Pellervon taloudellisen tutkimuslaitoksen raportteja 207

Pellervo Economic Research Institute Reports 207

THE EFFECTS OF A REVISION OF THE EMISSION TRADING DIRECTIVE FOR THE PERIOD STARTING IN 2013 ON THE EUROPEAN PULP AND PAPER INDUSTRY

Helsinki 2008

Pellervon taloudellinen tutkimuslaitos PTT
Eerikinkatu 28 A
00180 Helsinki
Puh. 09-348 8844
Fax. 09-3488 8500
Sähköposti econ.res@ptt.fi

ISBN 978-952-5594-83-6 (NID)
ISSN 1456-3215 (NID)
ISBN 978-952-5594-84-3 (PDF)
ISSN 1796-4776 (PDF)
Helsinki 2008

THE EFFECTS OF A REVISION OF THE EMISSION TRADING DIRECTIVE FOR THE PERIOD STARTING IN 2013 ON THE EUROPEAN PULP AND PAPER INDUSTRY. Pellervo Economic Research Institute Research Reports 207. p. 70. ISBN 978-952-5594-83-6 (NID), ISBN 978-952-5594-84-3 (PDF), ISSN 1456-3215, ISSN 1796-4776.

Abstract: The European Commission is preparing a revision of the Emissions Trading Directive for the period starting in 2013. The Commission has called for the auctioning of emission allowances to be given a larger role. If the European pulp and paper industry is not exempted from full auctioning of emission allowances in the new Emission Trading Directive, it is estimated that the total annual costs of the European pulp and paper industry will increase of 3.4 to 7.1 billion euros. This represents about 6 to 12 percent of the total cash manufacturing cost. To keep profits constant, the European pulp and paper industry should increase the final output price by about 3-7 percent. Because the European pulp and paper industry cannot pass through higher costs to final product prices, it will lose almost all of its profits.

Keywords: *Emission Trading Directive, European pulp and paper industry*

VUONNA 2013 VOIMAAN TULEVAN PÄÄSTÖKAUPPADIREKTIIVI-EHDOTUKSEN VAIKUTUKSET EUROOPAN PAPERI- JA SELLUTEOLLI-SUUTEEN. Pellervon taloudellisen tutkimuslaitoksen Raportteja 207. 70 s. ISBN 978-952-5594-83-6 (NID), ISBN 978-952-5594-84-3 (PDF), ISSN 1456-3215, ISSN 1796-4776.

Tiivistelmä: Euroopan komissio on valmistelemassa muutoksia päästö-kauppadirektiiviin vuonna 2013 alkavalle aikajaksolle. Komission valmistelun tavoitteena on lisätä päästöoikeuksien huutokauppaa. Jos Euroopan metsäteollisuudelle ei anneta täyttä vapautusta päästöoikeuksien huuto-kaupasta, Euroopan paperi- ja selluteollisuuden vuotuiset kustannukset kasvavat 3,4 – 7,1 miljardia euroa. Tämä vastaa kuudesta kahteentoista prosenttia tuotantokustannuksista. Pitääkseen voittonsa ennallaan Euroopan paperi- ja selluteollisuuden pitäisi nostaa hintojaan 3 - 7 prosenttia. Koska Euroopan paperi- ja selluteollisuus ei kykene siirtämään kohonneita kustan-nuksia lopputuotteidensa hintoihin, metsäteollisuus menettää lähes kaikki voittonsa kustannusten nousun vuoksi.

Asiasanat: *Päästökauppadirektiivi, Euroopan paperi- ja selluteollisuus*

FOREWORDS

The European Union has been the leading actor in the global context to reduce carbon dioxide (CO2) emissions. In 1997 the European Union signed the Kyoto Protocol and thereby committed to reducing its CO2 emissions by 8 percent compared to the level in 1990. To achieve the CO2 target the European Union created a trading mechanism for emission–allowances that started on 1.1.2005.

In the period from 2008-2012 the European Union is committed to reducing CO2 emissions by 8 percent compared to the level in 1990 according to the Kyoto Protocol. To achieve this target, the total amount of the emission allowances has been reduced by about 13 percent from the level of 1990. So far, emission allowances have been allocated free of charge.

The European Commission is now preparing a revision of the Emission Trading Directive (ETS Directive) for period starting in 2013. The Commission has called for the auctioning of emission allowances to be given a larger role. This implies that more firms in the future than now with CO2 emissions will face the direct cost depending on the amount of emissions.

This paper examines, firstly, the effects of a revision of the Emission Trading Directive on the European pulp and paper industry in the case where the European pulp and paper industry is not even partially exempted from the auctioning mechanism and where other large pulp and paper producing countries do not participate in the Kyoto Protocol. Secondly, the paper assesses the international competition faced by the European pulp and paper industry.

This report has been done by the research group: Pasi Holm, Hanna Karikallio, Petri Mäki-Fränti, Henna Nivalainen, Niko Suhonen and Tapio Tilli from Pellervo Economic Research Institute. We would like to thank warmly our supervisory group: Senior Researcher Lauri Hetemäki, Research Manager Erno Järvinen, Professor Erkki Koskela, Professor Markku Ollikainen and Director Stefan Sundman.

Pasi Holm
Managing Director

RESEARCH GROUP:

Pasi Holm, Dr.Soc.Sc. Managing Director, Pellervo Economic Research Institute (in Finland), pasi.holm@ptt.fi, 358-9-34888400, Eerikinkatu 28 A, FI-00180 Helsinki, Finland, http://www.ptt.fi

Hanna Karikallio, Lic.Sc., Economist, Pellervo Economic Research Institute (in Finland), hanna.karikallio@ptt.fi, 358-9-34888408, Eerikinkatu 28 A, FI-00180 Helsinki, Finland, http://www.ptt.fi

Petri Mäki-Fränti, Dr.Sc., Economist, Pellervo Economic Research Institute (in Finland), petri.maki-franti@ptt.fi, 358-9-34888420, Eerikinkatu 28 A, FI-00180 Helsinki, Finland, http://www.ptt.fi

Henna Nivalainen, M.Sc., Economist, Pellervo Economic Research Institute (in Finland), Eerikinkatu 28 A, FI-00180 Helsinki, Finland, http://www.ptt.fi

Niko Suhonen, M.Sc., Economist, Pellervo Economic Research Institute (in Finland), niko.suhonen@ptt.fi, 358-9-34888407, Eerikinkatu 28 A, FI-00180 Helsinki, Finland, http://www.ptt.fi

Tapio Tilli, Lic.Sc., Forest Economist, Pellervo Economic Research Institute (in Finland), tapio.tilli@ptt.fi, 358-9-34888410, Eerikinkatu 28 A, FI-00180 Helsinki, Finland, http://www.ptt.fi

SUPERVISORY GROUP:

Lauri Hetemäki, Dr.Soc.Sc., Senior Researcher, Finnish Forest Research Institute, Unioninkatu 40 A, 00170 Helsinki, lauri.hetemaki@metla.fi

Erno Järvinen, M.Sc., Research Manager, Central Union of Agricultural Producers and Forest Owners, Simonkatu 6, 00100 Helsinki, erno.jarvinen@mtk.fi

Erkki Koskela, Dr.Soc.Sc., Professor, University of Helsinki, Arkadiankatu 7, 000140 Helsingin yliopisto, erkki.koskela@helsinki.fi

Markku Ollikainen, Dr.Soc.Sc., Professor, University of Helsinki, Latokartanonkaari 9, 00014 Helsingin yliopisto, markku.ollikainen@helsinki.fi

Stefan Sundman, M.Sc., Director, Finnish Forest Industries Federation, Snellmaninkatu 13, 00170 Helsinki, stefan.sundman@forestindustries.fi

THE EFFECTS OF A REVISION OF THE EMISSION TRADING DIRECTIVE FOR THE PERIOD STARTING IN 2013 ON THE EUROPEAN PULP AND PAPER INDUSTRY

Chapters and writers:

"Summary", "Introduction" and "Conclusions"
Pasi Holm

"A revision of the Emission Trading Directive and the European pulp and paper industry"
Pasi Holm and Tapio Tilli

"Global markets in the pulp and paper industry"
Hanna Karikallio

"Estimation of price elasticities"
Petri Mäki-Fränti

"The law of one price in the pulp and paper market"
Niko Suhonen

"The structural change in the communication paper markets and its implications"
Lauri Hetemäki

JOHTOPÄÄTÖKSET

Euroopan komissio on valmistelemassa vuonna 2013 voimaan tulevaa uutta päästökauppadirektiiviä. Alustavien tietojen mukaan komissio olisi laajentamassa huutokauppamekanismin käyttöä päästöoikeuksien jaossa. Toimialat, jotka voidaan luokitella paljon energiaa käyttäviksi ja jotka kohtaavat voimakasta kansainvälistä kilpailua, voidaan joko kokonaan tai osittain vapauttaa huutokauppamekanismista. Nämä toimialat voisivat saada kaikki tai ainakin osan saamistaan päästöoikeuksista maksutta.

Tässä tutkimuksessa tarkastellaan päästökauppadirektiivin uudistuksen vaikutuksia Euroopan paperi- ja selluteollisuuteen siinä tapauksessa, että Euroopan paperi- ja selluteollisuutta ei edes osittain vapauteta huutokaupan piiristä ja että toiset merkittävät paperia ja sellua tuottavat maat jäävät kasvihuonekaasujen päästörajoitusten ulkopuolelle. Tämän lisäksi tutkimuksessa tarkastellaan Euroopan paperi- ja selluteollisuuden kohtaamaa kansainvälisen kilpailun laajuutta.

Tutkimuksessa määritellään kolme eri skenaariota siitä, kuinka päästökauppadirektiivin uudistus vaikuttaa Euroopan paperi- ja selluteollisuuteen. Päästöoikeuden hinnan arvioidaan nousevan nykyisestä noin 20 eurosta/tonni 30 – 50 euroon/tonni vuonna 2013 alkavalla päästökauppakaudella. Päästöoikeuden hinnannousun 30 euroon/tonni arvioidaan nostavan sähkön markkinahintaa 7,5 euroa megawattitunnilta (MWh). Koska nykyinen sähkönhinta, noin 50 euroa/MWh, perustuu päästöoikeuden hintaan 20 euroa/tonni, päästöoikeuden hinnan ollessa 30 euroa/tonni sähkön markkinahinnan arvioidaan olevan 57,5 euroa/MWh. Kun päästöoikeus on 40 euroa/tonni tai 50 euroa/tonni, sähkönhinnan arvioidaan olevan 65 euroa tai 72,5 euroa/MWh. Päästöoikeuden hinnan nousun arvioidaan nostavan pyöreän puun ja kierrätyspaperin hintaa 10 prosenttia, 15 prosenttia ja 20 prosenttia nykytilaan verrattuna riippuen eri skenaariosta.

Jos Euroopan paperi- ja selluteollisuutta ei vapauteta lainkaan päästöoikeuksien huutokaupasta, sen vuotuisten päästöoikeuksien hankinnasta aiheutuvien kustannusten arvioidaan nousevan 1 250 – 2 150 miljoonaa euroa. Samanaikaisesti vuotuisten sähkökustannusten arvioidaan nousevan 700 – 2 150 miljoonaa euroa ja vuotuisten pyöreän puun ja kierrätyspaperin hankintakustannuksien arvioidaan nousevan 1 450 – 2 850

miljoonaa euroa johtuen päästöoikeuden korkeammasta hinnasta nykytilaan verrattuna. Vuotuisten kokonaiskustannusten 3,4 – 7,1 miljardin euron nousu vastaa 6 – 12 prosenttia Euroopan paperi- ja selluteollisuuden kokonaiskustannuksista. Jo tämä laskelma osoittaa, että metsäteollisuus on energiavaltainen toimiala.

Pitääkseen tuloksensa nykyisellä tasolla Euroopan paperi- ja selluteollisuuden pitäisi pystyä nostamaan lopputuotteidensa hintoja noin 3 - 7 prosenttia. Jos se ei pysty siirtämään kohonneita kustannuksia eteenpäin lopputuotteidensa hintoihin, se menettää lähes kokonaan tuloksentekokykynsä. Metsäteollisuuden voittojen osuus liikevaihdosta on keskimäärin viime vuosina ollut noin viisi prosenttia.

Jos Euroopan metsäteollisuus vapautetaan kokonaan huutokauppamekanismista, päästökaupan arvioidaan aiheuttavan noin 2,1 – 5,0 miljardin euron lisäkustannuksen Euroopan paperi- ja selluteollisuudelle kohonneiden energian ja kuituraaka-aineen hintojen seurauksena. Kokonaisuudessaan vuotuisten lisäkustannusten arvioidaan tässä tapauksessa olevan 4 – 9 prosenttia kokonaiskustannuksista. Pitääkseen tuloksensa nykyisellä tasolla Euroopan paperi- ja selluteollisuuden pitäisi pystyä nostamaan lopputuotteidensa hintoja noin 2 – 5 prosenttia.

Voiko Euroopan paperi- ja selluteollisuus yksipuolisesti nostaa lopputuotteidensa hintoja menettämättä oleellisesti markkinaosuuksiaan kansainvälisillä markkinoilla? Tutkimuksessa tätä kysymystä tarkastellaan (i) tutkimalla maailman 100 suurimman metsäteollisuusyrityksen markkinaosuuksia ja niiden alueellisia investointisuunnitelmia, (ii) estimoimalla paperin ja sellun vientikysyntäyhtälöitä ja tarkastelemalla vientikysynnän hintajoustoja, (iii) tarkastelemalla ”yhden hinnan lakia” kansainvälisillä paperi- ja sellumarkkinoilla ja (iv) analysoimalla viestintään ja informaatioon käytettävien paperilaatujen markkinoiden rakennemuutoksia, jotka johtuvat elektronisen informaatio- ja kommunikaatioteknologian nopeista muutoksista.

Tutkimuksessa osoitetaan, että (i) maailman 100 suurimman metsäteollisuusyrityksen markkinaosuus on laskenut vuoden 2002 55 prosentista 44 prosenttiin vuonna 2006. Eurooppalaisten yritysten markkinaosuus maailman 100 suurimman metsäteollisuusyrityksen joukossa on laskenut vuoden 2002 35 prosentista 31 prosenttiin vuonna 2006. Paperi- ja selluteollisuusyritysten keskimääräisten voittojen osuus liikevaihdosta on laskenut vuoden 2000 6,7 prosentista 5,5 prosenttiin vuonna 2006. Melkein 60 prosenttia uusista maailman 100 suurimman metsäteollisuusyrityksen

selluteollisuuden investoinneista ja yli 70 prosenttia niiden uusista paperiteollisuuden investoinneista tapahtuu Aasiassa vuosina 2006 – 2010.

Tutkimuksessa osoitetaan, että (ii) paperin vientikysyntä on hintajoustavaa kaikissa tarkastelluissa ekonometrisissa malleissa. Hintajoustavuus tarkoittaa sitä, että paperin vientihinnan nousu vähentää viennin arvoa. Koska merkittävä osa kansainvälisestä sellukaupasta tapahtuu yritysten sisäisenä kauppana, mikä saattaa tuoda siirtohinnoittelun mahdollisuuden hinnanmuodostukseen, estimoidut sellun vientikysynnän hintajoustot ovat itseisarvoltaan pienempiä kuin paperin vientikysynnän hintajoustot. Estimoidut paperin, kartongin ja sellun vientikysynnän hintajoustot osoittavat, ettei eurooppalaisilla paperi- ja selluteollisuuden yrityksillä ole riittävästi markkinavoimaa, jotta ne pystyisivät siirtämään huutokauppadirektiivin uudistuksen aiheuttaman kustannusnousun vientihintoihinsa.

Tutkimuksessa osoitetaan standardeja ekonometrisia menetelmiä hyödyntäen, ettei (iii) ”yhden hinnan lain” –hypoteesia kansainvälisillä paperi- ja sellumarkkinoilla voida hylätä. ”Yhden hinnan lain” mukaan paperin ja sellun hinnat muodostuvat kansainvälisillä markkinoilla ja eri maiden hintataso on yhdenmukainen, kun otetaan huomioon valuuttakurssien ja kuljetuskustannusten vaikutukset.

Tutkimuksessa osoitetaan, että (iv) paperiteollisuuden yritykset eivät ainoastaan kilpaile toisten toimialojen yritysten kanssa kansainvälisillä markkinoilla vaan nykyään myös elektronisen viestintä- ja informaatioalan yritysten kanssa. Sen lisäksi, että elektronisen viestintä- ja informaatioteknologian kehitys vähentää paperin kysyntää, se myös laskee paperin hintoja. Tätä kautta viime vuosien aikana syntynyt kilpailu aiheuttaa paperin hintojen laskupaineita ja vähentää paperiteollisuuden yritysten hinnoittelu-voimaa.

Tutkimus tukee käsitystä, että kansainvälisillä paperi- ja sellumarkkinoilla vallitsee kova kilpailu. Eurooppalaiset paperi- ja selluteollisuuden yritykset eivät voi hinnoitella lopputuotteitaan ottamatta huomioon lähinnä USA:sta ja Aasiasta tulevaa kilpailua.

Tutkimuksen keskeinen johtopäätös on se, ettei Euroopan paperi- ja selluteollisuus voi siirtää kohoavia kustannuksia kuluttajiensa maksettavaksi lopputuotteidensa hintoja nostamalla. Kireä kansainvälinen kilpailu estää hintojen korotukset. Jos toiset merkittävät paperia ja sellua tuottavat maat jäävät Kioton, sen jatkosopimusten tai sitä korvaavien muiden kansainvälisten sopimusten mukaisten päästörajoitusten ulkopuolelle ja jos

Euroopan paperi- ja selluteollisuus tulee täysimääräisesti huutokauppamekanismin piiriin, kun vuodesta 2013 voimaantulevaa huutokauppadirektiiviä uudistetaan, sen tuotantokustannukset nousevat 6 – 12 prosenttia. Kustannusten nousu heikentäisi merkittävästi Euroopan paperi- ja selluteollisuuden kilpailukykyä kansainvälisillä markkinoilla.

CONTENTS

SUMMARY

The European Commission is preparing a revision of the Emission Trading Directive for the period starting in 2013. The Commission has called for the auctioning of emission allowances to be given a larger role. The branches that can be classified as an energy-intensive and subject to international competition will be exempted, totally or partially, from the auctioning mechanism when emission allowances are allocated.

This paper examines, firstly, the effects of a revision of the Emission Trading Directive on the European pulp and paper industry in the case where the European pulp and paper industry is not even partially exempted from the auctioning mechanism and where other large pulp and paper producing countries do not participate in the Kyoto Protocol. Secondly, the paper assesses the international competition faced by the European pulp and paper industry.

According to the scenarios of the paper, a revision of the Emission Trading Directive will increase the price of the emission allowances to a level of 30 to 50 euros per ton. An increase in the price of the emission allowances from 20 euros (the price at the beginning of 2008) to 30 euros per ton will increase the market price of electricity by 7.5 euros per MWh, i.e. from 50 euros (the price at the beginning of 2008 in Finland) to 57.5 euros per MWh. When the price of the emission allowances is 40 or 50 euros per ton the respective market price of electricity is 65 or 72.5 euros per MWh. Higher price of emission allowances will put upward pressure on the price of wood and recovered paper amounting to about 10, 15 and 20 percent in three separate scenarios compared to the current price level.

If the European pulp and paper industry is not exempted from full auctioning of emission-allowances in the new Emission Trading Directive, it is estimated that the annual emission costs of the European pulp and paper industry will increase by about 1 250 to 2 150 million euros. In addition, the annual electricity cost of the European pulp and paper industry will increase by about 700 to 2 150 million euros and the annual wood and recovered paper cost will increase by about 1450 to 2850 million euros due to higher price of emission allowances. The total annual cost increase of 3.4 to 7.1 billion euros represents about 6 to 12 percent of the total cash

manufacturing cost, demonstrating that the forest industries are very energy-intensive.

To keep profits constant, the European pulp and paper industry should increase the final output price by about 3-7 percent. If the European pulp and paper industry cannot pass through higher costs to final product prices, it will lose almost all of its profits. Industry profits have on average been about 5 percent of the turnover in recent years.

If the European pulp and paper industry is totally exempted from the auctioning mechanism, emission trading will cause about 2.1 to 5.0 billion euros of additional costs to the European pulp and paper industry due to higher energy and fibre raw material prices. The total annual cost increase in this case represents about 4 to 9 percent of the total cash manufacturing cost. To keep profits constant, the European pulp and paper industry should increase the final output price by about 2-5 percent.

To evaluate whether the European industries can unilaterally increase their output prices without significant losses in market shares, this paper (i) considers the global market shares of the world's top 100 pulp and paper firms and their regional investment plans, (ii) estimates the export demand equation for pulp and paper to analyze the export price elasticities, (iii) studies the "law of one price" in the global pulp and paper markets and (iv) analyses structural change in the communication paper markets caused by the rapid development of electronic information and communications technology.

The paper shows that (i) the market share of the world's top 100 firms in the pulp and paper industry has decreased from 55 percent in 2002 to 44 percent in 2006. The market share of European firms among the world top 100 has decreased from 35 percent in 2002 to 31 percent in 2006. The profitability of the pulp and paper companies has decreased on average from 6.7 percent in 2000 to 5.5 percent in 2006. Almost 60 percent of the pulp investments and over 70 percent of the paper investments of the world's top 100 firms will be realised in Asia during 2006-2010 indicating that the sector is exposed to a potential carbon leakage.

The paper shows that (ii) the export demand for paper is price-elastic in all estimated econometric models, implying that an increase in the export price reduces the value of export. Since a large part of the pulp trade is intra-firm trade, implying also an element of intra-firm transfer pricing in the market price formation, the estimated price elasticities of the exports

demand for pulp are lower in absolute value than those for the paper. Our estimates of the price elasticities of paper, cardboard and pulp, suggests that the market power is not sufficient to enable the companies to transfer to their export prices the cost increases resulting from emission trading and full auctioning of emission allowances.

The paper shows that (iii) the “law of one price” cannot be rejected in the global pulp and paper markets by standard econometric methods. The “law of one price” means that prices are determined globally, and that regional prices are almost identical when taking into account the impact of exchange rates and transaction costs.

This paper demonstrates that (iv) paper companies are not only competing against each other, but today also against the electronic information and communications technology (ICT) sector. In addition to reducing demand for communication papers, ICT development also seems to affect the prices of paper products. Increased competition puts downward pressure on paper prices and weakens the pricing power of the paper industries.

Overall, our results support the view of competitive pulp and paper markets, where companies cannot set their prices without taking into account the global competition originating from the USA and Asia. The paper concludes that due to severe international competition in the pulp and paper markets, the European pulp and paper industries cannot pass through the cost increase to their final consumers by increasing pulp and paper prices. Therefore, if the European pulp and paper industry is subject to full auctioning of emissions allowances in line with the Commission proposal on the Emission Trading Directive for the period starting in 2013 in the case where other large pulp and paper producing countries do not participate in the Kyoto Protocol or subsequent future international agreements with binding targets for emission reduction, this will increase the costs of the industry by about 6 to 12 percent. This would mean a serious loss of competitiveness of the European pulp and paper industry in internal and global markets.

1. INTRODUCTION

The European Union has been the leading actor in the global context to reduce carbon dioxide (CO2) emissions. In 1997 the European Union signed the Kyoto Protocol and thereby committed to reducing its CO2 emissions by 8 percent compared to the level in 1990. To achieve the CO2 target the European Union created a trading mechanism for emission–allowances that started on 1.1.2005. In the first trading period of 2005-2007 the emission allowances for firms producing in the Europe were allocated free of charge. At the beginning of the period the price of tradable emission allowances even exceeded 30 euros per ton. At the end of the first round the price was close to zero.

In the period from 2008-2012 the European Union is committed to reducing CO2 emissions by 8 percent compared to the level in 1990 according to the Kyoto Protocol. To achieve this target, the total amount of the emission–allowances has been reduced by about 13 percent from the level of 1990. The price of tradable emission allowances rose to about 20 to 25 euros per ton at the beginning of 2008.

So far, emission allowances have been allocated free of charge. This means that if a firm's total amount of emissions has been less than its emission allowances given in the initial allocation, it has been able to sell its additional emission allowances to achieve extra earnings. If, in turn, a firm's total amount of emissions has been more than its emission allowances, it has had to buy additional emission-allowances at the market price.

The European Commission is now preparing a revision of the Emission Trading Directive (ETS Directive) for period starting in 2013. The Commission has called for the auctioning of emission allowances to be given a larger role. This implies that more firms in the future than now with CO2 emissions will face the direct cost depending on the amount of emissions.

The European Council emphasised in its conclusions in March 2007 the great importance of the energy-intensive sector and that cost-efficient measures are needed to improve its competitiveness. In practise, some sectors could be granted exemptions from the auctioning of allowances. This kind of reasoning calls for exact criteria for exemptions. At least four points can be identified: energy intensity, global competition, profitability and the degree of pass-through of costs.

This paper will focus the European pulp and paper industry. It will firstly analyse the effects of a revision of the Emission Trading Directive on the European pulp and paper industry in the case where these industries are not exempted from the auctioning mechanism and where other large pulp and paper producing countries do not have binding Kyoto targets or an emission trading system. Secondly, the paper evaluates the strength of international competition in pulp and paper markets and the pricing power of pulp and paper companies.

A revision of the ETS Directive will affect the European pulp and paper industry via three main channels that will reduce their competitiveness in the global markets. Firstly, it will increase the emission costs of the European forest industries. Secondly, it will increase the electricity cost of these industries. Thirdly, it will increase the wood and recovered paper costs of the European pulp and paper industry.

After quantifying the costs resulting from a revision of the ETS Directive, the paper compares these costs with the turnover and profit of European pulp and paper firms and estimates the upward pressure on producer prices of the European pulp and paper producers caused by higher costs. To determine whether the European pulp and paper industry will be able to unilaterally increase its output prices without significant losses in market shares, the paper estimates the strength of international competition in the global markets by using various econometric model specifications.

The paper uses four approaches. Firstly, the global market shares of the world's top 100 forest firms and their regional investment plans are evaluated. Secondly, export demand equations are estimated using pooled cross-section time-series data concerning trade flows between the most important countries from the European point of view. Thirdly, the "law of one price" is evaluated by econometric analyses of the pulp and paper prices in different regions. Fourthly, structural change in the communication paper markets is examined in the markets for newsprint, uncoated woodfree paper (~ office paper), and magazine paper in the USA, Germany and the UK.

2. A REVISION OF THE EMISSION TRADING DIRECTIVE AND THE EUROPEAN PULP AND PAPER INDUSTRY

In this section we try to evaluate the cost push effects of a revision of the Emission Trading Directive (ETS Directive) on the European pulp and paper industry. We apply a kind of first-round benchmark analysis by assuming that all relevant quantities remain constant. After collecting the proper data we calculate changes in terms of values due to changes in terms of prices. A revision of the ETS Directive will affect to the European pulp and paper industry by increasing the direct emission costs, by increasing the price of electricity and by increasing the price of wood and recovered paper.

In the first trading period of 2005-2007 the emission allowances for firms producing in Europe were allocated free of charge. At the beginning of the first trading period (2005-2007) the price of tradable emission allowances even exceeded 30 euros per ton. At the end of the first period the price was close to zero. At the beginning of the second trading period (2008-2012) the price of tradable emission allowances has been about 20 to 25 euros per ton.

What will happen to the price of emission–allowances in the third trading period starting in 2013? According to the study of Russ and Criqui (2006), the prices of CO2 emissions allowances may vary between 16.5 and 45.2 euros per ton in 2010 and between 53.5 and 99.8 euros per ton in 2020. Based on this, three scenarios are specified in this study. The price of emission allowances is assumed to be 30 euros per ton, 40 euros per ton and 50 euros per ton in three alternative scenarios. In these scenarios the emission allowances are allocated by an auctioning mechanism.

There is a straightforward impact of the price of emission allowances on the price of electricity. According to the Finnish business analysts specialised in the electricity markets, a one euro increase in the price of emission allowances will increase the price of electricity by about 75 cents. An increase in the price of emission allowances from 20 euros (the price at the beginning of 2008) to 30 euros per ton will increase the price of electricity by 7.5 euros per MWh, i.e. from 50 euros (the price at the beginning of 2008 in Finland) to 57.5 euros per MWh. In the same way, when the price of

emission allowances is 40 or 50 euros per ton the respective price of electricity is 65 or 72.5 euros per MWh.

It is reasonable to assume that the emission trading will put upward pressure on the prices of wood and recovered paper, since they can be used as a raw material in energy production. We assume that the price of wood and the price of recovered paper will increase at the same rate of about 10, 15 and 20 percent in scenarios I, II and III, respectively. Prices of other cost components in the pulp and paper industry, including the price of pulp, are assumed be independent of the ETS Directive. The different scenarios are summarized in Table 2.1.

Table 2.1. *Three scenarios for the effects of the Emission Trading Directive on the prices of emission allowances, electricity and wood and recovered paper.*

	Scenario 1	Scenario 2	Scenario 3
Price of emission allowances, euros per tons	30.0 *(20%)*	40.0 *(60%)*	50.0 *(100%)*
Price of electricity, euros per MWh	57.5 *(15%)*	65.0 *(30%)*	72.5 *(45%)*
Price of wood and recovered paper	*(10%)*	*(15%)*	*(20%)*

The percentage price increases are provided in parentheses.

To calculate the effects of the scenarios we have collected data from 2006 on the total amount of CO2 emissions, the purchased electricity and the use of wood and recovered paper in the European pulp and paper industry (see Table 2.2). The total production in the European pulp and paper industry was 130.6 million tons in 2006, which implies 42.5 million ton of CO2 emissions. The European pulp and paper industry consumed about 4.8 billion euros of electricity and 14.3 billion euros of wood and recovered paper. The cash manufacturing cost was about 56.8 billion euros.

By assuming that all quantities are constant, the effects of the scenarios on the costs of the European pulp and paper industry can be calculated as shown in Table 2.2. For comparison, the effects are calculated for four large European pulp and paper producing countries.

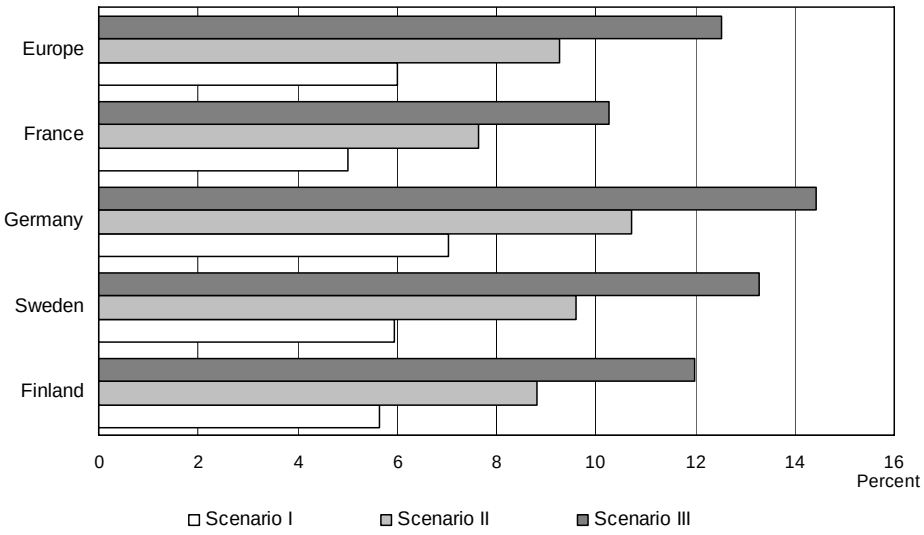
Table 2.2. *The effects of a revision of the Emission Trading Directive on the European pulp and paper industry in the case where the European pulp and paper industry is not even partially exempted from the auctioning mechanism and where other large pulp and paper producing countries do not participate in the Kyoto Protocol*

The base year 2006	Europe	Finland	France	Germany	Sweden
Total production, million tons	130.6	17.6	11.5	23.3	16.8
CO2 emissions, million tons	42.53	5.2	2.9	6.3	2.0
Purchased electricity, million euros	4751	710	284	1124	789
Use of wood, million euros	9784	1842	664	674	2185
Use of recovered paper, million euros	4514	66	515	1510	215
Cash manufacturing cost, million euros	56825	8011	4950	1894	7023
Scenario I					
- emission cost, million euros	1276	156	86	378	59
- additional cost of electricity, million euros	713	106	43	169	118
- additional cost of wood raw material, million euros	1430	191	118	218	240
- total cost of a revision of ETS Directive, million euros	3418	453	247	765	417
Scenario II					
- emission cost, million euros	1701	208	115	504	78
- additional cost of electricity, million euros	1425	213	85	337	237
- additional cost of wood raw material, million euros	2145	286	177	328	360
- total cost of a revision of ETS Directive, million euros	5271	707	378	1169	675
Scenario III					
- emission cost, million euros	2126	260	143	630	98
- additional cost of electricity, million euros	2138	319	128	506	355
- additional cost of wood raw material, million euros	2860	382	236	437	480
- total cost of a revision of ETS Directive, million euros	7124	961	508	1573	933

Sources: Risi, 4th quarter in 2006, the Finnish Forest Industries, the Finnish Institute of Forest Research and the authors' calculations.

If the European pulp and paper industry is subject to full auctioning of emission allowances in line with the Commission proposal on the Emission Trading Directive for the period starting in 2013, this will cause about 3.4 to 7.1 billion euros of additional costs to the European pulp and paper industry.

The total amount of CO2 emissions of the European pulp and paper industry in 2006 was about 42.5 million tons. The direct costs of a revision of the ETS Directive with full auctioning in terms of the emission–costs are 1276, 1701 and 2126 million euros in three respective scenarios. The indirect costs of a revision of the ETS Directive due the increases in the electricity and the wood and recovered paper prices are 2142, 3570 and 4998 million euros in the three scenarios, respectively. As shown in Figure 2.1, a revision of the ETS Directive will increase the cash manufacturing cost of the European pulp and paper industry by about 6 to 12.5 percent.



Source: Risi, 4th quarter 2006, and authors' calculations

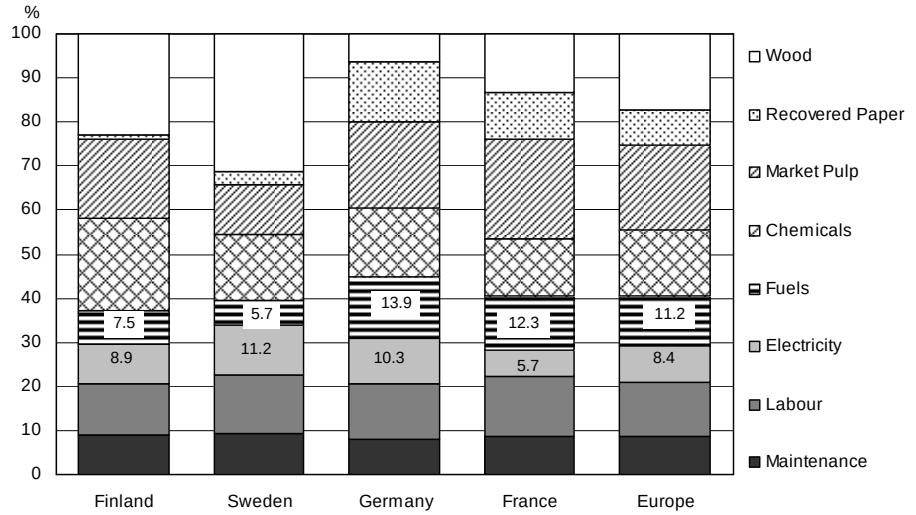
Figure 2.1. *Increase in the cash manufacturing cost due to full auctioning of emission allowances*

The European pulp and paper industry is a very energy intensive sector.

The largest increase in costs will be in Germany and the lowest in France. The variations between countries in the cost increase are due to the differences in the cost structure, as shown in Figure 2.2. The cost share of wood and recovered paper varies from 20 percent in Germany to 34 percent in Sweden. The cost share of electricity varies from 5.7 percent in France to 10.3 percent in Sweden. The European pulp and paper industry is very energy intensive. The share of electricity and fuel costs together is about 19.4 percent. The most energy-intensive steps in producing paper and paperboard are (a) converting trees into fibres suitable for making paper, (b) recovering pulping chemicals (relevant only for chemical pulp mills) and (c) removing the water that must be added during the paper or paperboard making process.

Paper can in practice be made both of virgin wood-based fibres or recovered fibres. Wood fibre can be recovered and used a limited number of times as paper raw material. The paper recovery loop continuously needs an input of fresh wood fibre. As such, paper production based on recovered paper does not exist without an input of fresh virgin wood-based paper. The production of wood-based mechanical and chemical pulps is energy intensive compared to the production of paper from recovered paper. As the latter does not exist without the energy-intensive virgin fibre-based products, fair treatment of the whole production chain is of utmost importance.

By relating the total costs of emission trading to the total turnover of the European pulp and paper industry one can estimate the upward pressure in producer prices (see Table 2.3).



Source: Risi, 2nd quarter 2007

Figure 2.2. *Share of the different components of the cash manufacturing cost in the European pulp and paper industry*

Table 2.3. *The upward pressure on the producers prices of the European pulp and paper industry caused by a revision of the Emission Trading Directive in the case where the European pulp and paper industry is not even partially exempted from the auctioning mechanism and where other large pulp and paper producing countries do not participate in the Kyoto Protocol (base year 2006)*

Total production, million tons	130.6		
Total turnover, million euros	103591		
Cash manufacturing cost, million euros	56825		
Profits, % of the total turnover	5.3		
	Scenario 1	*Scenario 2*	*Scenario 3*
- total cost of a new ETS Directive, million euros	3418	5271	7124
- total cost increase, % of the cash manufacturing cost	6.0	9.3	12.5
- total cost increase, % of the total turnover	3.3	5.1	6.9

Sources: Risi, 4th quarter in 2006, the Finnish Forest Industries, the Finnish Institute of Forest Research and the authors' calculations.

To compensate for the increase of about 6.0 to 12.5 percent in the cash manufacturing costs due to a revision of the ETS Directive with full auctioning of emission allowances, the producer prices of the European forest industries should increase by about 3.3 to 6.9 percent of the turnover.

If the European pulp and paper industry is totally exempted from the auctioning mechanism, a revision of the ETS Directive will cause about 2.1 to 5.0 billion euros of additional costs to the European pulp and paper industry. The total annual cost increase in this case represents about 3.8 to 8.8 percent of the total cash manufacturing cost. To keep profits constant, the European pulp and paper industry should increase the final output price by about 2.1-4.8 percent.

In next sections we consider whether the European pulp and paper industry is able to pass through the cost increase to their final customers.

3. GLOBAL MARKETS IN THE PULP AND PAPER INDUSTRY

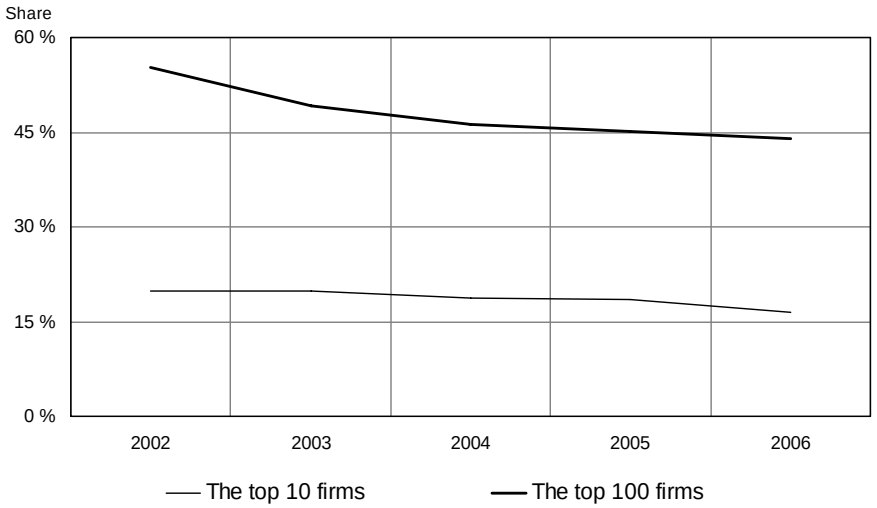
3.1 International competition and economic performance of the pulp and paper industry

The pulp and paper industry is going through a fundamental structural change. The rapid growth of emerging economies has altered global patterns of supply and demand. Constant price and cost pressures also force mills to close in Europe and shift new investments out of the area. On the other hand, technological changes have opened up new opportunities.

A significant development in global pulp and paper markets is the emergence of new competitors. Competition has become a very important driving force in the forest industry. In this chapter we provide some indicators of the tightness of competition in the industry and also represent the development of the economic performance of the pulp and paper industry in recent years. We have used data on the top 100 pulp and paper firms in the world.

During the past years the main global pulp and paper industry companies have faced a quite high loss of market share (Figure 3.1). The production share of the top 100 pulp and paper firms was 55 percent in 2002 and 44 percent in 2006: the more than 10 percentage unit loss of market share in 5 years is considerable. Similarly, the production share of the top 10 pulp and paper firms has declined from 20 percent to 16.5 percent during the period from 2002-2006. These numbers indicate strong and continuously increased competition in the global pulp and paper markets[1].

[1] More proper way would be to measure competitiveness at paper quality and pulp quality level. However, our data sources do not include information needed for quality level analysis.



Source: The database of Pellervo Economic Research Institute

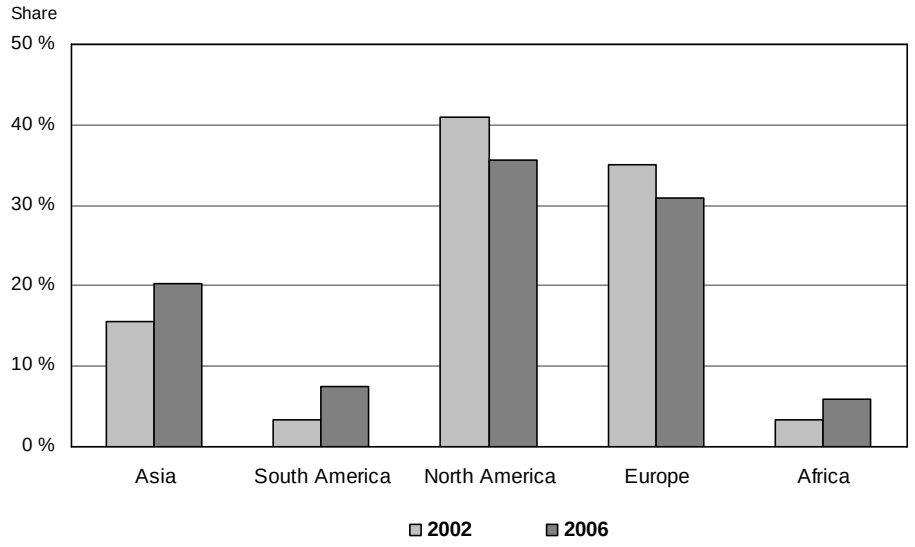
Figure 3.1. *The top 10 and the top 100 firms' share of total production in the global pulp and paper market.*

The world's major producers of pulp and paper products are in North America and Europe. However, the relative importance of the European and North American pulp and paper industry at the global level has decreased. The global marketplace has become extremely dynamic.

The European and North American firms have lost their production shares among the world's top 100 pulp and paper firms (Figure 3.2). The market share of the European firms decreased from 35 percent in 2002 to 31 percent in 2006. Similarly, the market share of the North American firms has decreased from 41 percent to 35 percent. Consequently, an industry that should be a major part of a sustainable economic future for many European and North American countries is shrinking rather than realizing its full potential.

The European and North American companies are still the top leaders in the pulp and paper product markets. However, substantial new capacity in pulp and paper production has come online in non-traditional supply regions. Asian, South American and African firms have increased their production shares among the world's top 100 pulp and paper firms. Attention has now

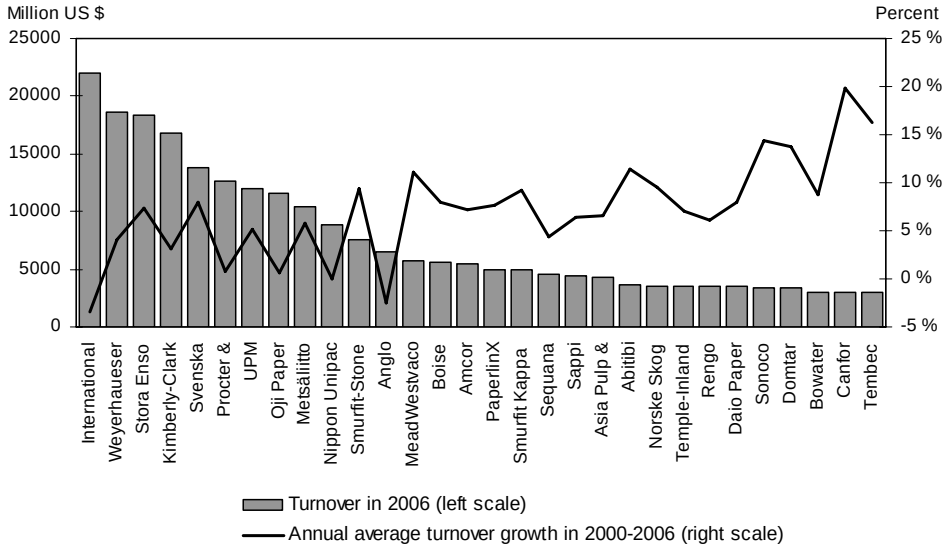
focused on the potential of new competitors to capture trade opportunities from traditional suppliers in North America and Europe. These competitors' comparative advantages generally include large areas of natural forests, high-productivity plantation sites, no binding Kyoto targets or emissions trading and lower labour costs. At the same time, the main pulp and paper industry companies in North America and Europe are grappling overcapacity, high energy costs and increased chemical prices.



Source: The database of Pellervo Economic Research Institute

Figure 3.2. *Distribution of the top 100 pulp and paper industry firms by region in 2002 and 2006.*

In 2006, four of the top 10 global pulp and paper firms was from North America, four from Europe and two from Asia. The turnover of nine of them exceeded the limit of 10 billion US dollars. Still the top leaders have not been able to increase their turnover in recent years as rapidly as the next largest firms (Figure 3.3). In the top 30 there are firms whose average annual growth rates have been almost 20 percent, but among the top 10 firms the maximum average annual growth rate has been below 8 percent. The top 10 leading firms are facing strong competition from the other large companies in the global pulp and paper markets.

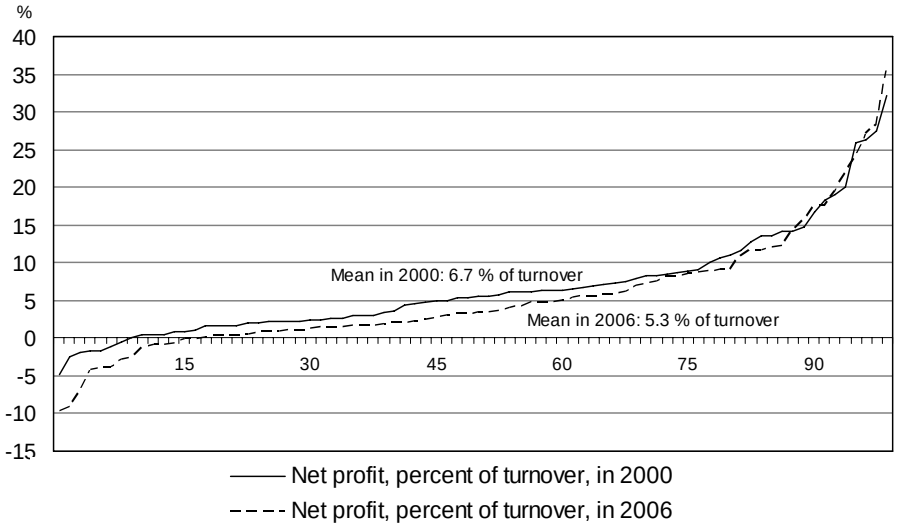


Source: The database of Pellervo Economic Research Institute

Figure 3.3. *The top 30 pulp and paper industry firms' turnover in 2006 and average annual growth during 2000-2006.*

On a global level, the profitability of pulp and paper industry companies has been low, especially when compared to many other sectors. The profitability – measured by the profits after taxes on annual sales – of the top 100 forest industry companies has decreased on average from 6.7 percent in 2000 to 5.3 percent in 2006 (Figure 3.4).

The pulp and paper sector has proven to be particularly vulnerable to the vagaries of the economy. However, the overall economic situation in both years under investigation (2000 and 2006) was very good. A noticeable issue is also that in 2000 about 7 percent of the firms among the top 100 were unprofitable. In 2006 the corresponding percent share was 15, which is quite a high share of the largest firms in the pulp and paper industry.



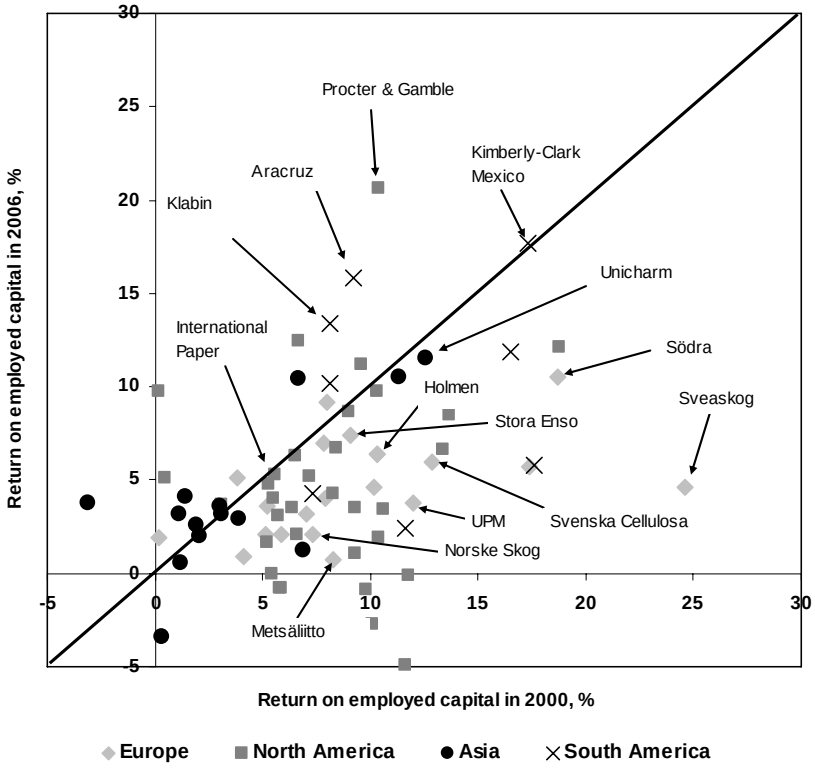
Source: The database of Pellervo Economic Research Institute

Figure 3.4. *The top 100 pulp and paper industry firms' net profits in 2000 and in 2006, sorted from the lowest to the highest.*

Figure 3.5 presents another profitability measure, the return on capital employed. It matches the net after tax profits with the assets used to earn such profits. According to this ratio we also observe a clear decrease in the largest firms' profitability between 2000 and 2006. Firms below the line of 45 degrees have faced a decrease in the return on employed capital from 2000 to 2006. The figure also shows that European firms are outperformed by many of their competitors, especially the firms from emerging countries in South America but also some traditional ones from North America.

The key factors at play in the pulp and paper industry are profitability and ability to attract new investment capital. Under tight competition the traditional European pulp and paper industry companies are under pressure to build new competitive advantages. The prospects for the technological development of the pulp and paper industry are enormous and this could offer the key to succeed for these companies. New technologies could lead to cost reductions, energy savings, lower emissions per tonne produced, the development of better equipment, increased production of bioenergy and second generation biofuels and the creation of high value-added products,

while reducing the pressure on wood resources. To achieve this objective, it is essential that European firms are able to step up their R&D efforts. Only in this way could they be productive and competitive in the long term. Additional costs due to a revision of the ETS Directive with full auctioning of emissions allowances to the European pulp and paper industry weaken their possibility to realise these prospects and could lead to a carbon leakage.

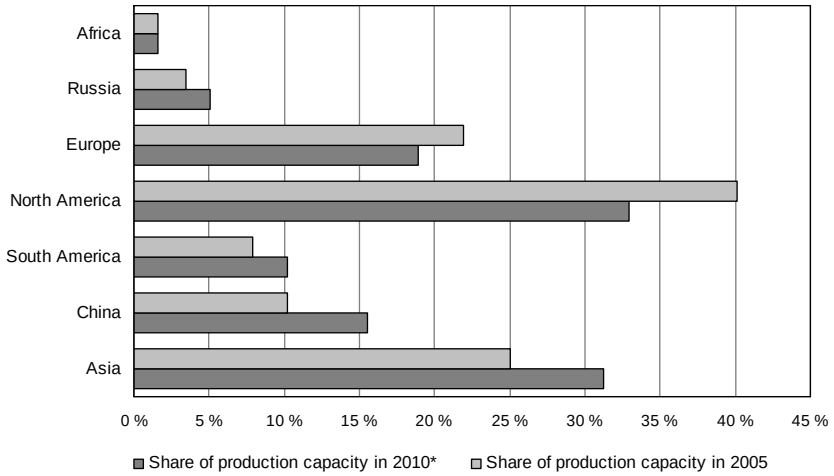


Source: The database of Pellervo Economic Research Institute

Figure 3.5. *The top 100 pulp and paper industry firms' return on capital employed by region in 2000 and in 2006.*

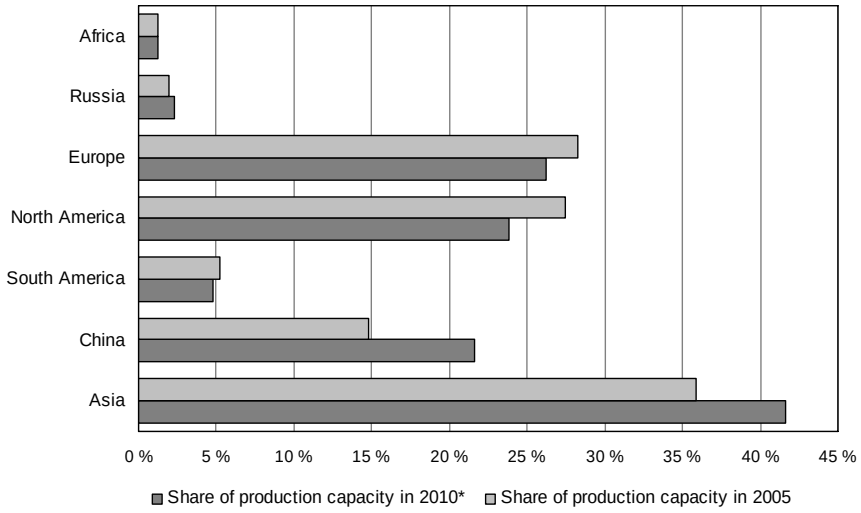
3.2 Geographic shifts in production capacity

The pulp and paper industry in Europe has strongly increased its capacity over the last decades. The European industry in total represented close to 22 percent of the world pulp production and 28 percent of the world paper production in 2005 (see Figures 3.6a and 3.6b). However, in the coming years, production capacity development in Europe will not be as strong as in Asia, South America and Russia. The dominance of European and North American firms in the global marketplace has diminished in recent years and the same kind of development will continue. We estimate that in 2010 close to one third of the world pulp production and 42 percent of the world paper production will be located in Asia. In addition, South America and Russia will increase their pulp production capacity by about 30 percent in the coming years. According to our estimation, the European pulp production capacity is 18 percent (4 percentage units lower than in 2005) and paper production capacity 26 percent (2 percentage units lower than in 2005) of the total production capacity of the world in 2010.



Source: The database of Pellervo Economic Research Institute based on the investment plans announced by the top 100 firms

Figure 3.6a. Share of the pulp production capacity in different regions (Asian production capacity includes also the production in China).



Source: The database of Pellervo Economic Research Institute based on the investment plans announced by the top 100 firms

Figure 3.6b. *Share of the paper production capacity in different regions (Asian production capacity includes also the production in China).*

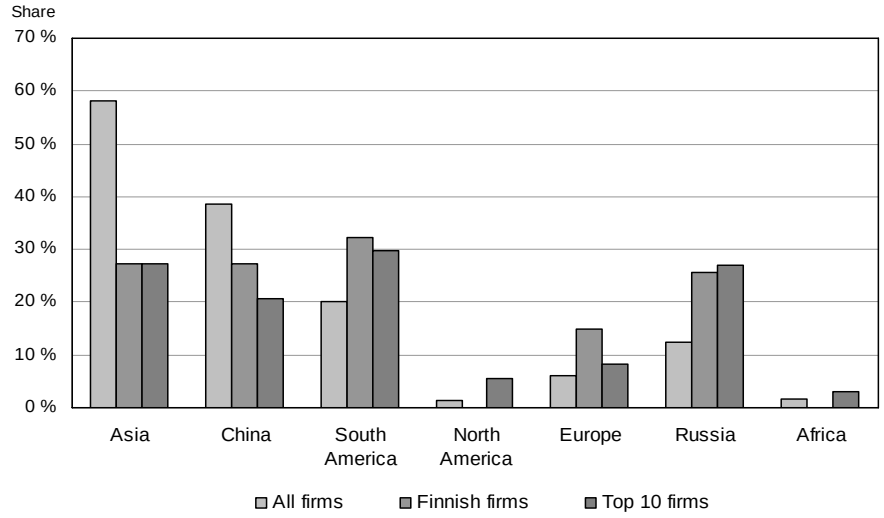
Radical changes are taking place worldwide in the pulp and paper industry. Fundamental changes are taking place as capacity ramps up in Asia and the major players shift their production lines to Asia, Latin America and Russia. It seems highly likely that the pulp and paper industry of the next decade will look dramatically different from that seen today.

Figures 3.7a and 3.7b present the percentage shares of pulp and paper investments by region during 2005-2010. Investments of the Finnish firms and of the top 10 firms are also presented by region.

According to Figure 3.7a, huge pulp investments will be made in Asia, South America and Russia in the coming years. Particularly the Finnish and the largest firms will invest heavily in South America and Russia. Approximately one third of the pulp investments of the Finnish and of the top 10 firms are located in South America. In addition, foreign investments in South America's forest sector are expected to rapidly increase immediately after 2010. The investments announced and envisaged in Europe and North America remain relatively limited.

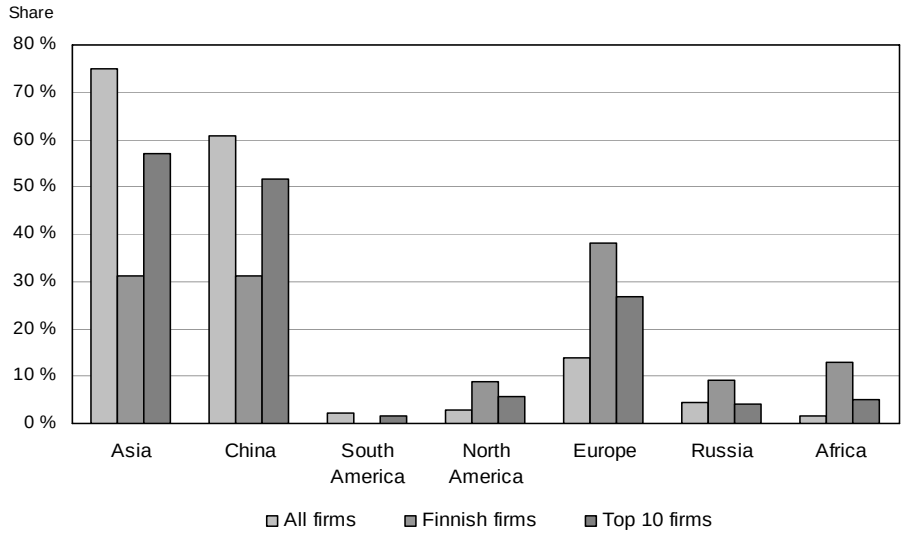
Massive paper investments are also expected in Asia during the next years. Paper investments in Europe and in North America in the coming years are rather limited. The Finnish paper industry invests in Asia and in Europe; 30 percent of the Finnish firms' paper investments are made in China and 40 percent in Europe. The top 10 firms also invest in China: over half of their investments are announced to take place there.

In total, during 2005-2010 almost 60 percent of pulp investments and over 70 percent of paper investments will be realised in Asia. The internationalization of Finnish forest industry groups is reflected in large investments abroad. Finnish firms' pulp investments will be located in South America and paper investments in Asia.



Source: The database of Pellervo Economic Research Institute based on the investment plans announced by the top 100 firms

Figure 3.7a. *Share of the pulp investment in the different regions in 2005-2010 (Investments in Asia includes also investments in China).*



Source: The database of Pellervo Economic Research Institute based on the investment plans announced by the top 100 firms

Figure 3.7b. *Share of the paper investment in different regions in 2005-2010 (Investments in Asia includes also investments in China).*

Asia, South America and Russia seem to offer the greatest development potential for the pulp and paper industry. Production will increase strongly in these areas, where the pulp and paper industry has access to an abundant supply of raw material, low energy costs and large consumer markets. Consequently, the firms in these areas make competition in the global pulp and paper markets extremely strong.

In summary, the pulp and paper industry operates in a global market where the higher cost levels of the domestic market are difficult to shift to higher product prices. Therefore, industries are enhancing the efficiency of their business operations and improving their competitiveness. Only companies that manage to keep production costs low and increase productivity can prosper in global competition.

4. ESTIMATION OF PRICE ELASTICITIES

Estimating the price elasticities of export demand provides one approach for investigating the pricing power of forest companies, and thus the degree of competitiveness of an industry. If a one percent increase in the price of paper decreases the export demand by more than one percent, the value of the export decreases. This means that pulp and paper companies may not be able to fully transfer an increase in their marginal costs due to a revision of the Emission Trading Directive and full auctioning of emission allowances to their output prices.

In the following, we estimate the price elasiticities of the export demand for paper and cardboard (henceforth in short: paper), and pulp. Anticipating the results, the estimate for the elasticity for paper is greater than one in the absolute value, indicating a high degree of competitiveness in the industry. In the case of pulp, however, the estimation results are ambiguous, since the estimated price elasticity of export demand varies around minus one.

4.1 Model

To obtain the price elasticities for export flows in the pulp and paper industry, we regressed the export demands for pulp and paper with their prices. To control for the potential factors affecting demand, other than price, and to avoid possible omitted variable bias in estimation, we ended up by specifying our model as a well-known gravity model of international trade, augmented by the price of paper or pulp. The gravity model builds on the idea that variation in the volume of trade between two economies increases with their size (the usual proxies are GDP, population and land area) and decreases with transaction costs (commonly measured as bilateral distance, adjacency and cultural similarities such as common language) (e.g. Cipollina and Salvatici 2006). The pioneers in using the gravity model in bilateral analysis were Tinbergen (1962) and Pöyhönen (1963). Since then, gravity models have been widely applied for explaining bilateral trade. It should be stressed, however, that the parameter estimates of the gravity variables per se were not of interest to us. Rather, the variables are included

in the model to control for the factors affecting export demand other than prices.

Thus, our equations to be estimated take the form of equations 4.1 and 4.2 below. Technically, the latter specification with GDPs per capita as explanatory variables instead of GDPs and populations as such, simply restricts the absolute values of the coefficients of population and GDP of a country to be equal.

4.1 $$x_{ijt} = \alpha + \beta_1 gdp^{\exp}_{ijt} + \beta_2 gdp^{imp}_{ijt} + \beta_3 pop^{\exp}_{ijt} + \beta_4 pop^{imp}_{ijt} + d_{ij} + \beta_5 p_{ijt} + \varepsilon_{ijt}$$

4.2 $$x_{ijt} = \alpha + \beta_1 \frac{gdp^{\exp}_{ijt}}{pop^{\exp}_{ijt}} + \beta_2 \frac{gdp^{imp}_{ijt}}{pop^{imp}_{ijt}} + d_{ij} + \beta_3 p_{ijt} + \varepsilon_{ijt}$$

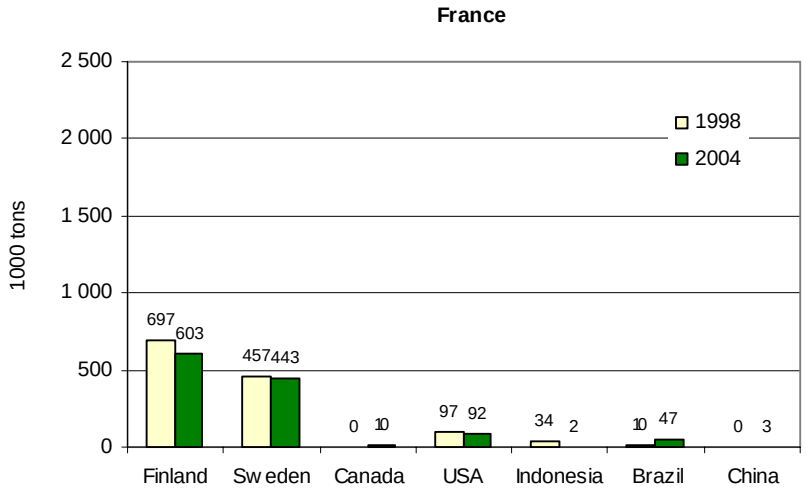
where $gdp^{\exp}_{ijt}$ and gdp^{imp}_{ijt} are the (logs of) GDPs of the exporting and importing countries in year t, $pop^{\exp}_{ijt}$ and pop^{imp}_{ijt} are the (logs of) the populations of the countries, d_{ij} is the distance between the capital cities of the trade partners and p_{itj} is the price of pulp or paper.

4.2 Data and methods

We used panel data, where the dependent variable consisted of annual observations on the volumes of export of pulp and paper and cardboard from seven countries to six importing countries in the period spanning from 1997 to 2004. The export countries were Finland, Sweden, Canada, Indonesia, Brazil, China and USA, whereas the import countries included China, France, Germany, Japan, UK and USA. Since China and USA belong to both exporting and importing countries, a total of 40 observations of bilateral trade flows between the countries were available. The export series for paper and cardboard as well as pulp are aggregated series for a number of different product qualities, and they were attained from the FAO database.

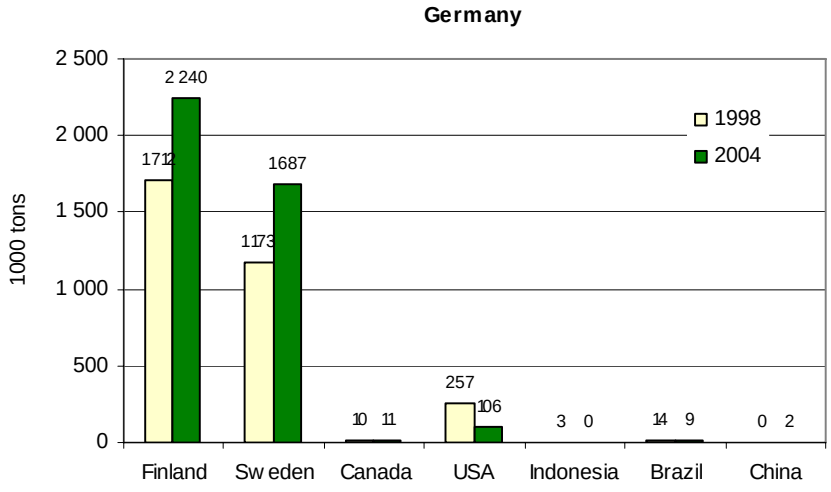
Figures 4.1. and 4.2. present the imports of pulp and paper of France, Germany and UK. Looking at the figures, one might expect that the pulp markets are more globally competitive than the paper markets. The demand of the largest importers of paper products has mainly been satisfied by

imports from other European countries. In the case of pulp, in contrast, imports outside Europe have also played an important role.



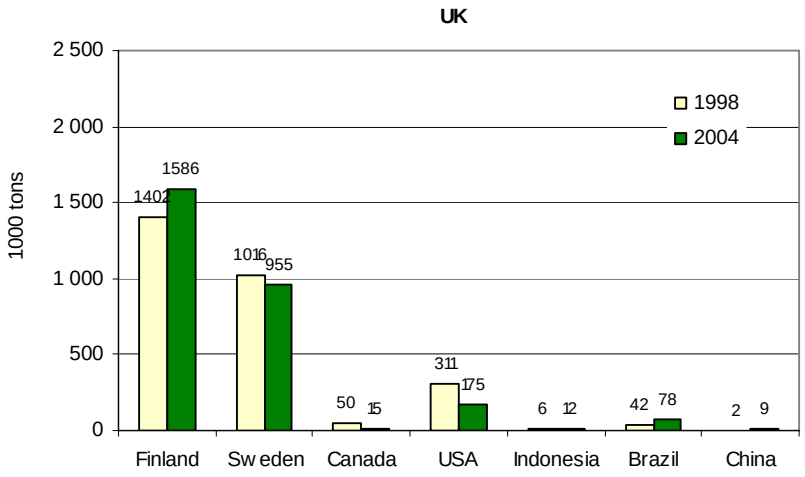
Source: FAO statistics

Figure 4.1a. *Paper and paperboard imports of France in 1998 and 2004 (thousand tons).*



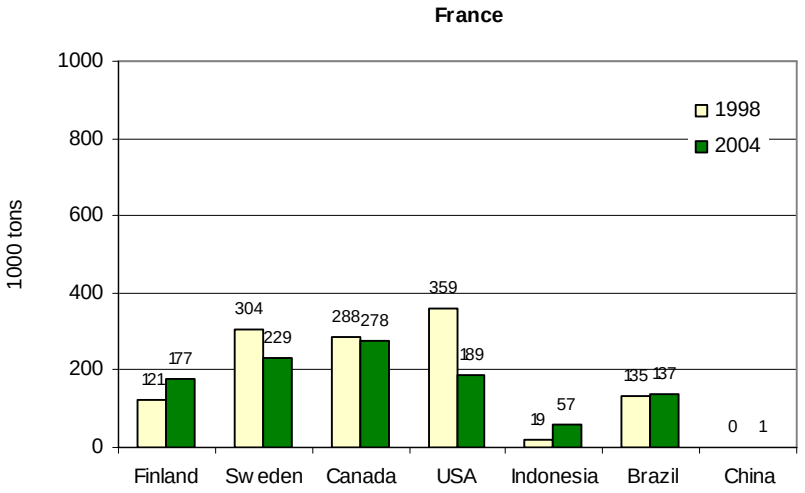
Source: FAO statistics

Figure 4.1b. *Paper and paperboard imports of Germany in 1998 and 2004 (thousand tons).*



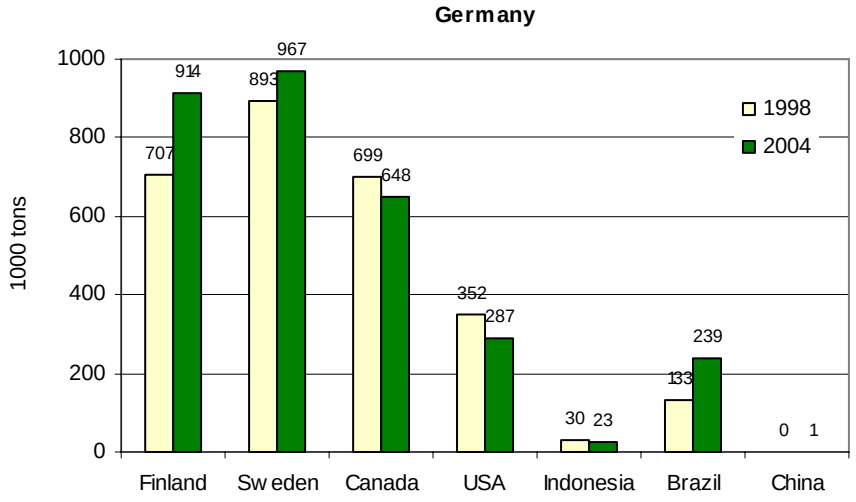
Source: FAO statistics

Figure 4.1c. *Paper and paperboard imports of the UK in 1998 and 2004 (thousand tons).*



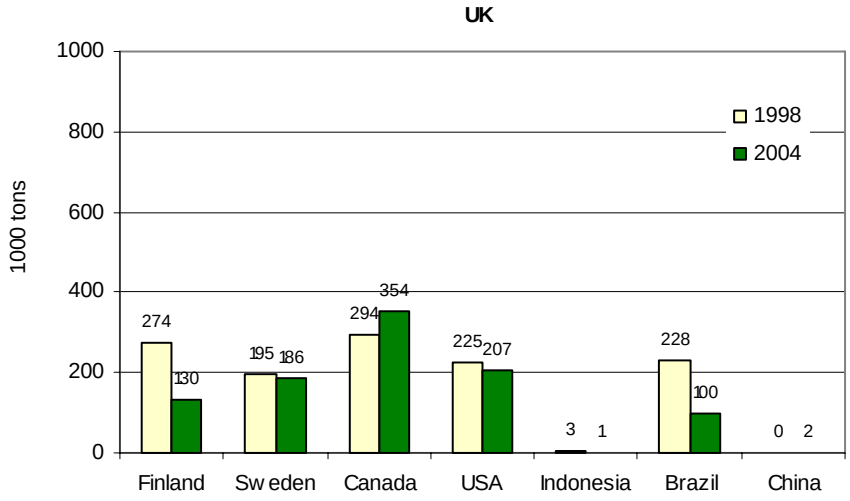
Source: FAO statistics

Figure 4.2a. *Pulp imports of France in 1998 and 2004 (thousand tons).*



Source: FAO statistics

Figure 4.2b. *Pulp imports of Germany in 1998 and 2004 (thousand tons).*



Source: FAO statistics

Figure 4.2c. *Pulp imports of the UK in 1998 and 2004 (thousand tons).*

During the period from 1998-2004 there was variation in the trade flows of pulp and paper between different years and countries. In the case of paper, Finland and Sweden are by far the two biggest exporters among seven export countries. Although the USA exports to France, Germany and the UK its export shares are small compared to Finland and Sweden. Canada, Indonesia, Brazil and China are also minor traders.

In the case of pulp, differences between export countries are smaller. Besides Finland and Sweden, Canada, the USA and Brazil also have significant trade flows to Europe. However, export from Indonesia and China is almost nonexistent. Notably, Finland has increased its export to every country (except export of pulp to the UK), while export to the USA of both commodities has decreased.

Recent data from 2007 show that paper exports from the US and China to Europe have risen more than 50% from 2006. Substantial investments and an increase in the production capacity in China and other Asian countries are likely to further boost exports in the coming years. Similarly, exports of pulp from Latin America to Europe will increase in line with the growing production capacity there.

Turning next to the independent variables of the model, they included the pulp and paper prices, the GDPs and populations of both exporting and importing countries, and the distances between the capital cities of the countries. The time series of the variables were also obtained from the FAO database. All our model specifications were estimated for two different price variables for both pulp and paper. As our first price measure we simply used the nominal export price, whereas the second price variable was constructed by deflating the nominal export price by a proxy for the own producer price of paper or pulp of the importing country. Since data on the actual producer prices were not available, they were approximated by a trade-weighted average of the own export prices of the importing country. All price series were expressed in US dollars.

The robustness of the results was examined by estimating both Equations 4.1 and 4.2 in three different ways: by a fixed effect (FE) model, by a random effect (RE) model, and by pooled OLS. Since the exports, their price and the GDP of the exporting country are likely to be determined simultaneously, an endogeneity problem emerges in our empirical model. We handle the endogeneity problem by also estimating the FE and the RE

models using the 2SLS instrumental variable method. The instrument set for the GDPs and prices include three lagged values of these variables.

4.3 Results

In all the estimated models the point estimates for the price elasticity of paper obtain values greater than one measured in the absolute value. The result holds irrespective of the model specification and the price series used. The estimated price elasticities from our all model specifications are presented in Tables 4.1 and 4.2 below with the standard errors of the coefficient estimates in parentheses. The coefficient estimates of the GDPs, populations and distances for the FE models with specification 4.1.) for both pooled OLS and the 2SLS are reported in Appendix 1. To save space, the detailed estimation results for all the other estimated models are available from the authors upon request. Overall, the estimation results for these parameters, in terms of their sign and significance, remained mixed.

Table 4.1. *Estimates of the price elasticities of the export demand for paper and cardboard and pulp when the exp*ort prices have been measured as nominal dollar prices.

Nominal prices	Fixed effect model	Random effect model	OLS
Paper	**-1.47 - -1.75**	**-1.54 - -1.78**	**-2.23**
Specification 1	(0.17) (0.13)	(0.17) (0.13)	(0.19)
Paper	**-1.47 - -1.75**	**-1.48 - -1.76**	**-2.16**
Specification 2	(0.17) (0.13)	(0.17) (0.13)	(0.22)
Pulp	**-0.83 - -0.86**	**-0.93 - -1.0**	**-2.68**
Specification 1	(0.19) (0.20)	(0.18) (0.20)	(0.39)
Pulp	**-0.87 - -0.89**	**-0.95 - -1.01**	**-2.60**
Specification 2	(0.18) (0.20)	(0.18) (0.20)	(0.38)

Table 4.2. *Estimates of the price elasticities of the export demand for paper and cardboard and pulp when the export prices have been measured as nominal dollar prices, deflated by the approximated producer prices of the importing countries.*

Deflated prices	Fixed effect model	Random effect model	OLS
Paper	**-1.08 - -1.25**	**-1.12 - -1.27**	**-1.48**
Specification 1	(0.16) (0.12)	(0.15) (0.11)	(0.16)
Paper	**-1.08 - -1.26**	**-1.05 - -1.22**	**-1.19**
Specification 2	(0.16) (0.12)	(0.16) (0.12)	(0.18)
Pulp	**-0.41 - -0.58**	**-0.52 - -0.61**	**-1.50**
Specification 1	(0.15) (0.16)	(0.15) (0.16)	(0.29)
Pulp	**-0.44 - -0.54**	**-0.53 - -0.63**	**-1.49**
Specification 2	(0.15) (0.16)	(0.15) (0.16)	(0.28)

The cells of the tables report both the OLS and the 2-SLS estimates for the fixed effects and random effects models. It can be seen that the estimates of the price elasticities obtain values more than two standard deviations above one measured in the absolute value in all model specifications, in which the prices of exports have been measured as nominal prices. However, in some of the models with export prices deflated by the approximated producer prices of the importing country, minus one is inside the two standard deviations' confidence interval for the estimates.

The estimation results for the price elasticity of pulp, in contrast, are ambiguous. In the fixed effect and the random effect models, the elasticities mostly obtain values below one. In the pooled OLS, on the other hand, the point estimates always exceed one, although they do so by less than two standard deviations in models with deflated prices as explanatory variables.

All in all, the results from the price elasticity analysis support the view that the exports markets for the paper and cardboard have been rather competitive during the sample period.

Some recent research (e.g. Zhang and Buongiorno 2007) shows that there is substantial intra-industry trade of pulp and paper products. Countries import and export the same products to exploit economies of scale which is only possible by extending markets abroad. The notion of intra-

industry trade is also confirmed by our data, in which the same countries tend to be both exporters and importers of forest products at the same time. Our estimates of the price elasticities of paper, cardboard and pulp, suggest that the market power is not sufficient to enable the companies to transfer to their export prices the cost increases resulting from the ETS directive and full auctioning of emission allowances. A likely outcome of the price increases would be that the demand of European importers for paper, cardboard and pulp would shift to imports from outside Europe.

5 THE LAW OF ONE PRICE IN THE PULP AND PAPER MARKETS

5.1 Introduction

Early economists, including Cournot and Marshall (1947), suggested the notion of the Law of One Price (LOP). The LOP states, in its strict sense, that abstracting from transportation costs, all identical goods must have only one price in the same currency unit if the markets are to be efficient. (Formally, the LOP is presented in Appendix 2.1.). In the following, we will test the LOP econometrically to examine the efficiency of the global pulp and paper markets. Instead of the strict version of the law, however, we assume and test the weak version, which also takes into account the transaction costs.

Our econometric model is estimated using time series data on the prices of pulp and paper. Such data tend to be non-stationary, meaning that the means and variances of the price series often depend on time (non-stationarity). Accordingly, problems of spurious correlation and spurious regression arise, so that normal statistical inference is not valid. Luckily, Engle & Granger (1987), Stock & Watson (1988) and Johansen (1988) have developed a method of co-integration analysis for handling non-stationary time series.

Loosely speaking, two or more non-stationary time series with a unit root are said to be co-integrated if at least one linear combination of the series is stationary. (A more formal definition of co-integration can be found in Appendix 2.2.) In the case of non-stationary price series, co-integration analysis provides a straightforward means of testing the LOP: If price series turn out to be co-integrated, we can conclude that the markets are efficient and competitive. The efficiency and competitiveness of the market means, moreover, that no company can increase its prices without losing its market share.

Both weak and strong versions of the LOP have been examined in the previous literature (for a review, see Goldberg and Knetter 1997). Previous studies on the LOP in forest products markets based on co-integration analysis, including Uusivuori & Buongiorno (1992), Murray & Wear (1998), Nyrud (2002), Toivonen et al. (2002), Storhdal & Nyrud (2003) and Yin & Xu (2003) have obtained evidence that supports the theory of LOP. On the

other hand, Hänninen (1998), Nanang (2000), Nagubadi (2001), Zhou & Buongiorno (2005) and Yin & Baek (2005) obtained results showing that the LOP does not hold.

5.2 Data

Our data include monthly price series of pulp and paper from the following countries or regions: 1) pulp (USA, Europe, and Asia); 2) newsprint (USA, China, Germany and UK); 3) LWC (USA, China, Germany and UK) and 4) uncoated woodfree paper (USA, Taiwan, Germany and UK). Although our primary goal was to obtain a representative sample from the global markets, our data lacks any price series from South America. Our data were the best available, however. The length and sample periods for the monthly price series were dictated by the availability of data, but all the observations were selected from a period of 1999Q1 – 2007Q12, and the number of observations ranged between 69 and 108. A detailed description of the sample periods of the different series can be found in Appendix 2.3 in Table 2.1.

We were only interested in the existence of co-integration between prices in the forest product markets, but not, for instance, in testing individual parameter values in the co-integration space. Thus, we used the simple two-step method of Granger and Engle (1987) (see details in Appendix 2.2) instead of the more advanced procedure for testing co-integration developed by Johansen (1988).

Figures 5.1-5.4 gives some preliminary motivation for the results. Figure 5.1 illustrates the development of the pulp prices from March 2002 to December 2007. According to the figure, prices of the USA, Europe and Asia have clearly drifted together, suggesting that prices seem to be integrated and markets are efficient.

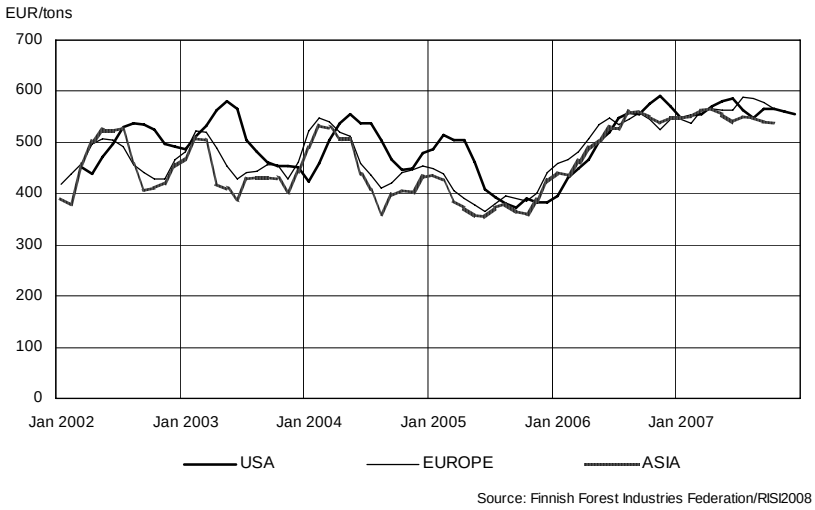


Figure 5.1. *The price development of pulp in the USA, Europe and Asia.*

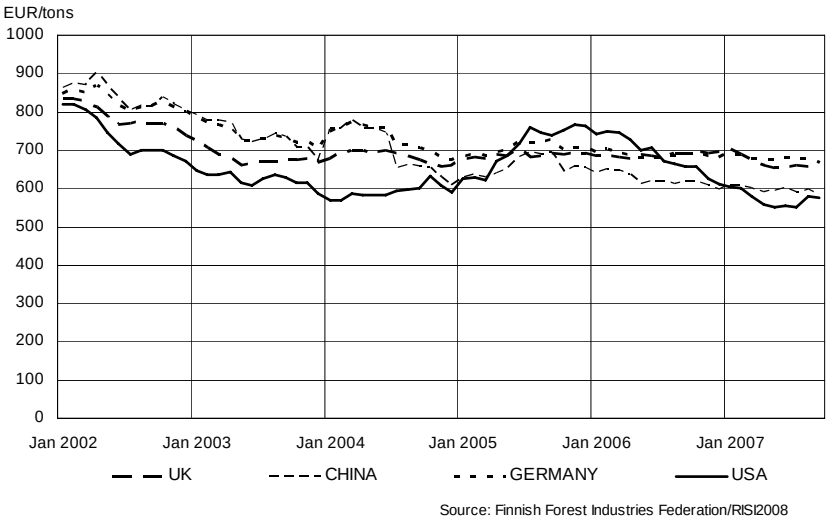


Figure 5.2. *The price development of LWC in the USA, China, the UK and Germany.*

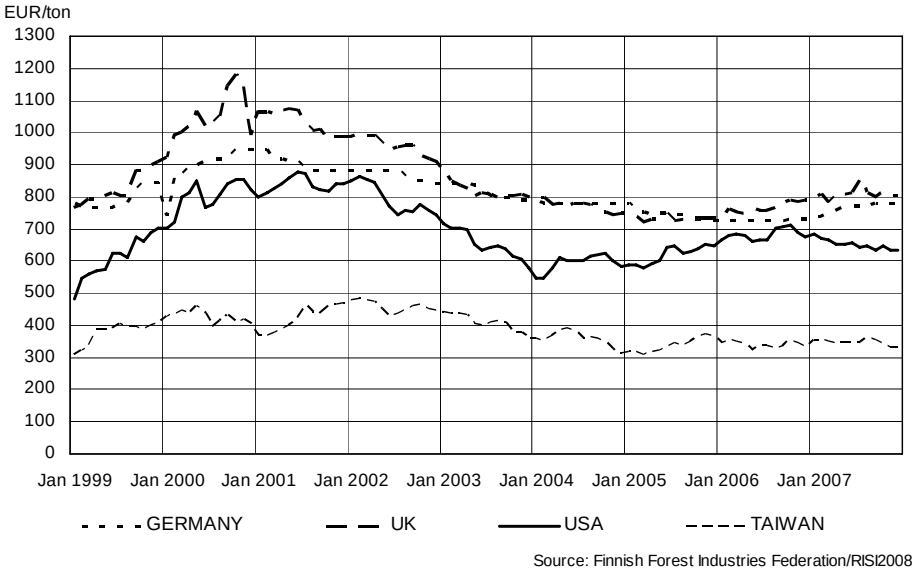


Figure 5.3. *The price development of uncoated woodfree paper in the USA, Taiwan, the UK and Germany.*

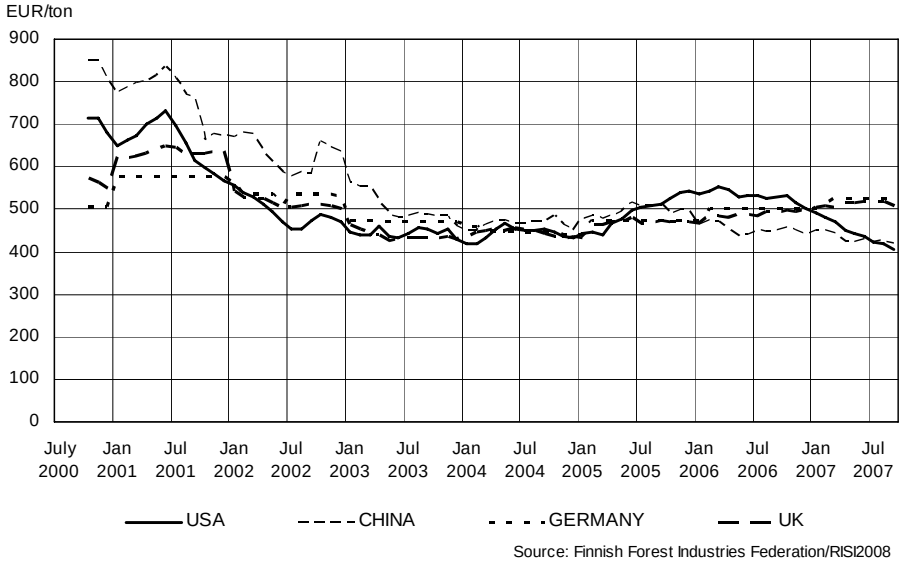


Figure 5.4. *The price development of newsprint in the USA, China, the UK and Germany.*

5.3 Results

Our estimation results, presented in Table 5.1 below, clearly validate the LOP at least in some of the pulp and paper product markets examined. The rows of Table 5.1 report the results of our co-integration analysis for the four forest product prices from a total of eight different country pairs. As the dependent variables in the Engle-Granger estimations we used the product prices in Germany, the UK and Europe. The prices of Germany and the UK were then regressed on the prices of China, the USA and Taiwan, while the price aggregated for Europe was regressed on prices of the USA and Asia. Any pairwise co-integration relation found was interpreted as a sign that the prices in the European pulp and paper product markets are not determined independently of the price setting of competitors outside Europe.[2]

The existence of a pairwise co-integration relation between the prices was marked by * if the relation was found to be significant at the 5% level, while ** denotes statistical significance at the 1% level. The cells were left empty in the case of no pairwise co-integration.

In short, our most important findings can be listed as follows:

- Uncoated woodfree prices were also integrated with all the countries;
- LWC is integrated fully, except between the UK and China, and the UK and Germany;
- Newsprint prices were only co-integrated between Germany and UK.
- Other countries were not integrated. Table 5.1 illustrates the results.[3]

Overall, our results support the view of competitive European pulp and paper markets, where companies cannot set their prices without taking into account the global competition originating from the USA and Asia.

[2] More detailed results of the co-integration analysis are available from the author upon request.

[3] The results of unit root tests for all series and unit root tests for the residuals of the pairwise regressions are presented in Appendix 2 in Tables 2.4 and 2.5.

Table 5.1. *Co-integration of pulp and paper prices between German, the UK or Europe and other countries.*

Dependent variable	Germany			UK			Europe	
Independent variable	China	USA	Taiwan	China	USA	Taiwan	USA	Asia
Newsprint			n.a.			n.a.	n.a.	n.a.
LWC	*	*	n.a.		*	n.a.	n.a.	n.a.
Uncoated Woodfree	n.a.	*	**	n.a.	**	*	n.a.	n.a.
Pulp	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	**	**

Note: ** denotes the 1% significance level and * the 5% significance level.

It is worth noting that the results should be treated with some caution. The time series were rather short and they were taken from different databases. However, on the basis of this method and data, we conclude that at least on some level the markets are integrated and the markets are efficient and competitive.

6. THE STRUCTURAL CHANGE IN THE COMMUNICATION PAPER MARKETS AND ITS IMPLICATIONS

6.1 Background

As long as people have used paper for communication its consumption has tended to increase along with economic growth and population growth.[4] This trend evidenced over time, and across countries, seems to have broken in some high-income western countries, such as in North America and Western Europe. In the past decade, the consumption of communication paper grades has stagnated or declined in these countries despite the continuing economic and population growth. Thus, this development cannot be explained by business cycles (GDP), or indeed by other conventional factors (population, prices of paper products).

On the basis of a number of studies and industry analyses, it is evident that the rapid development of electronic information and communications technology (ICT) is one of the major causes behind the above-mentioned structural change (e.g. Boston Consulting Group 1999, Hetemäki & Obersteiner 2001, Hetemäki 2005, 2006, Hohol 2007, Pira International 2004, The State of the News Media 2007). Moreover, it is likely that the impacts of ICT on the communication paper sector will be even stronger and more extensive in the coming years.

This development has had, and will have, many implications for the paper industry. First, it tends to reduce the demand for communication paper consumption. Secondly, ICT development also seems to affect the prices of paper products. Today, paper companies are not only competing in the markets against other paper companies, but also against the ICT sector. One result of this competition is the increasing downward pressure on paper prices, and the weakening ability of the paper industry to influence prices in the paper markets. The exact magnitude of these impacts is difficult or even impossible to identify, because of many other factors simultaneously

[4] *Communication paper* refers to newsprint and printing and writing papers, often known also as *graphics papers*. This group of papers accounted about 40% of the total world paper and paperboard production volume, and 56% of the export value of paper and paperboard in 2006.

influencing the consumption and price development. However, the direction of the impacts is unambiguous.

In this chapter, the above structural change and its implications are discussed in more detail by analyzing some case studies. In particular, newsprint, uncoated woodfree paper (~ office paper) and magazine paper markets in the USA, Germany and the UK are studied. In 2006, the three countries respectively accounted for 36, 42 and 48 percent of the world total consumption of these paper grades. Thus, the countries are also of a major significance for the world markets.

6.2 Recent Developments in the Communication Paper Markets

At the beginning of the 21st century, the paper industry and the bulk of industry analysts still considered ICT development to enhance communication paper demand. This is evident, for example, by looking at the trade journals, many outlook consulting studies (e.g. Jaakko Pöyry, RISI), and company presentations at that time. These views were grounded on the historical development that supported this outlook. ICT development had helped to generate more demand for many paper products in the past decades, such as office paper. Today, this view is no longer prevailing. ICT development is increasingly seen as a challenge to many communication paper products in high-income industrialized countries.

This change is clearly reflected in the data. For example, by analyzing the historical data for communication paper consumption and price development, and economic growth in USA, Germany and the United Kingdom, the structural change can be demonstrated. However, this data analysis does not itself provide information on why such a change has taken place. Consequently, the data analysis needs to be supported by a closer look at and analysis of the media markets, and the reasons behind the structural change.

Newsprint Markets

The newsprint market in USA is the single most striking example of the structural changes taking place in paper markets. This is mainly because of

three factors. First, the structural change first took place in this market and can be traced back to the late 1980s. Secondly, the magnitude of the change is clearly the largest – a 36 percent drop in consumption in the last two decades. Consumption in 2007 was at the same level as in 1968, and the per capita consumption was at the 1947 level. Thirdly, the evidence pointing to the fact that ICT development is a major cause behind the structural change is most clear in this market.

The newsprint consumption decline in the USA has taken place despite the fact that the GDP has been growing annually on average by 3 per cent from 1987 – 2007 (Figure 6.1). Also, population growth has been more rapid in the last two decades (on average 1.08 percent) than in 1971-1987 (on average 0.98 percent). Finally, newsprint price has been declining, and in 2007 was about 30% lower than in 1987 (inflation adjusted). On basis of the above trends, one would have expected newsprint consumption to increase, instead of decline. Thus, the structural change cannot be explained by these conventional factors.

The decline in newsprint consumption can be expected to continue. The ongoing transformation of consumption in the USA from the print media to the electronic media is reflected clearly in the newspaper readership and newspaper advertising expenditure figures. That is, newspaper readership is declining, and businesses and consumers advertise less and less in newspapers. The lower the readership and the amount of advertising in newspapers, the smaller the newsprint consumption will be.[5]

[5] The simple correlation coefficient between USA newsprint consumption and newspaper readership was 0.93 in 1997 to 2007, and that of consumption and advertising expenditures was 0.91.

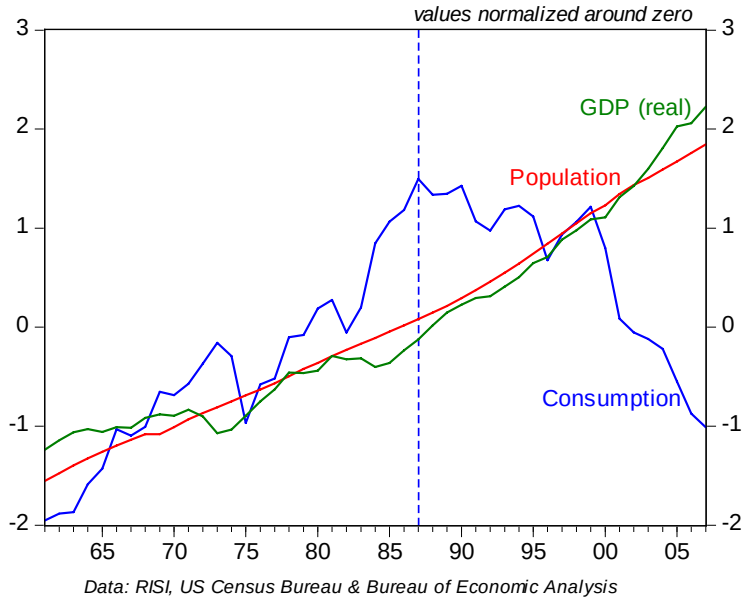


Figure 6.1. *US newsprint consumption, GDP and population, 1961-2007*

Figure 6.2 illustrates the development of newsprint consumption, readership and advertising expenditures for 1990 to 2007 and forecasts to 2020. The forecasts are based on the following simple, but still informative analysis. First, it is assumed that readership and advertising expenditures will in the forecasting period follow the trend computed using data from 1997 to 2007, i.e. they will follow a similar pattern to that in the past decade. Although these are simple trend forecasts, it may be noted that newspaper media analysts also expect newspaper readership and advertising expenditures to continue to decline in the USA in the future. Using the data for readership and advertising expenditures from 1990 to 2007, the newsprint consumption was regressed against these variables. Next, the estimated coefficients, and the ex post forecasted values for readership and advertising expenditures were used to compute forecasts for newsprint consumption.

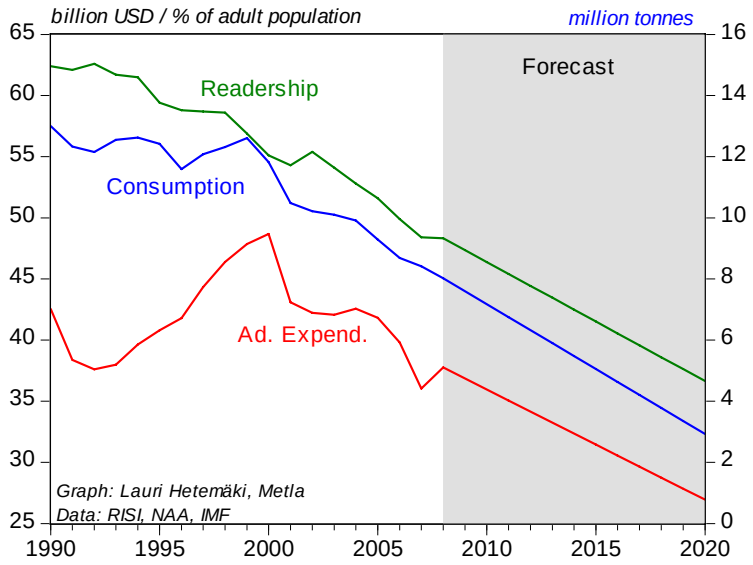


Figure 6.2. *USA newsprint consumption, daily newspaper readership and newspaper advertising expenditures, 1990-2007, and forecasts to 2020*

The forecast shows a decline in newsprint consumption from 8.4 million tons in 2007 to 2.9 million tons in 2020. In reality, there is likely to be even larger variation around the trend, and the trend itself could change, particularly the further into the future we look. However, more important than the precise figures and the slope is the general pattern. That is, with a high level of probability, newsprint consumption in the USA is going to continue to decline in the coming decades.

Although the USA newsprint market is clearly the most striking example of the structural change, similar but weaker patterns are evident in other high-income industrialized countries. In Germany and the United Kingdom newsprint consumption has stagnated and slightly decreased during the past 8 years (see Figures A1-A3 in Appendix 3). Newsprint consumption in, for instance, Austria, Belgium, Finland, the Netherlands and Norway has also been declining since the end of 1990s, and was at a 15% lower level in 2006 than in 1998 (see Figure A4 in the Appendix 3).

As in the case of the USA, the decline in newsprint consumption in these countries has taken place despite economic growth and declining newsprint prices. What then explains the declining newspaper readership (circulation) and consumption trends?

Many studies have pointed out that one of the most significant reasons behind the decline has been the rapid development of electronic information technology, such as cable TV, the Internet, broadband and the general changing trend in consumers' media behaviour (Boston Consulting Group 1999, Hetemäki & Obersteiner 2001, Hetemäki 2005, 2006, Hohol 2007, Pira International 2004, The State of the News Media 2007). The Newspaper Association of America surveyed the media behaviour of a nationally representative sample of 4003 adults (NAA 2001, p. 4). According to the study: "The first and perhaps most significant finding of the study is the decline in penetration of traditional media including newspapers, TV and radio and the concurrent rise in the use of the Internet as a source of news and information." The study also reports evidence that the increasing use of the Internet is accelerating the decline in newspaper readership. This finding is also supported by other recent media surveys (e.g., Digital Future Report 2004), and by the U.S. Census Bureau findings (see Table 6.1). To sum up, people, especially the younger generations, read fewer newspapers (and magazines, and books). As the younger generations move to older age cohorts, they no longer take up newspaper reading to the extent that happened in the past.

Table 6.1. *Media use by U.S. consumers and projections to 2007 (hours spent annually). (Data source: Statistical abstract…2000 and 2007e)*

Media	1990e	2000	2007e	%-change 1990-2007e
1. Newspapers	208	180	168	-19%
2. Magazines	146	135	119	-18%
3. Books	117	109	108	-8%
4. TV	1470	1640	1785	21%
5. Radio	919	945	1098	19%
6.Video, movies	57	130	226	296%
7. Internet	1	107	216	21500%
Total	2918	3246	3720	27%

A similar trend is also taking place in EU countries. According to the European Commission (2004a, p. 101), increasing use of the Internet is seen as a threat by the European newspaper industry. This study reports: "At present, less time is spent using the Internet than reading newspapers, but these relationships are changing all the time. The increasing use of broadband Internet access by consumers is making the experience easier, more attractive and cheaper in many EU member countries, and many commentators believe that it will lead to more use of online news services as a substitute for newspaper purchase."

Office Paper Markets[6]

Besides the newsprint market, the market for office paper (uncoated woodfree paper) appears to have been undergoing a structural change in recent years. Statistics indicate that the rate of growth in consumption of office paper in certain OECD countries has either slowed markedly, come to a halt, or even started to decline (Hetemäki 2005, 2006).

In the USA, the consumption of uncoated woodfree paper in 2007 was 2.5 million tons (19%) lower than in the turning point year 1999 (Figure A5 in Appendix 3). In Germany and United Kingdom, the data does not indicate a clear decline, but rather a stagnation since the mid-1990s. That is, the growth has clearly stopped, and there is some evidence of a consumption decline in the last couple of years (Figures A6-A7 in Appendix 3). As Hetemäki (2006) shows, the consumption of uncoated woodfree paper has also been declining in Canada and France since the turn of the millennium.

Office paper comprises a number of paper products, such as copying paper (A4), business forms, offset paper and envelopes. US statistics, for instance, provide evidence of continuing growth in A4 paper consumption and unchanged consumption of offset paper, and a definite decrease in consumption of business forms and other office papers. With the use of the Internet and microcomputers, access to online services (e.g. invoicing, statements of account, documents and e-mail messages) has become more

[6] The term "office paper" is used here as a synonym for the paper grade known as uncoated wood-free papers (or uncoated free-sheet papers). These papers are used for office and business printing (copiers, computer printers, facsimiles), business forms and envelopes, on-demand publishing (text reports and trade books), and commercial printing and writing (stationery). Office papers represented 45% of the total consumption of printing and writing paper in the USA in 2003.

frequent, thereby displacing the use of forms and envelopes. On the other hand, increasingly cheaper information technology products and lower printing costs have boosted the consumption of A4 paper.

Accordingly, ICT developments have had both positive and negative implications for office paper consumption. The negative effects have strengthened over time. Commercial banks, for example, have switched from paper to electronic statements of account and forms. This trend is motivated by efforts to improve service provision, economic factors and environmental considerations. In 2005 the Bank of America introduced a programme on paper usage that aims to minimize the use of paper, for example, via increased electronic communication. Behind this change are pressures from environmental organizations and economic factors. Similar guidelines have been issued by many other US and European companies (e.g. Citigroup and HVB Group). Because the banking and insurance sector ranks among the major consumers of business forms, these changes have inevitable impacts on office paper consumption.

The public sectors in many countries are also trying to reduce paper consumption. Typical examples are objectives set by central and local government administrations and universities to change over to the use of electronic documents.

In summary, there are a number of trends in high-income industrialized countries that create challenges to office paper demand. ICT development is a important enabler that helps these trends to take place.

Magazine Paper Markets[7]

In the magazine paper sector, the indication of a structural break in consumption is weaker. Magazine paper consumption has continued to increase, albeit at a slower growth rate, until very recently. In the USA, the last four years have shown stagnation and a slight decline in magazine paper consumption. In United Kingdom, magazine paper consumption has also shown stagnation since the turn of the century. In Germany, however, magazine paper consumption has still been growing.

[7] Magazine papers here refer to coated and uncoated mechanical papers, and coated woodfree papers. These papers are not used only for magazines, but also for catalogues, inserts, flyers, directories and books.

Again, the changes in economic growth cannot explain the stagnation in magazine paper consumption in the USA. During the four years from 2004-2007, the GDP growth rate varied between 1.9 to 3.6 percent, the average being 2.9. Indeed, a more detailed analysis of the magazine paper markets clearly points to the impact of electronic media (Hohol 2007, Soirinsuo & Hetemäki 2008, the State of the News Media 2007).

The household media statistics and surveys indicate that ICT may have reduced the time spent on reading magazines (see Table 6.1). Also, according to the Digital Future Report (2004), Internet users in the United States spent on average two hours per week reading magazines; those not using the Internet spent 3.1 hours reading magazines. Finally, Hohol (2007) and the study by Soirinsuo and Hetemäki (2008) indicate that the USA magazine paper markets are going through a similar structural break to that of newsprint and office paper markets, but with a time lag.

Soirinsuo and Hetemäki (2008) demonstrate how sensitive the outlook for the USA magazine paper consumption is to the time horizon one uses to make projections. Figure 3 shows magazine paper consumption in the USA up to 2007, and three trend projections based on different samples used for computing the trends. If one uses the trend from 2000-2007, the consumption would continue to increase to about 24 million tons in 2030. If one instead used the trend from only the last four years, the consumption would end up at about 13 million tons in 2030.

The data are still too limited to allow any definite conclusions about the future development. However, the industry analysis and media analysis discussed above indicate that the trend projection from 2004-2007 is more likely than that from 2000-2007.

The structural changes in communication paper markets are clearly reflected in the changing relationship between paper consumption and economic growth. In Appendix 3.2, the correlation coefficients between paper consumption and GDP are presented. They clearly point to a striking change in the relationship. Before the structural breaks, GDP and paper consumption were highly and positively correlated. Since the break, the correlation has been the opposite, i.e. either high and negative, or very low. Thus, in recent years, high economic activity has been associated with declining consumption.

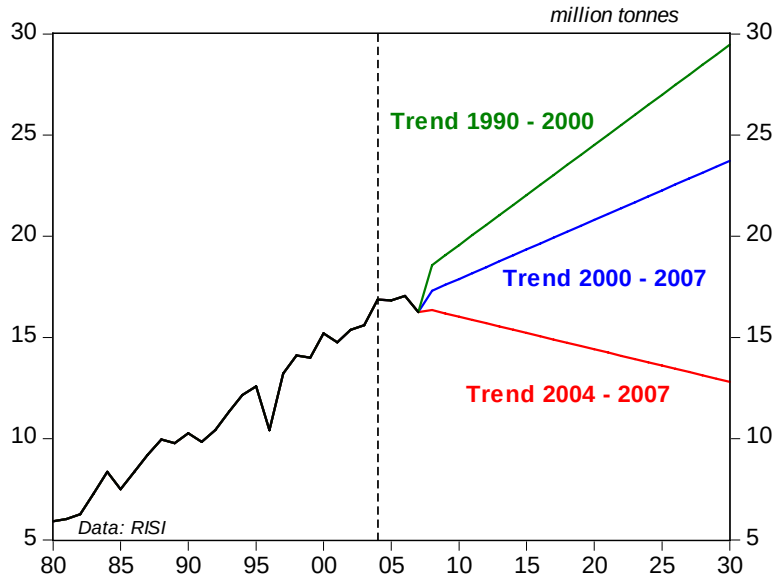


Figure 6.3. *USA magazine paper consumption, 1980-2007, and trend forecasts to 2030*

In a more detailed analysis of the role of GDP in determining the long-term newsprint consumption in the USA, Hetemäki (2005) demonstrated that GDP can no longer be used and interpreted in the way the conventional models used by forest economists have done. Indeed, the usefulness of the classical model for modelling and projecting the markets faced with the type of structural change discussed here can be questioned. It is no longer capable of tracking recent behaviour in these markets. The newsprint price variable also seems to have a low or insignificant importance in explaining the long-term development of newsprint consumption in the USA.

What is the explanation for this change? One plausible one is the following. As indicated above, recent data and studies on US media behaviour show newspaper readership declining while the consumption of electronic media is simultaneously increasing, especially the Internet (NAA, 2001; Digital Future Report, 2004). Economic wealth, i.e., GDP, is apparently one of the factors that allow this substitution to take place. The higher the GDP, the more wealth households have at their disposal to buy relatively expensive multimedia services (PCs, Internet accounts, broadband

services, televisions video games). Society as whole also has more opportunities to invest in new electronic media and innovate new services and products, and therefore increase opportunities for electronic media to be substituted for print newspapers.

In addition, new media and digital facilities (e.g. video games, Internet surfing, various multimedia devices) may lead to abandonment of newspaper reading altogether – whether printed or online. With the constraint of 24 hours a day, the various communications media and entertainment forms engage in a zero-sum game for the consumer's time.

These types of structural change tend to be slow and gradual and can be clearly identified only over periods that are longer than the typical business cycles. Such impacts can thus be captured only by long-term GDP elasticities, whereas short-term GDP elasticities tend to reflect the cyclical economic impacts.

6.3 Implications for Paper Prices

ICT development also affects the prices of paper products through various channels. First, the competition between printed and electronic media is tightening. The increasing competition has implications both for media consumers and publishers. As different ICT applications provide ever more opportunities to substitute for paper, consumers tend to be less willing to pay for print products. On the other hand, in the face of the increasing competition between print and electronic media, publishers of print products seek to cut costs, and thereby also reduce the prices of paper products. In short, communication paper prices are increasingly also determined by ICT sector development.

Secondly, ICT enables and enhances globalization. Due to ICT development, impediments for operations in different geographic regions are reduced. For example, pulp and paper investments move more readily across continents, e.g. to low cost regions. On the other hand, due to stagnating communication paper consumption in industrialized countries, incentives to invest in the emerging and growing markets outside North America and Western Europe are enhanced. In recent decade, these trends, among other factors, have resulted to a rapid growth in paper capacity in China and pulp capacity in Latin America. The pulp and paper production in

these low cost regions also has an increasing influence in the world markets. This, in turn, tends to lead to price convergence in global paper markets across the continents, and strengthens pressures to also homogenize end-product prices in the European markets.

Finally, as a result of the increasing application of ICT, productivity in the paper industry has improved, and will continue to do so in the future. Traditionally, enhanced productivity has also been reflected in lower end-product prices over time.

There are no such factors in view that would give cause for assuming that the already protracted downward trend in real prices would be reversed. However, there will still be cyclical upswings in prices when markets are moving to high business cycles.

Hetemäki (2006) analyzed the newsprint prices and 'oversupply' of newsprint in the United States from 1979–2005. The oversupply was defined as production + imports –consumption. This measure tends to reflect the demand-supply market situation. The weakness of the measure is that it does not take into account the variation in newsprint inventories. However, it can be used as an indicator, rather than a precise measure of the tightness of the newsprint markets.

According to the analysis, prices started to markedly fall after 1988, when consumption dropped but capacity was not adjusted accordingly. Newsprint machines were not closed down or switched over to production of other paper grades until after the mid-1990s, which subsequently resulted in the adjusting of supply more in line with consumption. However, despite this adjustment, prices continued to decline. Admittedly, recent years have seen some cyclical upturns following the price collapse. One might speculate that the rapid dissemination of the Internet since the mid-1990s and the introduction of broadband connections somewhat later may have contributed to these price developments. In other words, electronic media have increased competition, and thereby moved prices further down, irrespective of a reduction in the oversupply of newsprint.

As can be observed in the price lines shown in Figures A1-A7 (see Appendix 3), the newsprint and uncoated woodfree paper prices have declined significantly in the USA, Germany and the United Kingdom in recent decades. The decline in prices has taken place despite a simultaneous increase in paper manufacturing costs in the USA and Western Europe, as well as in the major producing countries of Canada, Finland and Sweden.

It is highly likely that the increasing competition between print and electronic media is one major cause behind the declining price trends. That is, paper companies have increasing difficulties to transfer their production costs to communication paper prices in the North American and Western European markets. It is hard to say to what extent this is a result of the increasing competition between print and electronic media and the declining paper consumption. Still, it is most probably one major cause behind this pattern. Given the outlook for the future, this trend is more likely to strengthen than weaken in the future.

As a result of the above development, the pulp and paper industry appears to have two major strategies through which it can try to adjust to the structural changes in the communication paper markets. First, the industry has to keep on cutting the production costs and increase its productivity. This is essential to keep the current businesses profitable. Secondly, it has to innovate new products for which there will also be growing markets in the high-income industrialized countries.

7. CONCLUSIONS

The European Commission is now preparing a revision of the Emission Trading Directive for the period starting in 2013. The Commission has called for the auctioning of emissions allowances to be given a larger role. This implies that in the future more firms than now with CO2 emissions will face the direct cost depending on the amount of emissions.

The European Council emphasised in its conclusions in March 2007 the great importance of the energy-intensive sector and that cost-efficient measures are needed to improve its competitiveness. In practise, some sectors could be granted exemptions from the auctioning of allowances. This kind of reasoning calls for the exact criteria for exemptions. At least four points can be identified: energy intensity, global competition, profitability and degree of pass-through of costs.

This paper focuses the European pulp and paper industry. It firstly analyses the effects of a revision of the Emission Trading Directive on the European pulp and paper industries in the case where these industries are not exempted from the auctioning mechanism and where other large pulp and paper producing countries do not have binding climate targets or an emission trading system. Secondly, the paper tries to evaluate how the European pulp and paper industries fit into the preliminary criteria of the exemptions from auctioning of emission allowances.

If the pulp and paper industry will be subject to full auctioning of emission allowances, Emission Trading System starting in 2013 will:

- Increase the emission costs of the European pulp and paper industry by about 1250-2150 million euros if it is not eligible to receive emissions allowances for free on the basis of being a highly energy-intensive industry facing strong international competition;
- Increase the electricity cost of the European pulp and paper industry by about 700-2150 million euros;
- Increase the wood and recovered paper cost of the European pulp and paper industry by about 1450-2850 million euros.

To compensate for the cost increase of about 6.0 – 12.5 percent due to a revision of the ETS Directive with full auctioning of emission–allowances, the producer prices of the European pulp and paper industry should increase by about 3.3 - 6.9 percent of the turnover.

If the European pulp and paper industry is totally exempted from the auctioning mechanism, a revision of the ETS Directive will cause about 2.1 to 5.0 billion euros of additional costs to the European pulp and paper industry due to higher energy and fibre raw material prices. The total annual cost increase in this case represents about 3.8 to 8.8 percent of the total cash manufacturing cost. To keep profits constant, the European pulp and paper industry should increase the final output price by about 2.1-4.8 percent.

Because the European pulp and paper industry is not able to unilaterally pass through higher costs to product prices without significant losses in market shares due to international competition, they will lose almost all of their profits that have on average prevailed at the level of 5 percent of turnover in recent years.

REFERENCES

Boston Consulting Group (1999). *Paper and the Electronic Media: Creating Value from Uncertainty*.

Boungiorno, J. & J. Uusivuori (1992) *The Law of One Price in the Trade of Forest Products: Co-integration Tests for U.S. Exports of Pulp and Paper*, Forest Science 38, 539-553.

Cipollina, M. & Salvatici, L. 2006. *Reciprocal trade agreements in gravity models: a meta-analysis*. TradeAg working paper.)

Dickey D.A. & W.A. Fuller (1979) *Distribution of the Estimators for Autoregressive Time Series with a Unit Root*, Journal of the American Statistical Association 74, 367-401.

Dickey D.A. & W.A. Fuller (1981) *Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root*, Econometrica 49, 1057-1072.

Digital Future Report, 2004, *Surveying the Digital Future, Year Four,* U.S.C. Annenberg School Center for the Digital Future, September, UCLA, Los Angeles, CA, USA. www.digitalcenter.org

Engle, R.F, & C.W.J. Granger, (1987) *Co-integration and Error Correction: Representation, Estimation and Testing*, Econometrica 55, 251-76.

European Commission, 2004, *Publishing Market Watch*, Sector Report 1: The European Newspaper Market & the European Magazine and Journal Market. http://europa.eu.int/comm/enterprise/ict/policy/publ-ind/

Goldberg, P.K. & M.M. Knetter (1997) *Goods Prices and Exchange Rates: What Have We Learned?* Journal of Economic Literature 35, 1243-1272.

Granger, C.W.J & P. Newbold (1974) *Spurious Regression in Econometrics*, Journal of Econometrics 2, 111-120.

Hänninen R.H. (1998) *The Law of One Price in United Kingdom Soft Sawnwood Imports-A Cointegration Approach*, Forest Science 44, 17-23

Hetemäki, L. (2005). ICT and Communication Paper Markets. In the publication Hetemäki, L. & Nilsson, S. (eds. 2005), '*Information Technology and the Forest Sector'. IUFRO World Series. Vol. 18*. IUFRO. Vienna. http://www.metla.fi/julkaisut/muut/ICT-forest-sector-2005.pdf

Hetemäki, L. (2006). *Changing paper markets and prices*. Bank of Finland Bulletin, No. 1., 79-83. http://www.bof.fi/NR/rdonlyres/3CCA75CE-32C3-4CAE-AA9E-8D3E402E9CD4/0/06b1_CPMP.pdf

Hetemäki, L. and Obersteiner, M. (2001). *US Newsprint Demand Forecasts to 2020. International Institute for Applied Systems Analysis*, Interim Report IR-01-070. 2001. http://www.iiasa.ac.at/Admin/PUB/Documents/IR-01-070.pdf

Hohol, R. (2007). *Don't Look to Magazine Industry For Any Growth in Paper Demand. PaperTree Letter*, RISI, July 2007. s. 2–3.

Johansen, S. (1988) *Statistical Analysis of Co-integration Vectors*, Journal of Economic Dynamics and Control 12, 231-254.

Marshall, A. (1947), *Principles of Economics*. London, Macmillan.

Murray, B.C. & D.N.Wear (1998) *Federal Timber Restriction and Interregional Arbitrary in U.S. Lumber*, Land Economics 74, 76-91.

NAA (Newspaper Association of America) (2001). *Leveraging Newspaper Assets: A Study of Changing American Media Usage Habits*. http://www.naa.org

Nagubadi V., Munn I.A. & A. Tahai (2001) *Integration of Hardwood Stumpage Markets in the Southcentral United States*, Journal of Forest Economics 7, 69-98.

Nanang D.M. (2000) *A Multivariate Cointegration Test of the Law of One Price for Canadian Softwood Lumber Markets*, Forest Policy and Economics 1, 347-355.

Nyrud, A.Q. (2002) *Integration in the Norwegian Pulpwood Market: Domestic Prices versus External Trade*, Journal of Forest Economics 8, 213-225

PIRA International (2004). *The Future of Print 2,* PIRA International, Leatherhead, Surrey, UK.

Pöyhönen, P. 1963. *A Tentative Model for the Volume of Trade between Countries.* Weltwirtschaftliches Archiv 90:93-99.

Russ, P. & Crique, P. (2007) *Pst-Kyoto CO2 emissions reduction: The soft landing scenario analyzed with POLES and other world models*, Energy Policy 35, 786-796

Soirinsuo, J. & Hetemäki, L. (2008). *Yhdysvaltojen aikakauslehtipaperin pitkän aikavälin kulutus* (The Outlook for the Long-Run Consumption of Magazine Papers in the United States), unpublished manuscript submitted to Paperi ja Puu (Paper and Timber) journal.

Statistical Abstract of the United States. 2004–2005. Section 24: Communications and Information Technology. U.S. Census Bureau, Washington, DC. http://www.census.gov/prod/www/statistical-abstract-2001_2005.html

Statistical Abstract of the United States. 2007. Section 24: Information and Communications. U.S. Census Bureau, Washington, DC. http://www.census.gov/prod/www/statistical-abstract.html

Stock, J.H & M.W. Watson (1988) *Testing for Common Trends*, Journal of the American Statistical Association 83, 1097-1107.

Stordal S. & A.Q. Nyrud (2003) *Testing Roundwood Market Efficiency Using a Multivariate Cointegration Estimator*, Forest Policy and Economics 5, 57-68.

The Finnish Forest Industries Federation/RISI 2008

The State of the News Media (2007). An Annual Report on American Journalism: Magazines http://stateofthemedia.org/2007/chapter%20pdfs/PEJ2007-Magazines.pdf

Tinbergen, J. 1962. *Shaping the World Economy: Suggestions for and International Economic Policy*. New York: The Twentieth Century Fund.

Toivonen R., Toppinen A. & T. Tilli (2002) *Integration of Roundwood Markets in Austria, Finland and Sweden*, Forest Policy and Economics 4, 33-42.

Yin R. & J. Baek (2005) *Is There a Single National Lumber Market in the United States?* Forest Science 51, 155-164.

Yin, R. & J. Xu (2003) *Identifying the Inter-market Relationships of Forest Products in the Pacific Northwest with Cointegration and Causality Tests*, Forest Policy and Economics 5, 305-315.

Zhang, S. & Buongiorno, J. (2007) *Does Monopolistic Competition Explain Intra-industry Trade of Forest Products?*, Forest Science 53/4, 519-528.

Zhou M. & J. Boungiorno (2005) *Price Transmission between Products at Different Stages of Manufacturing in Forest Industries*, Journal of Forest Economics 11, 5-19.

Appendix 1 (for Chapter 4)

Parameter estimates

Table A.1 – A.4. Estimates of the fixed effect model for paper and cardboard.

Export prices measured as nominal prices

Pooled OLS

	Coef.	Std. Err.	P>t
lpappricenom	-1.75	0.13	0.00
lgnpexp	1.07	0.30	0.00
lgnpimp	0.35	0.54	0.53
lpopexp	-2.57	3.23	0.43
lpopimp	0.11	6.09	0.99
cons	8.93	56.25	0.87

2SLS

	Coef.	Std. Err.	P>z
lgnpexp	0,87	0,67	0,19
lpappricenom	-1.47	0.17	0.00
lgnpimp	1.12	0.82	0.17
lpopexp	-3.04	7.33	0.68
lpopimp	-5.39	11.48	0.64
cons	66.59	121.27	0.58

Export prices deflated by producer prices

Pooled OLS

	Coef	Std. Err.	P>t
lpapprice	-1.25	0.12	0.00
lgnpexp	0.79	0.32	0.01
lgnpimp	0.73	0.59	0.22
lpopexp	-4.25	3.46	0.22
lpopimp	4.65	6.49	0.47
cons	-28.83	60.05	0.63

2SLS

	Coef.	Std. Err.	P>z
lgnpexp	0.64	0.72	0.37
lpapprice	-1.08	0.16	0.00
lgnpimp	1.40	0.89	0.12
lpopexp	-10.39	7.79	0.18
lpopimp	2.65	12.23	0.83
cons	52.09	129.91	0.69

lpappricenom = nominal export price of paper and cardboard; lppaprice = nominal export price of paper and cardboard, deflated by the producer prices of the importing country; lgnpexp, lgnpimp, lpopexp and lpopimp are the GNPs and populations of the exporting and importing countries, respectively.

Table A.5 – A.6. Estimates of the fixed effect model for pulp.

Export prices measured as nominal prices

Pooled OLS

	Coef	Std. Err.	P>t
lpulppricenom	-0.86	0.20	0.00
lgnpexp	0.06	0.31	0.85
lgnpimp	1.12	0.58	0.05
lpopexp	-3.10	3.37	0.36
lpopimp	-2.87	6.49	0.66
cons	53.79	60.57	0.38

2SLS

	Coef	Std. Err.	P>z
lgnpexp	0.91	0.56	0.10
lpulppricenom	-0.83	0.19	0.00
lgnpimp	0.26	0.69	0.71
lpopexp	-11.81	5.84	0.04
lpopimp	20.29	10.04	0.04
cons	-125.34	109.06	0.25

Export prices deflated by producer prices

Pooled OLS

	Coef	Std. Err.	P>t
lpulpprice	-0.42	0.15	0.01
lgnpexp	0.06	0.32	0.84
lgnpimp	1.14	0.59	0.06
lpopexp	-3.52	3.43	0.31
lpopimp	-2.38	6.63	0.72
cons	52.58	62.11	0.40

2SLS

	Coef	Std. Err.	P>z
lgnpexp	0.71	0.56	0.21
lpulpprice	-0.59	0.16	0.00
lgnpimp	-0.07	0.71	0.92
lpopexp	-10.95	5.96	0.07
lpopimp	31.60	10.10	0.00
cons	-257.67	108.58	0.02

lpulppricenom =nominal export price of pulp; lpulprice = nominal export price of pulp, deflated by the producer prices of the importing country; lgnpexp, lgnpimp, lpopexp and lpopimp are the GNPs and populations of the exporting and importing countries, respectively.

Appendix 2 (for Chapter 5)

2.1 Law of One Price

Consider two countries, i and j, which freely trade an arbitrary homogenous commodity with prices P_i and P_j, respectively, in the time period t. The strong version of LOP holds when

2.1 $$P_{it} = P_{jt}.$$

However, the strong version does not take into account any transaction costs (e.g. transportation costs). The weak version of LOP, in contrast, also includes the transaction costs, so that it can be written as

2.2 $$P_{it} = c + P_{jt},$$

where c is the transaction costs, which we assume to remain constant over time.

Alternatively, we can propose that the prices vary randomly in both countries so that the difference between the two prices becomes a random variable

2.3 $$X_t = p_{it} - p_{jt}.$$

It follows that the two countries trade with each other only if the price difference exceeds the transaction costs. More formally, the market price is determined as follows

2.4 $$P = \begin{cases} p_{st} & if \quad X_t > c \qquad s = i \\ p_{st} & if \quad -c \le X_t \le c \quad s = i, j \\ p_{st} & if \quad X_t < -c \qquad s = j \end{cases}.$$

We can illustrate the price determination by a hypothetical example of Figure 2.1. The price difference at point *A* denotes the market price inside the so-

called inaction band. Now, it is not rational to trade, because the gain from buying from the cheap country and selling in the expensive country does not even cover the transaction costs. At points *B* and *C* outside of the inaction band, by contrast, the price difference exceeds the per unit transaction costs so that it is possible to make a profit from the trade.

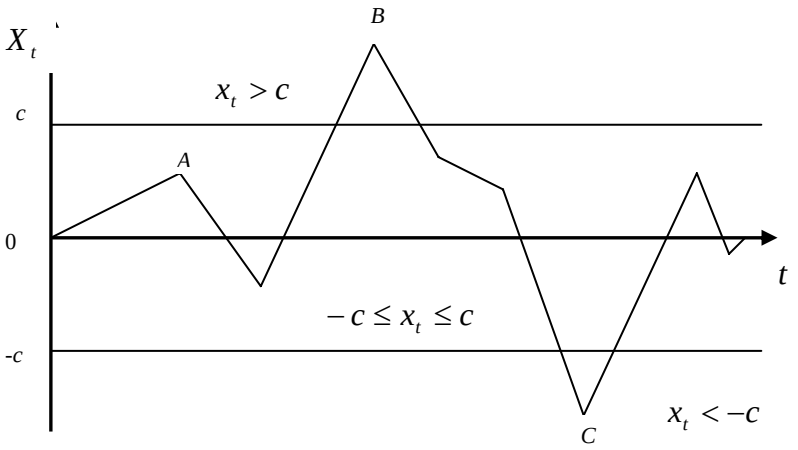


Figure 2.1 *Hypothetical case: the effect of transaction costs on international trade.*

Because of the transaction costs, therefore, the price differential between two countries can grow relatively large until the commodity arbitrage between the countries pays off and the price levels of the countries start to equalize.

2.2 Econometric methods

The basic statistical relationship of the LOP is

2.5 $$p_{it} = c + \beta p_{jt} + \varepsilon_t ,$$

where $p_{.t}$ are the price series on a log scale, c is a constant, β is a coefficient and ε_t is the IID error term. In the strong version we assume that c is zero and β is one. Respectively, the weak version allows that $c \neq 0$ and $\beta \neq 1$. We can estimate Equation (2.5) by OLS. However,

Granger and Newbold (1974) showed that a regression can lead to statistically significant results even when p_i and p_j are unrelated, if the price series are non-stationary (*spurious regression*).

In general, time series are said to be stationary (I(0)), when $E(p_t)$, $Var(p_t)$ and $Cov(p_t, p_{t+k})$ are constants for all t and $k \neq 0$. Most economic time series are non-stationary and usually integrated of order one (I(1)), that is, they follow a random walk. The random walk process can be written as

2.6 $$p_t = p_{t-1} + \varepsilon_t ,$$

where ε_t is IID with zero mean and variance σ_ε^2. The random walk process becomes stationary after the first differencing and, thus, it is called the I(1) process.

However, Engle & Granger (1987), Stock & Watson (1988) and Johansen (1988) have developed methods for dealing with non-stationary time series data. These methods are usually referred to as co-integration analysis. By definition, co-integration means that two I(1) series are co-integrated if and only if a linear combination of the two series is I(0). We proceed by using the Engel and Granger two-step method (1987).

At the beginning, we check that all the series are I(1), using the Augmented Dickey-Fuller tests (Dickey & Fuller 1981, 1979). The test equation is

2.7 $$\Delta p_{it} = \alpha_0 + \alpha_1 t + \delta p_{t-1} + \sum_{s=1}^{k} \theta_s \Delta p_{t-s} + e_t ,$$

where t is a time trend, α_0 is a constant, ϕ, δ are coefficients and e_t is an error term. When necessary, the model includes a constant, a time trend and a sufficient number of lagged differences to remove autocorrelation in residuals. The test hypotheses are

$$H_0 : \delta = 0$$
$$H_1 : \delta \neq 0 .$$

If we cannot reject the null hypothesis, we can conclude that the price series are non-stationary and I(1).

Next, we proceed to the Engel and Granger two-step-method. As a first step, we estimate the static regression (2.5), rewritten as

2.8 $$\hat{\varepsilon}_t = \hat{c} - \hat{\beta} p_{jt} - p_{it} .$$

The second step is to test the stationarity of the residuals $\hat{\varepsilon}_t$ from Equation (2.8), again, by using the ADF tests. Hence, the test equation is

2.9 $$\Delta\hat{\varepsilon}_t = \delta\hat{\varepsilon}_{t-1} + \sum_{s=1}^{k} \phi_s \Delta\hat{\varepsilon}_{t-s} + u_t .$$

The test procedure and hypotheses are similar to those in Equation (2.7) above, but now the constant and time trend are excluded from the estimable equation.

If the residuals are stationary, we conclude that the prices are co-integrated and LOP holds. Accordingly, the markets are competitive and efficient.

2.3 Data descriptions

Table 2.1. *Summary of the data. [U. S. East]*

Product	Country/Region	Time period
Newsprint 48,8 g	U. S East	2000.10–2007.9 (*n*=84)
Newsprint 48,8 g	China	2000.10–2007.9 (*n*=84)
Newsprint 48,8 g	UK	2000.10–2007.9 (*n*=84)
Newsprint 48,8 g	Germany	2000.10–2007.9 (*n*=84)
Lightweight coated paper 60 g	U. S East	2002.1–2007.9 (*n*=69)
Lightweight coated paper 60 g	China	2002.1–2007.9 (*n*=69)
Lightweight coated paper 60 g	UK	2002.1–2007.9 (*n*=69)
Lightweight coated paper 60 g	Germany	2002.1–2007.9 (*n*=69)
Uncoated woodfree paper	U. S East	1999.1–2007.12 (*n*=108)
Uncoated woodfree paper	Taiwan	1999.1–2007.12 (*n*=108)
Uncoated woodfree paper	UK	1999.1–2007.12 (*n*=108)
Uncoated woodfree paper	Germany	1999.1–2007.12 (*n*=108)
Softwood pulp	USA	2002.3–2007.12 (*n*=70)
Softwood pulp	Asia	2002.3–2007.12 (*n*=70)
Softwood pulp	Europe	2002.3–2007.12 (*n*=70)

Source: Finnish Forest Industries Federation/RISI 2008

2.4 Estimation results

Table 2.2. *Stationary tests (ADF test t-values) for all series.*

Level	Newsprint	LWC	Woodfree	Pulp
USA	-1.88	-1.83	-2.12	-1.87
China	-1.65	-3.29	n.a.	n.a.
Taiwan	n.a.	n.a.	-2.47	n.a.
UK	-1.75	-2.19	-2.43	n.a.
Germany	-1.05	-2.75	-3.08	n.a.
Asia	n.a.	n.a.	n.a.	-1.80
Europe	n.a.	n.a.	n.a.	-1.69
1. Difference	**Newsprint**	**LWC**	**Woodfree**	**Pulp**
USA	-3.10**	-2.56*	-4.59**	-4.28**
China	-3.98**	-3.22**	n.a.	n.a.
Taiwan	n.a.	n.a.	-5.12**	n.a.
UK	-3.24**	-3.12**	-3.57**	n.a.
Germany	-4.20**	-3.25**	-3.82**	n.a.
Asia	n.a.	n.a.	n.a.	-4.82**
Europe	n.a.	n.a.	n.a.	-4.34**

The level series include a constant, a time trend and 5 lags.
The 1. Difference series includes 4 lags and no deterministic terms.
****** denotes the 1% significance level and ***** the 5% significance level.

Table 2.3. *Residual tests results for LOP.*

Product	Dependent variable	Independent variable	Residual *t*-value (ADF)	Concluding
Newsprint	USA	China	-1.88	LOP does not hold
Newsprint	USA	Germany	-1.07	LOP does not hold
Newsprint	USA	UK	-1.23	LOP does not hold
Newsprint	China	Germany	-0.40	LOP does not hold
Newsprint	China	UK	-0.39	LOP does not hold
Newsprint	Germany	UK	-1.68	LOP does not hold
LWC	UK	China	-1.90	LOP does not hold
LWC	UK	Germany	-1.67	LOP does not hold
LWC	UK	USA	-2.24*	LOP holds
LWC	Germany	China	-2.11*	LOP holds
LWC	USA	Germany	-2.26*	LOP holds
LWC	USA	China	-2.12*	LOP holds
Woodfree	Germany	UK	-3.06**	LOP holds
Woodfree	Germany	USA	-1.95*	LOP holds
Woodfree	Germany	Taiwan	-2.90**	LOP holds
Woodfree	UK	USA	-2.65**	LOP holds
Woodfree	UK	Taiwan	-2.22*	LOP holds
Woodfree	USA	Taiwan	-2.53*	LOP holds
Pulp	Europa	USA	-2.66**	LOP holds
Pulp	Europa	Asia	-3.20**	LOP holds
Pulp	USA	Asia	-2.99**	LOP holds

Note: ****** denotes the 1% significance level and ***** the 5% significance level.

Appendix 3 (for Chapter 6)

3.1. Paper Consumption and Price Data Graphs

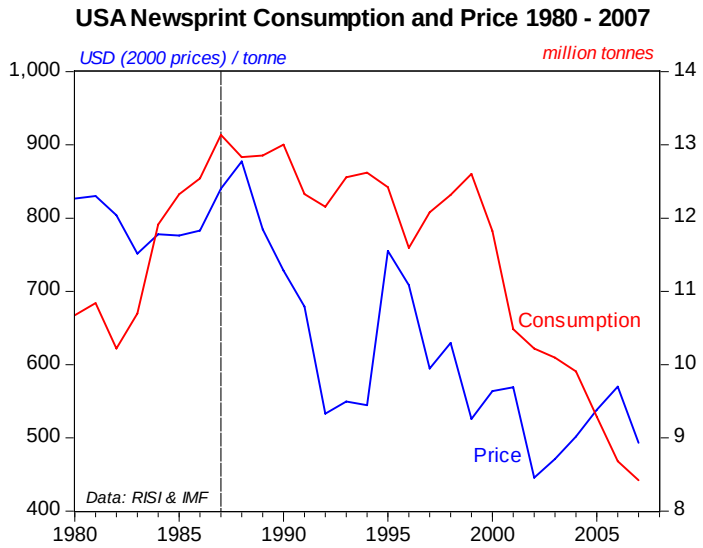


Figure A1

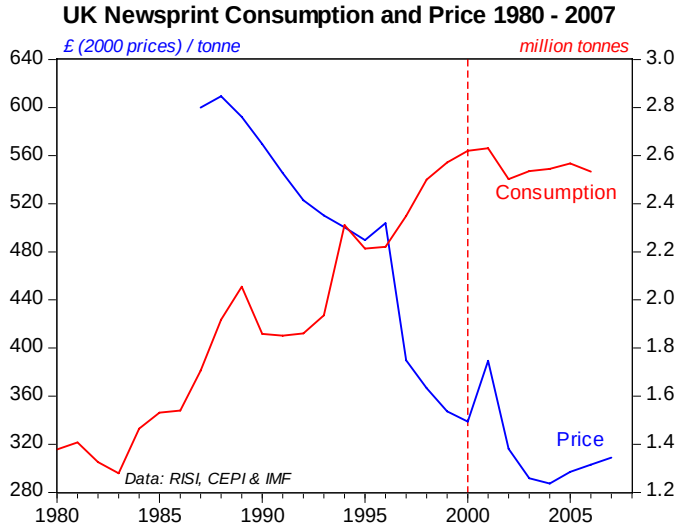


Figure A2

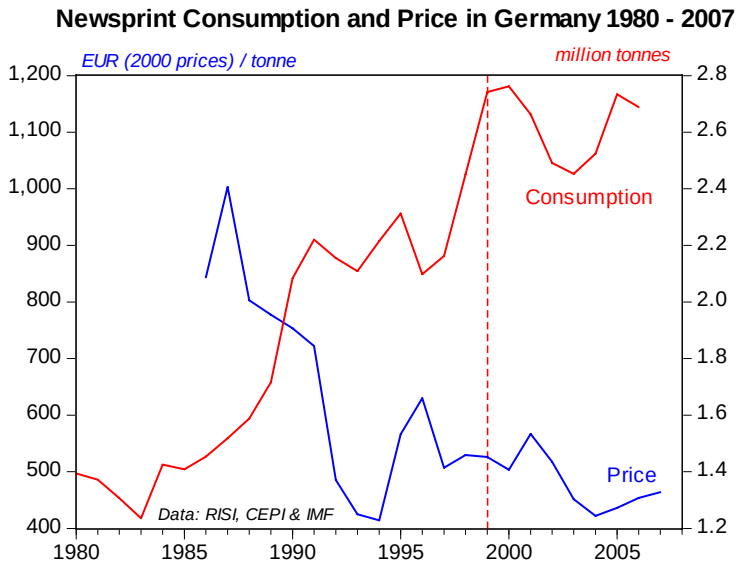
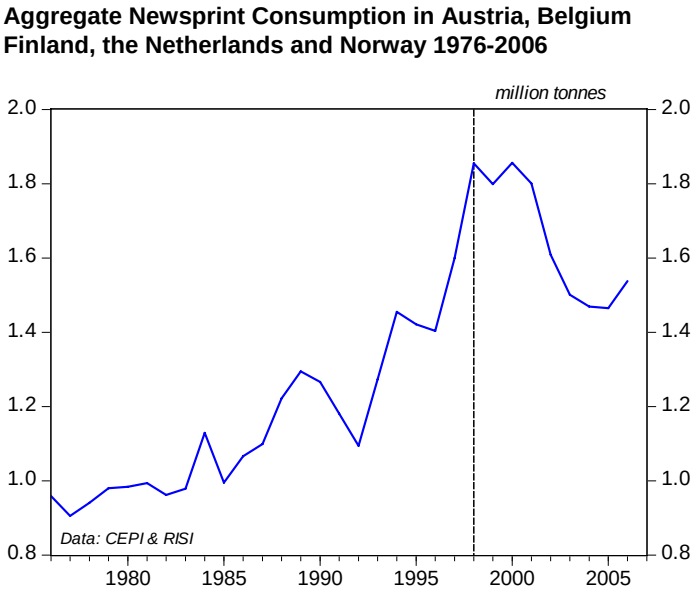


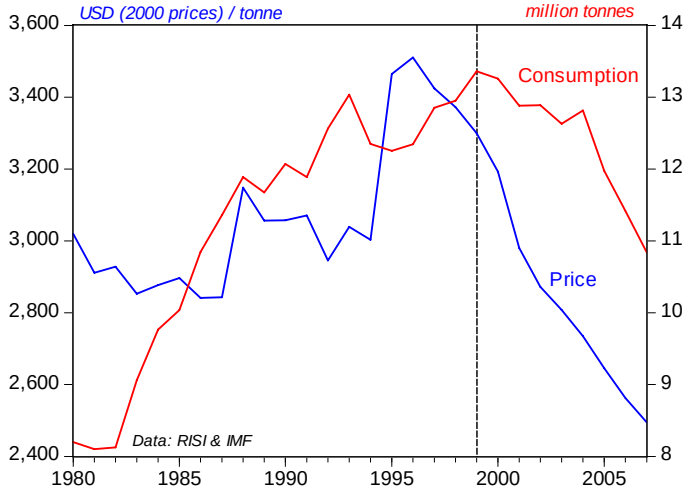
Figure A3



** In all the five individual countries consumption has declined after the turning point level in 1998-2000*

Figure A4

USA Uncoated Woodfree Consumption and Prices 1980-2007



Change from 1999 to 2007: consumption - 2.5 million tons (-19%) and prices - USD 805 (-24%)

Figure A5

Uncoated Woodfree Paper; the UK, Consumption and Prices 1980-2007

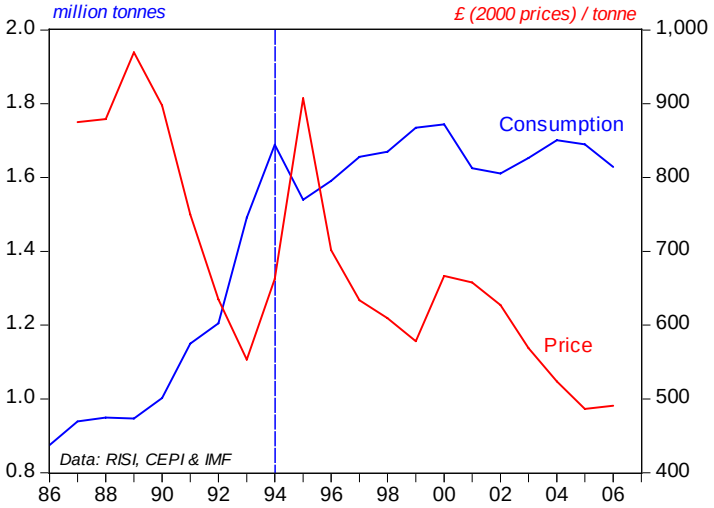


Figure A6

Uncoated Woodfree Paper Consumption and Prices in Germany
1980 - 2006

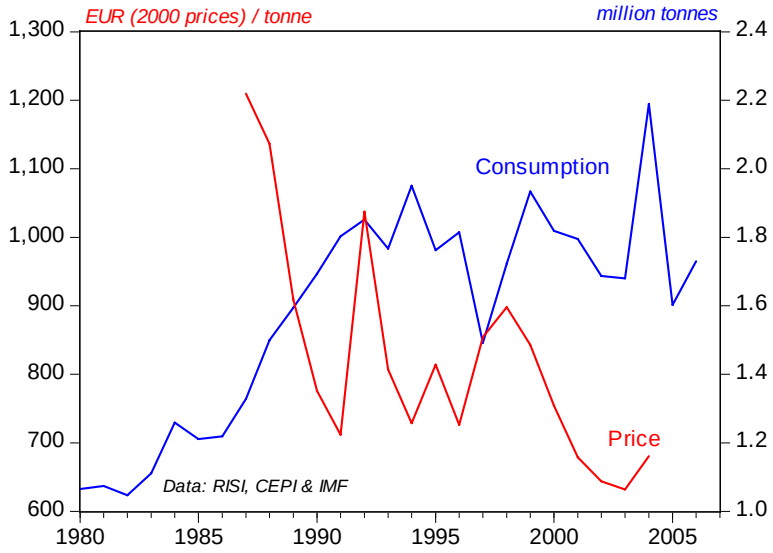


Figure A7

3.2. Some Correlations

Table A1. *Correlation Coefficients Before and After the Structural Break in the Paper Markets**

Newsprint	**Pre Structural Break**			**Post Structural Break**		
	USA	GER	UK	USA	GER	UK
Consumption – GDP	0.98	0.97	0.98	-0.90	-0.12	-0.47
Consumption - Price	0.93	-0.63	0.09	-0.15	0.13	-0.09
GDP – Price	0.96	-0.64	0.11	0.24	-0.26	-0.70

Office Paper	**Pre Structural Break**			**Post Structural Break**		
	USA	GER	UK	USA	GER	UK
Consumption – GDP	0.92	0.99	0.88	-0.94	-0.03	0.23
Consumption - Price	0.85	-0.53	0.05	0.67	-0.11	-0.29
GDP – Price	0.98	-0.26	0.35	-0.74	-0.88	-0.14

*Note! The pre structural (1980-1994; 1980-1998; 1987-1997)and post structural (1994-2006; 1997-2006; 1999-2006) dates differ depending on the country and product, as well as data availability. The break point year is determined according to the turning point year of paper consumption.

PELLERVON TALOUDELLINEN TUTKIMUSLAITOS PTT
Pellervo Ekonomiska Forskningsinstitut
Eerikinkatu 28 A, 00180 Helsinki, Finland, puh. (09) 348 8844,
fax (09) 3488 8500, sähköposti: econ.res@ptt.fi, www.ptt.fi

Pellervon taloudellisen tutkimuslaitoksen julkaisuja, publikationer, Publications

19. Perttu Pyykkönen. 2006. Factors affecting farmland prices in Finland
18. Vesa Silaskivi. 2004. Tutkimus kilpailuoikeuden ja maatalouden sääntelyn yhteensovittamisesta
17. Aki Kangasharju. 1998. Regional Economic Differences in Finland: Variations in Income Growth and Firm Formation.
16. Pertti Kukkonen. 1997. Rahapolitiikka ja Suomen kriisi

Pellervon taloudellisen tutkimuslaitoksen raportteja, forskningsrapporter, Reports

206. Pasi Holm- Satu Nivalainen – Raija Volk. 2008. Työvoiman alueellisen liikkuvuuden kannustavuus *(verkkojulkaisu)*
202. Pasi Holm – Anneli Hopponen. 2007. Vammaisten työkyky vuonna 2007. Vertailua työttömiin.
201. Meri Virolainen – Panu Kallio – Philip Abbott. 2006. Implications of export subsidy removal for the Finnish and EU dairy sectors
200. Pasi Holm - Jaakko Kiander - Timo Rauhanen - Matti Virén. 2007. Elintarvikkeiden arvonlisäverokannan alentamisen vaikutukset
199. Erno Järvinen – Anna-Kaisa Rämö – Harri Silvennoinen. 2006. Energiapuun tuotanto ja markkinat: Metsänomistajakysely
198. Janne Huovari – Jaakko Kiander - Raija Volk. 2006. Väestörakenteen muutos, tuottavuus ja kasvu

Pellervon taloudellisen tutkimuslaitoksen työpapereita, diskussionsunderlag, Working Papers

104. Mika Maliranta – Petri Rouvinen, 2007, Aineettomat investoinnit Suomen yrityksissä vuonna 2004: Kokeilu yritysaineistolla
103. Mika Maliranta – Rita Asplund. 2007. Training and hiring strategies to improve firm performance
102. Antti Lönnqvist. 2007. Intellectual capital and productivity: Identification and measurement of the relationship at company-level
101. Esteban Fernández Vázquez - Bart Los. 2007. A Maximum entropy approach to the identification of productive technology spillovers.
100. Jukka Jalava - Pirkko Aulin-Ahmavaara - Aku Alanen. 2007. Intangible capital in the Finnish business sector, 1975-2005
99. Allan Flink – Erno Järvinen – Ritva Toivonen. 2007. Norhtwest Russia: Development of the woodworking industry and opportunities as a potential market area for Finland
98. Liisa Kähkönen. 2007. Neljä näkökulmaa kuntasektorin palvelujen kilpailuttamiseen
97. Matti Virén. 2007. Analyzing the Incidence of Consumption Taxes