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Enhancing Financial Performance through Strategic Cost Reduction Initiatives

An investigation into cost efficiency gains related to print- and distribution processes in a global newspaper supply chain

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Acknowledgment

This thesis is written as a conducting part of our Master in Finance at Norwegian School of Economics, NHH. We wanted to investigate a practical case for an international operating company, as these are exposed to different challenges compared to domestically based companies. Through a practical case we can apply all our economic knowledge to address a real-life problem. For the company this can be an up-to-date theoretical solution to a problem, or at least a valuable assessment, from an objective view.

Several of topics were suggested, but the consensus between the management of NHST and us was to investigate ways to enhance the overall financial performance through initiatives regarding operations. We would therefore like to thank NHST AS for providing us with the topic and data to investigate the problem.

We would like to thank NHST AS representatives; Leonard Optiz Stornes, Hege Hansen and Geir Førde for data, guidance and discussions throughout the semester. We would also like to thank our supervisor Jens Bengtsson for his guidance, advice and discussions throughout the thesis. In addition, we would like to thank our families and friends for their love and support.

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Abstract

In this thesis, we investigate different approaches to enhance financial performance through strategic cost reduction initiatives related to print- and distribution processes in a newspaper supply chain. First, we examine the processes of print and its corresponding cost drivers. We run regressions and marginal effects in order to estimate the most predictable cost, subject to certain constraints regarding pages and volume. Our findings indicates that pages has the largest impact on the cost of printing. Thus, we obtain reduced cost with 95% certainty by introducing a standardised approach in line with their strategy.

Then, we examine distribution and seek to minimize the cost of transportation, delivery and packaging. We construct an unbalanced multi-product transportation model and use linear programming to minimize our objective function, subject to constraints regarding regional demand for each newspaper. Our findings indicates that an optimal allocation will result in reduced cost and is a more efficient with respect to the current strategy. More interestingly, we find a causal linkage between print and distribution. Where standardisation of print would ultimately reduce the cost of distribution, due to less weight and number of items sent. We extend our investigation and introduce a measure for further reduction of distribution cost and find that discrimination of subscribers have a negative impact of total distribution cost.

After streamlining the operations we expand our analyses to investigate the impact of exchange rate fluctuations on the financial outcomes. We run a sensitivity analysis to expose the vulnerability of each newspaper with respect to depreciation and appreciation of the exchange rate. Our findings indicates that standardisation and optimal allocation will not change the relative sensitivity between the newspapers, but fluctuations will affect the total cost.

Finally, we find that standardisation and optimal allocation will enhance the overall financial performance due to cost reductions in a more efficient supply chain. Although these reductions would ultimately depend on the exchange rate, we argue that our strategic approach would enhance financial performance more in comparison to the current practices.

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1. Introduction

Today the newspaper industry is exposed to increased disruptions and fall in profitability. An industry that was once highly profitable is now in sharp decline. The disruption of digital news sources has led to better accessibility for the readers, changing their reading habits and demand for printed newspapers. Consequently, print and distribution of newspapers is therefore considered as a large cost liability for any publisher striving to become profitable.

As a result, publishers are forced to rationalize their operations by cutting operating cost of print and distribution and find ways to secure predictable income from subscriptions and advertising (Russel, Chiang & Zepeda, 2008). Efficient supply chain management is therefore imperative in order to enhance the overall financial performance and to withstand this turbulent environment. Several academic methods have been proposed as solutions to this renowned problem. One of the proposals has been cost reduction methods in order to achieve lower operating cost in supply chains (Russel, 2013). However, few address the scenario of reducing operating costs in a global newspaper supply chain, which is exposed to exchange rate fluctuations.

In this thesis, we are considering the case of the global media conglomerate NHST AS. The conglomerate is facing similar challenges regarding disruptive digital trends and fall in profitability. The thesis seeks to investigate possible solutions to the fall in profitability through rationalize and streamline its supply chain. In particular through cost reducing initiatives in order to enhance the overall financial performance. The cost reduction objective can be subdivided into two segments, namely reduce printing cost and the cost of distribution. The main question is whether NHST AS can enhance the financial outcomes by still offering printed newspapers?

1.1 Research question

The purpose of this study is to investigate how the sub-branch of NHST AS, Global Publications, can enhance the overall financial performance by achieve cost efficiency gains related their supply chain, in particularly within the processes of print and distribution.

Prior research suggests that a good way to structure the research question is by asking “what”, “how”, “why”, and “where” – questions in order to explore the phenomenon in a more

comprehensive way (Yin, 2003 p.7). On the basis of these remarks, we defined our initial research question as:

How can NHST Global Publications design a more cost efficient supply chain which will result in increased financial performance?

Broadly speaking, the research question is seeking to investigate possibilities of reducing the print- and distribution costs within the supply chain and thereby increase the financial performance. In order to achieve further increased financial return in the global supply chain we are also addressing issues regarding the exchange rate. International production and global distribution implies that NHST is exposed to different currencies regard revenue and expenses. Thus, fluctuations in the exchange rate would have a direct and immediate effect resulting in possible loss of profit. Henceforth, we seek to investigate how these exchange rates impact the financial performance in several scenarios. Thus, the analysis can be divided into the three following parts:

Part I: How can NHST Global Publications streamline and standardise products to reduce and obtain more predictable print costs?

Part II: How can NHST Global Publications minimize the total cost of distribution through better allocation and strategic decision making regarding routing and packaging?

Part III: How will exchange rate fluctuations influence print- and distribution cost for NHST Global Publications?

1.2 Limitations

The limitations define the scope of study and creates the main frames of this thesis. This research is restricted to focus on the Global Publications branch within NHST Media Group and will only focus on physical printed newspapers which implies that digital newspapers and events will be excluded from our analyses. As the research is limited to the subscription mass of print it is naturally not concerned about digital subscribers. In addition, the study will not address various feature magazines as these are considered as individual operations each time produced and sent.

We restrict our scope to focus solely on the print- and distribution processes within the supply chain of NHST. The rationale behind this restriction is an internal desire to focus on enhancing the financial performance through cost efficiency gains for these supply chain processes in the upcoming years. As a result the study will be limited to focus simply on cost and will therefore not address potential changes in the revenue and the overall profit. An increase in financial performance will only occur through a cost reduction, given that revenue remains constant.

2. NHST Media group

Since the thesis investigates a real business case within a sector that is typical unknown for many, we find it appropriate to present the organization. This includes market information, processes and other relevant areas that need to be addressed to solve the case in a best possible way.

2.1 Historical perspective

"Norges Handels- og Sjøfartstidende AS" (henceforth NHST) is a Norwegian conglomerate that has deep roots in the history among other large newspapers in Norway. It all started in 1889 when the Norwegian sailor Magnus Andersen moved back to Norway from the US with the idea to establish a newspaper for the people in the offshore industry and perceived the economic conditions as favourable due to recent booms in the shipping industry, declining illiteracy and political polarization (Møst, 2015, p.27-29).

After a period with rescission, NHST was bought up and eventually gained reputation and experienced increase in circulation and advertising revenues. The modernization of NHST coincided with the economic and political shift of the 1980s. The newspapers where grouped into several subsidiaries due to structural changes. This resulted in a changed focus from solely offshore to Norwegian all industries and later took the name "Dagens Næringsliv" (Møst, 2015, p.49-302).

At this time, there was a consensus between the management that the company had limited growth potential based on the Norwegian speaking population. Shipping and oil & gas was naturally identified as areas for an international expansion, due to Norway's long history as a major force within shipping and an emerging role in the oil industry. Simultaneously, they had a target to develop NHST into a company with operations diversified over many markets becoming less vulnerable to business cycles and competition. This resulted in a strategic plan to conquer a global niche by launching international publications targeting these particular industries (Møst, 2015, p.278-361).

The expansion started with the launch of TradeWinds on sea-blue paper targeting the shipping industry in 1990. Six years later they followed up with the launch of Upstream on financial-pink targeting the oil and gas sector. Some years later, following the same strategy, they

launched both Intrafish for the fishing industry and Recharge for renewable energy industry. For the first time in industries where Norwegians companies did not already had unique expertise in (Møst, 2015, p.361).

Throughout the years, the company has gradually expanded its distribution network and aim to be the leading provider of business news in Norway, as well as a world leading news source within shipping, seafood and oil & gas. In 2007, the organization changed its name to simply NHST Media Group as a more appropriate name for managing the conglomerate with four distinctive sub-branches; Digital & Nordic, Global Publications, Nautical Charts and DN (Figure 1) (Møst, 2015, p.7). In addition, Møst (2015, p.16) argues that the organization has managed to remain profitable because they have always been careful about publish free content and maintained their circulation base.

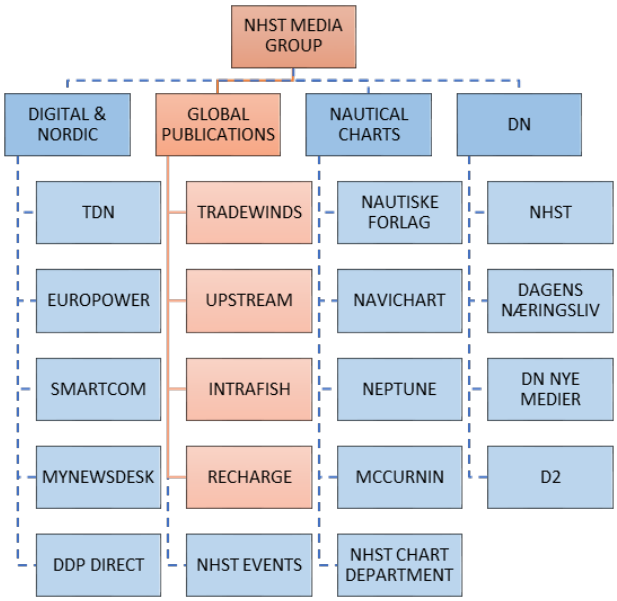


Figure 1 – *Organizational chart of NHST Media Group (Møst, 2015, p.7)*

2.2 Global Publications

TradeWinds, Upstream, Recharge and Intrafish previously operated as individual corporations up to the time of a comprehensive restructuring in 2017. To attain more efficient operations the publishers were merged together as Global Publications. This sub-branch consists of 19 offices worldwide targeting subscribers for the different publications within shipping, energy and seafood (NHST Global Publications, 2019).

The newspapers are sold as both printed and digital publications. In addition, an increasing part of the revenue stream comes from their event-branch, which hosts conferences and industry events. Even though a large part of the profit is derived from events within Global Publications the thesis will not seek to address this subsidiary in detail, as it will focus exclusively on physical printed products of Global Publications.

Although digital solutions are expected to have a major impact in the upcoming years, the printed products are set to continue to be a vital medium due to substantial revenues attached to advertising- in printed products (Opitz Stornes, L., 2019, March 21). There are still a demand for these products although a number of substitutes offers less expensive alternatives. Thus, a transition towards more digital solutions must take place without totally abandoning the printed products (NHST Global Publication, 2018).

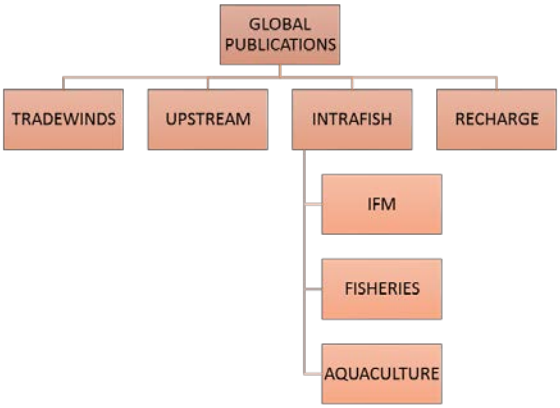


Figure 2 - *Divisional chart of Global Publications*

TradeWinds is a world leading news source within the global shipping industry. They offer a weekly printed newspaper complemented by digital news. The publication is 100% owned by NHST Media Group with headquarter located in Oslo, Norway. In total it has 70 employees in editorial- and sales offices worldwide (NHST Global Publications, 2019).

Upstream is also a world leading news source, but within the oil- and gas sector. Like TradeWinds, it offers a weekly printed newspaper complemented by digital news. The publication is 100% owned by NHST Media Group with headquarter located in Oslo, Norway. In total it has 64 employees in editorial- and sales offices worldwide (NHST Global Publications, 2019).

Recharge is a primarily an internet based news and business intelligence source within renewable energy. It offers digital news complemented by a printed newspaper five times

annually. The publication is 100% owned by NHST Media Group with headquarter located in Oslo, Norway. In total it has 16 employees in editorial- and sales offices worldwide (NHST Global Publications, 2019).

Intrafish is also a primarily internet based news and business intelligence source within the global fishing and aquaculture industry. It consist of three products, each with a printed newspaper complementing the digital news; IFM (Marketplace), Fisheries and Aquaculture printed respectively 4, 12 and 4 times annually. These publications are 100% owned by NHST Media Group, but different from the other publishers conduct most of their operations in Bergen, Norway. In total it has 26 employees in editorial- and sales offices worldwide (NHST Global Publications, 2019).

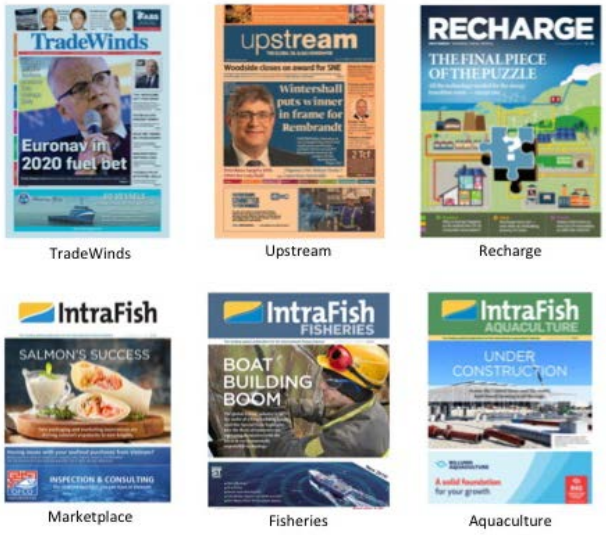


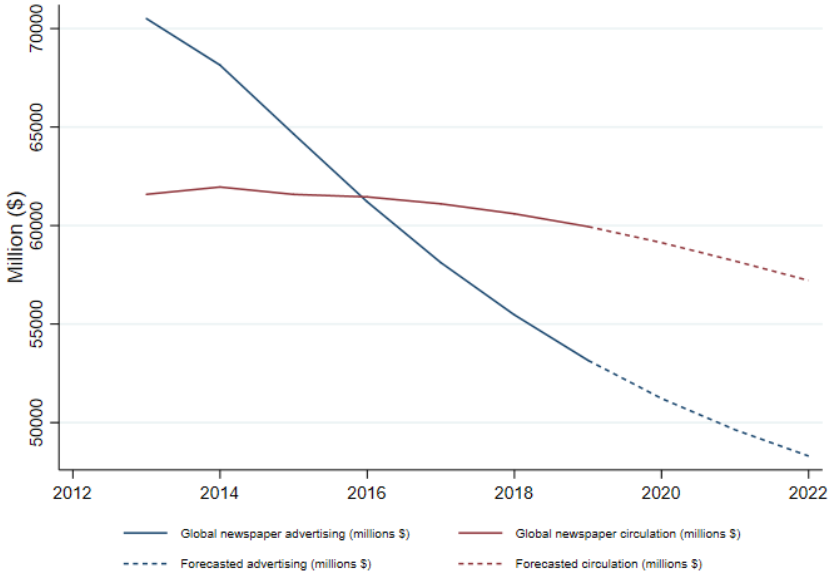
Figure 3 – *The printed newspapers of Global Publications*

2.2.1 The printed newspaper market

The global newspaper industry is currently challenged by numerous concerns. Intense competition from internet and social media, as well as shrinking advertising revenues in the print segments harms the overall profitability of the publishers (Russel, 2013).

Today, the total circulation revenue from global printed newspapers accounts for about $60,6 billion, whereas the advertising revenue accounts for about $55,4 billion (World Press Trends report, Nov. 8, 2018). Likewise, the report illustrates that the global circulation of print and advertising has declined between 2013 and 2018. This is especially evident for the advertising where there has been a substantial decline since 2013 (Graph 1). Although printed publications

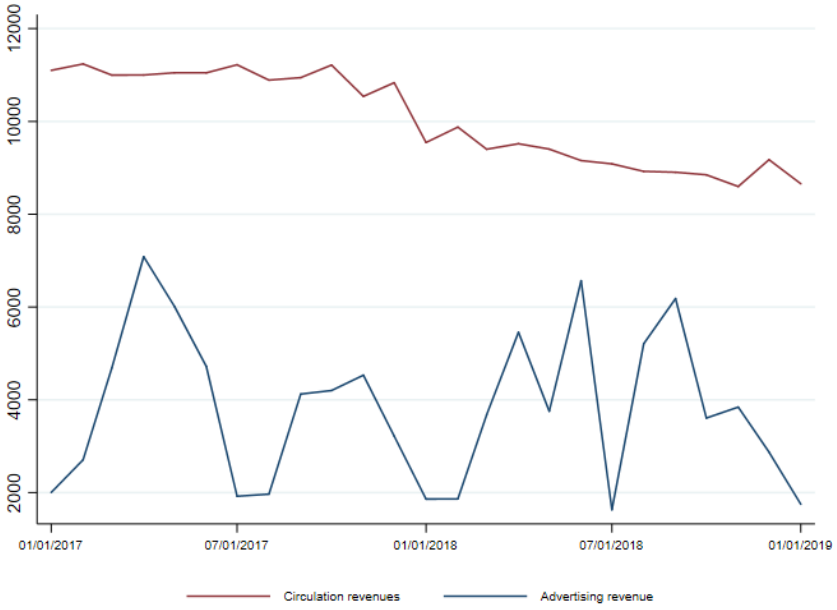
face enormous challenges in regard to the profitability, the printed revenues still account for nearly 90% of the revenues, as compared to digital. (World Press Trends report, Nov. 8, 2018).



Graph 1 - *Global newspaper circulation- and advertising revenue 2013 - 2022*

The report (World Press Trends report, Nov. 8, 2018) stipulates that developed markets in North America and Europe are expected to coincide with the largest adaptation towards digital solutions. However, the decline is not as evident in the emerging markets in the Asia Pacific region. Indeed, circulation of printed products in these markets is expected to grow in the years to come (1,25%) (Appendix 1). This implies that there still are possibilities to generate both advertising- and circulation revenues from printed products for these regions in the years to come.

NHST has experienced similar trends where revenue derived from circulation and advertising has experienced a consistent reduction from 2017 to 2019. The greatest reduction has been in circulation between 2017 and 2018 with a fall of 14%. In addition, advertising is fluctuating the same period during due to cyclic upturns and more advertising being sold in relation to upcoming events (Førde, G. 2019, March 22). Consequently, this resulted in an overall fall of 7,14% between 2017-2018.



Graph 2 - *Circulation- and advertising revenues (NOK 1000) of Global Publications*

In general NHST serves five main markets; Asia (including Oceania), Europe, Americas (both North- and South), Africa and the Middle East. Although western markets make up the largest subscription base (55% Europe and 26% America), the circulation of global printed newspapers is experienced a shift towards the emerging markets in Asia (19%). Devineni, Green, Rose, Zuckerman, & Zwillenberg, (2012) argues that growing income and education levels, as well as a demographic evolution, has had a drastic impact on the circulation and advertising of printed media in these markets. Simultaneously, people from western countries are changing their reading habits and moving towards more digital solutions resulting in a decline in quantity of printed products (Devineni et al., 2012). These findings are consistent with NHST as they face similar trends in these regions and experience a noticeable decline in revenue (Q4, 2018).

Although printed media is expected to eventually die out in the future, reports from Boston Consulting group (Devineni et al., 2012) has allegedly found evidence that print media companies will continue to have commanding brands and strong consumer relationships. Due to current disruptive challenges in the industry, publishers have started offering new printed products to drive incremental revenues. NHST has done the same by offering feature type magazines like TW+ in order to attract additional advertising revenues.

2.2.2 Strategy

Global Publications vision is to be the preferred editorial supplier of B2B information within the segments of shipping, energy and seafood, and a mission to help their subscribers within the same segments in their daily business life through journalism. Thus, the content has to be tailored for these segments (NHST Global Publication, 2018).

In the previous strategic period (2017-2019) Global Publications addressed strategies and corresponding initiatives within revenue, digital transformation, modernisation and efficiency. During the last few years they engaged in major digitalisation efforts to strengthen the publications digital position, but the current structure is to a high extent built around print. The time has come to make the organization even more adept using digital tools as digital content revenues is expected to be the most important revenue source in the upcoming years (NHST Global Publication, 2018).

In the current strategic period (2019-2021) Global Publications have addressed strategies and initiatives within the pillars of; customers, products and processes. They will to a higher extent focus on digital subscribers because it would provide ten times more page impression than print subscribers, and therefore generate valuable data in terms of content creation. This implies actions to increase digital subscribers, while also taking better care of the current subscribers (NHST Global Publication, 2018).

For printed physical products they seek to build a more consistent approach towards content creation, packaging and distribution to increase product quality and efficiency. With customers moving towards more digital products and cost under constant pressure, the focus will be centralized around creating quality content rather than increasing the quantity printed. This implies a data driven content production and a KPI driven approach to create more suitably-sized print publications that deliver the best package possible to the customers (NHST Global Publication, 2018).

Cost reduction initiatives will be pursued to create more manoeuvrability and among them finding efficiency gains in productions by automating and streamlining existing processes. Standardising products create a more systematic flow between printed editions and the online channels and will boost readership and conversation. This can be achieved by eliminate barriers to utilize print page design templates that provide added value to stories (fact-boxes, data visualisation, maps, graphics and other story enhancements) (NHST Global Publication,

2018). Some of the strategies and corresponding initiatives are already in the process of being implemented (Hansen, H. 2019, February 26).

2.2.3 Competitors

The global newspaper markets in which NHST operates in can be categorized as an oligopoly, with only a few large competitors in each niche sector. The extent to which NHST enjoys high market power relies on the density of competitors for each paper (Argentesi & Filistrucchi, 2007). According to the strategy report (NHST Global Publication, 2018) competition is especially strong among pure online content producers, aggregators and event organizers, as well as legacy news providers.

The publishers are exposed to different competitors and NHST is able to reduce exposure of direct competition by diversifying into often uncorrelated niche markets. This implies that newspapers such as Financial times, Wall Street journal or The Economist are not considered direct competitors as they seek a broader base of customers (Førde, G, 2019, March 22).

Currently, TradeWinds maintains strong reputation and brand loyalty within the shipping segment. However, there are numerous concerns in terms of competition. In regard to a practically static subscriber base, intense competition from a broad range of rivals and pure online content providers is making it gradually challenging to maintain a high circulation (NHST Global Publication, 2018).

For the oil- and gas segment the competition has changed due to the late downturn in the oil market. As a result, several competitors were shut down, while some remained strong. Among these are Gulf Publishing, Petroleum Economist, World Oil, Gas Processing and Hydrocarbon Processing (NHST Global Publication, 2018).

In the renewable energy industry, Recharge is exposed to fierce competition with Bloomberg NEF in addition to other online news providers in this niche market. There are several online news providers such as newenergyupdate.com that provides free access to news, while Windpower is a strong monthly competitor in the wind segment (NHST Global Publication, 2018).

Intrafish faces numerous international competitors that offers a mix of free and paid content. Although Intrafish holds a strong position in the Nordic market, there are competitive challenges which negatively impacts Intrafish' subscription rates and ad prices globally.

Consequently, the main challenge for Intrafish today is to expose the potential in the international market through identifying and attract new subscribers worldwide (NHST Global Publication, 2018).

2.2.4 Customers

NHST targets customers within both B2C and B2B, and segments them into three distinct groups; Subscribers, Advertisers and Event delegates. The characteristics of these customers differs for each distinctive newspaper because they have different concerns and needs. The subscribers of TradeWinds and Upstream are defined as more time sensitive because they expect weekly content that is only valuable for a short amount of time. The value is therefore derived from a time component. Subscribers of Intrafish and Recharge are considered to be less time sensitive due to the fact that the printed newspapers are merely a complementary news source. The frequency of the newspapers reflects this time sensitivity (Førde, G, 2019, March 22).

All newspapers are 100% subscription based and subscribers are segmented into paying and free. Paying subscribers are defined as ordinary subscribers and free subscribers have an extraordinary agreements with NHST (sponsorships and several types of discounts, etc.) (NHST Global Publication, 2019).

In addition, subscribers are generally perceived as price insensitive due to the fact that the purchasing decision is often based upon the content and not price paid. According to reports price is seldom a reason for annulment of their subscription (Førde, G, 2019, March 22). Naturally, an understanding of the reading habits is therefore imperative in order to enhance the relevance of the editorial products. This implies that NHST generally focus on the quality of their products in terms of content, rather than the quantity printed. This could indicate a high marginal willingness to pay, which allows NHST to have more freedom regard to pricing policy.

TradeWinds has today 6.356 paying- and 472 free subscribers in 89 countries worldwide (Appendix 2) with an annual subscription rate of NOK 9.350 excluded VAT (2018). Upstream has today 3.194 paying- and 580 free subscribers in 76 countries worldwide (Appendix 2) with an annual subscription rate of NOK 8.900 excluded VAT (2018). Recharge has today 584 paying- and 523 free subscribers in 40 countries worldwide (Appendix 2) with an annual subscription rate of NOK 5.450 excluded VAT (2018).

The subscribers of Intrafish are currently distributed unevenly, where Marketplace (3342 paying/897 free), Fisheries (47 paying/33 free) and Aquaculture (76 paying/130 free) which adds up to 3465 paying- and 1060 free subscribers in 74 countries worldwide (Appendix 2). Marketplace has an annual subscription rate of NOK 7.800 excluded VAT (2018), while both Fisheries and Aquacultere has an annual rate of NOK 3.300 excluded VAT (2018) (NHST Global Publication, 2018).

2.3 Global Publications supply chain

This section will seek to elaborate on the different supply chain processes, specifically print and distribution. The publishers and their subscribers requires a certain standard which implies paper quality, colour, content and other properties are all crucial components of the ultimate customer experience. These unique characteristics translates to different requirements between the papers and consequently different processes in the supply chain.

The typical supply chain of a newspaper company is shown below and highlights the part we seek to analyse (Hansen, H. 2019, February 26). The unique feature of the newspaper supply chain is that printing and distribution is more or less a combined process because the distribution starts immediately after printing is done to ensure that the papers arrive on time. In that sense, newspapers can be seen as perishable goods because the value of the paper is typically derived on the basis of how fast the news can reach the readers.

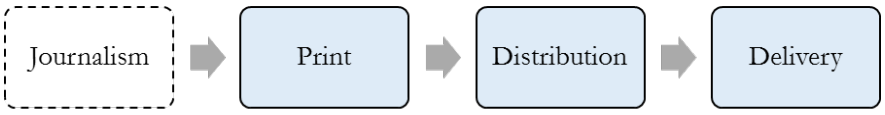


Figure 4 - *The typical supply chain of a newspaper company*

2.3.1 Printing process

All production is outsourced and the printing is done at Mortons Print (henceforth Mortons) in Horncastle (UK) with given specification. This was a strategic decision made in 2010 after "Dagblad-trykk" decided to shut down in Norway. At this time, Intrafish already outsourced through Mortons which made it naturally as one of several alternatives (Hansen, H. 2019, February 26).

Several reasons supports the choice of Mortons. In regard to the quality demanded by Global Publications, Mortons offers significant lower printing cost as opposed to other printing houses. In addition, the ability to combine a “premium print slot” (printing Wednesday night) with a strategic location, as opposed to “Schibsted” in Norway, was ideal in terms of distribution due to proximity to the international airport Heathrow. Taking all this into account the decision to print elsewhere has not changed (Hansen, H. 2019, February 26).

Although all newspapers are printed at the same facility they vary in terms of quality, number of pages, frequency as well as the volume. While it is true that Global Publications outsource the printing process, they can directly affect material costs by choosing quality, number of pages and the volume printed (volume and quantity are identical concepts and used interchangeably throughout the thesis) (NHST Global Publication, 2019).

The quality component depends on the pagination print efficiency, the printing technique used (digital/offset printing), paper quality and other specifications in regard to produce the product (inserting, folding, facilities needed etc.). The quality specifications are different between the newspapers, except the use of offset printing facilities. The newspapers follows pre-selected standards which implies that the quality not vary within the newspapers (NHST Global Publication, 2019). These quality components are important to understand how cost of newspapers can differ although the use the same paper quality. NHST wants to keep the current quality standards as part of their brand and image (Hansen, H. 2019, February 26).

Number of pages varies a lot between and within the newspapers, but a preferred page number is divisible by eight (rule-of-eight) which results in a more efficient printing process (printing side-by-side). This can also lead to a faster process which increase the probability to reach distribution deadlines (Hansen, H. 2019, February 26). The combination of quality and number of pages creates the base cost per page set by Mortons. Practically speaking could a choice of efficient number of pages reduce the cost per page in the long term (Hansen, H. 2019, February 26).

How frequent the newspapers are published are predetermined by NHST and depends on several factors. Subscribers’ expectation and the structure of the newspaper are two main reasons for this decision (Hansen, H. 2019, February 26). The structure implies whether the newspaper is primarily an internet based- or printed news source. These decisions are annually

revised and NHST want to keep todays frequency as they believe it is optimal for the years to come (Hansen, H. 2019, February 26).

Common for every publication is how the volume is decided. The amount printed is based on the number of subscribers globally (both paying and free) and adjusted upwards to include internal office- and replacement copies as a safety stock. The average upward adjustment is today 6% for each newspapers (Hansen, H. 2019, February 26). In addition, extra copies are produced before events where the volume is determined by the size of the event. In combination with the subscription volume this results in greater variations between and within the newspapers (Hansen, H. 2019, February 26).

TradeWinds is printed once a week with certain quality specifications defined as News Blue. The weight of each page depends on how wet the paper is, but on average 3,075 grams per page. Number of pages varies between 32 and 56 pages with an average of 40. The printing process starts right after the editorial deadline, 8 PM GMT, on Wednesday. The overall objective is to reach as many subscribers as possible by Friday every week, which implies a target lead time of under two days. NHST choose volume and production is done using offset printing. After printing the papers are prepared (addressing, bundling and sorting) on pallets for distribution (NHST Global Publication, 2019).

Upstream is also printed once a week, but with quality specifications defined as Financial Pink. The average weight for this paper is also on average 3,075 grams per page. Number of pages varies between 40 and 80 pages with an average of 50. The printing process and preparation is identical to TradeWinds. The also aim to reach as many subscribers as possible by Friday, which indicates a similar lead time to TradeWinds (NHST Global Publication, 2019).

Recharge is printed five times a year, often in combination with an industry event, but typically every second month on average. The merged quality specifications are defined as Finesse Matt and the average weight is 2,13 grams per page. Number of pages varies between 68 and 76 with an average of 71. The editorial deadline is normally a week before the deadline, but the printing process and preparation are identical to TradeWinds and Upstream. It differs from TradeWinds and Upstream, due to the fact that lead time is less important as long as the subscribers acquire the newspaper within 14 days (NHST Global Publication, 2019).

Intrafish and its newspapers have equal merged quality specifications and same editorial deadline, printing- and preparation process as Recharge. This quality is defined as Near Woodfree Gloss and have an average weight of 4,71 grams per page. Marketplace is quartly printed and varies between 32 and 44 pages with an average of 37. Fisheries is monthly printed and varies between 28 and 36 pages with an average of 32. Aquaculture is quarterly printed and varies between 32 and 40 pages with an average of 37. Like Recharge, lead time is less important as long as customers get the product within 14 days (NHST Global Publication, 2019).

2.3.2 Distribution and delivery process

All newspapers have approximately equal production methods, but the process of distribution and delivery differs between and within them. In general, distribution and delivery can be addressed as the same stage in the supply chain, because for newspapers this is an overlapping process. Factors like market size (number of subscribers), delivery time, density of subscribers and how developed delivery systems are in each country will decide what kind of delivery Global Publications can offer its subscribers. Distribution is mainly conducted through airfreight in order to deliver within reasonable time, but customers' behaviour will determine what the efficient solution is.

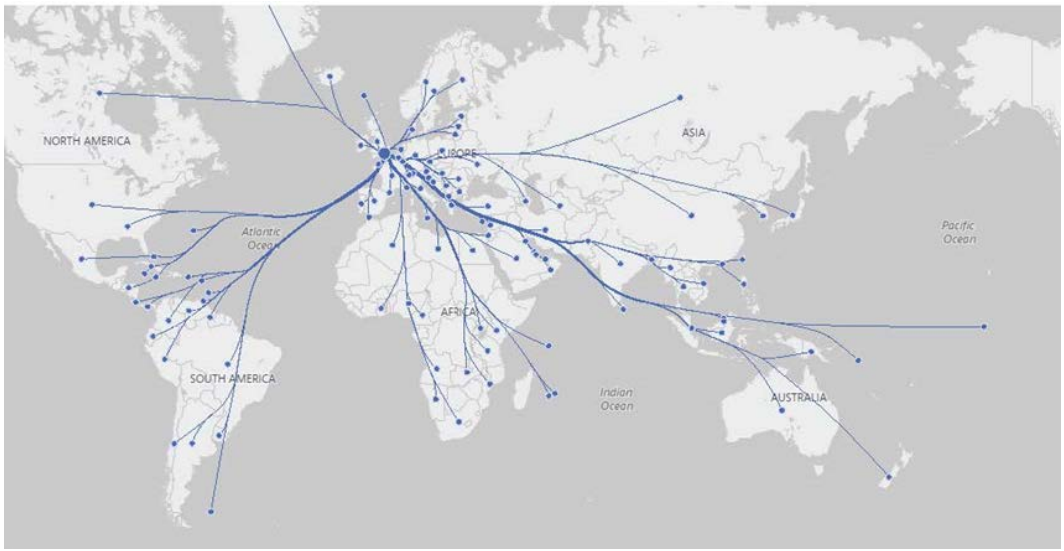


Figure 5 - *The worldwide distribution network of Global Publications*

Today, Global Publications operates with three different methods for distribution and delivery to subscribers in 119 countries worldwide (Figure 5). All distribution are outsourced to Air Business (UK) which implies that Global Publications is not responsible for setting up the

optimal distribution in terms fuel, cars, delivery routes etc. However, Global Publications is able to tailor different delivery methods which affects costs and is therefore decision-relevant. Similar to print, there are several decision relevant variables and methods that directly affects cost and service level (NHST Global Publication, 2019).

In terms of packaging there are three alternatives used for all delivery methods. These alternatives are either a letter that can hold one newspaper, a parcel that can hold 0-1kg, or a parcel that can hold 1-2kg, all consists of a fixed cost per item. For the parcels it depends on the weight of the newspaper how many that can fit. In addition, they operate with a time factor that is negative correlated with cost. This implies that a shorter lead time would ultimately increase the cost of distribution and is reflected through 1st and 2nd class packaging (NHST Global Publication, 2019). Similar to print, the expectations of subscribers and the structure of the newspaper decides the optimal class. Today, TradeWinds and Upstream use 1st class while Recharge and Intrafish use 2nd class due to time sensitivity (Hansen, H. 2019, February 26).

The cost of sending products is determined by two factors, number of items and weight. This implies that the rate per item is a fixed cost plus a variable rate per kg for every country. The cost will therefore depend on the volume and the weight of the newspapers. In addition, a postage cost with the same structure leads to an additional cost of sending newspapers to subscribers (NHST Global Publication, 2019).

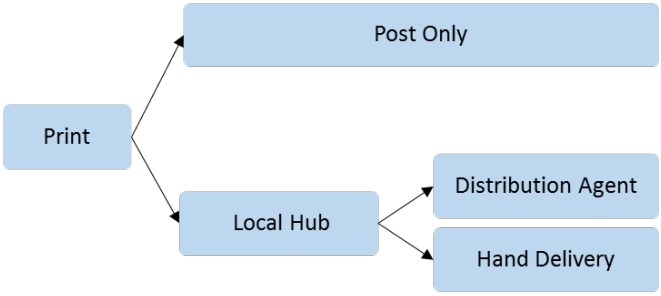


Figure 6 - *Distribution- and delivery methods of Global Publications*

Post-Only

The first method is sending by post-only which implies outsourcing to The Royal Mail (UKs mail service) via Air Business. This method is assumed today as the cheapest solution, but not feasible for all destinations, due to regional challenges regarding the post service (Hansen, H.

2019, February 26). The method is therefore perceived as inappropriate due to unreasonably long lead time, delays or no delivery at all for some countries. Accordingly, it is currently not considered to be a viable method for TradeWinds and Upstream due to more time dependent subscribers (NHST Global Publication, 2019).

Distribution Agent and Hand Delivery

The remaining two methods has an approximate equal distribution process, but different methods when it comes to delivery. Newspapers are transported from Mortons to a hub in the respective country using Air Businesses network of remailing systems. Cost savings in form of coordination of products to different hubs is a plausible justification for this method as compared to post-only. When the newspapers reach a local hub it has two alternative forms of delivery (NHST Global Publication, 2019).

The first alternative is to hire a local handling agent who is part of Air Businesses network of remailing systems. This implies an agent picking up the papers at the hub and deliver it to the customer's mailbox, like a private mailman (NHST Global Publication, 2019).

The second alternative, Hand delivery (HD) is based upon the process of using a private mailman. In some geographic areas, with defined limits, e.g. "Aker Brygge" in Norway, the agent can provide HD directly to the subscriber if this is suitable (NHST Global Publication, 2019). Today, HD is only offered in certain places and where it is now. This implies that the method will not be offered to new subscribers, and thus the only alternative is to downgrade if it is deemed necessary (Hansen, H. 2019, February 26).

Newspaper	**Delivery method**		
	Post Only	Distribution agent	Hand Delivery
TradeWinds	Yes	Yes	Yes
Upstream	Yes	Yes	Yes
Recharge	Yes	No	No
Marketplace	Yes	No	No
Fisheries	Yes	No	No
Aquaculture	Yes	No	No

Table 1 - *Delivery methods offered to subscribers today*

Even though distribution and delivery can be dismantled and simplified in the steps above (Figure 6) Global Publications have some extraordinary cases. For instance, newspapers going to China, Vietnam, Philippines, Taiwan and Malaysia are first transported to Hong Kong. Here they are put in envelopes and relabelled before dispatched to the respective country (Hansen,

H. 2019, February 26). Most destinations do not have such a demanding process, but it illustrates the complexity for some countries in practice.

2.3.3 Cost of Print and Distribution

This section will provide information of the actual operating costs in 2018, which will serve as a reference of comparison to the results from the analyses. Table 2 summarize the quantity produced over one year (2018) with the corresponding costs related printing and distribution.

The printing costs is given by the sum of Mortons asking price quoted in GBP and then converted to NOK with the coherent exchange rate (Appendix 3). We were also provided with the total distribution cost for Global Publications in NOK. In order to get a holistic view of the overall cost structure, we used historical ratios to estimate an accurate allocation of distribution cost for each newspaper. Total costs are calculated as the sum of annual printing costs plus the annual distribution cost.

Newspaper	Total cost of print and distribution in NOK					
	Quantity	Cost of printing	Distribution cost	Total	Issues	% of total cost
TradeWinds	437.486	873.459	15.406.121	16.279.580	51	60,60%
Upstream	262.861	780.295	8.046.945	8.827.240	51	32,86%
Recharge	15.000	170.760	252.816	423.576	5	1,58%
Marketplace	13.232	95.318	258.215	353.533	4	1,32%
Fisheries	14.609	194.804	410.177	604.981	12	2,25%
Aquaculture	14.673	67.112	310.001	377.112	4	1,40%
Total	**757.861**	**2.181.748**	**24.684.274**	**26.866.022**		100%

Table 2 - *Total print- and distribution cost in NOK over 1 year (2018)*

The total quantity of newspapers produced in 2018 is 757.861 with related costs divided into the two segments of print and distribution. This allows for more accurate monitoring of the operational cost structure. The largest cost is the distribution cost which accounts for NOK 24.684.274. The printing cost is significantly smaller and accounts for NOK 2.181.748. The total cost accounts for NOK 26.866.022. As of today, TradeWinds and Upstream represent 93,46% of total cost.

3. Literature review

In this section we introduce essential theory about the fundamental economics of newspapers, the unique supply chain features, financial performance measures, as well as cost minimisation theory and global supply chain risk theory. The theory sets the foundation for later analyses and discussions.

3.1 The Newspaper Economics

Economic literature often characterizes newspapers as a two-sided market, targeting both readers and advertisers. Thus, the primary revenue stream for newspapers is derived from selling two kinds of products. The sales of newspapers to readers and selling publishing space for advertisement for companies (Angelucci, Cage, & De Nijs, 2013).

According to Picard (2002), the advertising revenue has traditionally accounted for about 80% of the total income for US newspapers and stipulates a causal relationship between circulation and the sales to advertisers. This is because the likelihood of increased advertising revenues depends on the amount of total circulation. Likewise, the sales to advertisers would typically increase if the circulation also increases, due to the fact that advertisers would be able to reach a broader market (Picard, 2002). However, research has found that the advertisers value readers more than readers value advertising, implying that higher demands for copies increases the advertising rates, and an increase in demand for advertising decreases the copy prices (Anderson, Waldfogel & Strömberg, 2016 p.420).

According to Argentesi & Filistrucchi (2007) the publishers' optimal market power depends on the elasticities of readers as well as advertisers, with respect to the price- and quantity demanded. Traditionally, the pricing strategy of newspapers has been to increase the price if number of subscribers' falls in order to maintain a stable income base (Collins, Olson &Furey, 2009). However, this policy is contradicting the fundamental principle of law of demand, where the demand would ultimately increase if the prices falls. Instead of lowering the price when demand falls, the publishers tend to increase their price to compensate for the loss.

Today, revenue is also generated through sophisticated methods such as online paywalls where subscribers have the option to pay for access to the news online through a periodically subscription. In addition, bundling strategies has been introduced for products or content in

order to reach out to a larger customer base. For instance, many newspaper companies are bundling print and digital products in order to attract more subscribers. Thus, enables newspapers to generate incrementally more revenues as well as ultimately higher returns on investments (ROI) for the advertisers (Arthofer, Aryana, Green, Sheerin, & Zuckerman, 2016).

According to Alexander, Owers, Carveth, Hollifield & Greco (2004 p. 115) the costs of Newspapers are broadly distinguished by; the costs of journalism, the cost of producing the newspapers as well as the cost of distributing the end product to the final customer. In addition, they argue that newspapers have high first-copy costs – that is essentially the editorial cost of preparing the newspaper for printing. Henceforth, the cost of printing would typically decline as economies of scale develop and the number of copies are reproduced.

Picard (2002) argues that the costs of distribution and printing are typically the largest costs newspapers incur. However, because newspapers often enter into agreements with subcontractors, a proportion of these costs are often absorbed by third-party subcontractors. Although some of these costs are absorbed, he argues that the cost of distribution is primarily the most problematic for newspapers. Due to the fact that it would ultimately rise with increased travel distance as well as decreased distribution densities.

As a result, both distance and density of readers creates situations where the costs are affected dramatically because the distance between the print and delivery location is large (Picard, 2002). Similarly, transportation erodes the profit margins and is likely to impact the price levels of the products. In addition, transportation does not improve the end product in terms of value creation or customer utility (Nwaogbe, Omoke, Ubani, & Ukaegbu, 2013). Henceforth, the value derived from distributing newspapers is obtained by providing the readers with fresh news by ultimately reducing the overall lead time and transportation cost.

The past three decades has witness significant changes in how the editorial work is conducted as well as improvements for both production and distribution of papers (Alexander et al, 2004 p. 115). First of all, the enhancement of printing facilities has had a significant impact with regards to the cost efficiencies for the publishers. Second, the new technologies have increased the speed of which the preparing and printing processes is conducted. This allows newspapers to publish more up-to-date content.

3.2 The newspaper supply chain

A supply chain for a product or service is the network of firms and facilities involved in the transformation process from raw materials to a product, and the distribution of that product to customers (Souza, 2014). Historically supply chain management was seen as the result of an integration between logistics processes when companies realized how logistics affects the final cash flow. This resulted in encouraged efforts to integrate the processes of distribution and material management (Camerinelli, 2009, p.6).

Firms operating globally are part of a global supply chain. In such chains, the objective is to find the balance between profitability and productivity, and move goods and materials between nations in a timely and seamless manner (Manuj & Mentzer, 2008). As a consequence, firms have to take into account numerous considerations in regard to economic, cultural and political aspects, among other.

A workflow diagram of the typical newspaper supply chain was proposed by Böhnlein, Schweiger, & Tuma (2011) and highlights the major steps of consideration, where transport and delivery are considered to be parts of the distribution process.

Figure 7 - *Newspaper supply chain*

According to Chopra (2003) distribution are the steps taken to move and store a product from the supplier stage to a customer stage in the supply chain. The distribution cost typically involves transportation, inventory, warehousing, and service costs. In general, the transportation cost would typically increase if there are fewer distribution centres in the chain, resulting in longer travel distance. In addition, the distribution has the potential to be the key driver of profitability because it impacts both the supply chain cost as well as the customer experience (Chopra, 2003).

Furthermore, research has identified two dimensions in which one should evaluate the quality of distribution. First, the customer needs have to be met in order to maximize the revenue stream. Second, the cost of meeting these needs should be as low as possible (Chopra, 2003). The logistics needs in the global newspaper supply chain consists of many interrelated

services, each with its own set of requirements and constraints. Thus, when selecting a logistics agent- or air freight forwarder, research has identified three distinct criteria's that are important for selection. These are, delivery time, costs associated with freight rates and prices and lastly the risk of losing the freight (Chen, 2010).

The production processes for media products varies widely across the industry. In the case of newspapers, the production- or the printing process is by necessity compressed into few hours, due to the fact that news should circulate as soon as possible (Alexander et al, 2004 p.28). Because the readers value the timeliness of the content, the newspapers are produced as close to the distribution time as possible (Chiang, Russell, Xu, & Zepeda, 2009). In addition, Alexander et al. (2004 p.119) argues that the processes of print- and distribution typically incur the significant costs in a newspaper supply chain. Thus, the processes concerning distribution and printing have become more important in eyes of the publishers (Toth & Vigo, 2002, p. 266).

Traditionally, supply chain problems that addresses the integration of production and distribution often incorporate some kind of inventory management. However, the nature of the newspaper industry is different. Holding inventory is rarely a viable option because the customers values the timeliness of the product (Chiang et al, 2009). Holding inventory would instead impose significant holding costs for the publishers and is merely a viable option in terms of risk mitigation (Chiang et al, 2009). When modelling a global supply chain there are additional considerations affecting performance measures that are not present in supply chains operating in a single nation (Beamon, 1998). Henceforth, the various sizes, weights, zones, distribution dates, exchange rate fluctuations, as well as other variables, are significant cost associated with the production and distribution of newspapers in a global supply chain network.

3.3 Financial performance

Performance measures are used to determine the efficiency of an existing system or to compare competing alternative systems. The measures can be applied as decision-making variables by determining the most desirable level of performance. In supply chains, performance measures are often based upon financial measures such as cost or profit (Beamon, 1998).

According to Mentzer, Myers & Stank (2007) there are three key drivers of financial performance for any company. Among these are, growth in revenues, overall profitability and capital utilization (revenue relative to the investment in assets). However, aggregated financial measures oppose significant limitations because they are merely lagging measures of the past performance of the company. Likewise historical measures are not able to account for present states and thus reduces the actionability for the decision makers (Kaplan & Norton, 1996). Building on these statements, Camerinelli (2009, p.31) argues that financial performance measures can be enhanced through effective supply chain management, because it is a linkage between operational practices and the financial outcomes.

He goes on and proposes the following framework as an possible solution to this problem (Figure 8) where the operating margin, in its simplified form, relies on the difference between the revenue and the operating cost (Camerinelli, 2009, p.141). Consequently, breaking down the operating margin in its fundamental components allows for deep investigation and makes it possible to initiate actions to enhance the overall profitability and thereby the financial performance.

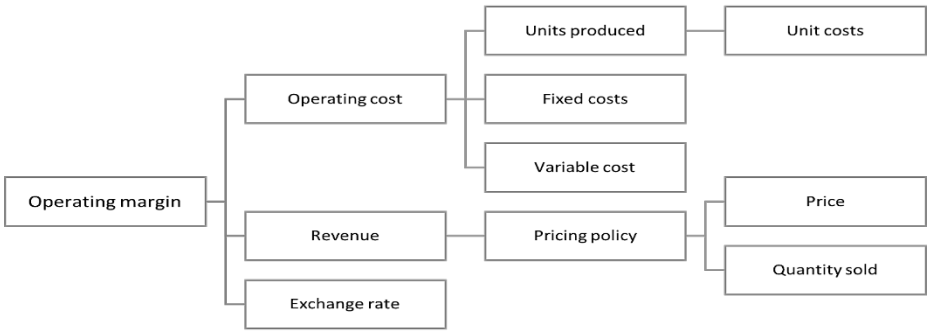


Figure 8 - *"The value three" - similarly to Camerinelli (2009, p.141)*

In practice, this implies that by either increasing the overall revenue or decreasing operating costs, holding all else equal, would ultimately result in enhanced financial performance (Camerinelli, 2009, p.142). He supports his findings by highlighting a DHL case where introduction of operational improvement initiatives resulted in reduced operating costs and had an equal uplift in the financial performance measures. Thus, concludes that operational decisions have a causal relation with the ultimate profitability (Camerinelli, 2009, p.147).

This exemplifies how effective supply chain management has a magnifying effect on the financial performance, where mapping of the different value drivers and implementing cost reducing initiatives have the potential to drive the overall financial performance.

3.4 Standardisation

George (2010, p. 271) stipulates that variance in the supply chain processes can generate hidden costs and argues that standardisation can be beneficial in terms of reducing such costs. This argument is supported by Timmerman and Epstein (2010) which states that standardisation is a tool that can be applied in order to meet an objective. Further on they argue that implementing standards requires a comprehensive understanding of processes and corresponding decision making around such processes.

A strategic approach to handle excessive product variety is according to Perera, Nagarur, & Tabucanon (1999) component part standardisation. Excessive product variety can create operational complexities that ultimate could result in poor performance. Part standardisation is a wieldy accepted strategy for improving performance while maintaining a required level of product variety to satisfy the customers need (Perera et al., 1999). The underlying idea refers to a situation in which different components are replaced by a single component which can perform the function of them all. There are typically two possible situations for standardising, either within a product or among products. Henceforth, there are two ways in which one can standardise the process. Either replace several unique components in a product by a common component or replace several unique components among products by a common component (Perera et al., 1999).

The component part standardisation will have an impact on the material- and production cost. By reducing the material variety through the processes of standardisation it is possible to reduce all the components of the material cost. A reduction in the part variety will increase the level of automation and thereby reduce production costs. It can also contribute to reduced labour cost by reducing requirement of multi-skills and interruptions. More importantly, the process of component standardisation will reduce cost of distribution due to reduced quantity and transportation (Perera et. al., 1999).

3.5 Transportation model

The main objective with this research is to reduce the distribution cost. Because the distribution cost is comprised of a complex distribution network we require special algorithms to solve the problem. There are a widespread of models for operational planning related problems, in particular for distribution problems. Among these are cost minimizing methods for achieving low cost solutions (Russel, 2013). In addition, Williams (1999, p. 69) stipulates that problems related to production and distribution can often be formulated as linear programming models because distribution related problems are often based upon networks.

One such model, the Transportation problem (first described by Hitchcock in 1941) is particularly useful because it is formulated in terms of obtaining the minimum cost flows while not exceeding the capacity limits within the particular network (Williams, 1999, p. 82). Prior research regarding cost minimisation in supply chain processes, in particularly distribution processes, often apply various versions of transportation problem models (Mula, Peidro, Díaz-Madroñero, & Vicens, 2010). In regard to this, transportation problems can either be modelled as a balanced transportation problem, where the demand is restricted to equal the supply of products, or an unbalanced problem where demand does not equal the supply (Winston, 1994, p. 341).

Although the problem would typically differ from various cases the model can be applied and tailored with respect to the specific case. However, for a general transportation problem with m suppliers, and n customers there will be m availability constraints and n requirement constraints giving a total of m + n constraints. If each supplier can be potentially used for each customer there are m*n variables in the LP model. It is clear that for problems involving large numbers of suppliers and customers, the LP model could be very large. Although this case only considers one supplier with several customers (regions) the statement above clearly illustrates the motive for using such special algorithms (Williams, 1999, p. 84).

3.6 Risk of global supply chains

Several implications have to be considered because NHST operates globally. Firms operating globally is part of a complex supply chain network, which requires high coordination between the flow of goods, services, information and cash across national boundaries (Manuj & Mentzer, 2008). In addition, globalization has made supply chains more vulnerable to various

risk factors that has a direct impact on the operations, and ultimately the profitability of the company (Liu, & Wang, 2019). Among such risks is the foreign exchange risk.

According to Mathur (1982), exchange rate risks can be subdivided into transaction risk and translation risk. The transaction risk refers to the risk of increased costs- or reduced income denominated in foreign currency as a result of exchange rate fluctuations. This implies that transaction risk relates to the possible reductions in the cash flow. Indeed, Homaifar (2004, p.217) builds on these definitions and argues that exchange risk is relevant because it ultimately affects the cash flow of the company.

The translation risk refers to how changes in exchange rates cause losses in the balance sheet, and exemplifies the magnitude movements in exchange rates has on the overall profitability. Due to the fact that multinational corporations with overseas subsidiaries often translate the subsidiaries income statements into the same currency of the parent, for consolidation and to report to regulatory agencies and shareholders, this risk needs to be monitored properly (Homaifar, 2004, p.217).

Furthermore, substantial changes in exchange rates are likely to be associated with high relative inflation in either the foreign or home currency. As a consequence the revenue or costs denominated in the foreign currency will be affected (McRae, 1996, p.117). Recent surveys of the top 500 global companies found that the foreign exchange risk was perceived as the second most important risk factor for companies operating globally (Scott, 2009).

4. Research method

In this section, we will elaborate on the research method and design used. We will also explain the process of data acquisition and the structure of the data. Furthermore, we will describe important quality criteria for case studies in order to secure robust research results. Similarly, we will seek to highlight possible biases and errors in regard to the data set.

4.1 Research design

The appropriate research methodology for this paper is a case study. According to Yin (2003, p. 13) case study is defined as an empirical enquiry that investigates a contemporary phenomenon in its real-life context. Especially when the boundaries between phenomenon and context is not clearly evident. Case study as method was chosen because it is able to provide in-depth insights into a real-life business problem. This particular case study is conducted as a single-case study and considers the distribution and printing processes of NHST. Single case study was chosen because it allows for a deep insight in the processes based on multiple sources of data in a triangulating fashion. Consequently, case studies appear to provide higher validity, because including both quantitative, data as well as qualitative data can lead to more robust results (Ellram, 1996).

For case studies the research design is a logical plan that links the data to be collected to the initial questions of the study (Yin, 2003, p.21). Moreover, the research design will provide strong guidance in determining what data to collect and what kind of techniques that should be applied in order to interpret and analyse the data. As a consequence, theory development prior to data collection is imperative in case studies.

Because NHST wanted to investigate possibilities for cost reductions in their print and distribution processes, extensive literature research within the topics of supply chain improvement- and cost reduction techniques was conducted prior to data collection phase. Henceforth, the research was largely exploratory in the starting phase due to less knowledge about the industry and the processes. As the research progressed, more secondary data was introduced in order to run analyses, and to accommodate the primary data collected.

4.2 Data collection

In order to conduct analyses, numerous types of data have been used. In addition, an extensive use of triangulation has been conducted throughout the case study, and among the data used is both primary and secondary data.

The primary data are generally interviews with informants from NHST. Initially, interviews were mainly conducted as a guided conversation rather than structured interviews. The questions were often asked in a fluid way, the reason behind this was to let the informants speak and not be interrupted by our own opinions and potential biases, as suggested by Yin (2003 p.90). This allowed us to gain valuable insights about the print- and distribution processes as well as the respondents' opinion of these processes.

Moreover, all of the informants were suggested internally through conducting interviews and described in the table below. For instance, when we asked questions about specific concerns, we were directed to persons tailored for our concerns. Later, when we had obtained sufficient knowledge about the processes, structured interviews were conducted in order to ask questions regarding specific issues, and thereby avoid response biases from the informants. In addition to interviews, there were weekly exchange of emails between us and the key informants.

Person	Position
Leonard Opitz Stornes	Managing Director of NHST Media Group Asia
Hege Hansen	Marketing Director and responsible for operations
Geir Førde	Content Sales Director

Table 3 - *Key Informants*

The secondary data is generally quantitative data obtained from NHST Global Publications database, as well as reports from consulting firms and "World Association of Newspapers and News Publishers".

Ellram & Tate (2016) argues that there are several benefits of using secondary data in case studies. First of all, secondary data has the potential of reducing the overall biases. This is because of the objective nature in the data. For instance, secondary data often relies on well-established measures such as price, revenue and costs. It is suitable when the analysis is economical in nature, such as for simulation purposes or econometric modelling, which will

be applied in this particular case. Moreover, the data was collected on the basis of the analysis that we wanted to conduct. This implies that we typically acquired quantitative data concerning cost and cost drivers for the print and distribution process.

However, due to the recent merging of NHST into Global Publications it was relatively difficult to collect coherent quantitative data for the purpose of the analyses. As a consequence, data had to be bundled up from 4 different individual newspapers, in order to collect sufficient amount of data. In addition, some newspapers only had a limited amount of printing data, which severely restricted our analyses.

4.3 Data Sources and Descriptive Statistics

We have collected several different datasets from NHST as well as global reports from consulting firms. The data from NHST consists of numerical data about distribution volume, number of pages for the different newspapers, distribution costs in GBP and NOK, content revenues from 2017 to 2019, advertising revenues from 2017 to 2019, exchange rates (17-18), number of subscribers, subscription rates with price adjustments as well as weights and specifications about the different newspapers.

In order to preserve the integrity in the dataset and adjust for possible outliers, initial descriptive statistics in STATA with minimum, maximum, means and standard deviations has been conducted as suggested by Woolridge (2016, p.610).

Newspaper data

The various newspapers have different characteristics in terms of weight, format and paper quality. In order to account for these differences we collected data in regard to weights, subscription price rates and printing. Thus, the data is a mixture of categorical and numerical variables.

The weights are calculated through a sophisticated weight calculator based on the different numerical values of “cover”, “inset”, as well as the length x the width of the newspapers. The weight calculator allows for investigations into adjusting the components influencing the weight, and thus allows us to influence the distribution cost.

Print data

The printing dataset contains data for all 6 newspapers. TradeWinds and Upstream with coherent printing cost between 2017 and 2018. However, there are independent annual datasets for Recharge and Intrafish newspapers because these newspapers are printed on different times. All datasets include numerical values about the number of printed pages, quantity printed as well as the dates for the different issues. In addition, the associated costs of print measured in GBP and NOK with corresponding exchange rates in GBP/NOK is also included.

Distribution data

The distribution data consists of total distribution costs for all newspapers for (2018) as well as air freight data from the third party logistic provider, Air Business (22. March, 2019). The freight data consists of different variables of importance, among these are (i) rate per kg (for the different countries in £), (ii) rate per item shipped (£), (iii) price per item shipped (£), (iv) number of items shipped, and lastly (v) the total weight of items shipped (kg). In addition, we collect unique data for the different delivery methods, as well as the distribution packaging methods. In short, these varies from letters to parcel packaging. The heterogeneity in delivery methods as well as packaging techniques implies price differentials. For instance, Air Business charges different rates on the basis of whether they ship parcels or letters. These rates also differ on the basis on how much kg that is shipped, and whether they are sent as 1st class or 2nd class.

Price and Revenue data

We also collected subscription rates for all newspapers between 2018 and 2019. Over this period, the price adjustments and VAT basis rates are also included. In addition, the subscription rates for the different papers varies for different subscription terms, ranging from 3-12 months.

The revenue data for printed publications is comprised of both advertising revenue as well as circulation revenue per region (Asia, Europe, America, Africa and Mid-East). The total circulation revenue consists of income streams from both combi- and digital customers, this implies that we have had to de bundle the income stream and omit the income from the digital part, as this research focus solely on the printed combi products. Price and revenue data are mainly collected in order to highlight the overall newspaper market.

Data about subscribers

We collect data of the number of subscribers per country for the last distribution date (01.03.2019). The subscription data was imperative for analytical purpose, because the quantity sent should idealistically equal the demand stipulated by the subscribers. The data also includes descriptions about the various methods of delivery for all newspapers, on the basis of which country it is sent. For instance, some countries have hand delivery (HD) of newspapers and this would have its own unique code attached to it.

Moreover, all newspapers were assigned different office codes such as: “UK” and “UKR” due to the fact that countries would have their own unique code for the various papers. Thus, we had to group the observations on the basis of their regional proximity in order to generalize the distribution of the different newspapers. Again, we were provided office codes for both digital and combi subscribers, meaning we had to exclude all the digital subscribers for analytical purposes.

4.4 Quality conditions for case studies

The overall research quality of case studies depends on the following conditions:

1. **Construct validity**

The first condition stresses the extent to which multiple sources of data has been used in order to address the issue. This criterion is imperative to avoid possible information biases, and thereby enhance the overall research quality. Ellram (1996) argue that multiple data sources tend to produce more stable and reliable results. Furthermore, data was continually reviewed and kept in an online-database accessible for both researchers and the draft of the case was reviewed by key informants in order to ensure that the research is conducted properly, as suggested by (Yin, 2003, p.20). Consequently, numerous drafts have been revised by key informants from NHST as well as our supervisor to ensure continuity in the research.

Although the main analysis is based upon secondary data obtained from NHST itself, some reports concerning the global newspaper market was collected, in order to achieve a holistic view of the current situation. Even though this data was collected from reliable sources (BCG, World Newspaper Association, etc.), we were cautious because the data was shown in compiled forms. Hence, this particular data was only used for descriptive actions rather than the analysis itself.

2. **Internal validity**

Is only a concern for causal or explorative case-studies, in which the investigator is seeking to find out whether event x led to event y. However, if it is some rival factor, z that also causes y, but the study has not addressed, then the internal validity is lacking (Ellram, 1996).

There could be issues regarding the internal validity due to the methods applied for analytical purpose. In addition, when we address the interdependencies of print- and distribution chain where the cause of printing process has an effect on the distribution part, there may be several omitted variables, which could lead to rival explanations. However, we later conclude that it is significant causality between both processes.

3. **External validity**

Reflects how accurately the results represent the phenomenon studied, and thereby seeks to establish generalizability (Ellram, 1996). In order to achieve better external validity within the case study several of precautions had to be made. For instance, the dataset provided were often from different years/months with different corresponding exchange rates and variation in the issues printed. This meant that we had to establish a general grouping of the data in order to achieve consistency for the purpose of estimation. Furthermore, when conducting the distribution analysis, the unit rates are based upon the assumption of a generalized region rate while in reality the rates would differ from country to country.

4. **Reliability**

Addresses the repeatability of the research, and whether replication is possible and will achieve identical results. Yin (2003, p.37) argues that reliability minimises the errors and biases in the study. Thus, the reliability and validity of the secondary data are functions of the method by which the data was collected and the source. There could be certain issues regarding the reliability. We introduce several assumptions in order to address this concern, and preserve the reliability of the models. Assumptions were set forth in order to provide guidelines and scope for the particular analyses.

4.5 Conducting analyses and possible drawbacks

There are possible drawbacks in the study which should be addressed in order to achieve better research quality. This is in particularly true for the data acquisition phase in which we experienced various drawbacks regarding the secondary data.

Printing analysis

First, the sample size was relative small for Recharge and Intrafish, which could be problematic for the purpose of statistical analysis. Small samples could lead to less precise estimates as standard errors tend to be larger relative to their coefficient estimates, which in return usually results in statistical insignificant estimates (Wooldridge, 2016, p. 145). Furthermore, this could imply that the significance levels are reduced, with respect to the smaller t-stats. Although, Recharge and Intrafish had smaller sample sizes, we have decided to keep the significance level constant at 95% as it does not seem to influence the ultimate results from the analyses.

Ideally, we would prefer balanced panel data over a longer time period, in order to estimate more accurate- and reliable models and investigate the trends related to costs. In addition, this could allow more accuracy of investigation into the costs of printing, in particularly to account for the heterogeneity in the newspaper characteristics, and possible explain the spurious relationship of cost and quantity for some of the newspapers. However, due to the late merging of the company's subsidiaries such data was difficult to obtain.

Second, the general lack of consistency in the dataset obtained made it difficult to run the initial analyses. In particularly regarding the inconsistency of the publication dates in the sample data complicates our estimations. Whereas both TradeWinds and Upstream has equal print and distribution dates, Recharge and Intrafish complicates the estimation as they are not printed on a weekly basis but varies between monthly and weekly. Furthermore, the number of pages is fluctuating for all publications (Graph 3) (Appendix 3).

The variance inflation factor (VIF) indicates no level of multicollinearity for all newspapers except for Recharge, where multicollinearity results in Stata omitting the variable of volume printed. Further, Durbin Watson tests confirm no autocorrelation. In addition, Kernal density plots and Shapiro-Wilk test indicates possible issues regarding normality in the residuals for TradeWinds and Upstream. Thus, possibly reducing the validity of the coefficient t-stats (Appendix 4.1- 4.3).

To account for the normality issues, Breusch-Pagan test for heteroscedasticity and autocorrelation has been conducted, as it is slightly more relaxed with respect to the normality assumption (Wooldridge, 2016 p. 251). The initial diagnostic tests confirm heteroscedasticity in Upstream printing cost (Appendix 4.4). As a consequence, this would have a major impact

on the constructed confidence intervals and t-stats due to biased standard deviations (Wooldridge, 2016, p. 245).

Consequently, we modelled the regression using robust standard errors, and we argue that, even though there seem to be a problem with heteroscedasticity, the coefficients are still consistent (Wooldridge, 2016, p. 244). In addition, residual plots indicate that the magnitude of heteroscedasticity is rather small, fluctuating around zero (Appendix 4.4). Henceforth, we convert to robust standard errors, to obtain more trustworthy estimates that would resemble the original standard errors.

Model misspecification tests (ovtest) confirm that a multiple linear regression performs a good fit of the dependent variable, printing cost. However, there are likely that some noise is contributed to omitted variables for both TradeWinds and Upstream (Appendix 4.5). Although, this is expected as the printing data is limited to only two explanatory variables, namely pages and volume. In reality, we know that there are more variables influencing the cost of printing, but these were not possible to obtain.

The quality of the printed newspapers is considered to be a fixed component and does not vary by the volume produced, but differs between the newspapers and thus explains the heterogeneity between them. While testing for omitted variables, these quality differences as well as printing techniques are plausible omitted variables in the model.

Distribution analysis

The main challenge regarding distribution analysis was the small number of observations. This made it difficult to run initial simple linear regressions in order to predict regional unit costs. In addition, the transportation model was simplified with several assumptions, implying that there could be rivalling solutions to ours, ultimately reducing the internal validity of the case study. Consequently, some of the complexity of distribution is not caught in the transportation model itself. However, as the model seeks to investigate the broader picture of global distribution, dividing into regions was perceived as a reasonable assumption for the management of NHST as well. Moreover, our assumptions are based upon the causality between the print and distribution processes, thus the model is built around standardised inputs from the printing analysis.

5. Analyses and discussion

"In a rapidly changing world with constant shifts in the business cycle, a daily newspaper can't rest on yesterday's laurels. New printing techniques and distribution routines call for the paper to adapt" (Møst, 2015 p.239).

In line with this statement, the analyses seeks to investigate components driving the costs of print and distribution, and how it can be reduced. The cost of significance is the total cost which is expressed by the following components:

$$Total\ cost = Cost\ of\ print + Cost\ of\ Distribution + \Delta\ Exchange\ rate$$

In the first section we will analyse the print costs in depth. For the first part, we will apply econometric modelling techniques in order to estimate the cost of print and investigate the marginal effects of changing the cost drivers. These estimates will later be applied as input in the distribution analysis.

In the second part we will introduce a modified transportation model and apply linear programming technique for minimization of total distribution cost. The total cost of distribution consists of transportation and packaging and we seek to reduce it through more efficient choice of delivery and packaging solutions.

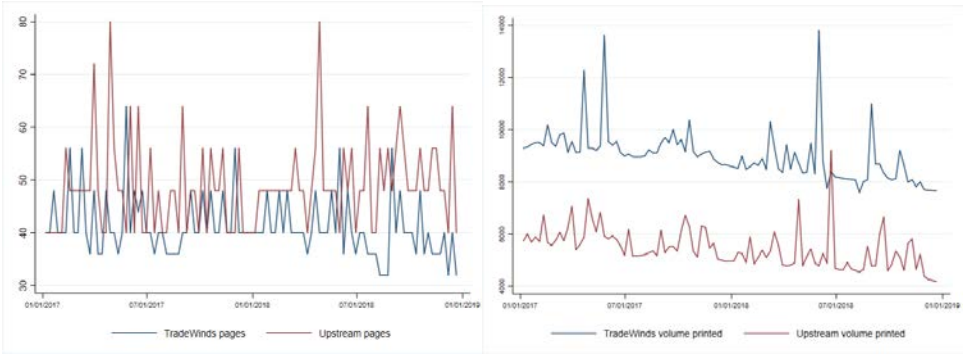
Further on, we will introduce sensitivity analysis, as suggested by Wooldridge (2016, p. 613). We will model exchange rates as the main parameter in order to modify our results and investigate how foreign currency impacts the financial performance of the supply chain.

5.1 Print cost analysis

This analysis will investigate the cost structure of printing and suggest improvement initiatives. The objective of this analysis is to highlight how deviations in the cost drivers of printing impacts the overall cost.

The quantity printed and the number of pages varies over time, in regard to events and conferences. This implies that the quantity printed will result in certain spikes and deviate from the initial demand, resulting in outliers of extreme quantity printed (Graph 3).These

spikes ultimately add to the cost of printing and thus by setting forth constraints for the cost drivers the cost could be reduced.



Graph 3 - *Total pages and quantity for TradeWinds and Upstream (2017-2018)*

Similarly, we expect that if we allow for standardisation the printing cost would ultimately be reduced and NHST would acquire more predictable cost streams. In return, this would have a positive impact on the financial performance. However, in order to obtain an estimate for a standardised newspaper, several assumptions will be taken into consideration.

5.1.1 Assumptions

For analytical purpose, we assume that all products can be printed on the same day (Wednesday), if this assumption is violated the newspapers have to be stored, resulting in coherent holding costs.

The number of subscribers is assumed to be constant in the short term, but will fluctuate in the longer term. This assumption is plausible because the newspapers maintains strong reputation and brand loyalty with a relative static subscriber base (NHST Global Publications, 2018). Furthermore, this allows us to model the demand as relatively constant over one year, as we assume that demand equals subscribers.

We also assume that the decisions regarding costs will not have an impact on the revenue, thus we allow for changes in the cost structure while holding all else constant. This assumption is based upon the rationale where NHST would increase the price if number of subscribers' falls in order to maintain a stable income base (Collins, Olson & Furey, 2009). As a consequence, a corresponding reduction in cost would result in enhanced financial performance, ceteris paribus.

Further, the heterogeneity between the newspapers is provided by the pages variable which essentially explains the difference between all newspapers. In practice, this implies that several components are aggregated into this particular variable, as previously defined as quality. Consequently, "pages" would therefore take up four different outcomes depending on the different quality among newspapers. As a result, this variable is generating the price differences implicitly in the regression, without the need to use additional binary variables to account for heterogeneity in quality. We therefore assume that quality remains constant within each newspaper.

5.1.2 Print cost estimation

On the basis of the assumptions above, we run OLS regressions in order get a holistic view of the printing process to obtain an expression on the cost structure of the printing- and distribution processes (Appendix 5). Consequently, all models are monitored in the case of possible violation of the Gauss Markov assumptions. We run regressions in order to get a holistic view of the printing process and investigate the causality between print and distribution.

In order to model an expression for the print cost we are taking into consideration relevant variables that have a direct impact on the cost of print. Because NHST can adjust the material costs directly by choosing the number of pages and the volume printed, we model this into the baseline regression.

In general, we expect a linear relationship, where an increase in pages and volume would translate in a coherent increase in the printing cost. Thus, we believe that multiple linear regression is a feasible model for estimation of print cost and model misspecification tests confirm our hypothesis.

The total print cost for the respective newspaper (i = TradeWinds, Upstream...) is representing the overall cost of printing. The explanatory variables are given as number of pages printed (p) with a coefficient (β) and volume printed (v) with a coefficient (η). The total printing cost of newspaper i, is given by the following multiple linear regression:

$$Total\ printing\ cost\ for\ newspaper_i = \alpha + \beta p_i + \eta v_i + \varepsilon_i$$

VARIABLES	(1) TW Printcost	(2) UP Printcost	(3) RE Printcost	(4) RE Printcost	(5) IFM Printcost	(6) IFF Printcost	(7) IFA Printcost
Volume	0.132***	0.126***	-		1.883	0.0540	-0.776
	(0.0176)	(0.00804)			(0)	(0.106)	(0)
Pages	13.31***	16.63***	39.20		-103.7	-49.15	216.3
	(2.662)	(0.958)	(0)		(0)	(33.73)	(0)
t	-0.0858	-0.00731	-0	-0	1.593	0.719	-3.082
	(0.0673)	(0.0411)	(0)	(0)	(0)	(0.663)	(0)
Total pages				0.0131			
Constant	1,743	85.64	354.4	354.4	-34,230	-12,321	62,158
	(1,491)	(827.7)	(0)	(0)	(0)	(14,824)	(0)
n	102	102	5	5	4	12	4
R^2	0.735	0.905	1.000	1.000	1.000	0.504	1.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The explanatory power of the estimations is measured by the adjusted R-squared. As follows, the regressions for TradeWinds explains 0,735 (73,5%) of the printing costs, whereas Upstream yields 0,905 (90,5%) indicating that both pages and quantity is able to explain a substantial amount of the variation in the printing cost. The outputs for Recharge and Intrafish are not significant, and therefore not noteworthy, but included in the table for a general overview.

As evident in the table, only TradeWinds and Upstream has significant coefficients for pages and volume (p<0,01), whereas Upstream is regressed with robust standard errors. For TradeWinds and Upstream, the coefficients for volume and pages are both positive. As expected, is the coefficient for pages greater than the one of volume, this seems reasonably because increasing volume by one, is significantly cheaper than adding a page for every newspaper printed. A unit increase in volume increases the total printing cost of TradeWinds or Upstream by £0,132 or £0,126. In addition, one more added page increases the total cost of £13,31 or £16,63. These results suggest that NHST should focus on the number of pages, because it has a greater magnitude on the printing costs than the volume, all else equal. Thus, standardisation of page number is expected to yield a solution with smaller amounts of costs.

When modelling Recharge, we encountered problems in regard to multicollinearity. Thus, instead of omitting the constant term we generate an interaction term of total pages (pages*volume) to account for the collinearity problem. However, due to small number of observations for both of these newspapers, we cannot predict the printing cost explicitly

through OLS. Consequently, the justification of the possible cost reductions of these newspapers are primarily based upon qualitative reasoning.

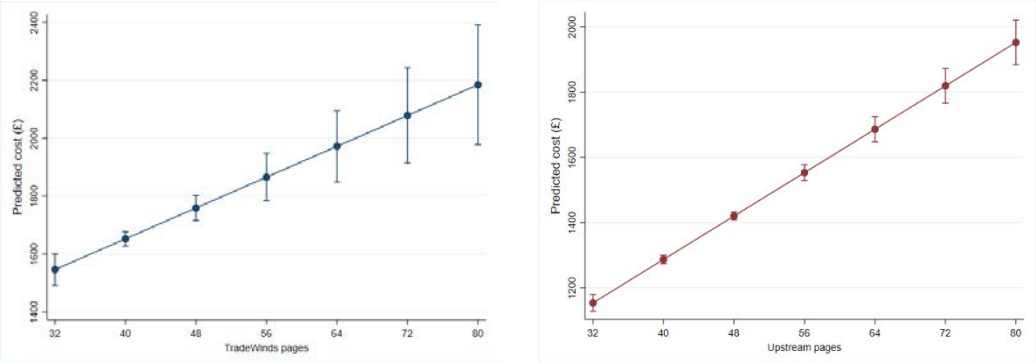
5.1.3 Marginal effects

We investigate the marginal effects of the printed pages and quantity on the total printing cost. A marginal effect or partial effect measures the effect on y of a change in one of the explanatory variables, x. In addition, margins allow for the marginal prediction of the dependent variable, if we constrain the independent variables by a certain number (Williams, 2011). Thus, margins allows us to investigate how we can influence the cost by adjusting the page number and the volume printed. Furthermore, by introducing margins it allows for precise prediction of the cost with corresponding confidence intervals of 95%.

$$\frac{\partial y}{\partial x} = \frac{\partial Printing\ cost}{\partial Pages} \qquad \frac{\partial y}{\partial x} = \frac{\partial Printing\ cost}{\partial Quantity}$$

For the purpose of running marginal analysis, we exclude the insignificant regressions of Recharge and Intrafish as we cannot with certainty predict these effects. The marginal effect of TradeWinds and Upstream are given as £1668.65 and £1433.23 respectively (Appendix 6.1). Where this number is based upon the assumption of the current printing process. Due to the fact that pages and volume printed typically drives the cost of printing upwards, a reduction is made possible by constraining both pages and quantity in order to obtain a desirable result.

First, we investigate the impact of constraining the number of pages by the rule-of-eight, because this is said to provide efficient printing pagination, and has a greater magnitude on the total costs (Hansen, H. 2019, February 26). Henceforth, the feasible range of pages are based upon the efficient printing solutions. Likewise, we expect that more efficient solutions would ultimately reduce the amount of printing cost. Regardless of volume, the marginal effects will indicate the number of pages that results in the most predictable printing cost under different page schemes.



Graph 4 - *Plot of predicted margins with 95% CIs under page constraints*

The margins plots illustrate the coherent costs of printing a newspaper restricted to a specific number of pages. Moreover, by constraining the page numbers, the costs are likely to change with the respective confidence intervals as shown in the plot. As depicted by the confidence intervals in the plots, Upstream yields more predictable printing costs on average. Whereas TradeWinds experiences more uncertainty when constraining the pages. Moreover, the margins plots states that the feasible solution is a page number of either 40 (£1652,47) (TradeWinds) or 48 (£1420,18) (Upstream). In addition, the margins plots depict strong support for 40 pages for TradeWinds, but for Upstream it seems to be either 40 or 48 pages. However, the marginal effects indicate that 48 pages is slightly in favour in terms of predictability, yielding a smaller standard deviation (Appendix 6.2).

Regardless of volume produced, this solution yields the most predictable printing cost with 95% confidence. In addition, even though 32 pages yields lower costs in general, 40 and 48 pages allows for more content creation. In return, these solutions set the foundation of more content value for the subscribers, due to more pages for advertising spots, and thereby increased revenues and ultimately better financial performance (all else equal). In addition, it also allows for better predictability in terms of monitoring the printing cost.

Furthermore, because the demand of newspapers is known, we can constrain volume in order to predict the weekly marginal printing costs. To account for internal and external security copies we adjust the volume up by 6% (Appendix 2). Consequently, the initial supply of newspapers is adjusted to 7238 for TradeWinds, and 4001 for Upstream respectively. The same adjustments are undergone for Recharge and the newspapers of Intrafish as well, but the marginal analyses are not conducted because of insignificant regression results. Henceforth, the feasible solution is presented in the table below.

	TradeWinds	Upstream
VARIABLES	margins	margins
40 pages 7238 volume	1,417*** (31.87)	
48 Pages 4001 volume		1,235*** (9.989)
n	102	102
Conf.int (95%)	[1353.58, 1480.07]	[1215.01, 1254.66]

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The new solution yields the following weekly printing costs for TradeWinds of £1416,83, and Upstream of £1234,84. According to these marginal effects, the predicted printing costs for TradeWinds would range between £1353,58 to £1480,07. For Upstream this cost would range between £1215,01 and £1254,66. Consequently, margins allow for a comprehensive analysis of how constraining the cost drivers of pages and quantity can ultimately result in more predictable streams of costs, and potentially enhance the financial performance.

5.1.4 Print cost discussion

The marginal analysis justifies the rationale behind standardisation in order to reduce- and achieve more predictable print costs. Moreover, both qualitative and quantitative reasons are in favour of standardisation in term of size and volume. It follows that, by obtaining more standardised products, NHST can reduce operational complexities in the printing process, and allow for more predictable flows of costs, while simultaneously maintaining the required quality (Perera et al., 1999). Thus, standardisation allows for enhanced financial performance while relaxing variations and complexities in the printing process

In regard to volume, both qualitative and quantitative reasons argue for a more strategic approach when choosing the correct amount of the quantity produced. With a higher engagement to increase digital acquisition of new subscribers and digital customers provide ten times more valuable data (NHST Global Publications, 2018) it is unreasonable to incur additional printing costs in regard to printing free newspapers. It is relative difficult to attract new subscribers within the printed segment. Consequently, marketing efforts through events is considered to be an unnecessary measure, which ultimately leads to excessive costs. Not just because the cost is substantial, but because the effects of the measures are unknown (Førde, G. 2019, March 22). Thus, the base will still be numbers of subscribers, but adjusted

upwards to include internal office copies and replacement copies. This approach allows for a closer approximation to the feasible cost of printing, and the extra copies would reflect the customer base and not merely random number. Indeed, as Møst (2015) argues, one of the main reasons why the organisation have remained profitable is due to caution of giving away free content.

Furthermore, NHST has stated that it seeks to deliver the best possible content for its subscribers. This implies maximization of content value for the target subscriber base. By reducing the number of pages, NHST can tailor its content within the standardised number of pages, while concentrating on content creation, and thus control the operating costs of print.

In addition, standardisation of products can also affect other operational costs, especially labour cost related journalism. It is reasonable to assume that larger publications require more amount of time to create the content, than smaller publications. A reduction of size could therefore implicitly result in a reduction of labour cost for journalism. This is in line with Perera et al. (1999) specifying that a reduction in material variety contribute to reduced labour costs. Thus, a size reduction will possibly reduce the annual labour cost, or at least result in less variability related journalism.

TradeWinds

As explained above, standardisation of page numbers allows for more predictable print cost. Both qualitative and quantitative reasons imply today's average of 40 pages should be the target. From the analysis 40 pages gives most predictable cost regardless volume. Constraining volume will result in a less printing cost on average (£ 1416,83 vs £ 1577,62) and considered to be an effective solution by the rule-of-eight. In addition, content analysis shows that NHST have 75% ability to produce 40 pages every week, which makes it possible to focus on quality rather than quantity (Appendix 7). NHST want to use 40 pages and has chosen this solution 65% of the time when the rule-of-eight is applied (52% otherwise) (Appendix 7) Thus, constraining size and volume would have reduced the printing costs by NOK 89.243,63 in 2018

Upstream

In order to achieve more predictable print cost, NHST should seek standardisation. Both qualitative and quantitative reasons imply today's average of 48 pages should be the target. From the analysis 48 pages gives most predictable cost regardless of volume. Thus,

constraining volume will result in a lower printing cost on average (£1433,23 vs £1234,84) and according to the rule-of-eight, a feasible solution. Furthermore, they have 70% ability to produce 48 pages every week, which makes it possible to focus on quality rather than quantity (Appendix 7). NHST want to use 40 pages and this is chosen 43% of the times with the rule-of-eight always applied (Appendix 7). Finally constraining size and volume would reduce the printing costs by NOK 96.687,70 in 2018.

Recharge

To achieve more predictable print cost, NHST want to standardise size. Qualitative and some quantitative reasons imply a reduction of today's average and have a target of 64 pages. They have 100% ability to produce content over 64 pages every time (Appendix 7) and reducing the average page size allows for extensive focus on quality rather than quantity (NHST Global Publications, 2018). NHST want to use a size of 64 pages and previously used ineffective solutions. The sample size of the analysis is too small to draw valid conclusions in terms of cost reductions.

On the other hand, the average cost per page regardless of page size is relative stable (£0,0148), which implies a reduction in number of pages will reduce the printing cost. There are currently no signs of economies of scale and will it will probably not occur when reducing volume by ⅔. Furthermore, considering the fact that the subscriber mass consists of 584 paying, while 523 are free, opens up for further cost reductions. We argue that one way to address this situation is to tailor the subscriptions so that the printed newspaper is limited to only paying subscribers, whereas the free subscribers could potentially have their subscriptions adjusted to merely digital

Intrafish

To achieve more predictable print cost NHST want to standardise size. Qualitative and some quantitative reasons imply a target of 32 pages for all Intrafish newspapers. For Marketplace and Aquaculture this implies reducing the average, which makes it possible to focus on quality rather than quantity. Their ability to produce content over 32 pages is 100% (Marketplace), 92% (Fisheries) and 100% (Aquaculture) every time they publish (Appendix 7). NHST want to use 32 pages and given the rule-of-eight Marketplace have used this 67% of the times (50% otherwise), Fisheries have used this 100% of the times (75% otherwise) and Aquaculture have used this 33% of the times (25% otherwise) (Appendix 6). The sample size of the analysis is too small to draw valid conclusions in terms of reduction in cost.

Likewise, for Marketplace there are some indications in the data that implies a standardisation would reduce total printing cost. Regardless of size and volume the average cost per page remains relatively constant (£0,018), which implies a reduction in number of pages or volume would reduce the printing cost (Print cost 2018).

Currently, there are no signs of economies of scale and we expect that this will remain as we continue to produce the same quantity. For Fisheries, the cost per page is fluctuating more from the average, due to variation in number of pages and volume. There are indications of potential economic of scale, but due to the fact that they only have 80 subscribers makes it reasonable to doubt that this will be the case in the future. The average price per page would probably be higher, but the total printing cost reduced when reducing volume by 93% on average.

For Aquaculture, the cost per page is also fluctuating from the average, due to variation in number of pages and volume. Moreover, this publication also shows signs of economies of scale (more total pages printed reduce the cost per page), but the fact that only have 206 subscribers implies a higher cost per page and a reduction in total printing cost would most likely occur when reducing volume by 94% on average. For Fisheries and Aquaculture, it is plausible to ask the question whether these newspapers should be printed at all, or whether they should adapt to solely digital solutions, with respect to the relative low number of subscribers.

Newspaper				**Average per newspaper**	
	Standard quality	Standard volume	Standard pages	Weight (grams)	Cost (£)
TradeWinds	*45 grams News Blue*	7238	40	123	0,20
Upstream	*45 grams Financial Pink*	4001	48	148	0,31
Recharge	*90 grams Finesse Matt*	1174	64	137	2,68
Marketplace	*65 grams Near Woodfree Gloss*	4494	32	151	0,49
Fisheries		85			17,61
Aquaculture		219			7,08

Table 4 - *Publications quality standard and related size/cost*

5.1.5 Print cost results

By implementing standard editions, the total cost of print would be reduced by NOK 185.931,33 in 2018 (Table 5) and in addition become more predictable. As a result, the weekly

variation will only occur through exchange rate fluctuations which will later be addressed. The table below summarize the magnitude of standardising pages and constraining the quantity with the predicted values from marginal effects. In practice, this provides us with the "as if" cost of 2018, adjusted for the currency effects for the coherent time period to provide an illustration on how the costs could have been for that respective period if standardisation scheme was implemented. Finally we propose further analyses to investigate the impact of adjusting the number of annual issues, as it is likely to yield further cost reductions.

Reduction in print cost in regard to standardised size and adjusted quantity:

Newspaper	Results					
	Print cost 2018 (NOK)	New print cost per week (£)	Issues	New print cost (NOK)	Reduction (NOK)	Certainty
TradeWinds	873.459,04	1416,83	51	784.215,41	89.234,63	95 %
Upstream	780.295,12	1234,84	51	683.607,42	96.687,70	95%
Recharge	170.759,76	N/A	5	170.759,76	0	N/A
Marketplace	95.317,90	N/A	4	95.317,90	0	N/A
Fisheries	194.804,28	N/A	12	194.804,28	0	N/A
Aquaculture	67.111,53	N/A	4	67.111,53	0	N/A
Total	**2.181.747,62**		**127**	**1.995.816,29**	**185.931,33**	**95%**

Table 5 - *Results given standardised size and volume*

5.2 Distribution cost analysis

The following section provides an in-depth analysis of the distribution cost. Scenarios will be addressed accordingly to investigate distribution through linear programming (LP) using an unbalanced multi-product transportation model. Building on the print analysis, the distribution analysis seeks to investigate possible ways to enhance the coordination and allocation of delivery among the different newspapers, and thus minimize the total distribution cost measured as total distribution- and packaging cost.

The cost of distribution is assumed to be total cost of transporting the newspapers directly from London to the five respective regions; Asia (AS), Europe (EU), America (AM), the Middle-East (ME) and Africa (AF). The distribution methods are through post-only, or via hubs and then distributed with an agent through post or hand delivery. The network diagram below (Figure 9) portrays the transportation flow of newspapers. Notice that the African region only offers post deliveries.

In addition, the choice of distribution method decides the cost of packaging. How NHST decide to send the products will affect the process of allocation and cost of packaging. Together they add up to the total distribution cost that we seek to minimize. A reduction in cost will lead to better financial performance.

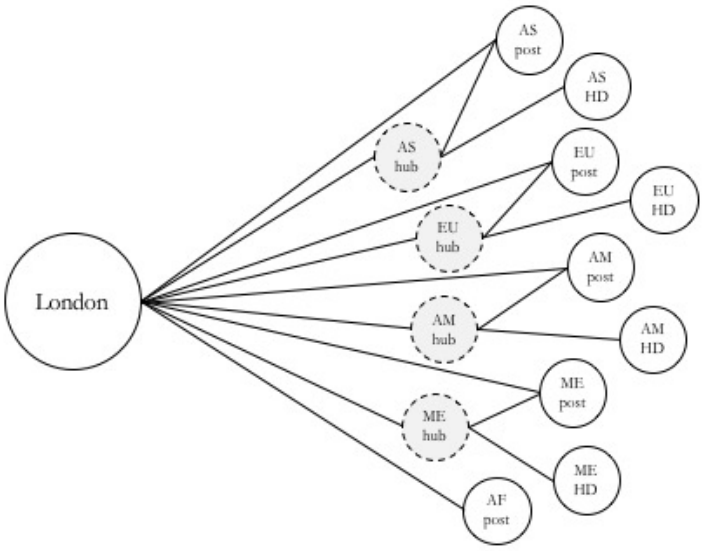


Figure 9 - *Network diagram of the transportation flow of newspapers*

Today, only TradeWinds and Upstream have coordinated delivery schedule, whereas the rest of the newspapers are printed and distributed randomly. This results in excessive distribution costs due to more frequent delivery dates and less bulk of newspapers being sent every time. Henceforth, we expect that coordination of deliveries and sending more newspaper in bulk could potentially reduce the total distribution cost.

The supply of newspapers (Table 6) is greater than the actual demand of the subscribers to account for internal and external security copies. The excessive supply of newspapers creates an unbalanced transportation problem, where the total supply is not equal to the total demand of all destinations. The table below depicts supply of every newspaper with corresponding demand for every region and delivery method.

Newspaper	Demand									Supply
	EU post	EU HD	AS post	AS HD	AF post	ME post	ME HD	AM post	AM HD	
TW	2098	1743	691	990	27	144	23	962	150	7238
UP	1424	286	751	91	34	103	0	1045	40	4001
RE	724	N/A	82	N/A	2	0	N/A	299	N/A	1174
IFM	2433	N/A	197	N/A	40	6	N/A	1563	N/A	4494
IFF	23	N/A	3	N/A	3	0	N/A	51	N/A	85
IFA	107	N/A	27	N/A	5	1	N/A	66	N/A	219
Total	6809	2029	1751	1081	111	254	23	3986	190	-

Table 6 - *Supply of newspaper with corresponding regional demand*

The network diagram below depicts the flow of newspapers graphically. In more detail the newspapers can be distributed through three distinctive paths: 1(A), 2(B+C), 3(B+D). The first path is considered to be the least expensive path from London to destination X. If this path is selected the cost incurred is A. The second path connects B and C and goes through the hub (Y). The cost incurred for this path is the cost of sending the newspapers from B, through the hub to the final destination of X through path C. The final path connects B and D through Y. The cost incurred for this path is the cost of transporting from B, through the hub to the final destination of Z through path D.

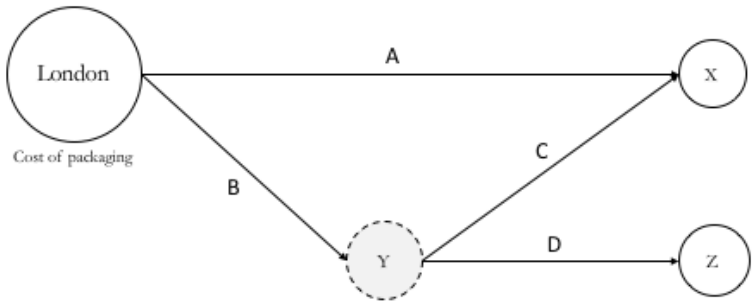


Figure 10 - *Network diagram in detail with the different paths*

A commonality for all methods is that the packaging costs are incurred in London, but the allocation of letters- and parcels are distributed directly through A or from B through a hub and towards the final destinations. This allocation is implicitly included in the model itself, and it will therefore choose the "correct" path based upon the most feasible packaging cost.

In general, the hubs could be seen as transhipment points for either post or hand delivery to the final destination. However, the model itself is modelled as an ordinary transportation model where the hub is an alternative route to post and hand delivery. In practise this implies that the newspapers flowing through the hub is doing this with an immediate effect, because

the packaging process is already done. Thus, the hub itself is only important in determining the ultimate flow of papers.

5.2.1 Assumptions

NHST outsource the process of transportation to third party logistics companies. Therefore, an understanding of the underlying assumptions behind how these third parties price their transportation services is imperative in order to investigate potential ways for NHST to reduce the cost of distribution. In order to take into account the complexity of the distribution network, several assumptions has to be made in order to run the model.

First, we assume that demand equals the number of subscribers for the different newspapers for each region. This means that the additional security copies (6%) are not part of the actual demand and excessive newspapers are stored at an office in London at no additional cost (holding cost).

Second, we assume that distribution- and postage rates is fixed on a yearly basis. This means that macroeconomic conditions will not affect prices. For instance, even though the fuel is a major variable cost component for the freight cost, it is assumed to be irrelevant for our analysis because it is irrelevant for the decision. This means that even though the fuel prices could experience sharp rise or fall, this does not play into the decision of delivering the newspapers or not.

Third, the model allows for exclusion of the extraordinary cases of distribution and delivery. While allowing for regional costs, we relax the cases of newspapers going to China, Vietnam, Philippines, Taiwan and Malaysia that are first transported to Hong Kong then relabelled with Chinese characters before transported again to a hub in China. However, in reality, this is a significant cost that should be addressed in further research.

Fourth, we assume that packaging solutions are efficient today and lead time is only affected by class of packaging, but not by the outcome of the model itself. This means that same allocation of packaging is used in practise, as in our model. This assumption needs to be met in order to have an accurate base case. In addition, the lead times will ultimately be affected by the choice of superiority in packaging methods. It follows that 2^{nd} class has a longer lead time than 1^{st} class and because some subscribers are considered to be less time sensitive.

Therefore, it is natural to include 2nd class delivery methods which is less costly (Graph 5) although the impact on lead times will not be modelled explicitly.

Fifth, we assume that all solutions are available for all destinations as we find it unreasonable to assume which countries that have underdeveloped postal systems. In practise this is problematic for some destinations alternative routes, but the model will not take this into account and treat all subscribers equally for all regions.

5.2.2 Transportation model

Let z represent the overall distribution cost, where the input variables are exogenous variables, determined outside of the model itself. Thus, the distribution cost is given by the cost of sending newspaper (i) with post-only, distribution agent or hand delivery, with the coherent packaging solution. There are cost heterogeneity for all locations, reflected by the postage in terms of number of items and the weight rates. In addition, the cost is going to vary by the delivery method used.

We will simulate three cases to illustrate cost reduction using standardised newspapers from the print cost analysis. First, the base case illustrates their current distribution strategy with standardised newspapers. Our objective is to illustrate how the standardisation of newspapers will affect the distribution cost. The difference between the real cost and the base case are fluctuations in term of size (affect rates and packaging) and volume (direct effect on distribution cost). Second, the optimized model will seek to find a more efficient allocation that will reduce the total cost of distribution. Our goal is to illustrate that a more optimal allocation will lead to an additional reduction of costs. Third, the optimized model excluding hand delivery is a proposed measurement for further cost reductions. This model moves the demand for hand delivery to post (not changing the total number of subscribers) and illustrates an optimal allocation without method 3 that can reduce cost further.

The objective function minimizes the total cost (z) of distributing newspaper i to destination j including packaging cost. The constraints stipulates that the total supply for a newspaper in the respective region must be greater or equal to the exact demand of the newspapers. For the optimized model there are in total there 38 constraints (6*5+2*4), where all 6 products can go to 5 destination (post) nodes, while only 2 products (TradeWinds & Upstream) can go to 4 destinations nodes (HD). For the optimized model without HD there are in total 30 constraints (6*5), which only include all 6 products can go to 5 destinations (post) nodes.

Variables

z	Total distribution cost of sending newspaper (*i*) to destination (*j*).
PR_{ij}	Post routing unit cost for newspaper (*i*) to destination (*j*).
AD_{ij}	Agent distribution unit cost for newspaper (*i*) to destination (*j*).
HD_{ij}	Hand delivery unit cost for newspaper (*i*) to destination (*j*).
$Parcel_i$	Cost of using parcel (1st/2nd class) for newspaper (*i*) to destination (*j*).
$Letter_i$	Cost of using letters (1st/2nd class) for newspaper (*i*) to destination (*j*).

Decision variable

x_{ij} = Number of newspaper (*i*) to destination (*j*).

(i = 1, 2, ..., m); (j = 1, 2, ..., n)

Objective function

$$\text{Min z} = \sum_{i=1}^{m}\sum_{j=1}^{n} PR_{ij}\,x_{ij} + \sum_{i=1}^{m}\sum_{j=1}^{n} AD_{ij}\,x_{ij} + \sum_{i=1}^{m}\sum_{j=1}^{n} HD_{ij}\,x_{ij} + \sum_{i=1} Parcel_i\,x_{ij} + \sum_{i=1} Letter_i\,x_{ij}$$

Subject to

$x_{TW,EU_1} \geq EU_1$	(1)
$x_{TW,EU_2} \geq EU_2$	(2)
$x_{UP,EU_1} \geq EU_1$	(3)
.	.
.	.
.	.
$x_{ij} \geq b_j$	(38/30)

$x_{ij} \geq 0$ for all i and j

Where

i = TW (TradeWinds), UP (Upstream), RE (Recharge), IFM (Marketplace), IFF (Fisheries), IFA (Aquaculture).

j = EU1 (EU post), EU2 (EU Hand delivery), AS1 (Asia post), AS2 (Asia hand delivery), AF1 (Africa post), ME1 (Middle East post), ME2 (Middle East hand delivery), AM1 (America post), AM2 (America Hand delivery).

m = total number of newspapers (*i*) (m = 6)

n = number of final destinations (*j*) (n = 9)

Distribution rates

In order to model the transportation problem, we estimate unit costs for all delivery methods as well as the coherent regional costs reflected by the postage. Because NHST distributes to 119 countries worldwide, we simplify the network by aggregating countries into regions for several reasons. Among these are lack of data, or no data at all, to several countries forces us to predict the "best possible estimate" and merge countries into regions. The simplified model will then treat each country in a region as the same. The simplification through a region-based approach makes it more manageable and easier to monitor. In addition, it provides a good foundation for further development.

The cost structure of the rates consists mainly of a fixed cost per item plus a variable weight cost, but in some countries they only operate with the fixed cost per item. Both components are set exogenously as a decision that occur before production (print). The number of pages they choose for the newspaper will affect the weight and therefore affect the variable weight cost. This implies a positive correlation between number of pages and distribution rates.

Due to standardisation of newspapers it allows all the rates to be fixed for newspaper i to region j in our model. Based on the weight calculator of the different newspapers, a standardised number of pages makes a constant average weight per newspaper every period (Table 7). This implies that the variable weight cost is fixed for newspaper i to region j.

Newspaper	Dimensions	Average weight per page	Number of pages	Average weight per newspaper
TradeWinds	400 x 270	3,06g	40	122,47 grams
Upstream	400 x 270	3,08g	48	147,6 grams
Recharge	297 x 230	2,13g	64	136,28 grams
Marketplace Fisheries Aquaculture	297 x 230	4,71g	32	150,62 grams

Table 7 - *Weight characteristics of the newspapers*

We predict a generalized unit cost of distribution to the respective regional market. In order to predict unit cost estimates for Postage, Post Routing, Alternative Routing, Post-delivery with agent and Hand delivery with agent for all regions (j),We run simple linear regressions as a function of the newspaper sent. The estimates are based upon the assumption of standardised

newspapers with various average weights between them. Moreover, this relaxation allows us to predict the aggregated unit cost for all Intrafish newspapers. The coherent costs of 2019 have been deflated with the average inflation rate of 2018 (2,48%) in order to achieve consistency with the corresponding costs of printing (UK Inflation Calculator).

Because the unit costs vary from country to country we seek to predict the best estimate for the regional cost. Thus, the costs of newspaper i is regressed with the dummy for the corresponding region (AS, EU, AM, ME, AF).

$$Region_j = \begin{cases} 1 \; if \; region \; is \; AS, EU \ldots etc \\ 0 \; if \; not \end{cases}$$

The cost includes both the fixed and the variable component, as well as the weight differences for the newspapers. Henceforth, the following regressions are given as:

$$Rate_{ij} = Cost \; of \; newspaper_i + Region_j$$

The regression outputs for all cost parameters are provided in the appendix (Appendix 8) with corresponding significance levels ($p<0.01$). The standard deviations are relatively small for all estimates indicating that the unit costs are a viable estimate for the regional cost. However, due to a small number of observations in some regions, the cost could not be predicted directly through simple regressions. The correct estimate for these regions is assumed to be the one observation. In addition, all regions except Africa offer alternative routing with agent delivery and hand delivery.

Postage rates

The predicted postage costs includes all regions except Africa and Middle-East (Appendix 8). Small number of observations indicates that the best estimate for these regions are given by this one observation. The cost differs accordingly from paper to paper for both regions and is assumed to be £1,035 (TW), £1,247 (UP), £1,151 (RE) £1,273 (IF) in Africa. For Middle-East the cost is assumed to be £1,022 (TW), £1,208 (UP), £1,124 (RE), and £1,230 (IF). Postage cost is an additive cost that is incurred for all delivery methods.

Post routing rates and Alternative routing rates

The predicted cost of post routing is given in the appendix and includes all regions (Appendix 8). Same goes for the predicted cost of alternative routing, except Africa where alternative

routing is not offered (Appendix 8). Notice that when alternative routing is not offered both post-delivery and hand delivery is not an option.

Post-delivery with agent rates

The predicted costs of delivery with agent includes all regions except Middle-East (Appendix 8). For all regions the agents only operate with a fixed cost per unit, making an equal cost per newspaper, regardless of type. Small number of observations indicates that the best estimate for Middle-East is given by this one observation and is assumed to be £0,246 per unit, regardless of which newspaper they send.

Hand Delivery (HD) with agent rates

The predicted cost of hand delivery with agent includes all regions except Middle-East and America (Appendix 8). Small number of observations indicates that the best estimate for these regions are given by the one observation. In Middle-East the cost differs accordingly from paper to paper and is assumed to be £3,321 (TW), £3,403 (UP), £3,366 (RE) £3,413 (IF). In America the agents only operate with a fixed cost per unit, making an equal cost per newspaper, regardless of type. The cost for this region is assumed to be £1,369 per unit, regardless of which newspaper they send.

All unit costs will ultimately vary by the chosen delivery method and all methods incur regional postage cost. As shown in the table below the rates can be added together to create the regional unit cost for newspaper i to region j.

Method	Corresponding rates
Post routing	Post routing + Postage
Alternative routing with post delivery	Alternative routing + Post with agent + Postage
Alternative routing with hand delivery	Alternative routing + Hand delivery with agent+ Postage

Table 8 - *The relevant costs for the respective delivery method*

Table 9 summarize regional unit costs for all newspapers with corresponding delivery method. This is done by using the predicted rates and adding them together according to method. This makes creates a regional unit cost of sending newspaper i to region j and includes all cost related to distribute a product from London to the respective region.

Newspaper	Delivery method rates												
	EU post	EU agent	EU HD	AS post	AS agent	AS HD	AF post	ME post	ME agent	ME HD	AM post	AM agent	AM HD
TW	2,565	2,813	3,012	3,049	3,434	4,093	3,057	3,046	2,279	5,354	3,087	2,531	3,572
UP	2,773	2,984	3,228	3,384	3,742	4,469	3,465	3,429	2,608	5,765	3,432	2,851	3,892
RE	2,679	2,907	3,131	3,233	3,603	4,299	3,281	3,256	2,459	5,579	3,276	2,707	3,748
IFM	2,798	3,004	3,253	3,425	3,779	4,514	3,515	3,474	2,647	5,814	3,472	2,888	3,929
IFF	2,798	3,004	3,253	3,425	3,779	4,514	3,515	3,474	2,647	5,814	3,472	2,888	3,929
IFA	2,798	3,004	3,253	3,425	3,779	4,514	3,515	3,474	2,647	5,814	3,472	2,888	3,929

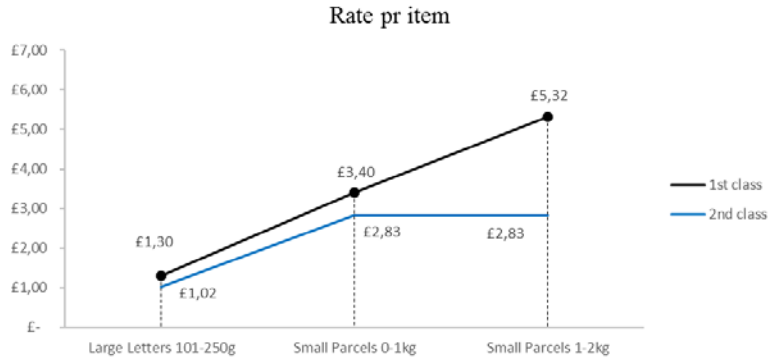
Table 9 - *Regional unit costs (in £) for all newspapers and delivery methods*

Packaging

We expand the analysis to include packaging costs and methods because it is an important cost to take into consideration when analysing optimal allocation. When it comes to packaging solutions, NHST can choose between numerous of methods that are ultimately tailored to the number of items sent with corresponding rates (deflated as cost parameters).

There are two types of packaging methods that can be used in delivery of newspapers, letters and parcels. The dimensions of the newspaper decide which type of letter and parcel that is appropriate. Today or with a standardised version the dimensions are the same qualifying for large letters and small parcels. Letters can only hold one newspaper within a limit of 250g, which is enough for any standardised newspaper. Parcels can take on two kinds of forms, whereas the first can carry 0-1 kg and the second 1-2 kg. With a standardised newspaper this implies 8 TradeWinds, 6 Upstream, 7 Recharge or 6 Intrafish for the 1 kg parcel. The 2 kg parcels can at least carry twice the amount, except for Upstream and Intrafish where they additional have room for one extra. Changing weights through number of pages will change these limits.

In addition NHST can choose between 1st - and 2nd class packaging. Moreover, this implies that packaging will have an impact on the lead times. As defined earlier TradeWinds and Upstream have more time sensitive customers and will only be using 1st class, while Recharge and Intrafish will employ 2nd class packaging. Based on this, the assumption of constant lead time will hold in the model. As seen in the graph below (Graph 5), the choice of class and method will affect packaging cost. An effective allocation of packaging will therefore minimize cost per unit.



Graph 5 - *Packaging methods with cost per item for the respective weight*

NHST can obtain the lowest cost per unit through the following allocation. Based on cost per unit the first choice should be to send as many 2 kg parcels as possible until it hit the threshold of 9 (TW), 7 (UP), 8 (RE) and 7 (IF). At this threshold it is more expensive to send one more unit with 2 kg parcel, then a combination of 1 kg parcel and letter. After reaching this level they will prefer 1 kg parcel until their threshold of 2 for every newspaper. If they are sending 1-2 they will prefer letters. This allocation of packaging is included in the model taking an effective allocation and use of packaging solutions.

5.2.3 Optimization results

Base case

Newspaper	Delivery method													Total
	EU post	EU agent	EU HD	AS post	AS agent	AS HD	AF post	ME post	ME agent	ME HD	AM post	AM agent	AM HD	
TW	0	2098	1743	0	691	990	27	0	144	23	0	962	150	6828
UP	0	1424	286	0	751	91	34	0	103	0	0	1045	40	3774
RE	724	0	0	82	0	0	2	0	0	0	299	0	0	1107
IFM	2433	0	0	197	0	0	40	6	0	0	1563	0	0	4239
IFF	23	0	0	3	0	0	3	0	0	0	51	0	0	80
IFA	107	0	0	27	0	0	5	1	0	0	66	0	0	206
Total	3287	3522	2029	309	1442	1081	111	7	247	23	1979	2007	190	16234

Table 10 - *Base case product allocation*

Newspaper	Total Distribution cost each time sent			2018	
	Distribution	Packaging	Total	Frequency	Annual cost
TradeWinds	21.081,32	2.275,72	23.357,04	51	1.191.209,12
Upstream	11.911,07	1.550,90	13.461,97	51	686.560,34
Recharge	3.190,79	228,44	3.419,23	5	17.096,14
Marketplace	13.070,44	930,51	14.000,95	4	56.003,80
Fisheries	262,25	22,64	284,89	12	3.418,63
Aquaculture	642,06	51,17	693,23	4	2,772,93
Total	50.157,92	5.059,38	55.217,30		1.957.060,96

Table 11 - *Base case distribution cost*

The base case considers distribution of a standardised newspaper with the current distribution strategy of NHST. As evident in table 10, their current strategy is to distribute TradeWinds and Upstream with agents through hubs because the current subscribers depend on these solutions. On the other hand, Recharge and Intrafish are sent with post only. The total distribution cost yields £1.957.060,96 (NOK 21.239.764,40 from Table 16) which is a reduction of 13,95% from the real distribution cost of 2018 (NOK 24.684.274,16).

The difference between the real distribution cost and base case is due to fluctuations in number of pages and volume sent between the papers. The main outliers in the dataset would therefore affect the total distribution cost. For instance; one week TradeWinds used 56 pages and a volume of 13.816, which is 6.988 more than demanded. Compared with the base case this page number would increase weights and distribution rates (Appendix 9). Additional weight would also affect packaging, resulting in less products fit one parcel. Increased volume would initially increase the cost, but higher rates and packaging cost further increase the total distribution cost. To illustrate these differences we have simulated the main outliers for every newspaper, but we are not able to simulate a base case with these parameters because the allocation of the excessive volume is unknown. Therefore, our findings state that standardised volume will have the greatest effects on total distribution cost.

Not surprisingly are TradeWinds and Upstream the largest drivers of the annual distribution cost due to high number of demand, frequency and 1st class packaging, with a share of 60,8% and 35,1% respectively. More surprisingly is it that Marketplace have increased annual cost and a higher distribution cost than Upstream each time it is produced. This could be explained by increase in volume and higher rates, since they are now producing to all subscribers which is more than Upstream. A heavier product leads to higher rates and some countries the post rates are more expensive than using an agent through a hub (ME). On the other hand, their packaging cost is low compared to TradeWinds and Upstream due 2nd class distribution. Annually Marketplace only stands for 2,9% of the total distribution cost due to low frequency.

The main findings in base case is the positive impact standardisation of newspapers have on the total distribution cost as opposed to the real case with fluctuations. We witness a reduction in distribution cost for all papers, except Marketplace. In addition, the volume has the greatest impact on total distribution cost, making it the main cost driver for distribution, while number of pages has the greatest impact on distribution rates and packaging options. But there are still several drawbacks of the current strategies that need to be investigated further.

Optimized model

Newspaper	Delivery method													Total
	EU post	EU agent	EU HD	AS post	AS agent	AS HD	AF post	ME post	ME agent	ME HD	AM post	AM agent	AM HD	
TW	1287	811	1743	691	0	990	27	0	144	23	0	962	150	6828
UP	908	516	286	722	29	91	34	0	103	0	0	1045	40	3774
RE	556	168	0	82	0	0	2	0	0	0	0	299	0	1107
IFM	1427	1006	0	196	1	0	40	0	6	0	208	1355	0	4239
IFF	23	0	0	3	0	0	3	0	0	0	0	51	0	80
IFA	107	0	0	27	0	0	5	0	1	0	0	66	0	206
Total	4308	2501	2029	1721	30	1081	111	0	254	23	208	3778	190	16234

Table 12 - *Optimized deliveries*

Newspaper	Total Distribution cost each time sent			2018	
	Distribution	Packaging	Total	Frequency	Annual cost
TradeWinds	20.496,05	2.279,92	22.775,97	51	1.161.574,62
Upstream	11.461,00	1.554,30	13.015,30	51	663.780,55
Recharge	3.058,94	228,44	3.287,38	5	16.436,89
Marketplace	12.482,41	931,30	13.413,71	4	53.654, 83
Fisheries	232,48	22,64	255,12	12	3.061,41
Aquaculture	602,71	51,17	653,88	4	2.615,52
Total	48.333,59	5.067,77	53.401,36		1.901.123,82

Table 13 - *Optimized cost allocations*

Solving the LP model, the minimum cost flows are achieved through more efficient allocation between the delivery methods with corresponding packaging solutions. The optimal solution reduces the annual cost by 2,86% from base case and yields a total distribution cost of £1.901.123,82. The total distribution cost each time a newspaper is sent is reduced for all newspapers. This cost reduction is the consequence of better consolidation between delivery alternatives, even though the exploitation of better allocation strategies does not change or drives up the cost of packaging.

When allowing for the minimum cost path, the table (Table 12) depicts a shift of allocation between agents and post deliveries, while allocation of hand delivery is unchanged. The cost path of hand delivery only has one option, via hub, and will therefore not be able to obtain a cost reduction. In Europe and Asia there is a positive shift towards post where Asia increase their post method by 457%. Accordingly, both, Europe and Asia, reduce post-delivery and agent by 29% and 98% respectively. Lower post rates compared to post-delivery with agent rates is the main reason for this shift, especially for TradeWinds and Upstream. Recharge and Marketplace are the exception of this, due to a more balanced distribution that will reduce their total cost. Fisheries and Aquaculture remains unchanged.

On the other hand, in Middle-East and America there is a positive shift towards post-delivery with agent. In Middle-East there is a reduction of 100% due to high rates for the post method

making it completely abandon post-only deliveries. In America there is a reduction of 89% and as a consequence all papers abandon this solution except Marketplace. The reason behind this shift is because a more balanced approach is less costly. Accordingly, both the Middle East and America increase post-delivery with agent by 3% and 88% respectively. Only a fixed rate per item contributing to lower rates and is the main reason for this shift. Moreover, the optimal allocation disallows to send more than demand, since cost minimization stipulates excess shipments as wastage. Thus, the feasible solution is distribution to the exact demand.

Compared to base case an optimal allocation reduce cost annually for TradeWinds by 2,49%, which result in a cost reduction of £587,24 each time, making the greatest annual reduction of £29.634,50 due to relative high frequency. Upstream is reduced by 3,32% which results in a cost reduction of £446,66 each time newspapers are dispatched, resulting in an annual reduction of £22.779,79. Recharge is reduced by 3,86% which results in a cost reduction of £131,85 each time and an annual reduction of £659,25. Marketplace is reduced by 4,19% resulting in the greatest cost reduction each time of £587,24, but due to relative low frequency an annual reduction of only £2.348,96. Fisheries have the greatest relative reduction of 10,45%, but due to low volume the reduction only amounts to £29,77 each time and as a result of relative low frequency the annual reduction accounts to £357,22. Aquaculture is reduced by 5,68% implying a cost reduction of £39,35 and an annual reduction of £157,40.

The main findings in the optimized model is the positive impact optimal allocation have on the total distribution cost as opposed to base case. We witness a reduction in distribution cost for all papers. In addition, with a target to minimize the total cost, we witness an evasion of expensive choice of paths and it’s not deemed profitable to send excess supply. Even though the model allows for more efficient allocation of distribution alternatives, hand delivery might not be the most feasible method, thus we will investigate further cost reductions of excluding it.

Optimized model without hand delivery

Newspaper	Delivery method									Total
	EU post	EU agent	AS post	AS agent	AF post	ME post	ME agent	AM post	AM agent	
TW	1232	2609	1223	458	27	0	167	64	1048	6828
UP	1055	655	768	74	34	0	103	0	1085	3774
RE	555	169	82	0	2	0	0	0	299	1107
IFM	1426	1007	194	3	40	0	6	211	1352	4239
IFF	23	0	3	0	3	0	0	0	51	80
IFA	107	0	27	0	5	0	1	0	66	206
Total	4398	4440	2297	535	111	0	277	275	3901	16234

Table 14 - *Optimized deliveries excluding HD*

Newspaper	Total Distribution cost each time sent			2018	
	Distribution	Packaging	Total	Frequency	Annual cost
TradeWinds	19.114,05	2.277,82	21.391,87	51	1.090.985,59
Upstream	11.235,83	1.554,30	12.790,13	51	652.296,52
Recharge	3.059,17	229,46	3.288,63	5	16.443,16
Marketplace	12.484,70	933,09	13.416,79	4	53.667,16
Fisheries	232,48	22,64	255,12	12	3.061,41
Aquaculture	602,71	51,17	653,88	4	2.615,52
Total	46.728,94	5.067,48	51.796,42		1.819.069,36

Table 15 - *Cost allocation excluding HD*

Hand delivery is considered to be an expensive solution of delivery and is one concise measure that we expect will have a direct effect on cost reduction. Thus, investigate potential cost efficiency gains by excluding hand delivery will affect the total distribution cost through changes in TradeWinds and Upstream, because these are the only newspapers that offers this delivery alternative. When modifying demand and solving the LP model, the final solution can be evaluated from two points of view. Either as an independent optimal solution, which is comparable to the base case, or as an extension of the optimal model to investigate further effects using the optimal model as the basis of comparison. As we seek to find a realistic measure that will reduce cost further we find the optimal model as the best pinpoint for assessment.

Excluding hand deliveries reduce the annual cost by 4,32% from the optimal solution, and yields a total distribution cost of £1.819.069,36. The main reason behind this reduction is that the distribution cost for both TradeWinds and Upstream is reduced each time they are sent.

The packaging cost is the same for Upstream, but a small reduction of £2,10 pound each time they send TradeWinds. Compared to the optimal solution an exclusion of hand delivery will reduce the cost each time, and annually for TradeWinds by 6,08% which result in a cost reduction of £1.384,10 and as a consequence an annual reduction of £70.589,04. Upstream is reduced by 1,73% which implies in a cost reduction of £225,18 every time and as a

consequence an annual reduction of £11.484,03. TradeWinds have more subscribers that demand hand delivery which make them reduce cost more than Upstream. Limit delivery paths will only affect TradeWinds and Upstream theoretical, but the total cost is also affected by rounding errors in the model for Recharge and Intrafish.

Table 14 depicts a shift of allocation between agents and post deliveries, while allocation of hand delivery is reduced by 100% in all regions. All regions have a positive shift, except post-only deliveries to Middle-East due to high rates. In Europe post-only will increase by 2%, while agent deliveries will increase by 78%. Notice that this includes TradeWinds decrease the amount of newspapers in the post only solution and deliver it with agent instead. In Asia the feasible solution suggests an increase in post by 33% and increase in agent deliveries by 1682% making the highest relative change. In Middle-East there is an increase of 9% for agents, which includes all newspapers due to still abandoned post solution as explained earlier. In America the post solution increase by 32% and agent delivery increase by 3%.

The main findings in the optimized model excluded hand delivery is the positive impact this measure have on the total distribution cost as opposed to the optimal allocation. We witness a reduction in distribution cost for both TradeWinds and Upstream. In addition, we also witness higher usage of agents than first assumed (due to rates), but with a target to minimize cost this is perceived as the most feasible solution.

Summarized results

The following table depicts the results of the different solutions annually. The results are converted to NOK with corresponding exchange rates in order to compare with real annual cost of 2018.

Newspaper	Annual cost 2018					
	Base Case		Optimized		Optimized ex. HD	
	GBP	NOK*	GBP	NOK*	GBP	NOK*
TW	1.191.209,12	12.928.122,53	1.161.574,62	12.606.501,06	1.090.985,59	11.840.402,40
UP	686.560,34	7.451.199,01	663.780,55	7.203.971,25	652.296,52	7.079.335,78
RE	17.096,14	185.664,08	16.436,89	178.504,60	16.443,16	178.572,71
IFM	56.003,80	607.641,19	53.654,83	582.154,92	53.667,16	582.288,65
IFF	3.418,63	37.120,65	3.061,41	33.241,78	3.061,41	33.241,78
IFA	2.772,93	30.016,95	2.615,52	28.313,04	2.615,52	28.313,04
Total	1.957.060,96	21.239.764,40	1.901.123,82	20.632.686,66	1.819.069,36	19.742.154,37

Table 16 - *Annual costs under different scenarios*

The real annual cost of distribution in 2018 was NOK 24.684.274,16 (Table 2). Given related exchange rates, standardisation of production and apply today's distribution strategy would

reduce the total distribution cost by NOK 3.444.507,76 (13,95% reduction). Furthermore, when we optimize the allocation of these newspapers, the costs are further reduced by NOK 607.077,37 (2,86% reduction). In addition, further cost reductions are possible through exclusion of hand deliveries. An optimal solution will reduce the cost further by NOK 890.532,28 (4,32% reduction). These findings stipulate the magnitude delivery methods has on the total cost of distribution.

5.2.4 Validation of the model

Even though the model is solvable, Williams (1999, p.106) argues that the value of an objective should be apparent in a discussion about the validation of linear programming models. Moreover, one way to test the validity is to test the model itself (Williams, 1999, p.106). Thus, several remarks can be made on the basis of the model.

The main critique of the model is that it only considers the case of a standardised newspaper. This implies that the model has to be modified in order to account for various weights and volume sent to account for other solutions. If these modifications are introduced, the model needs to be ran numerous times where the unit costs will also be affected by the modifications. Although, we adjust the base case to account for various page numbers and quantity printed, it is challenging to do these adjustments for all possible scenarios, with fluctuating pages and volume. The rationale is to explain differences between real distribution cost and base case through qualitative arguments and quantitative examples using modified rates based on outliers in dataset. We argue that the main point is to highlight the differences and causes between the real distribution cost and the base case.

The unit cost rates are solely based upon the available rates for the countries within a region. This implies that there could be deviations from the actual results, especially for the Middle East where the rates for posts are considerable, relative to regions with more observations. Even though there are more rates in reality, NHST where not able to provide us with all possible data in order to simulate a more accurate unit rate. It is also worth mentioning that the numerical differences in the simulations are due to rounding errors in the decision variables. This results in slightly deviations in the total cost and in the rows depicting the total sums. To account for these deviations, we used integers to test whether these cost differences are meaningful. In conclusion, these errors have no significant impact on the results, but it is worth mentioning nonetheless.

Henceforth, we argue that the although the model only considers standardised papers, it provides an accurate representation of the distribution process, and is applicable as a management tool in order to monitor the operating costs. Indeed, running the LP model with 49 iterations and 0 sub problems, confirms our findings with the high precision (0,000001).

5.2.5 Distribution cost discussion

The main finding in the distribution analysis is the magnitude weight and volume impose on the total costs of distribution. We can argue on the basis of our findings a positive correlation between weight and rates, as well as volume and total cost of distribution. The weight of the newspaper applies for postage, routing alternative and delivery method, except some destinations where they only operate with a fixed cost per item. In addition, the volume sent has an immediate effect on cost component as number of items sent is directly multiplied with a corresponding rate. Therefore, we conclude there is a causal relationship between print and distribution, where actions in one part has an immediate impact on the other part.

These remarks clearly exemplify the magnitude pages and quantity have on the total distribution costs and how standardisation in one part of the supply chain affects costs in another part. In our case the standardisation of newspapers will have a positive impact and reduce distribution cost, except Marketplace which increase volume. The standardisation of deliveries results in lower costs, which ultimately enhance the quality of the distribution process (Chopra, 2003), while also improves the overall financial performance of the supply chain holding all else equal (Beamon, 1998). Indeed, the simulations clearly indicate the positive impact standardisation has on the cost. This can be exemplified by the African region, where the only viable delivery method is post. Thus, the possible cost savings are solely due to more standardised formatting of newspapers.

Fluctuations in form of weight and volume also implies less predictability of distribution costs and makes it harder to retain the financial performance as the costs are fluctuating weekly. These fluctuations will also affect the packaging costs and solutions. Weight and volume will affect the amount of parcels and letters used, but weight an increase in weight will also change the amount newspapers in one parcel. Standardisation of weight and volume makes this cost more predictable.

As we argue that volume is the major cost driver of distribution, and NHST produce- and distributes a substantial amount of newspapers to free subscribers, this impose significant cost

increases. Thus, in order to justify the additional supply of newspapers, we argue that NHST should evaluate the ultimate value these subscribers adds to the overall financial performance.

However, because we do not know the numerical impact of these subscribers in isolation, we are not able to quantify the financial effect of supplying them with physical newspapers. Moreover, because they ultimately add to the total costs of print- and distribution, NHST should consider offering digital newspapers instead as a possible measure to exploit further costs reductions.

Further on, we argue that the current distribution strategy is less efficient, because it does not exploit the arbitrary possibilities of allocation and tailoring of different routing alternatives. In relation to Chen (2010), we argue that NHST should exploit the minimum possible cost route, given the same or faster delivery time. As all newspapers reduce cost through optimal allocation this implies their current distribution strategy is not efficient for any newspaper. In regard to cost we can therefore argue that the optimal allocation is a better alternative for distribution. The optimal scenario stipulates the possible cost reductions for all newspapers by setting applying a more opportunistic selection- and allocation of routes and delivery methods. NHST is therefore able to extract further cost gains by exploiting these potentials in combination with standardised newspapers.

In addition, excessive supply arguably drives up the total cost of distribution. As the optimal model is able to send more than demand the feasible solution avoids sending excessive supply as it seek to minimize cost. This excessive supply will only affect the total print cost and the LP model will address this as waste. We support the model and argue that excessive supply only results in increased cost and is likely to have a negative impact on the financial performance.

The excessive supply cannot be justified because the cost of producing and distributing is not compensated with the attraction of new subscribers, as the effects of marketing efforts is not quantified. Moreover, their strategy suggests an adaptation toward digital solutions and argues for a balanced distribution model with the excessive supply stored in London.

Furthermore, it is clear that hand delivery imposes significant effects on distribution cost, but there could be certain drawbacks of excluding it. This will have an immediate positive impact on the cash flow, reducing the total cost of distribution, and this amount could be used in strategic digitalisation efforts instead. For instance, investing in measures that could enhance

the content quality and thereby add value to the final customers over a longer term. On the other hand, it could result in incremental reduction of the service levels, due to the value it adds to the final customers. Excluding hand delivery might therefore not be a feasible solution with respect to the customers that value this solution of delivery.

However, considering the significant costs it imposes, NHST should evaluate the importance- and the value it adds to the customers, and whether this value compensates for the increased costs of using hand delivery. In other words, they should reflect on their willingness to reduce the marginal value of hand delivery with respect to the associated costs. Thus, although totally abandoning hand delivery might be difficult in practice, we argue from a cost saving perspective that downgrading to alternative delivery methods will improve financial performance.

5.3 Exchange rate sensitivity

It follows that the exchange rate can lead to a change in the expected cash flow and it is necessary to consider this factor and the uncertainty in several directions. A sensitivity analysis is a suitable method to investigate uncertainties around the basic assumptions (Bøhren & Gjærum, 2009).

The following section will therefore simulate how fluctuations of foreign currency will impact the overall cost and thereby have an impact on the financial performance. The model builds on results from the former analyses and investigate as-if scenarios for various movements in the exchange rate. The rationale behind this analysis is to provide the management in NHST with an understanding of how the currency risk of their foreign operations ultimately affects the cost.

NHST operates globally and is exposed to the risk of fluctuating currencies, especially in transactions, but also in terms of the print and distribution processes which could result in increased or decreased cost. NHST evaluates its exposure to different types of currencies, and whether hedging is deemed necessary. Following this reasoning, they are more likely to enter into forward contracts for greater currency positions which is uncovered. However, as of today, no such contractual obligation is initiated in regard to the GBP/NOK rate. Consequently, NHST expect that the fluctuations in exchange rates and the coherent losses would eventually be offset by the gain annually. In addition, there is a consensus that the

organization should not initiate speculative actions but follow a proactive approach to the exchange rate. In regards to these arguments there are currently no strategic approach towards the exchange rate fluctuations for print and distribution costs.

As the model is built on results from the former analyses we use the frequent print- and distribution costs in order to simulate the different scenarios. Henceforth, we use the standardised print cost estimates, as well as the minimised distribution cost obtained from the optimal distribution allocation as our inputs. The rationale behind these actions is that we want to investigate the impact exchange rates has on the already reduced costs in order to highlight the fact that there are still considerable operating costs. The adjusted total costs in NOK for newspaper i can be expressed as:

$$Total\ cost\ NOK_i = Total\ cost\ GBP_i \times Change\ in\ GBP/NOK$$

5.3.1 Assumptions

In order to simulate different scenarios, several assumptions have to be made. We assume that we only change one variable and keep everything else constant. Since we do not have any significant estimate on the standardised print cost for Recharge and Intrafish we assume the average print cost (2018) for these papers are representative cost estimates each time produced. In addition, we use monthly nominal exchange rates, and the median exchange rate quoted at 10,9 (Appendix 10) as our base case rate.

5.3.2 Sensitivity results

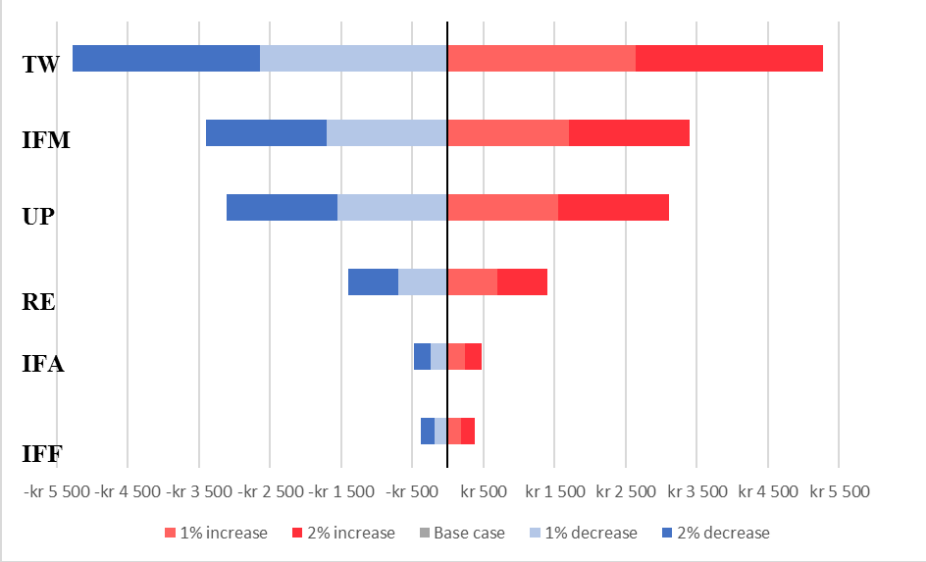
The results of the sensitivity analysis yield the total change in NOK of 14.047,19 due to a 2% change in the exchange rate. These percentages are based upon historical deviations for the monthly 2018 rates. We notice that the largest changes are contributed to TradeWinds and Marketplace, followed up by Upstream. Consequently, the scenario shows changes of NOK 5.274,03 for TradeWinds, NOK 3.401,82 for Marketplace and NOK 3.106,53 for Upstream that are costs or gains, solely due to the exposure of changes in the GBP/NOK exchange rate.

Newspaper	Total cost each time sent in GBP			Exchange rate scenarios in NOK		
	Print	Distribution	Total	Worst case (+2%)	Base case (10,9)	Best case (-2%)
TradeWinds	1.416,83	22.775,97	24.192,80	268.975,58	263.701,55	258.427,52
Upstream	1.234,84	13.015,30	14.250,14	158.433,11	155.326,58	152.220,05
Recharge	3.145,44	3.287,38	6.432,82	71.520,07	70.117,71	68.715,36
Marketplace	2.191,00	13.414,71	15.604,71	173.493,14	170.091,32	166.689,49
Fisheries	1.496,66	255,12	1.751,78	19.476,26	19.094,37	18.712,49
Aquaculture	1.550,50	653,88	2.204,38	24.508,31	24.027,75	23.547,20
Total	11.035,27	53.401,36	64.436,63	716.406,47	702.359,28	688.312,10

Table 17 - *Exchange rate scenarios and the effect on total cost*

The tornado chart below is designed to illustrate the impact of movements in exchange rates on the total costs. The advantage behind this chart is that it illustrate which newspaper that are most sensitive to changes in exchange rate each time they are produced and distributed. To be able to compare the different newspapers we are only looking at gains and losses with the same origin for all newspapers.

Moreover, there is a linear relationship which graphically identifies how sensitive the cost of each newspaper is in regard to the change in the exchange rate. The linear relationship can be explained by the notion of an equal outcome from appreciation as depreciation. The width explains sensitivity, whereas the wider implies a more sensitive total cost. The chart depicts TradeWinds, Marketplace and Upstream as the newspapers with the highest sensitivity. The rationale behind this finding is that these newspapers incur the largest one-time costs, whereas, Recharge, Aquaculture and Fisheries are less sensitive with lower corresponding cost schemes.



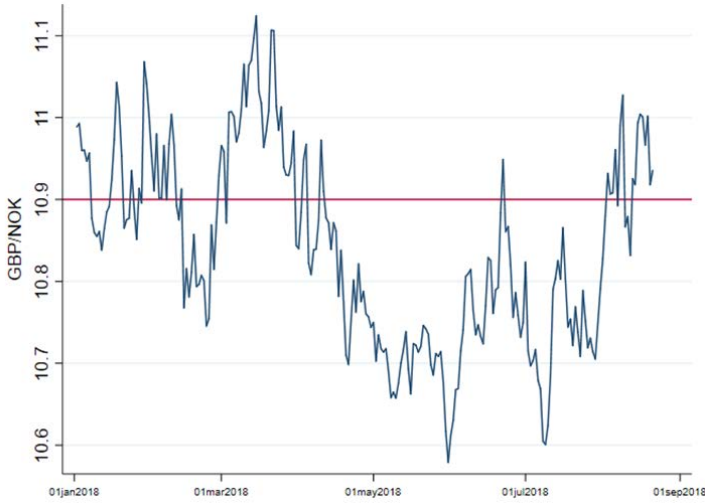
Graph 6 - *Tornado chart of the loss and gains of fluctuations in exchange rates*

5.3.3 Exchange rate discussion

The results illustrate that the total cost will be affected by fluctuations in exchange rate. It is clear that exchange rates have a significant effect on the total cost and thus ultimately impacts the cash flow of operations, which can cause reductions in the balance sheet as argued by Homaifar (2004, p.217). A greater appreciation or depreciation, than best case or worst case, would affect the total gains or losses, but the relative relationship would not be affected. This implies that greater fluctuations in exchange rate will have same the sensitivity results, but greater reduction in cost. There is a possibility that the exchange rate would move outside our scenarios and affect total cost further.

We argue that standardised cost would be affected by exchange rate fluctuations but need to address the real cost of 2018. As Perera et al (1999) argues eliminating excessive product variety will reduce operating cost. This implies that a reduction of the total sum would mitigate risk of exposure and large fluctuations due to lower total cost. In addition, the standardisation would lead to a consistent sensitivity between the newspapers. The excessive product variety would not be as predictable and consistent making the newspapers change both sensitivity and costs each time produced. This implies that one newspapers could be the most sensitive one week and another the next. Standardisation will at least eliminate their volatile sensitivity and maintain the constant relationship between them.

As depicted in the tornado chart TradeWinds, Marketplace and Upstream are considered to be most sensitive newspapers with respect to the exchange rate fluctuations. The question is therefore whether these changes are profound over time, or whether the frequently losses due to appreciation of the exchange rate, can be offset by the annual gains from depreciation of the same rate. Reflecting on the notion that TradeWinds and Upstream are printed weekly, we can argue that consistent appreciation in the exchange rate over time has detrimental impact on the financial performance of NHST. In addition, the graph below (Graph 7) depicts strong volatility in the daily GBP/NOK rates. However, as seen in the graph, the appreciations in the exchange rates seems to be more or less offset by later depreciation, indicating that NHST' hypothesis could be correct. In addition, because NHST does not want to follow a speculative strategy, hedging strategies might not be a necessity.



Graph 7 - *Daily deviations from the base-case Norges Bank (01.01.18 - 01.12.18)*

We argue that Marketplace is the decisive factor due to less circulation yearly, and random issue dates. Moreover, because Marketplace is printed- and distributed four times annually, the deviations in exchange rates are likely to impact the final costs for this newspaper more than newspapers that are more frequently issued. For instance, printing- and distributing Marketplace under less favourable exchange rate regimes can be avoided through better timing of the issue.

However, there are certain drawbacks of the analysis. First of all, it only changes one variable and don't consider other effects. In practise, it is reasonable to assume that macroeconomics conditions would also affect costs of both print and distribution. Second, it does not take into account the probability of the incidents of neither appreciating, nor depreciating exchange rates. This would not only affect cost, but potential behaviour. In addition, the results weight gain and losses equally which can have same drawbacks as probabilities.

5.4 Financial performance

In the past sections, we have sought to highlight the linkage between operational practice and financial outcome. In addition, we have addressed several types of methods in order to design a more cost-efficient supply chain. Where these are a causal relationship between the cost-efficient measurements and the financial outcome.

The current environment in the newspaper industry illustrates the challenges regarding falling profitability. By addressing the cost side, NHST could be able to enhance the overall financial

performance through cost reductions, provided that our assumption of a constant revenue holds based upon the static subscription base (Collins, Olson & Furey, 2009). By introducing the measurements from the analyses, NHST is able to reduce the total cost of print and distribution by NOK 4.237.518 annually. While, keeping revenue constant, this translates to a direct enhancement of the financial performance, provided the assumptions in the previous analyses. Again, this total sum is likely to fluctuate with the exchange rates, but we can in fact conclude that the total costs will be reduced as a result of the measures implemented in print- and distribution.

Newspaper	Total results of cost reductions (NOK)						
	Print cost 2018	Distribution cost 2018	Total	New print cost	New distribution cost	New Total	Reduction
TradeWinds	873.459,04	15.406.121	16.279.580	784.215,41	12.606.501,06	13.390.716,47	2.888.863,53
Upstream	780.295,12	8.046.945	8.827.240	683.607,42	7.203.971,25	7.887.578,67	939.661,33
Recharge	170.759,76	252.816	423.576	170.759,76	178.504,60	349.264,36	74.311,64
Marketplace	95.317,90	258.215	353.533	95.317,90	582.154,92	677.472,82	- 323.939,82
Fisheries	194.804,28	410.177	604.981	194.804,28	33.241,78	228.046,06	376.934,94
Aquaculture	67.111,53	310.001	377.112	67.111,53	28.313,04	95.424,57	281.687,43
Total	**2.181.747,62**	**24.684.274**	**26.866.021,6**	**1.995.816,29**	**20.632.686**	**22.628.502,95**	**4.237.518,65**

Table 18 - *Total cost reductions (NOK)*

However, Marketplace will naturally witness an increase in its cost of NOK 323.939 annually due to the fact that it will now print and distribute newspapers to all its subscribers, whereas today only a fraction of these subscribers receives a newspaper. Although, the new print cost for this newspaper is not depicting the actual new print cost, because we are not able to quantity the change due to small observations. Even though Marketplace increases its costs, this could potentially be offset by downgrading hand delivery services for TradeWinds and Upstream, which resulted in a cost reduction of NOK 890.532 annually.

In order to properly implement these initiatives with a pronounced effect, the measures require proper monitoring (Kaplan & Norton, 1996). Thus, NHST should set forth measures in order to track the value drivers in the respective supply chain processes. The measures should include both the final outcome and the performance drivers of these outcomes (Kaplan & Norton, 1996).

Building on these rationales, we argue that NHST should set specific targets with corresponding thresholds, in regard to their print- and distribution cost. Moreover, because we know the nature of the cost drivers for these processes, we can construct a value tree like

Camerinelli (2009) where we depict the causal relationship between the financial costs and the operational practices.

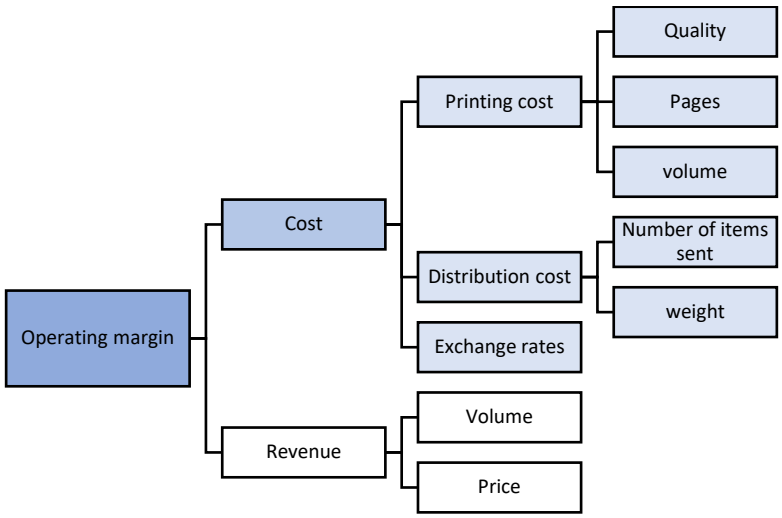


Figure 11 – *NHST value tree*

Thus, breaking down the financial outcomes in operational components allows us to influence these components, and ultimately enhance the overall profitability and thereby the financial performance (Camerinelli, 2009).

6. Conclusion

The thesis provides an in-depth insight on how NHST can design a more cost-efficient supply chain which could result in enhanced financial performance.

The main conclusion of the thesis can be summarized as follows: *standardisation of printed newspapers will have an immediate impact on the cost of printing, but it will also lead to further cost reductions further down in the supply chain.*

Breaking down the research questions we can conclude that NHST can set a specific value with respect to the cost drivers of pages- and volume in order to obtain more predictable printing costs. Further, standardising these values can result in further cost reductions of at least NOK 185.931. Moreover, we conclude that the cost of distribution is minimized by NOK 4.051.588 due to more efficient routing alternatives and feasible packaging, with respect to the assumptions set forth. We acknowledge that the fluctuations in exchange rates would ultimately affect these sums. Thus, our sensitivity analysis extends our findings of a cost-efficient supply chain, and concludes that the most sensitive newspapers are TradeWinds, Marketplace and Upstream.

The purpose of our work has been to provide NHST with an investigation into how their operational practices results in financial outcomes. The overall cost efficiency gains are found to be NOK 4.237.518 annually which directly translates into better financial performance.

Further research should seek to investigate the revenue side as well in order to obtain a more holistic picture of the drivers of financial performance. In particular the effect of adjusting page numbers and volume on the total circulation, and how this impacts the revenue traced from subscribers and advertisers. We also recommend an investigation into exploitation of digital solutions, as we expect that the markets for niche newspapers is going to develop into solely digital platforms in upcoming years.

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Appendix

1 - CAGR

Region	CAGR (2017-22)
North America	-4,46 %
EMEA	-3,62 %
Asia Pacific	1,25 %
Latin America	-1,09 %

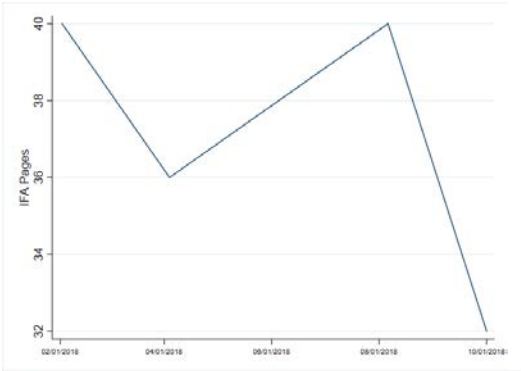
2 – Number of subscribers

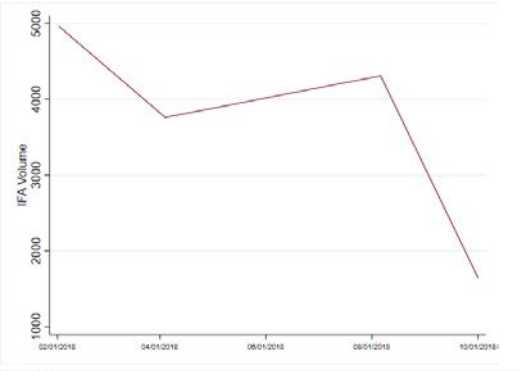
Appendix: Number of subscribers

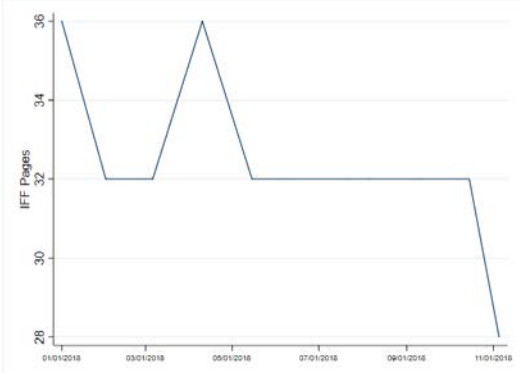
	Subscribers			
Publication	**Paying**	**Free**	**Total**	**Adjusted (6%)**
TradeWinds	6356	472	6828	7238
Upstream	3194	580	3774	4001
Recharge	584	523	1107	1174
IFM	3342	897	4239	4494
IFF	47	33	80	85
IFA	76	130	206	219

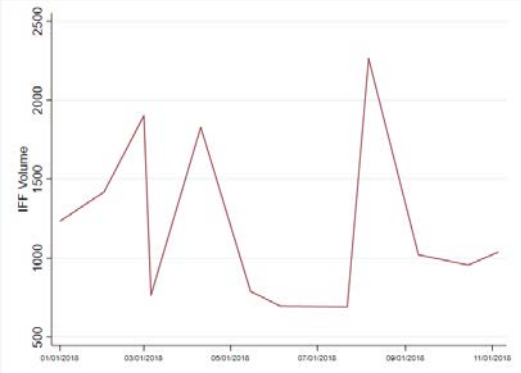
Number of subscribers (free+paying) and adjusted for security buffer.
Based on number of subscribers (Excel sheet)

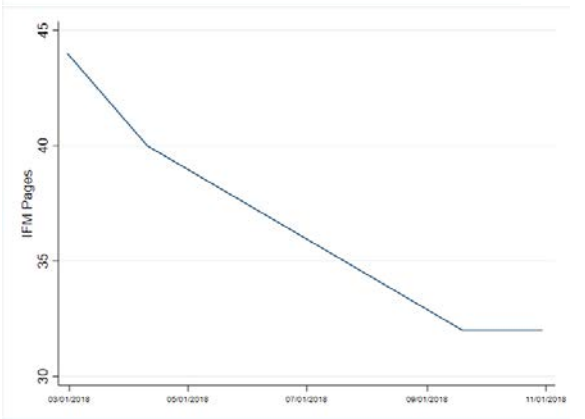
3 – Page and volume fluctuations

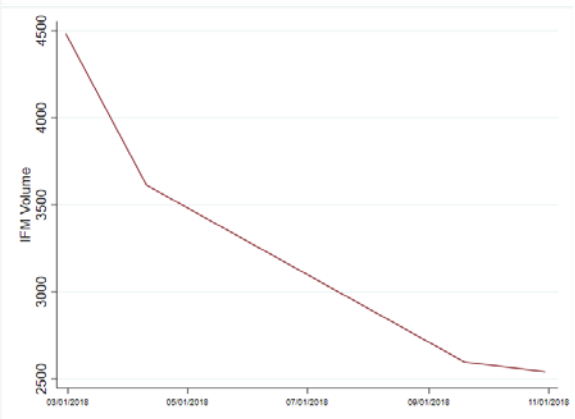


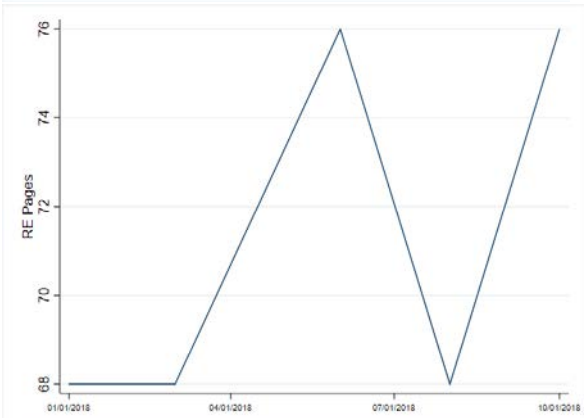


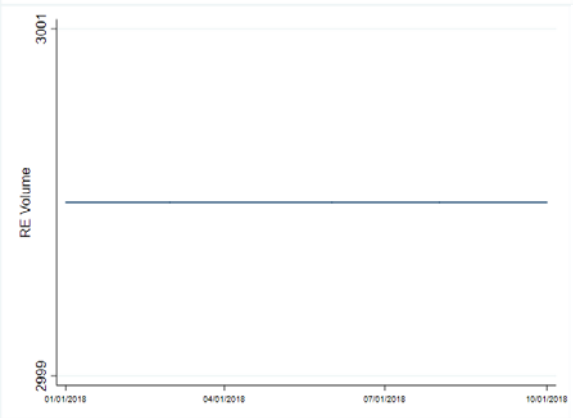












4 – Diagnostic tests

4.1 Multicollinearity

```
    Variable |       VIF       1/VIF
-------------+----------------------
QuantityUp~m |      1.73    0.577505
           t |      1.51    0.663350
PagesUpstr~m |      1.38    0.722498
-------------+----------------------
    Mean VIF |      1.54

    Variable |       VIF       1/VIF
-------------+----------------------
  QuantityTW |      2.12    0.471488
     PagesTW |      1.66    0.602532
           t |      1.37    0.729420
-------------+----------------------
    Mean VIF |      1.72
```

4.2 Autocorrelation

```
. dwstat
Number of gaps in sample:  101
Durbin-Watson d-statistic(  4,   102) =         0

. dwstat
Number of gaps in sample:  101
Durbin-Watson d-statistic(  4,   102) =         0
```

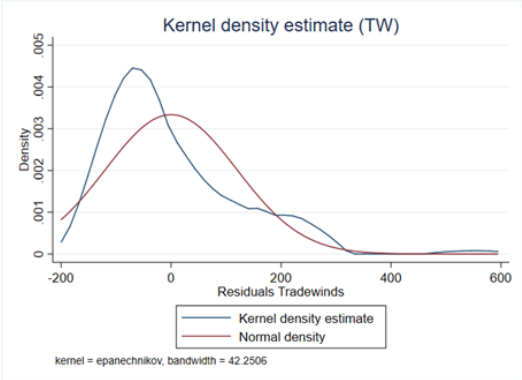
4.3 Normality

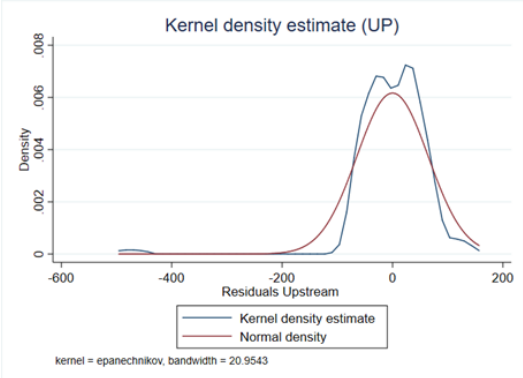
Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
e_TW	102	0.85537	12.141	5.544	0.00000

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
e_UP	102	0.70237	24.983	7.147	0.00000





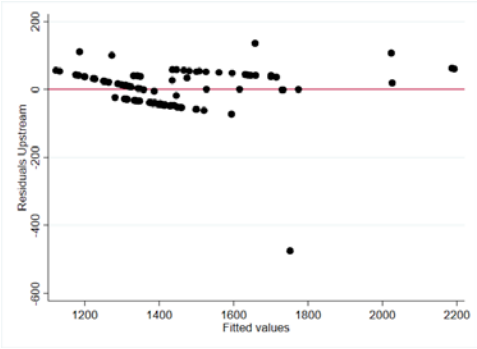
4.4 Heteroskedasticity

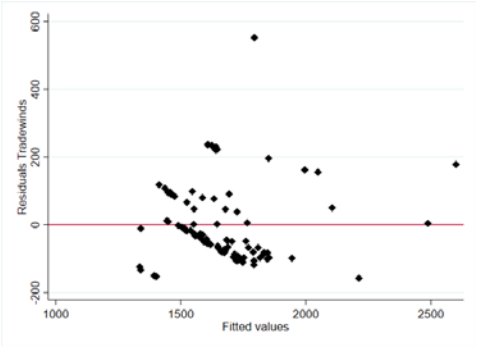
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of TWPrintcost

chi2(1) = 2.93
Prob > chi2 = 0.0870

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of UPPrintcost

chi2(1) = 49.62
Prob > chi2 = 0.0000





4.5 Model misspecification

Ramsey RESET test using powers of the fitted values of TWPrintcost
Ho: model has no omitted variables
F(3, 95) = 2.83
Prob > F = 0.0423

Ramsey RESET test using powers of the fitted values of UPPrintcost
Ho: model has no omitted variables
F(3, 95) = 3.99
Prob > F = 0.0100

5 – Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
TW_t	102	21,182	210.2	20,825	21,539
TW Pages	102	41.22	5.844	32	64
TW Volume	102	9,017	997.4	7,604	13,816
TW Printcost	102	1,669	232.3	1,206	2,778
UP_t	102	21,182	210.2	20,825	21,539
UP Pages	102	48.78	8.463	40	80
UP Volume	102	5,468	769.4	4,185	9,219
UP Printcost	102	1,433	209.8	1,178	2,253
RE_t	5	21,324	110.8	21,185	21,458
RE Pages	5	71.20	4.382	68	76
RE Volume	5	3,000	0	3,000	3,000
REPrintcost	5	3,145	171.8	3,020	3,334
IFM_t	4	21,365	119.6	21,243	21,487
IFM Pages	4	37	6	32	44
IFM Volume	4	3,308	923.6	2,541	4,480
IFM Printcost	4	2,191	945.3	1,460	3,477
IFF_t	12	21,336	102.9	21,185	21,493
IFF Pages	12	32.33	2.060	28	36
IFF Volume	12	1,217	526.4	693	2,263
IFF Printcost	12	1,497	215.4	1,124	1,738
IFA_t	4	21,339	110.7	21,217	21,458
IFA Pages	4	37	3.830	32	40
IFA Volume	4	3,668	1,434	1,647	4,957
IFA Printcost	4	1,551	94.36	1,450	1,670

6 – Marginal effects

6.1 No constraints

TradeWinds

```
Predictive margins                              Number of obs     =        102
Model VCE    : OLS

Expression   : Linear prediction, predict()

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _cons |   1668.648   12.01568   138.87   0.000     1644.804    1692.493
------------------------------------------------------------------------------
```

Upstream

```
Predictive margins                              Number of obs     =        102
Model VCE    : Robust
Expression   : Linear prediction, predict()

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _cons |   1433.234   6.503349   220.38   0.000     1420.328    1446.139
------------------------------------------------------------------------------
```

6.2 Constrained on pages

Pages	(TradeWinds) Marginal effects	(Upstream) Marginal effects
32	1,546***	1,154***
	(27.32)	(12.96)
40	1,652***	1,287***
	(12.44)	(6.610)
48	1,759***	1,420***
	(21.69)	(6.055)
56	1,865***	1,553***
	(41.15)	(12.12)
64	1,972***	1,686***
	(61.83)	(19.36)
72	2,078***	1,819***
	(82.82)	(26.83)
80	2,185***	1,952***
	(103.9)	(34.38)
n	102	102

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

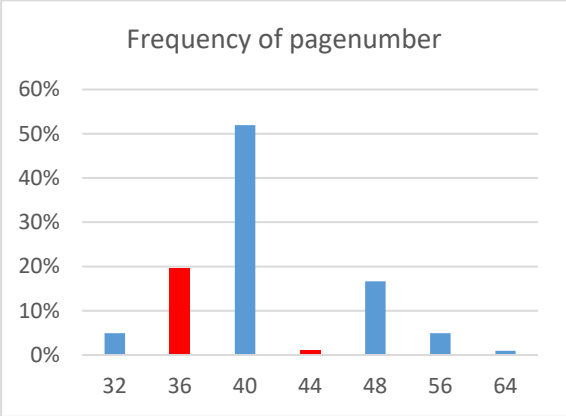
7 – Page frequency

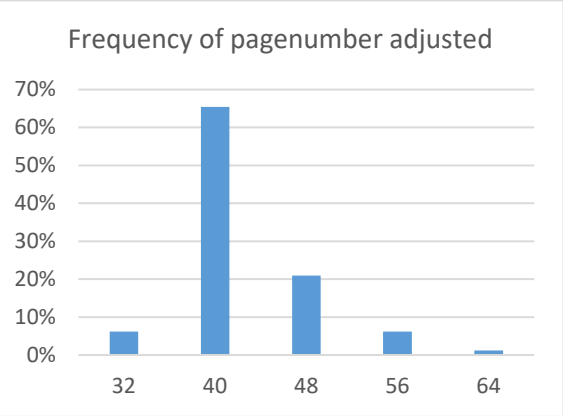
*Marked in red: Ineffective solution, not relevant to use.

Adjusted: Excluded ineffective solution(s), includes only rule-of-eight solutions.

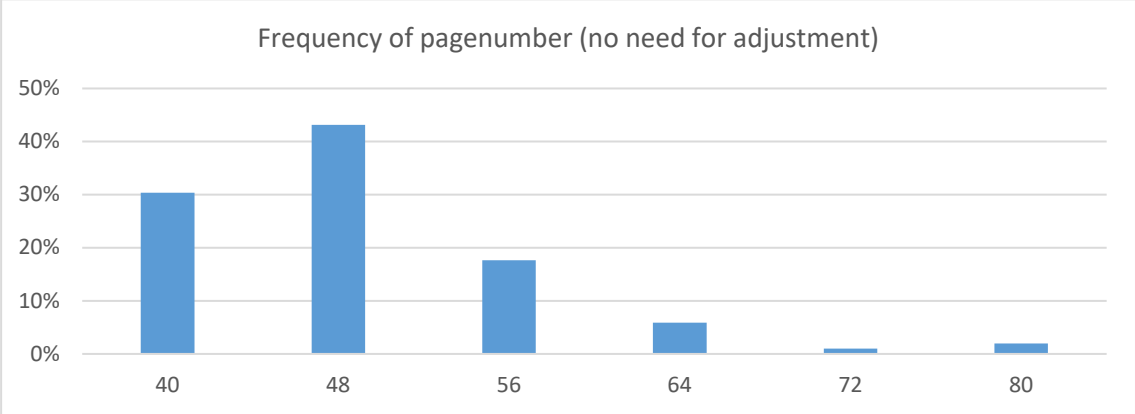
Page numbers not shown is used 0 times, but we show effective solutions every time even if not used.

TradeWinds:

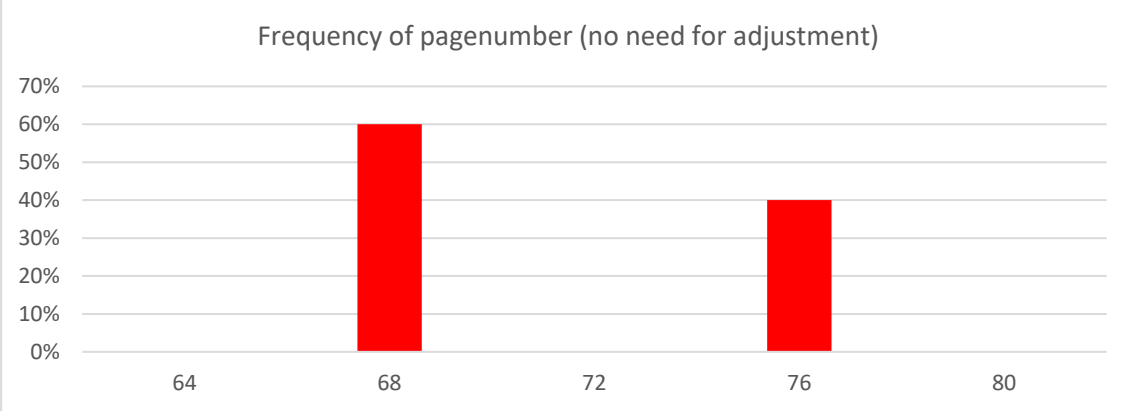




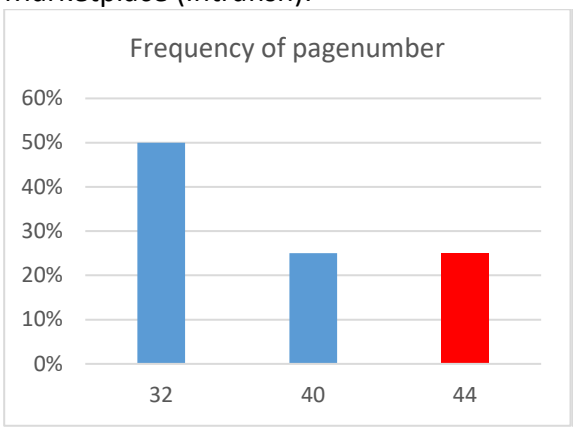
Upstream:

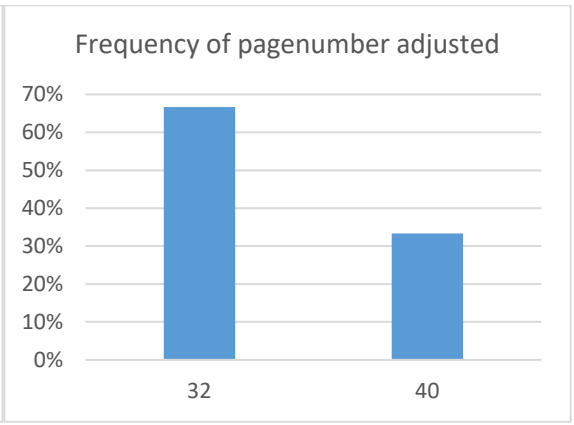


Recharge:

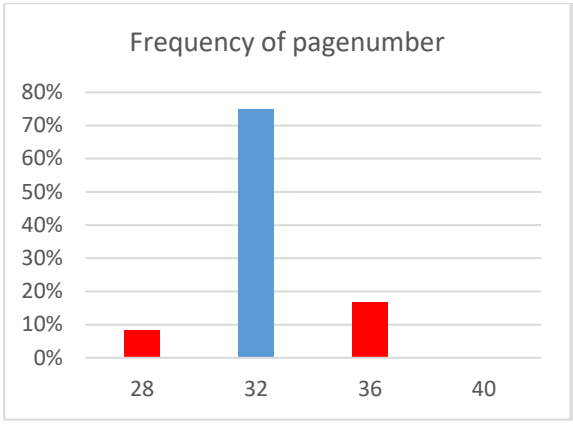


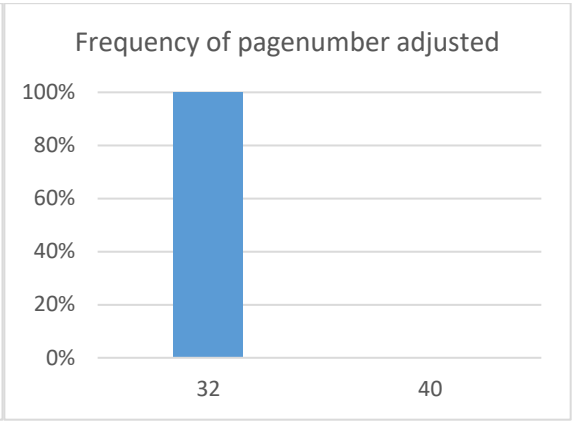
Marketplace (Intrafish):



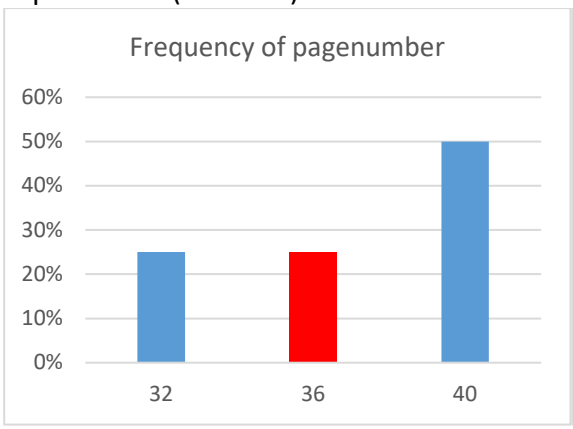


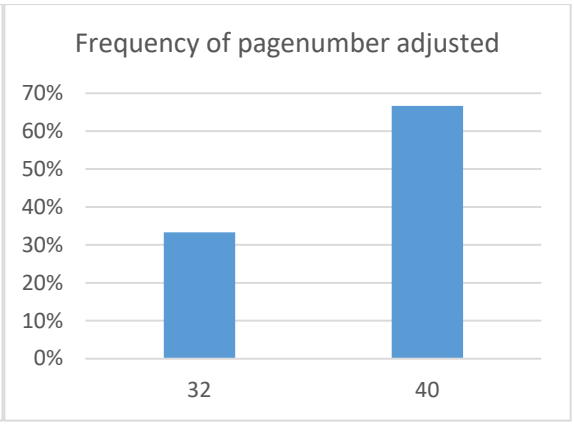
Fisheries (Intrafish):





Aquaculture (Intrafish):





Ability to produce content (based on size they publish):

TradeWinds								
Pages	32	36	40	44	48	56	64	64<
Ability	100%	95%	75%	24%	23%	6%	1%	0%
Upstream								
Pages	40	48	56	64	72	80	80<	
Ability	100%	70%	26%	9%	3%	2%	0%	
Recharge								
Pages	64	68	72	76	76<			
Ability	100%	100%	40%	40%	0%			
Marketplace								
Pages	32	40	44	44<				
Ability	100%	50%	25%	0%				
Fisheries								
Pages	28	32	36	36<				
Ability	100%	92%	17%	0%				
Aquaculture								
Pages	32	36	40	40<				
Ability	100%	75%	50%	0%				

8 – Distribution rates

Postage

VARIABLES	(1) TW AS	(2) TW EU	(3) TW AM	(4) UP AS	(5) UP EU	(6) UP AM	(7) RE AS	(8) RE EU	(9) RE AM	(10) IF AS	(11) IF EU	(12) IF AM
Postage	1.034***	0.836***	1.057***	1.174***	0.905***	1.204***	1.111***	0.874***	1.138***	1.191***	0.913***	1.221***
	(0.0386)	(0.0705)	(0.0405)	(0.0358)	(0.0747)	(0.0722)	(0.0357)	(0.0728)	(0.0579)	(0.0362)	(0.0753)	(0.0760)
n	5	28	3	5	28	3	5	28	3	5	28	3
R^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Post routing

VARIABLES	(1) TW AS	(2) TW EU	(3) TW AM	(4) TW AF	(5) TW ME	(6) UP AS	(7) UP EU	(8) UP AM	(9) UP AF	(10) UP ME	(11) RE AS	(12) RE EU	(13) RE AM	(14) RE AF	(15) RE ME	(16) IF AS	(17) IF EU	(18) IF AM	(19) IF AF	(20) IF ME
Post rates	2.015***	1.729***	2.030***	2.022***	2.024***	2.210***	1.868***	2.228***	2.218***	2.221***	2.122***	1.805***	2.138***	2.130***	2.132***	2.234***	1.885***	2.251***	2.242***	2.244***
	(0.00868)	(0.0224)	(0.0231)	(0.0154)	(0.0174)	(0.0103)	(0.0267)	(0.0276)	(0.0184)	(0.0207)	(0.00959)	(0.0248)	(0.0256)	(0.0170)	(0.0192)	(0.0105)	(0.0272)	(0.0281)	(0.0187)	(0.0211)
n	16	34	6	9	8	16	34	6	9	8	16	34	6	9	8	16	34	6	9	8
R^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Alternative routing rates

VARIABLES	(1) TWAS	(2) TWEU	(3) TWAM	(4) TWAF	(5) TWME	(6) UPAS	(7) UPEU	(8) UPAM	(9) UPAF	(10) UPME	(11) REAS	(12) REEU	(13) REAM	(14) REAF	(15) REME	(16) IFAS	(17) IFEU	(18) IFAM	(19) IFAF	(20) IFME
Agent rates	1.062***	1.075***	1.146***	1.150***	1.011***	1.230***	1.177***	1.319***	1.375***	1.154***	1.154***	1.131***	1.241***	1.273***	1.089***	1.250***	1.189***	1.339***	1.402***	1.171***
	(0.0572)	(0.0401)	(0.0710)	(0.0372)	(0.0530)	(0.0704)	(0.0407)	(0.0974)	(0.0495)	(0.0696)	(0.0643)	(0.0403)	(0.0853)	(0.0438)	(0.0619)	(0.0721)	(0.0409)	(0.101)	(0.0510)	(0.0717)
n	17	34	6	9	8	17	34	6	9	8	17	34	6	9	8	17	34	6	9	8
R^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Post-delivery with agent rates

VARIABLES	(1) TWAS	(2) TWEU	(3) TWAM	(4) UPAS	(5) UPEU	(6) UPAM	(7) REAS	(8) REEU	(9) REAM	(10) IFAS	(11) IFEU	(12) IFAM
Hub-to-post	1.338	0.902	0.328*	1.338	0.902	0.328*	1.338	0.902	0.328*	1.338	0.902	0.328*
	(1.062)	(0.337)	(0.0374)	(1.062)	(0.337)	(0.0374)	(1.062)	(0.337)	(0.0374)	(1.062)	(0.337)	(0.0374)
n	2	2	2	2	2	2	2	2	2	2	2	2
R^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Hand delivery cost

VARIABLES	(1) TWAS	(2) TWEU	(3) UPAS	(4) UPEU	(5) REAS	(6) REEU	(7) IFAS	(8) IFEU
HD rates	1.997***	1.101***	2.065***	1.146***	2.034***	1.126***	2.073***	1.151***
	(0.390)	(0.173)	(0.396)	(0.188)	(0.393)	(0.181)	(0.396)	(0.190)
n	9	11	9	11	9	11	9	11
R^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

9 – Outliers

POSTAGE

VARIABLES	(1) TW AS	(2) TW EU	(3) TW AM	(4) UP AS	(5) UP EU	(6) UP AM	(7) RE AS	(8) RE EU	(9) RE AM	(10) IF AS	(11) IF EU	(12) IF AM
Constant	1.307***	0.970***	1.342***	1.313***	0.973***	1.349***	1.254***	0.944***	1.287***	1.402***	1.016***	1.442***
	(0.0426)	(0.0791)	(0.102)	(0.0431)	(0.0793)	(0.103)	(0.0389)	(0.0773)	(0.0901)	(0.0514)	(0.0824)	(0.124)
n	5	28	3	5	28	3	5	28	3	5	28	3
R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

ROYAL MAIL

VARIABLES	(1) TW AS	(2) TW EU	(3) TW AM	(4) TW AF	(5) TW ME	(6) UP AS	(7) UP EU	(8) UP AM	(9) UP AF	(10) UP ME	(11) RE AS	(12) RE EU	(13) RE AM	(14) RE AF	(15) RE ME	(16) IF AS	(17) IF EU	(18) IF AM	(19) IF AF	(20) IF ME
Constant	2.395***	2.001***	2.415***	2.404***	2.407***	2.404***	2.007***	2.423***	2.413***	2.415***	2.321***	1.948***	2.340***	2.330***	2.332***	2.527***	2.095***	2.549***	2.537***	2.540***
	(0.0119)	(0.0308)	(0.0317)	(0.0211)	(0.0238)	(0.0120)	(0.0310)	(0.0319)	(0.0213)	(0.0239)	(0.0113)	(0.0292)	(0.0301)	(0.0200)	(0.0225)	(0.0130)	(0.0337)	(0.0347)	(0.0231)	(0.0260)
n	16	34	6	9	8	16	34	6	9	8	16	34	6	9	8	16	34	6	9	8
R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

ROUTING ALT

VARIABLES	(1) TW AS	(2) TW EU	(3) TW AM	(4) TW AF	(5) TW ME	(6) UP AS	(7) UP EU	(8) UP AM	(9) UP AF	(10) UP ME	(11) RE AS	(12) RE EU	(13) RE AM	(14) RE AF	(15) RE ME	(16) IF AS	(17) IF EU	(18) IF AM	(19) IF AF	(20) IF ME
Rates	1.388***	1.272***	1.482***	1.588***	1.288***	1.396***	1.277***	1.489***	1.598***	1.294***	1.325***	1.234***	1.417***	1.503***	1.234***	1.502***	1.341***	1.598***	1.741***	1.384***
	(0.0838)	(0.0426)	(0.123)	(0.0617)	(0.0865)	(0.0844)	(0.0427)	(0.125)	(0.0623)	(0.0873)	(0.0784)	(0.0417)	(0.113)	(0.0568)	(0.0796)	(0.0937)	(0.0446)	(0.142)	(0.0707)	(0.0989)
n	17	34	6	9	8	17	34	6	9	8	17	34	6	9	8	17	34	6	9	8
R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

HD

VARIABLES	(1) TW AS	(2) TW EU	(3) UP AS	(4) UP EU	(5) RE AS	(6) RE EU	(7) IF AS	(8) IF EU
Rates	2.129***	1.187***	2.132***	1.189***	2.103***	1.171***	2.175***	1.217***
	(0.401)	(0.204)	(0.401)	(0.205)	(0.399)	(0.198)	(0.404)	(0.217)
n	9	11	9	11	9	11	9	11
R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

10 – Currency report

	Monthly GBP/NOK	
Month	**2018**	**2017**
Jan	11,10	10,60
Feb	10,90	10,40
Mar	10,90	10,50
Apr	11,00	10,70
May	11,00	10,90
Jun	10,90	10,70
Jul	10,70	10,80
Aug	10,70	10,50
Sep	10,80	10,30
Oct	10,70	10,70
Nov	10,70	10,80
Dec	10,90	11,00
Avg	**10,86**	**10,66**