12	2006	.748295	.000585	.694474	.001441	.689543	.001553	.613390	.004357
12	2007	.813399	.002191	.749078	.005487	.757522	.004931	.754186	.005146
12	2008	.927110	.000002	.897673	.000009	.904902	.000007	.900610	.000008
96	-01-08	.841298	0.000000	.706268	.000000	.788373	0.000000	.709669	.000000
Spain									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.926129	.000001	.763140	.000205	.889489	.000004	.893585	.000004
12	2002	.623494	.002252	.160430	.196960	.564041	.004873	.487171	.011598
12	2003	.010769	.748247	.042278	.521453	.005019	.826818	.008739	.772604
12	2004	.282604	.075274	.205071	.139320	.235998	.109337	.240141	.105816
12	2005	.798989	.000089	.724333	.000447	.743284	.000310	.806836	.000072
11	2006	.299634	.065460	.209580	.134509	.189099	.157731	.140342	.230216
12	2007	.897612	.000003	.847705	.000022	.872477	.000009	.859059	.000015
12	2008	.614726	.002541	.502177	.009885	.575805	.004216	.599067	.003132
95	-01-08	.423057	.000000	.199455	.000005	.277085	.000000	.214728	.000002
Sweden									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.975127	.000033	.933328	.000399	.962289	.000095	.976692	.000028
12	2002	.784873	.000125	.544010	.006184	.698009	.000715	.686347	.000870
12	2003	.598786	.003144	.589958	.003525	.499728	.010149	.581503	.003926
12	2004	.560544	.005083	.480552	.012429	.474500	.013232	.509052	.009174
12	2005	.383372	.042220	.000883	.930887	.196622	.171924	.342535	.058551
12	2006	.569528	.004557	.544088	.006179	.487479	.011561	.461773	.015064
12	2007	.807343	.000071	.800574	.000085	.760833	.000215	.725281	.000439
12	2008	.160013	.222848	.120529	.295531	.296374	.083365	.307294	.076784
96	-01-08	.330442	.000000	.137847	.000341	.170894	.000057	.235235	.000001
All 15 countries									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.386828	.030823	.001801	.895808	.113504	.284235	.331207	.050235
12	2002	.192298	.153864	.151798	.210596	.115967	.278740	.023797	.632162
12	2003	.076357	.384619	.207584	.136618	.004215	.841127	.061071	.438717
12	2004	.546343	.006018	.224963	.119258	.415648	.023613	.501234	.009986
12	2005	.577905	.004107	.104362	.305731	.350972	.042378	.630249	.002049
12	2006	.004369	.838284	.016449	.691198	.001859	.894155	.006710	.800206
12	2007	.765337	.000195	.627293	.002136	.616964	.002465	.663735	.001249
12	2008	.760322	.000218	.798735	.000089	.648280	.001578	.661835	.001286
96	-01-08	.666993	.000000	.259781	.000000	.334374	.000000	.290321	.000000

Appendix 5.

Total deliveries									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales in euro		Transport costs		Variable costs		Fixed costs	
		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
Austria									
12	2001	.857401	.000015	.506273	.009456	.727957	.000417	.817664	.000054
12	2002	.381004	.032489	.066350	.418935	.284871	.073895	.162444	.193910
12	2003	.604459	.002917	.521272	.008016	.423170	.021989	.426293	.021343
12	2004	.523818	.007791	.199024	.146031	.429013	.020794	.510828	.008998
12	2005	.098458	.320608	.002639	.874022	.042695	.519358	.012202	.732532
12	2006	.702058	.000667	.740681	.000326	.631116	.002024	.479890	.012515
12	2007	.306854	.061657	.261831	.089031	.234999	.110203	.251636	.096588
12	2008	.733060	.000379	.688276	.000843	.683848	.000907	.720003	.000484
96	- 01-08	.775410	0.000000	.617739	.000000	.689031	.000000	.539455	.000000
Belgia									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.826975	.000041	.613090	.002598	.716549	.000516	.746387	.000291
12	2002	.753540	.000251	.411147	.024633	.721106	.000474	.556384	.005344
12	2003	.852622	.000018	.773917	.000161	.787190	.000118	.851847	.000019
12	2004	.229631	.114962	.106469	.300618	.088399	.347979	.091481	.339305
12	2005	.006244	.807150	.010739	.748593	.143210	.225132	.004292	.839704
12	2006	.198371	.146774	.225409	.118841	.108475	.295841	.021207	.651567
12	2007	.701262	.000676	.445369	.017738	.573280	.004351	.596579	.003236
12	2008	.570979	.004476	.361879	.038521	.463667	.014779	.487530	.011554
96	- 01-08	.579853	.000000	.109548	.000988	.272910	.000000	.355731	.000000
Czech									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.921267	.000001	.709573	.000585	.837997	.000030	.910814	.000001
12	2002	.874512	.000008	.755759	.000240	.862469	.000013	.875857	.000008
12	2003	.768377	.000183	.494235	.010763	.669685	.001138	.828686	.000039
12	2004	.038436	.541414	.003998	.845215	.000976	.923218	.000516	.944145
12	2005	.373563	.034731	.241970	.104295	.352814	.041704	.367664	.036602
12	2006	.164049	.191514	.160965	.196146	.100671	.314934	.098017	.321753
12	2007	.020909	.653885	.013053	.723672	.001795	.895973	.004044	.844340
12	2008	.343213	.045324	.293090	.069086	.319763	.055345	.221694	.122355
96	- 01-08	.274451	.000000	.196785	.000006	.085710	.003796	.176928	.000020
Denmark									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.699818	.000693	.357557	.040011	.531925	.007109	.607113	.002816
12	2002	.249293	.098407	.007742	.785691	.143493	.224638	.193841	.152032
12	2003	.651984	.001494	.791689	.000106	.610924	.002675	.644025	.001680
12	2004	.147643	.217503	.004074	.843768	.089964	.343539	.108177	.296543
12	2005	.360071	.039139	.265104	.086722	.249905	.097929	.337358	.047663
12	2006	.732408	.000383	.597209	.003209	.709292	.000588	.667648	.001175
12	2007	.888250	.000005	.739328	.000335	.850133	.000020	.849203	.000021
12	2008	.538953	.006558	.501541	.009953	.442258	.018288	.379351	.032976
96	- 01-08	.751593	.000000	.772522	0.000000	.585244	.000000	.612650	.000000

Appendix 6.

Total deliveries									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales in euro		Transport costs		Variable costs		Fixed costs	
Finland		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.782331	.000133	.211280	.132737	.378187	.033322	.703052	.000656
12	2002	.622923	.002270	.484742	.011897	.534350	.006914	.587016	.003661
12	2003	.744567	.000302	.140704	.229569	.667087	.001186	.763277	.000204
12	2004	.215167	.128768	.100008	.316623	.068794	.410190	.137293	.235755
12	2005	.141458	.228225	.049776	.485798	.122469	.264792	.098804	.319714
12	2006	.417020	.023310	.340324	.046465	.316373	.056944	.243957	.102666
12	2007	.232969	.111981	.407317	.025531	.059320	.445568	.044990	.508086
12	2008	.051390	.478620	.042282	.521433	.103441	.307999	.053698	.468638
96	- 01-08	.344811	.000000	.007207	.410855	.013848	.253510	.227548	.000001
France									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.746316	.000291	.325412	.052768	.599459	.003116	.750752	.000266
12	2002	.683339	.000914	.267894	.084796	.629751	.002063	.513665	.008722
12	2003	.817195	.000055	.677951	.000998	.612319	.002625	.771077	.000172
12	2004	.498104	.010328	.200809	.144018	.137320	.235705	.410905	.024689
12	2005	.881705	.000006	.466620	.014343	.870039	.000010	.913289	.000001
12	2006	.341931	.045827	.245313	.101568	.097424	.323300	.040095	.532638
12	2007	.614154	.002561	.365778	.037218	.508056	.009275	.537408	.006676
12	2008	.872277	.000009	.860413	.000014	.810356	.000066	.811765	.000063
96	- 01-08	.314475	.000000	.003091	.590572	.102625	.001463	.206695	.000003
Germany									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.403871	.026362	.011843	.736372	.006527	.802904	.188387	.158604
12	2002	.232415	.112470	.003698	.851090	.190796	.155667	.118993	.272151
12	2003	.506795	.009403	.597730	.003188	.568853	.004595	.463035	.014874
12	2004	.325366	.052789	.040461	.530733	.168439	.185112	.256574	.092857
12	2005	.753764	.000250	.174636	.176438	.711651	.000563	.788098	.000116
12	2006	.689545	.000825	.550459	.005733	.505929	.009492	.476943	.012903
12	2007	.586429	.003688	.400610	.027169	.350838	.042428	.501063	.010005
12	2008	.454966	.016129	.328003	.051622	.265730	.086286	.361946	.038498
96	- 01-08	.713097	.000000	.259851	.000000	.500960	.000000	.598785	.000000
Great Britain									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.503356	.009760	.001310	.911095	.001310	.911095	.418034	.023087
12	2002	.461221	.015148	.040711	.529442	.040711	.529442	.264723	.086988
12	2003	.092501	.336492	.484260	.011957	.484260	.011957	.081461	.368524
12	2004	.450050	.016937	.081368	.368810	.081368	.368810	.185856	.161748
12	2005	.372876	.034944	.000020	.989116	.000020	.989116	.352987	.041641
12	2006	.569944	.004533	.484121	.011975	.484121	.011975	.246804	.100372
12	2007	.351477	.042193	.131436	.246797	.131436	.246797	.196646	.148756
12	2008	.651348	.001508	.609860	.002714	.609860	.002714	.801730	.000083
96	- 01-08	.510390	.000000	.204913	.000004	.204913	.000004	.194145	.000007

Appendix 7.

Total deliveries									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales in euro		Transport costs		Variable costs		Fixed costs	
		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
Greece									
12	2001	.867686	.000011	.719151	.000492	.780629	.000138	.799203	.000088
12	2002	.533278	.007000	.286518	.072908	.475416	.013108	.475201	.013137
12	2003	.807031	.000072	.840772	.000027	.749448	.000273	.821548	.000048
12	2004	.754358	.000247	.575473	.004234	.690974	.000806	.686558	.000867
12	2005	.525717	.007626	.295674	.067633	.462544	.014948	.576745	.004167
12	2006	.806909	.000072	.774843	.000158	.752000	.000259	.684802	.000893
12	2007	.515308	.008565	.613648	.002579	.387080	.030752	.405211	.026036
12	2008	.179655	.169710	.273085	.081318	.133303	.243217	.126667	.256196
96	- 01-08	.626267	.000000	.510991	.000000	.491152	.000000	.434445	.000000
Holland									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.805925	.000074	.312115	.059012	.620971	.002333	.779396	.000142
12	2002	.686462	.000869	.066429	.418646	.550377	.005739	.338799	.047078
12	2003	.750071	.000270	.468126	.014125	.590340	.003508	.749832	.000271
12	2004	.374138	.034553	.105126	.303865	.273442	.081083	.288878	.071514
12	2005	.350609	.042512	.101426	.313026	.325273	.052830	.392079	.029384
12	2006	.093813	.332912	.100164	.316225	.066003	.420197	.034663	.562350
12	2007	.688166	.000845	.447690	.017337	.590268	.003511	.546910	.005978
12	2008	.392514	.029267	.073388	.394400	.187815	.159309	.239267	.106550
96	- 01-08	.277971	.000000	.044216	.039749	.140855	.000165	.148832	.000104
Hungary									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.888800	.000004	.791230	.000107	.833346	.000034	.859402	.000014
12	2002	.880684	.000006	.650939	.001517	.863125	.000013	.817467	.000054
12	2003	.695462	.000747	.760707	.000216	.544044	.006182	.711827	.000562
12	2004	.642646	.001715	.079623	.374221	.507093	.009372	.611615	.002650
12	2005	.704849	.000635	.455876	.015983	.678475	.000990	.681331	.000945
12	2006	.557038	.005302	.497420	.010403	.413746	.024040	.453204	.016415
12	2007	.274782	.080209	.182616	.165861	.162565	.193728	.198166	.147009
12	2008	.873765	.000008	.860703	.000014	.828991	.000039	.843150	.000025
96	- 01-08	.642267	.000000	.403099	.000000	.457575	.000000	.491254	.000000
Italy									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.879254	.000007	.542431	.006299	.818310	.000053	.847241	.000022
12	2002	.552772	.005579	.187334	.159904	.493431	.010855	.352636	.041769
12	2003	.696359	.000736	.813741	.000060	.638218	.001828	.669470	.001142
12	2004	.737491	.000347	.618341	.002419	.626253	.002167	.677924	.000998
12	2005	.359372	.051259	.139139	.258531	.203324	.163934	.152664	.234784
12	2006	.573074	.004362	.524831	.007703	.430195	.020559	.340025	.046585
12	2007	.816523	.000056	.757129	.000233	.655696	.001412	.745592	.000296
12	2008	.849903	.000020	.823567	.000046	.787125	.000119	.639516	.001794
96	- 01-08	.650469	.000000	.429187	.000000	.473187	.000000	.409744	.000000

Appendix 8.

Total deliveries									
Marked correlations are significant at $p < .05000$ (Casewise deletion of missing data)									
		Sales in euro		Transport costs		Variable costs		Fixed costs	
		vs. Gross margin		vs. Gross margin		vs. Gross margin		vs. Gross margin	
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
Schweiz									
12	2001	.931696	.000000	.660170	.001319	.859919	.000014	.892434	.000004
12	2002	.679388	.000975	.351538	.042170	.603139	.002969	.451960	.016619
12	2003	.693531	.000772	.784749	.000126	.455724	.016008	.694868	.000755
12	2004	.559768	.005131	.160345	.197089	.420925	.022463	.469739	.013894
12	2005	.501113	.009999	.271657	.082262	.387957	.030508	.537341	.006681
12	2006	.451161	.016752	.425265	.021554	.323103	.053808	.284213	.074293
12	2007	.329663	.050899	.356323	.040446	.298036	.066329	.325689	.052644
12	2008	.803449	.000079	.764608	.000198	.770040	.000176	.766138	.000192
96	- 01-08	.754363	.000000	.667625	.000000	.593617	.000000	.564339	.000000
Spain									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.755066	.000243	.376900	.033709	.602375	.002999	.646969	.001609
12	2002	.180443	.168677	.011872	.736063	.115463	.279854	.014031	.713880
12	2003	.025508	.620023	.113094	.285162	.016177	.693651	.035942	.555095
12	2004	.349016	.043105	.153878	.207224	.235165	.110058	.252407	.095997
12	2005	.733312	.000377	.436223	.019396	.712367	.000556	.751127	.000264
12	2006	.774699	.000159	.626913	.002147	.664068	.001243	.590927	.003482
12	2007	.663272	.001258	.512545	.008830	.520773	.008061	.656723	.001391
12	2008	.186726	.160660	.068650	.410696	.066700	.417667	.049389	.487543
96	- 01-08	.674138	.000000	.287066	.000000	.518624	.000000	.398830	.000000
Sweden									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.877112	.000007	.526968	.007520	.526968	.007520	.845393	.000023
12	2002	.492276	.010989	.217469	.126470	.217469	.126470	.320397	.055050
12	2003	.001141	.917017	.004214	.841144	.004214	.841144	.034264	.564644
12	2004	.292388	.069486	.110137	.291946	.110137	.291946	.173375	.178170
12	2005	.580655	.003968	.071301	.401472	.071301	.401472	.595855	.003266
12	2006	.659144	.001340	.652147	.001490	.652147	.001490	.608925	.002748
12	2007	.685200	.000887	.529750	.007287	.529750	.007287	.557536	.005270
12	2008	.052129	.475390	.078665	.377232	.078665	.377232	.015132	.703302
96	- 01-08	.425518	.000000	.147178	.000114	.147178	.000114	.358941	.000000
All 15 countries									
N	Year	r ²	p	r ²	p	r ²	p	r ²	p
12	2001	.299115	.065741	.068649	.410701	.034511	.563225	.251462	.096723
12	2002	.069366	.408179	.124836	.259907	.041671	.524521	.000004	.994913
12	2003	.024357	.628130	.207775	.136415	.000014	.990764	.049275	.488059
12	2004	.039632	.535062	.002150	.886223	.021085	.652513	.000576	.940961
12	2005	.587911	.003619	.123644	.262355	.457485	.015728	.580233	.003989
12	2006	.173976	.177342	.226571	.117761	.023254	.636121	.002085	.887930
12	2007	.356365	.040431	.137772	.234876	.136107	.237947	.163241	.192716
12	2008	.613773	.002574	.261929	.088960	.409650	.024981	.533464	.006985
96	- 01-08	.630227	.000000	.210919	.000003	.230747	.000001	.290655	.000000