

# *Nordic Journal of Business*

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The logo for the Nordic Journal of Business (NJB). It features the letters 'NJB' in a bold, dark green, serif font. Above the letter 'J' is a stylized graphic element consisting of two curved, overlapping shapes in shades of green and gold, resembling a leaf or a flame.

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# *Editor's Letter*

This issue of the *Nordic Journal of Business* includes three peer-reviewed research articles. In the first article, Erno Salmela (Lappeenranta University of Technology) and Niina Nurkka (Saimaa University of Applied Sciences) focus on the phenomenon of digital market capture from the viewpoint of market capturers in the startup and early growth stages. The second article by Jörgen Hellström, Yuna Liu and Tomas Sjögren from Umeå University examines the effects of stock exchange mergers on stock market information efficiency. Finally, the third article by Naufal Alimov (Pellervo Economic Research PTT) investigates the performance and portfolio choices of competing Swedish pension funds.

I hope you enjoy reading the interesting articles featured in this issue of the *Nordic Journal of Business*.

**Sami Vähämaa**

Editor

Nordic Journal of Business

# Digital Market Capture in Platform Business – How to Pass the Valley of Death?

Erno Salmela and Niina Nurkka

## Abstract

*Phenomenon of digital market capture is going on around the world, since newcomers are capturing customers from incumbent companies with digital platforms. Successful market capturers, such as Uber and Airbnb, have received much attention in the literature. This article, however, focuses on potential new market capturers at the beginning of their life cycle - at a stage where they may fall into the valley of death. A conceptual model was created and studied with potential market capturers on the two-sided market. The model and its dichotomic variables present the most important characteristics of the phenomenon. A successful market capture is challenging because of the complexity of platform business on the two-sided market. Success requires the attention of the whole but also the focus on the details. Article proposes means to pass the valley of death. Potential market capturers may utilize the new model as a tool for digital platform business ideation and planning.*

## Keywords:

*digital market capture, platform business, two-sided market, business ecosystem, network orchestrator, valley of death*

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## 1. Introduction

There is going on a phenomenon of digital market capture that means capturing the market from incumbent companies by challenging the present structures, services and business models. Digitality plays a key role, as it makes possible a comprehensive user experience, an efficient meeting of supply and demand, the creating of new value, and creating of totally new demand and supply (Parker et al., 2016; Evans and Schmalensee, 2016; Choudary, 2015). When studying the phenomenon of digital market capture comprehensively, it is best described with the concepts *platform business*, *business ecosystem of two-sided market* (Parker et al., 2016), *full stack or comprehensive customer experience* (Dixon, 2014) and *sharing economy* (Lessig, 2008).

Well known digital market capturers e.g. Uber, Alibaba and Airbnb have created a global market with their concepts that challenge incumbent companies. The most successful capturers are at present time the most profitable and the fastest growing businesses in the world (Parker et al., 2016; Libert, et al., 2014). Depending the sources, the business models of these businesses are network orchestrating (Libert et al., 2014), platform business (Parker et al., 2016) or two-sided market (Gassman et al., 2014). By combining these business model descriptions we get the following characterization for the platform business operated by the network orchestrator on a two-sided market:

*Network orchestrator creates a network of peers in which the participants interact and share in the value creation. It may sell products or services, build relationships, share advice, give reviews, collaborate, co-create and more. Network orchestrator facilitates interactions between multiple interdependent groups of actors. The value of orchestrator platform increases as more groups or members use it.*

In this study the network orchestrator is referred to *digital market capturer*, which means as follows:

*Digital market capturer is an orchestrator that captures the market from incumbent companies by creating new value for external stakeholders with a digital platform.*

It has been written tremendously about successful market captures like Uber. Much less attention has been paid to potential market capturers whose platform business is still small and most of these will never reach their goal. According to Parker et al. (2016), creating a successful digital platform is challenging, because different stakeholders have different interests and the interaction between them may vary. The most important identified requirement for successful digital platform is network effect (Shapiro and Varian, 1999), that later enhanced to the concept of two-sided market. According to the network effect, the user gets more value depending on how many users there are in the platform ecosystem. Therefore attracting users to the platform is the crucial success factor, in the case of a two-sided market in two or more user groups. (Parker and Alstynne, 2000; Parker et al., 2016.) The purpose of this study is to examine the phenomenon of digital market capture from the point of view of the new potential market capturers. The study was limited to digital employee and professional service platforms (later in text “DEPS platform”) that redetermine the nature of the work. The phenomenon greatly affects people’s lives, since freelancers, non-traditional work paths and self-employment are becoming more common. (Parker et al. 2016.)

The study answers the following research questions:

- What kind of conceptual model describes phenomenon of digital market capture, concerning the platform business on a two-sided market?

- How do the potential digital market capturers operate in the introduction and growth phases of life cycle?
- How could the potential market capturers pass the death valley?

In the following, the research methodology is presented. Chapter 3 suggests for the conceptual model that is created about the phenomenon of digital market capture on the base of the literature. In chapter 4 the model is explored with case studies, after which chapter 5 discusses the results. The final chapter introduces conclusions and presents the need of further research.

## 2. Research methodology

The starting point for the study was the practical need to understand what is required of the DEPS platforms in the two-sided market to overcome the death valley and thus reach a growth stage, which is a prerequisite for digital market capture. To find answers, we examined the phenomenon as a whole, but also focusing on details. The studied stakeholders were the potential market capturers (orchestrators and their platforms) and consumers of the service. Another crucial group of two-sided markets, i.e. service providers, will be considered in the further studies.

In this study abductive logic was used as a form of reasoning. Abduction starts from individual observations and it will lead you to the best explanation of those observations. A guiding principle is created at the beginning of the research based on partly intuition and partly facts. The guiding principle works as a source of inspiration and delimits the research. It is typical for abductive logic that theories are found along the way and therefore, unexpected findings are an essential part of this logic. The empiria and the theory are in continuing dialogue during the research. The premises do not guarantee the conclusion, but inference to the best explanation. (Järvensivu and Törnroos, 2010;

Harman, 1965; Heikkinen et al., 2010 Peirce.)

At the beginning of this study, observations from practical case literature were collected from the well-known digital DEPS platforms (Uber and Airbnb) operating on two-sided markets. Subsequently, the best possible explanations about the most important elements for DEPS platforms were created. Next the elements were compared to theory to define elements and find relationships between the elements. As a result of this, a conceptual model of the most important elements of DEPS platforms was created as the guiding principle of the study.

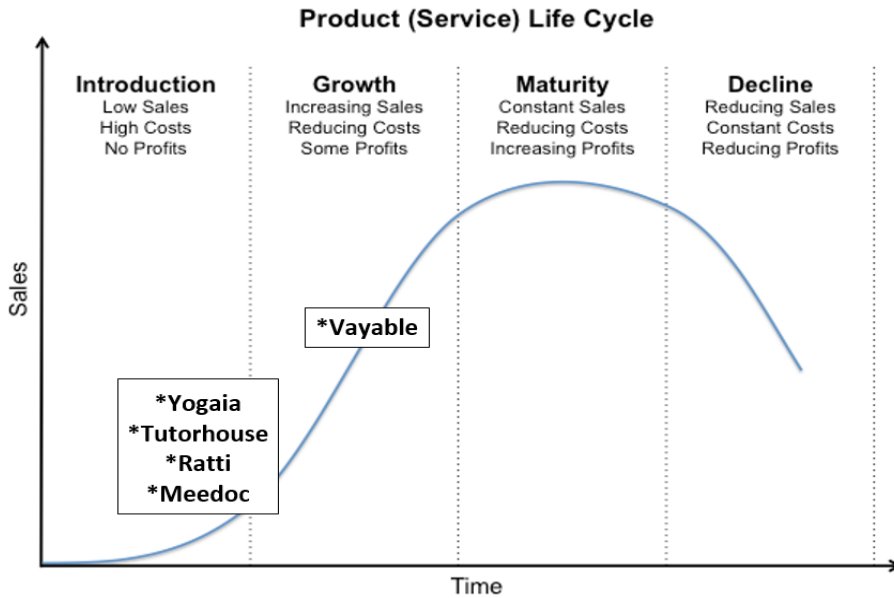
Each element of the model was examined in more detail in order to understand the differences between the DEPS platforms and identify the reasons why some platforms perform better than others. Based on a literature review, a set of dichotomous variables 0-1 (0 for no, 1 for yes) were created for each element of the conceptual model. After exploring different kind of platforms, such as Airbnb, Uber, TaskRabbit, Etsy and Husband service, ten variables were concluded to describe each element. So, also in creating and choosing the dichotomic variables the abductive reasoning was used in a way that both theoretical and empirical aspects were used. The main literature used in creating each variable is explained more detailed in characterization of each element of the conceptual model.

In the next stage of the study the conceptual model was tested and further developed by using cases of five potential market capturers working in different fields: Vayable, Ratti, Yogaia, Meedoc and Tutorhouse. The cases were selected using the following criteria:

1. The platform operates on two-sided markets. The popularity of platforms on two-sided markets has increased radically in recent years (Parker et al., 2016). On the other hand, digital platforms on one-sided markets have already been studied quite a lot.

2. The study focused specifically on DEPS

Figure 1. The location of the platforms studied in the lifecycle (Lewitt, 1965).



platforms that play an important role in the transformation of working life. The studied platforms are primarily meant for citizens. Platforms provide service providers new earning opportunities that affects how people work in the future (Parker et al., 2016).

3. The platform is operated by a Finnish company, except for Vayable. Finnish orchestrators were chosen in to this study because Finland and Europe is considered to be fallen behind with platform business, compared to USA and Asia (Parker et al., 2016).

4. Finnish platforms are still In introduction phase of life cycle (Fig.1) and they are struggling to get over the valley of death. In fact, Meedoc closed down after the data of the study was collected in 2016. Vayable was taken into the study as a reference that could be used to estimate the other platforms´ possible steps in the future. Vayable is in the growth phase, and it have crossed the valley of death. Vayable’s monthly turnover was \$ 1.4 million in 2013, which would amount to around \$ 17 million annually (Colao, J.J. 2013). In 2014, The turnover of Meedoc, Ratti.fi, Tutorhouse and

Yogaia were in 2016 in tens or hundreds of thousands of euros per year.

5. The platform operates on international market or is trying to get there. Scaling a platform business is best achieved when the market is seen globally (Parker et al., 2016). Vayable operated in 850 cities around the world (Zax, 2014).Yoga has customers in about 50 countries and studios in 3 countries. Meedoc has operations in five countries. Ratti.fi and Tutorhouse operated only in Finland.

6. The platform has sufficient documented material available and the researchers may trial run them.

The case data was gathered during April 1. 2016 – June 15. 2017. The conceptual model created in the first study stage was conducting the data gathering but did not restrict it. The analysis was done case by case and also comparing the cases to each other. In the cross case analysis the purpose was to find similarities and differences between the cases. Furthermore, the differences between Vayable and other platforms were compared to find out what it takes to reach the next stage in

the lifecycle. Finally, the proposed conceptual model was improved by widening it with the elements found in case study.

### 3. The conceptual model of digital market capture

Based on literature, the business ecosystem of two-sided markets, platform business, orchestration, sharing economy, comprehensive customer experience were identified as the most important elements of DEPS platforms. Digital market capture may be the result from high performance in those elements. In this section, the elements are linked to a scientific discussion to characterize concepts and to identify relationships between them. As a result, a conceptual model is proposed for DEPS platforms. More detailed features (dichotomic variables) of each element were also identified to better compare different platforms.

#### 3.1 Digital market capture

Digital platforms can be corresponded to physical marketplaces, but they operate on a larger scale and they are quicker, user-friendlier and more efficient than physical marketplaces. Digital platforms become scaled quickly and cost-efficiently which is not possible in the incumbent business, where scaling usually requires remarkable investments. The underutilized physical resources, such as users' apartments in the case of Airbnb, can be provided for effective use through platforms. On the other hand, the demand may scale quickly in digital and global environment. (Parker et al., 2016; Evans and Schmalensee, 2016; McQuivey, 2013.)

When the digital market capture succeeds it changes the existing economic and social area. This kind of disruptive innovations tend to be created by new entrepreneurs or outsiders, rather than incumbent market-leading companies (McQuivey, 2013; Sims, 2011). Market leaders do not pursue disruptions, because they are not profitable enough in the beginning and because their development can take

resources away from incremental innovations needed in competition with current competitors (Christensen, 1997). A disruptive innovation can require more time to develop and include higher risk than incremental innovation, but on the other hand it may have much better business potential (Marnix, 2006).

#### 3.2 Digital platform in the business ecosystem of two-sided market

On two-sided market, groups interact with each other through a common platform. These two-sides are usually labelled service consumers and service providers. The value obtained by one kind of user group increases with the number of the other kind of users. (Parker et al., 2016, Järvi and Kortelainen, 2011; Evans et al., 2006; Evans, 2003; Katz and Shapiro, 1985.) Two-sided market forms a business ecosystem. Moore (1993, 1996) defines the business ecosystem being made up of coevolving interdependent and interconnected actors: customers, suppliers, agents and channels, sellers of complementary products and services, and the hub company. A major reason that calls for collaboration with partners and even with competitors is the network effect (Katz and Shapiro, 1985; Ritala and Hurmelinna-Laukkanen, 2009).

Network effect is a prerequisite for the market development. The effect can occur on intragroup and intergroup level. Usually the benefits are larger the more these groups have users, because then the needs of the consumers and what the provider has to offer are most likely to meet. (Parker et al., 2016; Vogelsang, 2010; Caillaud and Jullien, 2003.) A digital platform scales business and the number of users more efficiently than a physical platform (Parker et al., 2016; Järvi and Kortelainen, 2011; Evans and Schmalensee, 2007). The platform may be the users' only contact surface to the company, like for example is the case with Uber (Mandell, 2016).

In any market with network effect, the focus of attention must shift from inside to

outside the company because there are more people and devices outside the firm than inside. In platform economy, the orchestrator must focus on exploiting and influencing external resources instead of own resource ownership. The external user ecosystem is a source of competitive advantage. (Parker et al., 2016.) In this article, internal resources means personnel inside the orchestrator company and external resources outside the orchestrator, particularly service providers and consumers.

Core of digital platform is to identify and match make unmet customer needs and underutilized service provider resources (Amit and Han, 2017). A platform enables value-creating interactions between service providers and consumers. It provides an open, participative infrastructure for these interactions and sets governance conditions for them. The platform matches users and facilitate the exchange of goods, services, or social currency, thereby enabling value creation for all participants. (Parker et al. 2016.)

Platforms have a fundamental role in creating cost-effective consumer experience and organizing resources in a new way. The role of a platform is to minimize transaction costs by through audience making and matchmaking, to minimize costs through the elimination of duplication, and to permit value-creating exchanges that would not take place otherwise. Platform does business with this added value for example by taking a part of the transactions to itself and by charging for the use of the platform. (Evans et al., 2006; Järvi and Kortelainen, 2011; Parker et al., 2016; Evans and Schmalensee, 2007.) DEPS platforms provide additional incomes for service providers alongside the actual job. For consumers platforms provide more options to choose. On the other hand, stability is reduced and uncertainty (i.e. quality of work) is increased. (Parker et al. 2016.)

Parker et al. (2016) identified factors that promote and prevent the breakthrough of platform business on two-sided markets. Pro-

moting factors include information intensity, poor scalable gatekeepers, market fragmentation, and asymmetry in information. The inhibiting factors are regulation and protection, the high error cost, and the importance of physical resources. (Parker et al. 2016)

The dichotomic variables describing the digital platform business ecosystem of two-sided market are presented in table 1. The variables 1.1 and 1.7 are created on the basis of the literature of Evans et al. (2006) and Parker et al. (2016), the variables 1.2 and 1.6 by Sundararajan (2016) and the variables 1.3 - 1.5 and 1.8 - 1.10 by Parker et al. (2016).

### 3.3 Orchestrators as digital market capturer

Platform business is operated by network orchestrator. In this study the network orchestrators are called *digital market capturers*. They may capture the market from the incumbent companies working inefficiently and creating incomplete customer value, or they can create totally new markets (Evans and Schmalensee, 2007).

The core business of network orchestrator is to provide a common meeting place, and to facilitate interaction between the distinct groups of users (Parker et al., 2016; Gassman et al., 2014; Evans and Schmalensee, 2007). How well a firm could access and orchestrate resources is viewed as core to a firm's capabilities (Helfat et al., 2007). The orchestration processes aim at creating and capturing value from the network through its resource configuration (Hitt et al., 2011).

Orchestration activities can be divided into three types: managing knowledge mobility, managing innovation appropriability, and managing network stability. Enhancing knowledge mobility requires an orchestrator to focus on the specific sub-processes of knowledge absorption, network identification and inter-organizational socialization. (Dhanaraj and Parkhe, 2006.) Concerning stability, orchestrators can control its network

by influencing the network membership (e.g. size and diversity) and structure (e.g. density and autonomy) (Dhanaraj and Parkhe, 2006).

Tarnacha and Maitland (2006) categorize orchestrators' roles into four. First, orchestrators streamline the transaction process with aggregation and mediating effective price-points and thus reducing search and transaction costs. They also minimize transaction costs through audience-making and cost minimization through the elimination of duplication. Second, orchestrators absorb risk. Third, orchestrators are market information repositories by acting as experts and matching consumers with service providers. Fourth, orchestrators can provide a mechanism for increasing market trust by monitoring and preventing opportunistic behavior by buyers and suppliers. (Tarnacha and Maitland 2006). Common to platform business orchestrators is that they do not own some important physical resource (Parker et al., 2016).

The following know-how is demanded from the network orchestrator in the first stages of lifecycle: 1) Differentiating from the competitors or creating a totally new demand, 2) Designing of a platform, 3) Creating a comprehensive user experience, 4) Creating a network effect, i.e. fast growth of users including the solving of 'the problem of the chicken and the egg', 5) Earning money with the platform, that is capturing the value coming from the network effect, and 6) Management of transparency i.e. who can use the platform and what they can do. (Parker et al. 2016.)

Libert et al. (2014) have been studying different business models. According to this study network orchestrates have bigger market values compared to other companies using other business models. They also have faster growth and larger profit margins than the others. Network orchestrators get approximately 2-4 times bigger market values, but from the 500 companies included in the study there was only 5 % network orchestrators. The reason for that is a relatively new business model, and

that the skills of the business managers are connected to managing physical resources and resources within one's own company, whereas network orchestrating demands management skills of immaterial capital, network relations, and network resources. (Libert et al. 2014.)

The dichotomic variables describing the network orchestrators are presented in table 2. The variables 2.1, 2.3, 2.6 - 2.9 are created on the basis of the literature of Parker et al. (2016), the variable 2.2 by Evans and Schmalensee (2007), 2.4 by Furr and Dyer (2014), 2.5 by Tarnacha and Maitland (2006) and 2.10 by Dhanaraj and Parkhe (2006).

### 3.4 Full-stack approach – A comprehensive consumer experience

According to Dixon (2014) and Horowitz and Dixon (2014), the full-stack approach is to build an end-to-end product or service that bypasses incumbents and other competitors. Full-stack approach is connected to market capture or creating a new market by a new consumer experience. The full-stack approach may bypass industry incumbents, completely control the consumer experience, and capture a greater portion of the economic benefits. (Dixon, 2014)

The whole product and comprehensive customer experience are used somewhat interchangeably with full-stack and end-to-end customer experience. A whole product is a core product augmented by everything that is needed for the consumer to have a compelling reason to buy. For example, if a personal computer is the core product, then whole product would include software applications, training classes, peripheral devices, and Internet service. Without these additional product components, the core product would not be very useful. (Levitt, 1980; McKenna, 1985.) The comprehensive consumer experience includes the whole lifecycle of consumer relationship or end-to-end consumer journey (Kim and Mauborgne, 2005) and multichannel approach

(Wolny and Charoensuksai, 2014). Companies providing comprehensive offering help their consumers to reach their goals. They use digital tools and platforms to get closer to their consumers and to get them to engage them in a more profound manner. (McQuivey, 2013.)

The dichotomic variables describing the full-stack approach are presented in table 3. The variable 3.1 is created on the basis of the literature of Levitt (1980) and McKenna (1985), the variable 3.2 by Kim and Mauborgne (2005), the variables 3.3 and 3.6 by Sundararajan (2016), the variables 3.4, 3.5 and 3.7 - 3.9 by Parker et al. (2016) and the variable 3.10 by Johansson (2017).

### 3.5 Sharing economy

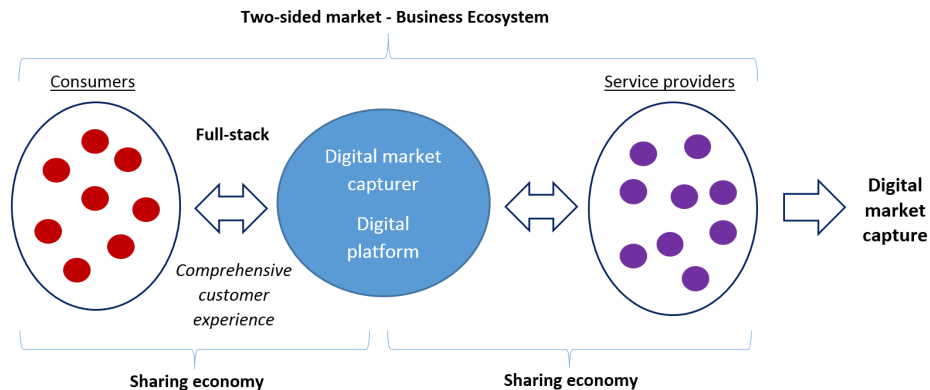
Sharing economy means the more cost-efficient way to share scattered resources to create new consumer value (Cohen and Kietzmann, 2014; Sundararajan, 2013). Digitalization enables the effective commercialization of underutilized resources controlled by individuals and firms alike (e.g., time and vehicles) and allows the generation of new resources (e.g., data) (Amit and Han, 2017). The business models based on the sharing economy work efficiently through digital platforms. They make possible to present and share free capacity in real time and accurately for those who need it. The main benefits of

the sharing economy are reducing costs connected to ownership and the expansion of variety. (Parker et al., 2016; PWC.com, 2015.)

The sharing economy is: 1) Largely market-based: it creates markets that enable the exchange of goods and the emergence of new services, resulting in potentially higher levels of economic activity, 2) High-impact capital: it opens new opportunities for everything, from assets and skills to time and money, to be used at levels closer to their full capacity, and 3) Crowd-based “networks” rather than centralized institutions or “hierarchies”: the supply of capital and labor comes from decentralized crowds of individuals rather than corporate or state aggregates. Future exchange may be mediated by distributed crowd-based marketplaces rather than by centralized third parties. (Sundararajan, 2016.)

The sharing economy has disrupted mature industries by providing consumers with convenient and cost-efficient access to resources without the financial, emotional, or social burdens of ownership (Eckhardt and Bardhi, 2015). Any kind of sharing economy will likely yield a greater range of available options for its participants and possibly a greater attention to long-term goals like sustainability, as well as an increased reliance on social rather than economic cues to facilitate the organizing of economic activity (Sundararajan, 2016).

Figure 2. The conceptual model of digital market capture.



The dichotomic variables describing sharing economy are presented in table 4. The variable 5.1 is created on the basis of the literature of Parker et al. (2016) and Sundararajan (2016), the variables 4.2 - 4.4 by Sundararajan (2016), the variables 4.5 - 4.8 by Parker et al. (2016) and the variables 4.9 and 4.10 by Morgan (2014).

### 3.6 The conceptual model of digital market capture

The elements of the conceptual model of digital market capture (Figure 2) are the digital platform, digital market capturer (network orchestrator), the business ecosystem of two-sided market consisting of service consumers and service providers, full-stack approach/comprehensive consumer experience, and sharing economy. Digital market capture, may originate by an outstanding comprehensive and interactive realization of model's elements.

## 4. Case study

Four Finnish and an American network orchestrators that had captured or planned to capture a market share with a digital platform from incumbent companies were studied. The network orchestrators operated on different fields. First the analysis of the case-by-case is presented, after which cases are compared to each other. Finally, more successful American platform is compared to the Finnish platforms.

### 4.1 Case analysis

Before the analysis of digital market capture, short descriptions of the cases chosen to this study are presented. The cases are Ratti.fi, Yogaia, Meedoc, Tutorhouse and Vayable.

#### Ratti.fi

Ratti.fi is a Finnish platform that was established in year 2015. The platform is meant for persons who wants to have a driving licence

and for those who have been granted the licence to teach driving and are interested in teaching. The platform is capturing markets from traditional driving schools where getting the driving licence can be quite expensive. Ratti.fi takes advantage of the reform of the Finnish driving teaching licence system that enables the teacher to teach students that are not teacher's family members. At present the amount of students is limited to three students in three years.

Ratti.fi offers the B-license basic phase including official fees about 50 % cheaper than traditional driving schools. The platform searches a teacher for the student who wants to have a driving licence from the same district. All the teachers will be paid the same hourly payment. As services for the teacher, the platform provides teaching of driving theory, a theory test, the installation of teaching pedals to the vehicle, and the vehicle inspection. Ratti.fi carries out the theory lessons for the students by using the digital platform. Ratti.fi is intended to expand the driving licence teaching also to other phases than the basic phase. The platform is now operating only in Finland, but it is aiming to operate also on the international market. The financial result of Ratti.fi has so far been unprofitable.

#### Yogaia

Yogaia is a Finnish platform established in 2013. It provides online teaching in yoga, pilates, muscular fitness, stretching and well-being. With monthly payment you can participate in live classes for an interactive experience with your teacher or you can watch recorded, on-demand classes regardless of time and location. For those interested in Yogaia, there is a possibility to have a trial period. The platform provides the sense of community with e.g. sharing photos (Instagram, Facebook) and arranging different kind of campaigns as well as competitions. It is possible to monitor one's own activity and history of taking part of classes. The platform

also monitors users' activity and suggests classes suitable for certain users. Initially the platform was launched for Finnish market but by 2015 it operated in 50 countries. The Yogaia teachers have their classes in Yogaia's own studios in Espoo, London, and Hong Kong. The platform furthermore provides various campaigns related to well-being, as well as lectures and blog articles. The financial result of Yogaia is so far unprofitable.

### **Meedoc**

Meedoc is a platform providing remote doctor services from the year 2012. The activity started in Finland, but expanded worldwide. At the beginning, the service had the possibility for general practitioner's consultation, but the operating model expanded to the services of public health nurse of child health center, psychologists, and physiotherapists. In the future it was supposed to expand the operation of platform to specialist doctors and also to usage of different equipments, that the client could monitor their own well-being and send information to professionals. Meedoc offered doctors the opportunity to take care of their own clients to and also get new clients. In addition to Meedoc's own doctors, the platform was offered to doctors working with medical partners. The consultation happened via remote connection using video conversation, so the client got the doctor service with possible prescriptions and sick-leaves quickly regardless of the time and the location. The doctors got payment from the consultations. The operation of Meedoc platform was essentially influenced by legislation related matters, such as information security, recording of patient data, and the recognition of professionals. Meedoc ceased to operate as unprofitable at the year 2016 and announced to concentrate on developing the technology.

### **TutorHouse**

Tutorhouse is a platform that was established in 2010. It provides individualized tutoring

services to support students' learning. TutorHouse provides an additional support to students in public education so there is no competition between the platform and public education. The customers of Tutorhouse are the parents who may worry about their children's learning or success in learning and are ready to pay about the extra support for challenges of learning. Before the beginning of the tutoring process, the student's need for support of learning will be tested. The student or the parents can not choose the teacher themselves nor the teachers have been introduced at the platform. The students can be tutored either individually or in small groups. The platform provides online tutoring, tutoring at student's home or in the classroom owned by the Tutorhouse. The costs are formed by the tutoring method and the amount of tutoring. The platform also provides different links and blogs related to learning. Furthermore at least for the students studying high school mathematics there is a hotline teacher available to help with the homework. TutorHouse teachers are qualified and skilled teachers of a special subject or specialist teachers. Most of them are working in comprehensive school or high school. TutorHouse platform accepts the teachers and the activity of teachers are guided by the strict ethical rules. At the time of the study there were 100 teachers working in TutorHouse. So far the platform has been unprofitable.

### **Vayable**

Vayable is an American platform established in 2011. Vayable connects travellers and local people, who want work as local guides for travellers. The platform provides travellers the opportunity for unique experiences with the guidance of local people, and the guides have an opportunity to use their local knowledge and special skills to earn extra income. Vayable's mission is to become the global platform for real-life experiences. Anyone can create an experience on Vayable as long as it meets Vay-

able’s guidelines. Guides create, curate and take full responsibility for the experiences they offer. Travellers may share travel experiences on the platform. The travellers have the opportunity to choose the guided services they are interested in and also the guide who offers services. The guides have the chance to take advantage of their own skills by offering services that are different from the traditional guided tours. The guide sets the price to be paid by the traveller.

Tables 1-4 present the dichotomic variables of the elements of the conceptual model, and the values of the variables case-by-case. Yes or No values are determined on the base of exploring the case platforms and finding out if the fact mentioned in the variable exists (Yes) or not (No). To some platforms re-

searches signed in to be a consumer (Meedoc and Yogaia) or to be a consumer and a service provider (Vayable). About Yogaia researches also got some complementary information by discussing with one person working on the management of Yogaia. The examples of Yes and No values in practice in each case, are explained in the cross case analysis.

#### 4.2 Cross case analysis

The cross-case analysis is based on the values of dichotomic variables. In addition it will be analysed how more successful Vayable differs in its actions from other platforms studied, and is it possible to explain the advance to faster growth with these differences. The results of the cross-analysis is discussed according the elements of the conceptual model. The

**Table 1.** Digital platform business in the business ecosystem of two-sided markets.

DICHOTOMIC VARIABLES	RATTI.FI	MEEDOC	YOGAIA	TUTORHOUSE	VAYABLE
1.1 Purchasing services on digital platform only	Yes	Yes	Yes	No	Yes
1.2 The service can be produced without a personal contact	No	Yes	Yes	Yes	No
1.3 Partners (other than service providers and consumers) are necessary for the platform	No	No	No	No	No
1.4 Service providers have the possibility to benefit their own partners without platform control	No	No	No	No	Yes
1.5 Platform doesn't choose the service providers, so anybody can sign in the platform to offer services	No	No	No	No	Yes
1.6 Service providers may determine the price for the service	No	No	No	No	Yes
1.7 Service providers pay for the use of the platform, or a commission	No	N/A	No	No	Yes
1.8 Operation was international at the time of the study	No	Yes	Yes	No	Yes
1.9 The operation is quite independent on legislation and taxation	No	No	Yes	Yes	Yes
1.10 The amount of consumers has an effect on how many service providers are needed	Yes	Yes	No	Yes	Yes

**Table 2.** Network orchestrators / Market capturers.

DICHOTOMIC VARIABLES	RATTI.FI	MEEDOC	YOGAIA	TUTORHOUSE	VAYABLE
2.1 Offers also other own services in addition to make the service provider and consumer to meet	Yes	No	Yes	No	No
2.2 Creates a totally new supply to the market	No	No	No	No	Yes
2.3 Creates new demand to consumers who do not use traditional services	No	No	Yes	Yes	Yes
2.4 Has made a pivotal change in platform business	No	N/A	Yes	No	Yes
2.5 Service providers get economic value (additional income)	Yes	Yes	Yes	Yes	Yes
2.6 Possibility for interaction between the service provider and the consumer through the platform	No	Yes	Yes	Yes	Yes
2.7 The increase in consumers doesn't increase costs in the same ratio	Yes	Yes	Yes	Yes	Yes
2.8 Decreases risks to service providers	No	Yes	Yes	Yes	Yes
2.9 Decreases risks to consumers	No	No	Yes	Yes	Yes
2.10 Manages the actions of the platform i.e. what can and what cannot be done (common rules)	Yes	Yes	Yes	Yes	Yes

**Table 3.** Full stack approach / Comprehensive consumer experience.

DICHOTOMIC VARIABLES	RATTI.FI	MEEDOC	YOGAIA	TUTORHOUSE	VAYABLE
3.1 Takes into account the whole consumer journey	Yes	Yes	Yes	Yes	Yes
3.2 The user has the possibility to choose the services during the consumer journey	Yes	Yes	Yes	Yes	Yes
3.3 The consumer may choose the most appropriate service provider	No	Yes	Yes	No	Yes
3.4 The consumer has the possibility to try the service, and to find out some advance information of the service or the service provider	No	Yes	Yes	No	Yes
3.5 Possibility for a personal contact with the service providers or the platform e.g. online camera	Yes	Yes	Yes	Yes	Yes
3.6 Centralized user support	Yes	Yes	Yes	Yes	Yes
3.7 One advantage is inexpensiveness compared to incumbent companies	Yes	Yes	Yes	No	No
3.8 One advantage is memorable user experience compared to incumbent companies	No	No	No	Yes	Yes
3.9 Creates or increases the sense of sociality or communality of consumers	No	No	Yes	Yes	Yes
3.10 Satisfaction guarantee	Yes	Yes	No	Yes	No

**Table 4.** Sharing economy.

DICHOTOMIC VARIABLES	RATTI.FI	MEEDOC	YOGAIA	TUTORHOUSE	VAYABLE
4.1 Providing financial support for the service providers by the platform	No	No	No	No	No
4.2 Sharing of physical facilities	No	No	Yes	Yes	No
4.3 Sharing of tools needed for service production	No	No	Yes	No	No
4.4 Sharing the service (e.g. teaching) to numerous consumers simultaneously	Yes	No	Yes	Yes	Yes
4.5 Sharing user feedback (feedback freely available)	No	N/A	Yes	Yes	Yes
4.6 Sharing experiences in using the service	No	No	No	Yes	Yes
4.7 Groups or communities for the service providers	No	No	No	No	No
4.8 Groups or communities for the consumers	No	No	No	No	No
4.9 Using the service is mostly free of any particular place	No	Yes	Yes	Yes	No
4.10 Using the service is mostly free of any particular time	No	Yes	Yes	No	No

numbers in brackets refer to certain dichotomic variable in which the differences or similarities between the platforms exist.

Digital platform business in the business ecosystem of two-sided markets

With the exception of Tutorhouse, the purchase of the service took place only through the platforms (1.1). In Tutorhouse it was also possible to take contact by calling. In two cases the production of the service called always for personal contact and appointment, when in two cases the service was enabled to produce through the platform (1.2). In the case of Tutorhouse the production of the service was done which way the service consumer preferred to. Business partners were not necessary for the operation of platforms (1.3), but in some of the cases they brought additional value. For example in the case of Ratti.fi business partners produced the installation of a brake pedal to the vehicle and in the case of Yogaia they affected to content production. In Vayable the service providers had the pos-

sibility to benefit their own business partners without platform control (1.4). For example the service provider could make a deal with a certain restaurant or transport company.

Only in Vayable, anyone who was interested in to be a service provider was able to sign in and set up the price of the service (1.5 and 1.6). Other platforms established the service providers and determined the price for all the service providers to be the same. In Meedoc and Yogaia, the consumer was able to choose the appropriate service and the service provider. Only Vayable charged the service provider a commission that was based on the price of the service (1.7). In Ratti.fi, Tutorhouse and Meedoc the fee was fixed, as well as the prices of the services.

The operation of Meedoc, Yogaia and Vayable was international (1.8). Vayable is the most international platform since it has service providers all over the world. Yogaia has studios in London and Hong Kong and at the time of the study it provided classes also in English and in German. Meedoc operated in five countries. In

Ratti.fi and Meedoc the various issues relating to the legislation and taxation substantially contributed to the operation (1.9). With the exception of Yogaia, the increase in of the number of consumers affected directly how many service providers were needed (1.10). So even though the operations in the platforms would scale efficiently, the service providers business did not become scaled.

#### Network orchestrators / Market capturers

In all cases, the network orchestrators helped the service providers and consumers to meet. Most of the network orchestrators were offering also their own services, such as virtual lessons (2.1). Excluding Vayable, all orchestrators offered service, that was also offered by incumbents (2.2). Vayable, TutorHouse and Yogaia created, however, new demand to consumers, who do not use traditional services (2.3). For example virtual yoga has acquired such consumers that may not go to traditional yoga lessons. Vayable and Yogaia have made pivotal change in platform business and changed their operations when the first experiment did not reach the desired market (2.4). Meedoc has finished operations and announced to concentrate on developing the technology.

For service providers, the orchestrators produced added value especially in the form of extra income (2.5). Only in Ratti.fi, there was no possibility for interaction between the service provider and the consumer through the platform (2.6). All orchestrators' actions were scaled so that the growth in the number of consumers did not cause extra costs at the same rate (2.7).

Orchestrators reduced the risk of service providers, with the exception of Ratti.fi case (2.8). From the consumer's perspective, the risk was reduced by Meedoc, Tutorhouse and Vayable (2.9). In all cases the orchestrator managed the actions in the platform by determining what can or cannot be done on the platform (2.10).

#### Comprehensive consumer experience

In all cases, the whole consumer journey from marketing to payment process was taken care (3.1). Also in all the platforms, the consumer had the opportunity to choose what services he wanted to use (3.2). For example in Yogaia, the consumer can choose the class she/he takes part or does she/he want to take part in live or recorded classes. In Vayable, Meedoc and Yogaia cases, the consumer was free to choose the appropriate provider (3.3). In Ratti.fi and Tutorhouse case, the network orchestrator chose the most appropriate service provider for the consumer.

On Meedoc, Yogaia and Vayable platforms, the consumer had the possibility to either try the service for free or to get advance information of the service provider or the service (e.g. a photograph) (3.4). All the platforms offered the possibility for the personal contact with the service provider or network orchestrator through the platform, e.g. using web camera or a virtual classroom (3.5). All platforms had a centralized consumer support, which was served to the consumer at all stages of the journey (3.6).

Comprehensive consumer experience includes, naturally, how the consumer benefits from the platform. In Ratti.fi, Meedoc and Yogaia cases, the advantage is the affordability of the service compared to traditional service providers (3.7). The user experience was emphasized in Vayable (3.8). The consumers of TutorHouse raised up the positive experience they had during the learning process was important. Distinctly experienced value seems to have a very crucial role in the success of platform business, therefore it would be important to study it more closely in further research. Except of Meedoc and Ratti.fi, other platforms could also create or increase the sense of sociality or communality of consumers (3.9). For example in Tutorhouse and Vayable it was possible to provide services to groups of consumers. In Yogaia case, the communality was increased for example by live

classes or Instagram photo campaigns. Ratti.fi, Meedoc, and TutorHouse promised a satisfaction guarantee to the consumer (3.10).

Sharing economy

Sharing economy in the platform business may be considered for example from the point of view of sharing physical facilities, tools or experience. For example Yogaia and TutorHouse shared the physical facilities (4.2). None of the platforms did not share tools needed for service production (4.3) or finance the tools or products necessary for the service production (4.1). Sharing of tutoring or teaching to more than one consumer was carried out by all the platforms, except Meedoc (4.4). Sharing experience during the use of the service happened in TutorHouse’s group teaching. The same was for Vayable, when the number of different users had chosen the same tour guide service at the same time (4.6). In both of these cases, sharing experience took place in a personal contact. In other cases, sharing of experience was not possible during the use of the service. None of the platforms provided the possibility to service providers (4.7) or consumers (4.8) to form groups or communities by themselves. Consumers of Yogaia, TutorHouse and Vayable had the op-

portunity to give feedback that was also transparent for all the other consumers (4.5). The services of Meedoc and Yogaia could be used anywhere (4.9) and anytime (4.10).

**4.3 Differences between Vayable and studied Finnish platforms**

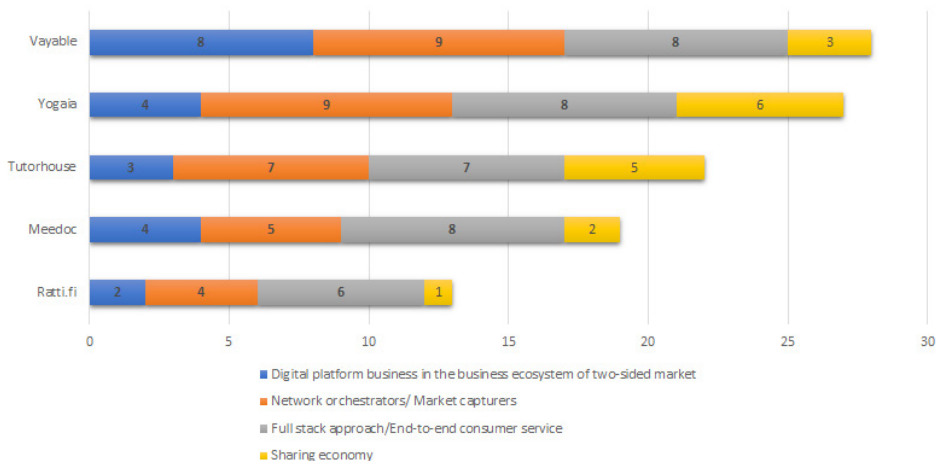
Figure 3 summarizes the numbers of “Yes” responses of different dichotomic variables in the different elements of the conceptual model. It is important to note that, especially in the element of the sharing economy, it is not always clear whether the “yes” response of a variable is good or bad thing.

As a whole, Vayable received the most “yes” responses from the variables (28 times), and Ratti.fi got the least (13 times). Vayable stood out the most from other platforms in “Digital platform business in the business Ecosystem of two-sided markets” element, with twice as many “yes” responses than the second best Yogaia. This seems to be the most important element for Vayable’s better success.

Single factors with the greatest differences between Vayable and Finnish platforms

Table 5 presents eight main characteristics in which the Vayable differs from the Finnish platforms. Based on this study, these factors

**Figure 3.** Summaries of “Yes” responses of variables in elements of conceptual model.



**Table 5.** The main characteristics in which the Vayable differs from the Finnish platforms.

THE ELEMENT OF THE CONCEPTUAL MODEL	THE CHARACTERISTIC
Digital platform business in the business ecosystem of two-sided markets	<p>The service provider has the possibility to take advantage of his own business partners without Vayable’s control.</p> <p>Vayable does not choose service providers, which means that anyone can provide service in the platform.</p> <p>The service provider can set the price of the service.</p> <p>Service providers pay for the use of the platform.</p> <p>Vayable’s business is extensively international.</p>
Network orchestrators/Market capturers	Vayable offers a new kind of supply (local citizens as guides) and creates a new demand for travellers who are tired of traditional tour guides.
Full-stack approach / Comprehensive consumer experience	For the consumer, the most important value is new experience instead of affordable price.
Sharing economy	Sharing experiences in using the service.

are potential causes why Vayable has advanced from the introduction phase to the growth phase, and passed the valley of death.

The operation of Vayable was clearly broader in the international context than the other platforms, since Vayable provided services in almost all of the world’s large cities. Vayable differed from other platforms also in the fact that it did not select the service providers, but anybody with any education background was able to offer services and also determine the price of the service. In the Vayable case it was also possible for service providers to utilize their own business partners in producing services, without the platform controlling it.

In Vayable case, the important fact was that Vayable has created new supply and demand in familiar tourist business. It has differentiated from traditional tour guides with a strong and natural local know-how. In addition, the service providers and the consumers are able to choose the tour or activity according to their interest. The tour supply is also easy to modify according to consumers interests. The description of the services and pricing are clearly

visible. The most important point for the consumer is the memorability and the sharing of experiences, and not the affordability of the service, what seems to be highlighted in the traditional travel guide business.

Platform business suitability for the studied platforms based on different industries

It is also important to consider the suitability of the platform business for different industries when comparing the studied platforms. Guide sector (Vayable case) seems to be the most suitable for platform business when examining platforms from point of view of promoting and preventing factors (information intensity, poorly scalable gatekeepers, market fragmentation, asymmetry of information, regulation and protection, high error costs, and importance of physical resources) that Parker et al. (2016) have recognized.

The guide sector is highly information intensive, as the work of the guide is precisely information work. The gatekeepers are scaled quite poorly. Potential guides are far more in relation to companies focusing on guide services. The market is very fragmented, because

there are a huge number of things worth introducing for people in the world. The information is fairly asymmetrical, even though the Internet has significantly diminished the guide and customer information gap. However, a good guide knows regional details that may not be found on the Internet. The guide sector is not regulated and protected. In practice, anyone can start to guide. The error costs are fairly small. Even if the guide is poor, there is no big harm to the customer. Physical resources are important in the guide sector, but guides do not own them, which also supports Vayable's suitability for the platform business.

When doing the same analysis for the studied Finnish platforms, their industries are not suitable for the platform business as well as the guide sector. Take for example Ratti.fi. The driving school is information intensive, but currently teaching is mainly performed with real cars and in physical classrooms. On the other hand, the gatekeepers are scaled in the sector quite poorly, which supports the platform business. There are far more potential teachers than room for teachers in driving schools. Likewise, the fragmentation of the sector supports the platform business, as students and potential teachers can be almost anywhere. The information is somewhat asymmetrical between the teacher and the student when the teacher has more experiential information. The biggest difference between the driving school and the guide sector is in legislation when the driving school is heavily regulated. The driving school has significantly higher error costs than the guide sector. A bad driving teacher can, in the worst case, cause the student's death. The importance of physical resources in the driving school sector was already mentioned above.

The profiles of Ratti.fi, Meedoc, TutorHouse and Yoagaia are different in terms of promoting and preventing factors, but when considering all the factors together, these

platforms suite to the platform business almost as well or badly. Tutorhouse and Yogai seems to have little bit better chances to success than Meedoc and Ratti.fi have.

## 5. Discussion

This section discusses the results of the study regarding the research questions: 1) What kind of conceptual model describes phenomenon of digital market capture?, 2) How do the potential digital market capturers operate in the introduction and growth phases?, and 3) How could the potential market capturers pass the death valley?

### 5.1 Conceptual model for phenomenon of digital market capture

At the beginning of the study, digital platform, market capturer (network orchestrator), the two-sided market business ecosystem, full-stack approach/comprehensive consumer experience and sharing economy were proposed as the crucial elements of the digital market capture. In the second phase of the study the model was tested by the case study. In the case study it was found that all the elements of the model were essential but the model was missing three important matters.

*The first shortcoming* of the proposed model was the lack of the perspective of individual value. The different kind of value, so called *thick value*, should be handled from the individual's point of view, because it is a reason to visit the platform for the first time, to do the first transaction, revisit the platform and to recommend it to others. When consumers feel to get exceptional value from the platform, they reject existent services and begin to use the platform. According to this study it seems that the orchestrators in the startup phase or in the phase of early growth do not pay enough attention to this. In studying the value, in addition to traditional economic and functional values, it should also be focused on social, emotional, esthetic,

entertaining, escapist, educational, ecological and cultural value. In the long run they are the matters that capture users (Tikka and Gävert, 2014; Haque, 2011; Pine and Gilmore, 1999; Morrison, 1996). It should also be noted must that different people value different things. An individual value has been emphasized by e.g. Wyman (2015), Flint et al. (2011) and Haque (2011). The platform orchestrator should identify these individual valuations and develop the platform more meaningful for individuals.

*The second shortcoming* of the proposed model was the fact that it took into account only the comprehensive experience of the consumers. Based on the case study it is also important to pay attention to comprehensive experience of the service providers. In order to get qualified service providers on the platform, the network orchestrator has to create an exceptional experience also for them.

Comprehensive value creation centred perspective is emphasized also by Amit ja Han (2017). They suggest that the digitalization of businesses calls for orchestrators to conceive of and design their resource configurations based on a system view and value creation centred perspective. This perspective views every potential participant as a potential value creator. Resource configuration of an orchestrator reflects its decisions on what resources to utilize; what needs are addressed with the resources; and how resources are accessed, connected, and coordinated to address the perceived needs. (Amit and Han, 2017). Distinct from a firm-based perspective, the system-based view is characterized by considering explicitly the value propositions for all participants, rather than only those for the customers (Amit and Zott, 2015).

*The third shortcoming* of the proposed model is its static nature. Creation, development and maintenance of platform business is a dynamic process – not only between the different stages of the life-cycle but also

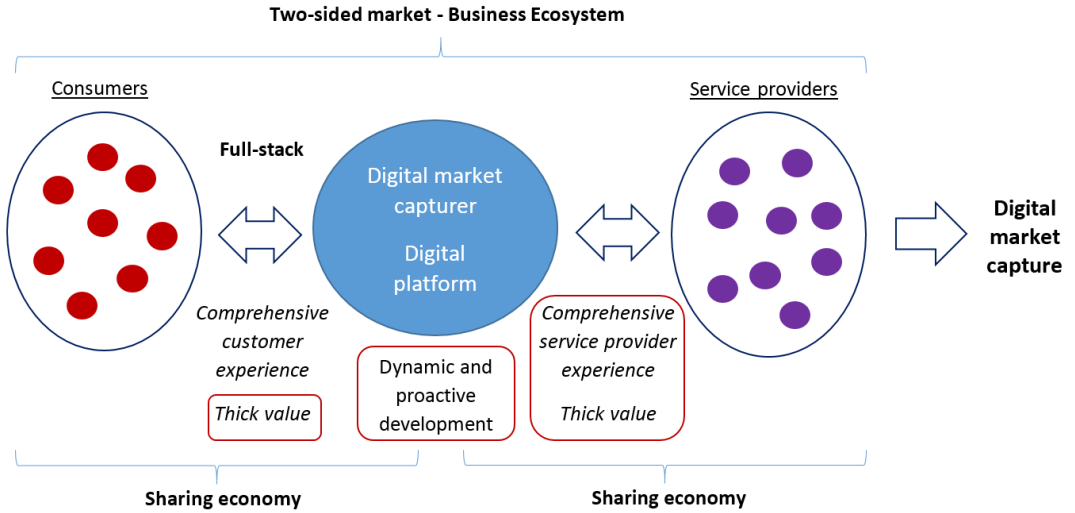
inside the stages. For example, the valuations change, competitors come and go, and legislation changes. This all happens also in the traditional business world but in platform business everything is much faster. In addition, proactive operations are emphasized against reactivity in the platform business. This is because of the possibility to track and analyse users' real actions on the platform which allows the orchestrator to anticipate the needs of change. Fast experiments are an essential part of the proactive development of platform business. By the experiments, user response can be obtained quickly. Even the beginning of platform business is often based on proactive measures as the potential market capturers take advantage of emerging market possibilities. The changes in legislation and human behavior gives the possibility to be proactive. An updated model of digital market capture is presented in the figure 3. Three changes compared to the original model are marked with text frames.

### 5.2 Potential market capturers' operation in introduction and growth phase

The elements of the conceptual model were classified to smaller parts by using 0-1 variables. The purpose was to help identify the similarities and differences between different platform businesses. In each of the four cases in startup or early growth phase, the consumer journey was considered comprehensively in every phase and the advantages of the digitality was utilized whenever it was possible. All the platforms helped the service providers and users to meet. In addition to this, the platforms offered also some own services. On all the platforms, the consumer was able to choose what services he wanted to use. All the platforms had a centered consumer support, which was available in all the stages of the consumer journey.

Monetary transactions were done on all of the platforms, but the business models

Figure 4. Updated suggestion for a model of digital market capture.



differed. Orchestrators did not own all crucial resources (e.g. vehicles or physical facilities) which incumbent companies usually owns. Hence, the principles of the sharing economy were used by all in some way. Each platform was able to scale efficiently, meaning that the orchestrator doesn't have to invest to platform business to the same extent as new consumers will be using the platform. In the start-up phase, the efforts made by the platform for marketing and committing the existing consumers were quite expensive compared to the revenue. This has made the platform business unprofitable. With regard to external service providers, there were remarkable differences in scaling between platforms. For example in Ratti.fi, the driving license teaching requires new teacher resources as the number of students increases. Instead, the virtual theory lessons scaled efficiently. All of the platforms try to get more consumers and service providers, since the limited user base is the greatest problem by far.

### 5.3 Proposals for startup platforms to pass the valley of death

The industry, entity and details affect the success of the platform business. Driving school, yoga, support teaching and medical services are not at the top of the line of business when it comes to their suitability for the platform business. On the other hand, the sectors of these platforms are also not at the bottom from the perspective of platform business. The appropriate timing for them is likely to be all the time closer. For example, demand for education platforms is expected to grow strongly in the future (Parker et al., 2016).

The right timing is strongly influenced, in particular, by changes in legislation and technological development. For example, Ratti.fi was at the time of the research the least potential for the platform business, but a legislative change may change the situation completely. If the limitation of student number is removed in the future, then the driving teacher can earn almost 3,000 euros per month for 150 hours of work, making the teaching much more attractive.

Based on the above, the question arises

whether the success of the platform business is influenced more by excellent overall performance or single factors. For example, in the case of Ratti.fi, the possible removal of the teaching limitation is a very important single factor. If driving teachers can earn more than 10 times more than in the present business, it will certainly attract new teachers, which in turn will attract more students. Probably this legislative change would be to Ratti.fi's business more important than improvements in other factors altogether.

On the other hand, eight factors were identified, in which the studied Finnish platforms operate differently than Vayable. In these factors, changing operations comprehensively or in a subset of factors could reduce the risk of falling into the valley of death. The weights between different factors are naturally different for different platforms. From the perspective of holistic development, it is necessary to improve the performance in those factors that are already being implemented. The element of "Digital platform business in the business environment of two-sided markets" contains the most elements that Vayable does differently than the studied Finnish platforms. It seems that the studied Finnish platforms have not yet sufficiently utilize the mechanisms of two-sided markets that differ according to Parker et al. (2016) clearly from traditional value chain thinking. Amit's and Han's (2017) view about differences in resource configurations as well as the distinct roles of the orchestrator in platform business supports this perspective. Based on their classification, Vayable is a pure transaction enabler, while the studied Finnish platforms are the intermediates of a collaborators and a transaction enablers. Collaborator engages other firms to create value together for customers, while transaction enabler facilitates or enables transactions between user groups. The role of collaborator is linked to traditional value chain thinking, while the role

of transaction enabler is related to platform business on two-sided market.

The studied Finnish platforms should increase the freedom of choice of service consumers and providers. For example, service providers could determine the price of service or consumers could choose the suitable service provider themselves instead of platform. Furthermore, the Finnish platforms should concentrate more on other value elements than just economical value. People are willing to pay for exceptional experiences such as, for example, Vayable offers. In this case it is possible to create completely new demand instead of compete against existing demand.

## 6. Summary and needs for further research

The study presents the proposal for the conceptual model of the digital market capture on a two-sided market. The model was utilized in analyzing five potential market capturers. For the main elements of the model were identified digital platform, market capturer (network orchestrator), business ecosystem consisting of a two-sided market including consumers and service providers as user groups, full-stack approach/comprehensive consumer and service provider experience, thick value, sharing economy, and dynamic and proactive development of platform business. When these elements are taken care of, the result can be the digital market capture, where the market is captured from incumbent companies or completely new market is created. The small size of the sample of this study has an effect on the possibilities to generalize the results.

According to the study, creation of successful platform business is not an easy task. One night wonders or quick profits are unlikely. The biggest obstacle is the slow growth of the number of users or imbalance between the different user groups, which is also identified in previous studies (Parker et al., 2016).

The digital market capture is a complex phenomenon, where a lot of details and the relations between them have to be taken into account. Therefore it is no surprise that so many of platform entrepreneurs falls to the valley of death on their way to growth phase. Network orchestrators at the start-up phase can utilize the results of this study and especially the o-1 variables as a support tool when trying to pass the death valley. At the beginning of the business, all the creativity and energy should be focused to attracting potential users to the platform.

There is and will be a multiple amount of attempts of digital market capturing. This is supported by the view of Dixon (2014), that many of incumbent companies will be captured if they don't act themselves first (Parker et al., 2016; Ilmarinen and Koskela, 2015, McQuivey, 2013). This is due to the fact that digital tools as well as consciousness of the world is increasing all the time. It means that the market capturer can come from wherever. Most of the capture attempts are due to fail, but just one successful capturing is enough and in the worst case it can destroy incumbent business. That is why the incumbents should start to generate ideas themselves to first capture their present market with a digital platform (McQuivey, 2013). The digital transformation is the counteraction or predictive strike of the existing businesses against new digital market capturers. In transformation, the businesses have to create themselves again in order to create new competitive advantage or in order to survive in the digitalized world (Rogers, 2016; Parker et al., 2016; Ilmarinen and Koskela, 2015). This article offers ideas and views from the digital market capturing to existing businesses and to newcomers.

For the incumbent businesses, the comprehensive change is a big challenge, but e.g. Nike, Disney and SAP have approved it to be possible (McQuivey, 2013). Incumbents have a good starting point to platform business,

because they already have existing customers and partners. On the other hand, as an obstacle and hindrance may be the existing business models as well as the operational models and practices that are not compatible with digital world (McQuivey, 2013; Parker et al., 2016).

#### Needs for further research

The digital market capture was studied from the perspective of network orchestrators. However, in the successful market capturing the outside resources play a crucial role – why are they coming to the platform for the first time, do the first transaction and return there again? It is a phenomenon of resource attraction and being hooked (Hagel III et al. 2012; Hamel 2012). In this study, it was found out that in digital platform business the comprehensive consumer experience should be approached from the perspective of individually experienced thick value as Tikka and Gävert (2014), Haque (2011), Flint et al. (2011) and Morrison (1996) have pointed out. In addition to the traditional economic and functional value, the emotional, cultural, social, ecological, symbolic, and esthetic values have to be paid attention to (Tikka and Gävert, 2014; Morrison, 1996; Tantalo and Priem, 2014; Pine and Gilmore, 1999). The competitive advantage is created by being able to offer individual thick value that is different from competitors (Parker et al., 2016; Tikka and Gävert, 2014; Kim and Mauborgne, 2005).

The new conceptual model of the digital market capture on a two-sided market and a list of dichotomic variables were presented. However, only five platforms of potential market capturers were studied. A wider sample is needed for the generalization of the results. On the other hand, the model was created for consumer businesses. It would be beneficial to study the phenomenon in business-to-business ecosystems.

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# Stock Exchange Mergers and Weak-Form Information Efficiency: Evidence from the OMX Nordic and Baltic Consolidation\*

Jörgen Hellström, Yuna Liu and Tomas Sjögren

## Abstract

*In this paper, we study whether the creation of a uniform Nordic and Baltic stock trading platform has affected weak-form information efficiency. A time-varying measure of return predictability for individual stocks is used in a panel-data setting to test for stock market merger effects. The results indicate that the stock market consolidations have had a positive effect on the information efficiency and turnover for an average firm. The merger effects are, however, asymmetrically distributed, indicating, among other, a flight to liquidity effect, i.e. relatively large (small) firms located on relatively large (small) markets experience an improved (reduced) information efficiency.*

**JEL Classification:** G12, G14, G15.

## Keywords:

*Time-varying return predictability, turnover, market structure.*

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## 1. Introduction

A major trend during the last decades has been the merger of international stock exchanges (see e.g. Kokkoris and Olivares-Caminal, 2008). A number of mergers have been made, e.g. the Euronext (2005), the OMX (2003-2006), the NYSE-Euronext (2006) and the NASDAQ-OMX (2007), and additional mergers can be expected in the future because of the competition between market exchanges and due to pressures to cut costs.<sup>2</sup> In light of this changing market structure for stock trading, an important question is how these changes potentially affect the quality of stock markets in terms of information efficiency; i.e. to what extent do current stock prices represent fair values given the available information? Stock price efficiency is important for a number of reasons. First, it is essential for an efficient allocation of savings within an economy, second, it is crucial for investor and firm-owner trust in stock markets, third, it is pivotal for an efficient construction of managerial compensation and incentives schemes, and fourth, it is of central interest through its connection to asset price predictability.

There are few theoretical models which predict how the trading behavior may be affected by a consolidation of stock exchanges. Arguments may nevertheless be put forth in favor of an expected overall increase in information efficiency. For example, a consolidation of markets may reduce the trading costs (Mendelson, 1987) thereby increasing the pool of potential investors available for each stock which, on average, makes deviations from a fair price less likely. That information efficiency increases following a merger is largely

unexplored, although tentatively supported by the empirical findings of Khan and Vieito (2012). Apart from the expected positive effect on overall market efficiency, one can also argue that effects may be asymmetrically distributed over firms. For example, stocks which after a merger receive more attention from investors abroad due to increased visibility on foreign markets may become more information efficient compared with firms which after a merger receive unchanged or less investor attention. Nielsson (2009) finds that after the Euronext merger, liquidity increases for large, but not for small and medium sized, firms. Conditional on the changes in the level of investor attention (i.e. liquidity), it is also possible that the composition of informed versus uninformed investors following a stock may change, leading to additional asymmetric merger effects. For example, a change which leads to an increase in the proportion of informed investors that follow a given stock may make the given stock less likely to deviate from its fundamental value, whereas an opposite argument applies if it instead is the proportion of uninformed investors that goes up. Since knowledge of how stock exchange mergers influence stock price information efficiency to date largely is missing<sup>3</sup>, in this paper we provide new empirical evidence by studying the effect of the OMX Nordic and Baltic stock exchange consolidation (henceforth the OMX merger).

During the period 2003-2006, the previously national stock markets in Denmark, Finland, Iceland, Sweden and the Baltic<sup>4</sup> countries merged into a single trading platform (the OMX merger).<sup>5</sup> To study the effect of these

<sup>1</sup> The harmonization of regulatory environment for capital markets in Europe combined with technological advances are likely to further fuel merger activities in the European capital markets.

<sup>2</sup> Nielsson (2009) studies stock venue merger effects from the Euronext merger upon liquidity, while Kokkoris and Olivares-Caminal (2008) focus up corporate access to financial capital. Khan and Vieito (2012), in an exploratory study, investigate the impact on weak-form market efficiency of the merger between the Portuguese stock exchange and Euronext in 2002.

<sup>3</sup> Estonia, Latvia and Lithuania.

<sup>4</sup> Since data for stocks on the Icelandic stock market partly are missing for the considered sample period, we exclude the Icelandic merger into the OMX in 2006 in our subsequent analysis.

mergers on information efficiency, time-varying measures of return predictability are estimated on stock returns for individual firms. These measures are then in a second stage related to variables measuring the mergers as well as to other covariates. This allows us to study possible asymmetric merger effects upon information efficiency based on firm location, size, and pre-merger visibility. A main advantage with our approach of identifying potential merger effects is that we can condition on other factors affecting information efficiency, both in the period before and in the period after the mergers. This is an extension compared with Khan and Vieito (2012) who compare the level of weak-form market efficiency for a pre-merger period with a post-merger period without conditioning on other covariates. The main contributions of the current paper are therefore that we (i) provide new empirical evidence concerning the effects of stock exchange mergers up information efficiency, (ii) analyze the issue using time-varying measures of efficiency, (iii) utilize panel data which makes it possible to use covariates and control variables for time- and firm-specific unobserved heterogeneity. Since much of the recent market efficiency literature (e.g. Gu and Finnerty (2002); Lagoarde-Segot (2009); Kim et al. (2011); Chuluun et al. (2011)), supports the notion that the relative level of weak-form market efficiency is time-varying and to a large extent depends on (for the researcher) unobservable factors, an approach allowing for covariates and controls of unobserved heterogeneity is of central importance.

To measure the time-varying level of return predictability, multiple versions of Wright's sign test (see Kim and Shamsuddin, 2008) are estimated on moving sub-samples over the considered time period.<sup>6</sup> Based on these measures, we obtain time-series of the

test statistic for each individual stock. In the empirical analysis, these time-series are then analyzed directly as measures of the relative level of information efficiency. In the second stage of the analysis, merger event variables corresponding to each sub-sample window are used to measure the effect of the stock exchange mergers, conditioning on firm size, the prevailing market condition and on annual time- and firm-specific fixed effects. To examine possible asymmetric merger effects upon firms, we use interaction variables between the merger event variable and firm pre-merger listing locations, pre-merger firm size, and pre-merger foreign sales (to capture pre-merger foreign visibility). In addition to this analysis, we also provide evidence for merger effects on stock liquidity (measured by stock turnover) to gain further insights into the causes behind asymmetric changes in information efficiency.

The main findings of our study indicate (i) that the information efficiency and the turnover for an average firm are both improved by a consolidation of stock markets and (ii) that the effects are asymmetrically distributed over firms. In terms of asymmetric merger outcomes, we find tentative evidence supporting a flight to liquidity effect, i.e. improved information efficiency and turnover for relatively large firms located on relatively large markets, and reduced information efficiency for relatively small firms located on small markets. Our results also indicate that firms already visible to (i.e. traded by) foreign investors in the pre-merger period receive a relatively lower increase in information efficiency than firms less available to foreign investors in the pre-merger period. These results indicate that changes in the level of investor attention (turnover) may explain some, but not all of the changes in information efficiency. This lends support to the

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<sup>5</sup> As a comparison, we also repeat our empirical analysis instead using the multiple variance ratio (VR) tests by Chow and Denning (1993) as a measure of time-varying return predictability. Results, who are qualitatively (in terms of signs and significance) similar, may be obtained on request. Evidence from Monte-Carlo studies in Kim and Shamsuddin (2008), do, however, favor the use of the multiple versions of Wright's sign test.

idea that merger effects may also stem from changes in the composition of informed versus uninformed investors following a stock.

The outline of the paper is as follows: Section 2 describes the OMX mergers and discusses different hypotheses about how stock market mergers may affect weak-form market efficiency. In Section 3 the data, the variable measurement and the empirical model are presented. Section 4 contains the results while the final section concludes.

## 2. The OMX merger and information efficiency

### 2.2 Background

The cooperation between the Nordic stock exchanges was formally initiated by the establishment of the NOREX alliance in 1998. It linked the stock exchanges in Stockholm and Copenhagen via a joint system for equity trading called SAXESS<sup>7</sup> and harmonized trading rules and membership requirements. The aim of this alliance was to facilitate interaction between exchanges without formally merging them. In 2000, both the Oslo and the Icelandic stock exchanges joined the alliance, followed by the stock exchanges in Helsinki,

Riga and Tallinn in 2004. The stock exchange in Vilnius joined the alliance in 2005. In addition to this alliance, formal mergers of the Danish, Finnish, Icelandic, Swedish and the Baltic stock exchanges have taken place via the OMX mergers (today NASDAQ-OMX). In 2003, the Stockholm stock exchange (OMX) merged with the Helsinki (HEX), in 2004 the stock exchanges in Riga and Tallinn were included, and in 2005 the Vilnius exchange joined and in the same year OMX-HEX acquired the Copenhagen stock exchange. Finally, in 2006 the Icelandic stock exchange merged with OMX. After these mergers OMX offered access to about 80 percent of the Nordic and Baltic securities markets through a unified trading platform. Since the effects of a stock exchange merger are likely to be observed from the date when investors are given access to the common trading platform, these dates have been identified. Table 1 shows the dates when investors from each market were given access to the other trading venues for our considered markets (i.e. excluding the merger with the Icelandic stock market). For example, as of September 27, 2004, Swedish investors could access and trade stocks listed

<sup>6</sup> Securities-trading on the stock exchange takes place through the common SAXESS trading system. The SAXESS system was implemented at Stockholm stock exchange March 12, 1999, Copenhagen June 21 1999, Oslo May 27, 2002 and Helsinki, Riga, and Tallinn, 27 September 2004.

**Table 1:** Merger date for each market.

MARKET	2004-09-27	2005-01-03	2005-05-30
Stockholm (Sth)	Hel, Rig, Tal	Cop	Vil
Helsinki (Hel)	Sth, Rig, Tal	Cop	Vil
Copenhagen (Cop)	-	Sth, Hel, Rig, Tal	Vil
Riga (Rig)	Sth, Hel, Tal	Cop	Vil
Tallinn (Tal)	Sth, Hel, Rig	Cop	Vil
Vilnius (Vil)	-	-	Sth, Hel, Cop, Rig, Tal

on the Helsinki, Riga, and Tallinn stock exchanges via the SAXESS cash trading system. Later, Swedish investors could also trade Danish stocks when the trading platforms in Stockholm and Copenhagen were merged on January 3, 2005.

### 2.3. Information efficiency and stock exchange mergers

The prior literature emphasizes that the level of market efficiency may vary over time (e.g. Gu and Finnerty, 2002; Lo, 2004; Lagoarde-Segot, 2009; Kim et al., 2011; Chuluun et al., 2011). In this literature, it is acknowledged that different financial markets may be weak-form efficient to varying degrees instead of either being weak-form efficient or not, and that the level of weak-form efficiency may change over time. This is in contrast to much of the earlier empirical literature (see e.g. the survey by Lim and Brooks, 2011) which is based on the assumption of a constant level of information efficiency and which tries to reject or accept that markets are either weak-form efficient or not.

There is also a literature which looks at under what types of conditions markets are efficient. Lim and Brooks (2011) point out that factors that may lead to departures from market efficiency are characteristics of the market microstructure, limitations to arbitrage, psychological biases among investors, noise trading, and market imperfections. The degree of market efficiency is also likely to evolve over time due to changes in market conditions, macro institutions, market regulations, and information technologies. Today, there is a large literature which attempts

to show a link between events to periods of low(er) market efficiency. Some studies<sup>8</sup> relate market conditions (mainly financial crises) to market efficiency whereas other studies<sup>9</sup> link financial reforms and changes in the regulatory framework to market efficiency. Yet other studies<sup>10</sup> test how technology improvements (the introduction of electronic trading systems) and the introduction of price limitation systems affect market efficiency.<sup>11</sup>

Is a stock exchange merger also a factor, or event, which may influence the information efficiency of stock prices? There are few theoretical models which provide guidance on what to expect after a consolidation of stock markets. A number of arguments in line with Nielsson (2009) may, however, be put forward leading to testable hypotheses. One is that a stock exchange merger brings buyers and sellers together on a common trading venue which reduces both the direct and the indirect (non-monetary) costs related to trading. Investors' direct costs may decrease if exchange operators pass on possible gains from the merger, e.g. due to scale effects from common trading and clearing systems, to investors in terms of lower fees. Indirect costs (e.g. in terms of saving time) are also likely to decrease when trading and clearing systems become more uniform.<sup>12</sup> This argument is in line with Mendelson (1987) who advances the network argument, i.e. that lower trading costs are linked to the concentration of buyers and seller to one consolidated market. Reduced direct and indirect trading costs are also likely to broaden a stock exchange in terms of the number of participants, both domestic and foreign, which implies that each

<sup>7</sup> See Hoque et al. (2007), Kim and Shamsuddin (2008), and Kim et al. (2011).

<sup>8</sup> Lagoarde-Segot (2009), Kim and Singal (2000a, b), Antoniou (1997), and Groenewold et al. (2004).

<sup>9</sup> Jain (2005), Naidu and Rozeff (1994), Freund et al. (1997), and Ryoo and Smith (2002).

<sup>10</sup> See e.g. Lim and Brooks, (2011), for a more comprehensive survey.

<sup>11</sup> Direct fee's could possibly increase on a consolidated market if the merger reduces venue competition in trading of stocks and exchanges exert monopoly power. In a cross-country merger of stock markets, most stocks are, however, usually only traded on one market in the pre-merger period. Thus, competition in trading of a given stock is not likely to change to any larger extent in this type of merger.

individual firm faces a potentially larger pool of investors after a merger. A large number of participating investors may lead to a deepening of the market, i.e. larger quantities available at prices marginally above and below the prevailing market prices, which makes individual trades less likely to drive price movements. These arguments imply that a consolidation of stock markets is likely to have a positive effect on the number of investors analyzing and trading in a given stock, and it may also imply that deviations from a fair price become less likely. Hence, information efficiency for an average firm is expected to increase on an overall basis.

Given the arguments in favor of an overall positive effect of exchange mergers upon market efficiency it is, however, possible that the effect is asymmetrically distributed, c.f. Nielsson (2009). One may expect that the effect of a merger on an individual stock depends on how much investor attention it receives after the merger compared to the attention received before the merger, as well as on the initial level of efficiency. If a stock, which before the merger displayed much deviation from a random walk (i.e. a low level of information efficiency), after the merger receives more investor attention then the information efficiency may increase. Whether a given stock receives more or less investor attention in the post-merger period is likely to depend on the firm's previous (pre-merger) visibility on the foreign market. The latter is, in turn, likely to depend on the firm's size and foreign sales. A large firm, or a firm with sizable foreign sales, may already be known to foreign investors. For a firm with a high pre-merger visibility, the merger may either increase trading in the stock if it attracts new foreign investors, or not affect trading if foreign investors are already trading in the stock. These arguments imply that previous visibility may work in either direction.

Another size related argument is that a firm which before the merger is large on a small stock market may end up being a medium sized (or small) firm on the consolidated market. Given that many investors form portfolios with firm size as a determining factor, a change in a firm's relative position in the firm size distribution may lead to a corresponding change in investor attention after the merger. Since many institutional investors favor relatively large firms in their portfolios, this may imply that a reduction in a firm's relative position in the firm size distribution will lead to less investor attention and reduced information efficiency.

One may also argue that asymmetric merger effects may originate from changes in the composition of traders following different stocks, i.e. in the proportion of informed versus uninformed investors (c.f. discussion in Grossman and Stiglitz, 1980). If the relative proportion of informed investors that trade in a given stock increases after a merger then this may, all else equal, decrease the likelihood of price deviations from a fair price.<sup>13</sup> An opposite argument applies if, instead, the proportion of uninformed traders goes up after a merger.

Empirical studies which look at how stock venue mergers affect market efficiency are to date scarce. One exception is Khan and Vieito (2012) who investigate the effects of the 2002 merger of the Portuguese stock exchange with Euronext. Although this study provides mixed results depending on the method used, it favours the finding of a positive effect upon weak-form market efficiency. Another relevant study is Nielsson (2009) who looks at the impact of stock exchange mergers (Euronext) upon liquidity. Since liquidity, in general, is found to be positively correlated with market efficiency (see e.g. Chordia et al. (2008) and Chung and Hrazdil (2010)), the results from Nielsson (2009) offer some guidance. A no-

<sup>13</sup> This line of reasoning is in line with the conjecture made by Grossman and Stiglitz (1980) that "the more individuals who are informed, the more informative is the price system".

**Table 2:** Sample summary statistics, 2000-2007.

	FULL SAMPLE	STOCKHOLM	HELSINKI	COPENHAGEN	BALTIC
Return characteristics:					
- Mean daily return (%)	0.013 (0.087)	-0.021 (0.092)	0.006 (0.083)	0.045 (0.060)	0.088 (0.056)
- Mean volatility (s.d., %)	3.182 (2.141)	3.893 (2.663)	2.825 (1.485)	2.369 (1.355)	3.109 (1.396)
- Mean kurtosis	36.861 (87.321)	20.937 (44.498)	23.310 (69.192)	55.881 (109.806)	82.988 (149.996)
Market capitalization (MC):					
- Mean MC (thousands, Euro)	1,177,481 (9,060,110)	1,729,362 (12,315,835)	1,444,537 (8,906,824)	501,707 (1,644,029)	69,760 (148,238)
- Mean MCLarge firms (thousands, Euro)	9,613,610 (27,446,593)	14,342,741 (23,432,462)	11,335,759 (25,937,724)	4,042,294 (3,750,743)	440,395 (277,543)
- Mean MCSmall firms (thousands, Euro)	9,834 (14,936)	10,264 (20,719)	10,048 (5,795)	10,358 (10,714)	5,690 (8,999)
GDP per capita (Euro)	7,358 (1,859)	8,040 (511)	7,322 (501)	9,456 (337)	4,615 (898)
Nr. of firms	551	236	111	153	51
Nr. of firms missing foreign sales info.	186	79	20	43	44
Proportion of firms with foreign sales <sup>a</sup>	0.649	0.745	0.725	0.464	0.429

Returns and market capitalization are calculated as averages over all/large/small firms over the full sample period. GDP per capita is based on real, quarterly, seasonally adjusted data. <sup>a</sup>Proportion based on fully observed sample, i.e. net of firms missing foreign sales information. Standard deviations in parenthesis.

table finding by Nielsson is the asymmetric effect on liquidity for different firms. For large firms, liquidity is positively affected by mergers while there are no effects for medium sized and small firms. Translating these findings to market efficiency indicate an asymmetric effect with a gain in market efficiency for large firms but no effect for medium and smaller firms.

### 3. Data, measures, and the empirical model

#### 3.1 Data

To study to what extent the return predictability on the Nordic and Baltic stock markets have been affected by the OMX mergers, daily stock price data has been collected from the Thomson Reuters Datastream. The

sample covers the period January 4, 2000 to December 31, 2007<sup>14</sup> and includes stock price data for 236 Swedish, 111 Finnish, 153 Danish, and 51 Baltic (13 Latvian, 10 Estonian and 28 Lithuanian) stocks. Descriptive statistics are presented in Table 2 along with measures of stock market capitalization, per capita GDP, and indicators of foreign sales.

To illustrate some key characteristics of the rates of return among the considered stocks, the average of the mean daily stock returns for individual firms, the average of the mean standard deviations (volatility), as well as the average of the mean kurtosis over all stocks and time periods, separated over each of the considered markets, are displayed in Table 2. During the sample period the average daily return for stocks located in Stockholm

<sup>14</sup> To avoid effects on time-varying return predictability from the financial crisis in 2008, and from the increased fragmentation in stock trading, due to the introduction of MTFs from 2008 and onwards, the sample is restricted until the end of 2007. The issue of market efficiency and fragmentation of trading is studied in Hellström, Liu, Sjögren (2013).

was negative, while it was positive for stocks on all the other markets. The highest average return, 0.088 percent, is found on the Baltic markets. The average volatility (s.d.) indicate that the highest mean variation in returns are found among Swedish firms followed by Baltic firms. In terms of kurtosis, the aggregated numbers indicate clear deviations from normality. The average kurtosis is highest on the Baltic markets.

We use a firm's market capitalization as a measure of company size. Table 2 also displays the mean market capitalizations on each market both for the full sample as well as for large and small firms. Here, large and small correspond to the 10 percent of firms with the highest and lowest, respectively, market capitalization. The average market capitalizations show that the highest average values are found in Stockholm, Helsinki, Copenhagen and the Baltic markets, in descending order. Among the 10 percent largest firms on each separate market there are considerable differences. The average large firm listed in Stockholm is about 1.27 times larger than the average large firm in Helsinki, 3.55 times larger than the average large firm listed in Copenhagen, and about 32.57 times larger than the average large firm listed on the Baltic markets. This means that firms that in the pre-merger period were large on the Baltic market, are likely to be ranked as small or middle sized on the post-merger stock market.

Table 2 also shows that the average (over time) seasonally adjusted real per capita GDP is highest in Denmark, followed by Sweden, Finland and the Baltic states. Foreign sales data at the end of the pre-merger period have been collected from the Thomson Reuters Datastream Worldscope database. Unfortu-

nately, data on foreign sales are missing for a number of firms. For the full sample, 34 percent of the firms lack information about whether they had foreign sales at the end of the pre-merger period. Here, 33 percent of the firms listed in Stockholm, 18 percent of the firms listed in Helsinki, 28 percent of the firms listed in Copenhagen and 86 percent of the firms listed on the Baltic markets lack this information. In Table 2, we also report the proportion of firms with foreign sales (for the firms on which we have full information). This proportion is highest for firms listed in Stockholm, 0.74, and lowest for firms listed on the Baltic markets, 0.43. This means that over 7 out of 10 firms on the Stockholm stock exchange had foreign sales at the end of the pre-merger period, while this figure in the Baltic states was roughly 4 out of 10 firms.

### 3.2 Measures of time-varying return predictability

To measure the relative level of stock return predictability over time, we use the multiple version of Wright's sign test (*JS*, see Kim and Shamsuddin, 2008) on moving sub-sample windows over the considered time span.<sup>15</sup> The test, performed on each sub-sample, has in Monte Carlo experiments (Kim, 2006; Kim and Shamsuddin, 2008) been found to perform well (better than conventional *VR* tests) in terms of size distortion and power, and the test is robust to more general forms of conditional heteroscedasticity such as GARCH and stochastic volatility errors. The test is, as the conventional *VR* tests, based on the fact that if asset return is purely random, then the variance of the *k*-period return is *k* times the variance of the one-period return. The multiple *VR* test considers whether the set of *VR* statistics for different holding periods *k* are jointly

<sup>15</sup> Apart from the multiple version of Wright's sign test we also test the robustness of the reported results by using the multiple variance ratio (*VR*) test by Chow and Denning (CD, 1993). We are grateful towards Professor Jae Kim for sharing the Gauss code concerning the multiple *VR* tests used in this paper. In the empirical analysis we also considered the wild bootstrap test of Kim (2006) on a sub-sample of firms rendering qualitatively similar results, i.e. with regard to sign and significance. This test was, however, time consuming to perform.

equal to one. For  $r_t, t=1, \dots, T$ , asset returns the conventional VR statistic can be written as

$$VR(r; k) = \frac{\frac{1}{Tk} \sum_{t=k}^T (r_t + r_{t-1} + \dots + r_{t-k+1} - k\hat{\mu})^2}{\frac{1}{T} \sum_{t=1}^T (r_t - \hat{\mu})^2}$$

where  $\mu = T^{-1} \sum_{t=1}^T r_t$ . Under regularity assumptions for  $r_t$ , corresponding to  $r_t$  being serially uncorrelated with a general form of heteroscedasticity including the ARCH-type of conditional variance (see Lo and MacKinlay, 1988), it can be shown that under the null hypothesis the unknown population VR is equal to one, i.e.  $V(k)=1$ , and the test statistic is given by

$$M(r; k) = \frac{VR(r; k) - 1}{\left( \sum_{j=i}^{k-1} \left[ \frac{2(k-j)}{k} \right]^2 \delta_j \right)^{1/2}}$$

where

$$\delta_j = \frac{\sum_{t=j+1}^T (r_t - \hat{\mu})^2 (r_{t-j} - \hat{\mu})^2}{\left[ \sum_{t=1}^T (r_t - \hat{\mu})^2 \right]^2}$$

is asymptotically standard normal distributed (Lo and MacKinlay, 1988). The non-parametric sign based VR test of Wright (2000) is recommended in the case of non-normal time series and has been found to have a high power against a wide range of models displaying serial correlation. Let  $s_t \in (0,1)$ , be an indicator variable with  $s_t=1$  if  $r_t > 0$ , and zero otherwise. The sign based test of the individual hypothesis  $V(k)=1$  against the alternative  $V(k) \neq 1$  is then given by

$$s_i(k) = \left( \frac{Tk^{-1} \sum_{t=k}^T (s_t + s_{t-1} + \dots + s_{t-k+1})^2}{T^{-1} \sum_{t=1}^T s_t^2} - 1 \right) \left( \frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}$$

Kim and Shamsuddin (2008), in spirit of Chow and Denning (1993), propose a multiple joint test of  $V(k_i)=1$  for  $i=1, \dots, J$ , against the

alternative hypothesis that  $V(k_i) \neq 1$  for some  $i$ . The test is given by

$$JS = \max_{1 \leq i \leq J} |S_i(k_i)|.$$

The exact sampling distribution of JS may be obtained through simulation, see Chow and Denning (1993) and Kim and Shamsuddin (2008).<sup>16</sup>

### 3.3 Testing for merger effects

To study to what extent weak-form market efficiency has been affected by the OMX mergers, we study the time-varying predictability in asset returns. The most straightforward measure of relative time-varying return predictability is to use the estimated series of the VR test statistics as a direct measure. The magnitude of the test statistic is then interpreted as a relative indicator of efficiency where a higher test statistic implies a lower probability of making a type-I error when rejecting the efficiency hypothesis, see e.g. Lagoarde-Segot (2009). In the second stage analysis, a panel data regression model is used to model the test statistics directly. To measure the effect of the OMX merger upon the time-varying return predictability of individual stocks, dummy variables are created with the value one, zero otherwise, from the date when the stock was possible to trade on the common OMX trading platform.<sup>17</sup> This means that for stocks on the Stockholm, the Helsinki, the Riga, and the Tallinn stock exchanges this dummy takes the value one from September 27, 2004 onwards, while for stocks on the Copenhagen stock exchange the dummy takes the value one from January 3, 2005 onwards. Since our dependent variable is constructed based on the VR tests for sub-samples, the dating of these in regard to the co-

<sup>15</sup> For example, the 5 and 10 percent critical values for with are 2.40 and 2.10, while 2.32 and 2.04 for , respectively.

<sup>16</sup> It is possible that the trading on, e.g. the Copenhagen stock exchange, was affected by the merger between the Stockholm, the Helsinki, the Riga, and the Tallinn stock exchanges, even though Copenhagen was not directly involved. For example, investors already trading on many of the Nordic and Baltic markets during the pre-merger period could have changed their trading patterns due to the merger, possibly also affecting trading on markets not directly involved in the merger. These effects are, however, likely to be of minor order and are therefore ignored.

variates and the merger dummies need some consideration. If we let  $t_m$  indicate the date of the merger (i.e. the date from when investors could trade on a common trading platform), then we define a sub-sample window from  $t_0$  to  $t_1$  where  $t_0 < t_m < t_1$ . Based on the returns in the sub-sample window the VR statistic is calculated. Since the test indicates return predictability within the given sub-sample, and the time indexing for sub-samples do not correspond to the specific dates of the mergers, the merger event variable in the second stage analysis is the average of the merger event dummy during the sub-sample window. Thus, the merger event variable is a proportion between zero and one. For sub-samples with all return observations pertaining to the period before  $t_m$  the variable takes the value zero, for sub-samples containing return observations from both before and after  $t_m$ , a value between zero-one, and for sub-samples containing return observations only from the period after  $t_m$ , the value one.<sup>18</sup>

Apart from using fixed effects to control for unobserved time-constant stock specific characteristics, time-varying control variates unrelated to the merger event but possibly related to weak form information efficiency, are also included. Since large firms are usually better covered by analysts, and since investors typically are more familiar with big salient firms<sup>19</sup>, the firms' market capitalization, as a measure of stock size, is included. Here we assume that price levels and the number of outstanding stocks are relatively unaffected by the merger event. In line with Nielsson (2009), GDP per capita is included as a control for

the prevailing market condition. The market condition is unrelated to the merger and has been found to affect both trading volumes (Nielsson, 2009) and weak-form market efficiency (e.g. Hoque et al., 2007; Kim and Shamsuddin, 2008; and Kim et al., 2011). For the GDP and market capitalization, the average value during each sub-sample period is used in the second stage analysis.

## 4. Empirical analysis

### 4.1 Return predictability

Before turning to the main analysis of potential merger effects upon weak-form information efficiency, let us first discuss some results for the time-varying VR statistics. These are estimated on moving sub-sample windows of two years (500 trading days), moving the window forward one week at a time.<sup>20</sup> In Table 3, we summarize our results for the repeated JS test statistics over the considered time period aggregating the firm statistics over different categories based on location, size and foreign sales for the pre- and post-merger period, respectively.<sup>21</sup> In our sample, a number of stocks on the Helsinki and Baltic stock markets are characterized by infrequent (thin) trading leading to a relatively large number of zero return observations on the daily frequency. Many studies (Lo and MacKinlay, 1990; Stoll and Whaley, 1990; Miller et al., 1994) have found that thin trading can generate spurious serial correlation in stock returns, i.e. return predictability, and seriously bias the outcome of empirical tests of market efficiency. Summary statistics excluding thinly traded stocks are therefore also shown in Table 3.<sup>22</sup>

<sup>17</sup> Once the merger event variables take the value one, i.e. is only based on return observations after the merger date, they retain this value until the end of the sample period.

<sup>18</sup> Large and influential investors, e.g. pension funds, often focus on trading in the biggest companies.

<sup>19</sup> The choice of 500 trading days is motivated by the fact that the tests have been shown to perform reasonably well for this sample size (Kim and Shamsuddin 2008). In the robustness testing, similar results were also obtained with sub-sample windows of 400 and 600 trading days.

<sup>20</sup> Given that the non-parametric sign test (JS) is more appropriate for non-normal return distributions, we focus mainly on analysis of this statistic within the paper. Results pertaining to the analysis of the CD test statistic may be obtained from the authors upon request.

<sup>21</sup> To define thinly traded stocks we have chosen stocks with more than 10 percent out of the full sample consisting of zero volume trading days.

Table 3: Summary statistics for Wright's joint sign test.

	PRE-MERGER PERIOD					POST-MERGER PERIOD				
	Meanb	s.d.	Min.	Max.	Obs.	Meanb	s.d.	Min.	Max.	Obs.
Joint sign test										
Full sample										
- All	10.347*	22.008	0.143	111.961	78,027	6.279*	13.840	0.085	111.961	88,375
- Exclu. thin	1.808*	1.105	0.143	11.695	62,985	1.685*	0.908	0.894	12.706	70,499
Stockholm										
- All	1.627*	0.769	0.171	6.032	32,568	1.573*	0.706	0.111	6.622	38,704
Helsinki										
- All	26.064*	28.245	0.143	106.193	15,318	14.242*	20.510	0.085	104.973	18,204
- Exclu. thin	2.639*	2.162	0.143	11.695	5,106	1.777*	0.974	0.171	8.594	6,068
Copenhagen										
- All	1.859*	1.025	0.179	8.318	23,103	1.709*	0.850	0.089	5.724	23,103
Baltic										
- All	44.353*	36.672	0.268	111.961	7,038	23.353*	22.684	0.376	111.961	8,364
- Exclu. thin	2.035*	1.455	0.268	8.723	2,208	2.917*	2.125	0.376	12.706	2,624
Large firms										
- All	1.868*	2.249	0.143	22.460	7,884	1.724*	1.480	0.180	18.532	9,028
- Exclu. thin	1.602*	0.842	0.143	6.039	7,746	1.569*	0.607	0.180	3.578	8,864
Small firms										
- All	15.780*	30.687	0.182	111.961	7,962	10.855*	21.285	0.189	110.498	8,950
- Exclu. thin	1.570*	0.710	0.182	4.472	6,444	1.943*	0.977	0.189	6.708	7,146
Foreign sales										
- All	4.911*	10.345	0.171	83.913	33,369	2.695*	4.564	0.085	60.362	38,205
- Exclu. thin	1.733*	1.079	0.171	11.655	28,263	1.560*	0.771	0.098	8.594	32,137
Non-foreign sales										
- All	11.082*	23.155	0.143	107.275	18,431	7.050*	15.396	0.147	94.386	20,225
- Exclu. thin	1.895*	1.151	0.143	11.695	15,119	1.660*	0.811	0.147	4.919	16,289

aNote that the merger date differs between markets (Stockholm, Helsinki, Riga, and Tallinn: 2004-09-27; Copenhagen: 2005-01-03; Vilnius: 2005-05-30) and that no stocks are excluded due to thin trading on the Stockholm and Copenhagen stock markets. bMean of time-varying variance ratio test over time and firms for different locations/categories. \*Indicates a significant difference in sample means of the JS test statistics between the pre- and post-merger periods based on two sample t-tests at significance level p<0.05.

A comparison of the pre- and post-merger periods for the full sample, as well as for the different categories, indicates that the mean of the *JS* test statistic distribution is, in general, significantly lower (based on two sample *t*-tests) in the post-merger period. This indicates an (unconditional) overall average improvement in relative information efficiency potentially due to the mergers. Exceptions to this general tendency of improved efficiency concern small and Baltic firms for the samples excluding thinly traded stocks. For Baltic firms the mean of the *JS* distribution increases from 2.035 in the pre- to 2.917 in the post-merger period, while for small firms the mean increases from 1.570 in the pre- to 1.943 in the post-merger period, both excluding thinly traded stocks. This is a tentative indication that the merger effects upon information efficiency may be asymmetrically distributed over firms with possible negative effects for Baltic and small firms. A comparison between the distributions for the *JS* test statistic including and excluding thinly traded stocks, respectively, reveal significant size differences. For the full sample the mean value including thinly traded stocks is about 5.7 times (and the maximum value 9.6 times) larger than for the sample excluding thinly traded stocks. Because of the potential bias in the test statistic for thinly traded stocks, we therefore focus on the sample where these are excluded. A comparison across firm location shows that the mean *JS* statistic is smallest for firms listed in Stockholm followed by Copenhagen, the Baltic countries, and Helsinki, respectively. Somewhat surprising the *JS* statistic is on average lower for smaller than for larger firms. This is most likely due to a proportionally larger exclusion of firms due to thin trading for the group of smaller

firms. Comparing firms with foreign sales at the end of the pre-merger period with those without, shows that the *JS* statistic is on average smaller for those with foreign sales. Observe that if we interpret the mean *JS* statistic in terms of significant deviations from a random walk, i.e. we compare the mean *JS* to the 5 percent critical value 2.10, only the sample corresponding to firms listed in Helsinki indicate a significant deviation from a random walk in the pre-merger period. In the post-merger period, only the sample with firms listed in the Baltic countries shows a significant deviation from a random walk.

#### 4.2 Return predictability and stock exchange mergers

To study the effects of the stock exchange mergers upon weak-form market efficiency in a conditional analysis accounting for other factors affecting market efficiency in the pre- and post-merger period, we relate the time-varying *JS* measure to covariates. Given that we also are interested in how the stock market mergers affect liquidity (to better understand the drivers for changes in information efficiency), the analyzed sample has been restricted to firms for which we observe stock turnover (to facilitate a comparison of merger effects between information efficiency and liquidity). In the main analysis our sample therefore excludes thinly traded stocks and stocks for which we lack data on turnover. In total, this sample consist of 411 firms (214 listed in Stockholm, 35 in Helsinki, 151 in Copenhagen, and 11 in the Baltic stock markets). In Table 4 we report estimation results for models based directly on the *JS* test statistic.<sup>23</sup>

In Model 1, the basic regressions are presented controlling for firm size (market capi-

<sup>23</sup> Apart from the included control variables, fixed effects (favored over pooled OLS based upon F-test and over random effects based on the Hausman test), controlling for time-invariant firm specific heterogeneity, and time-specific effects, to control for annual unobserved heterogeneity, are included in all regressions. Given that the analysis uses *JS* test statistics based on overlapping subsample windows, potentially inducing autocorrelation in error terms, Newey-West robust standard errors are throughout presented.

Table 4: Estimation results for panel regression with fixed firm specific effects – information efficiency.

	MODEL 1		MODEL 2		MODEL 3		MODEL 4		MODEL 5		MODEL 6		MODEL 7		MODEL 8	
	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.
dOMX	-0.32*	(0.07)	-	-	-0.36*	(0.07)	-	-	-0.33*	(0.07)	-0.78*	(0.08)	-0.76*	(0.08)	-0.77*	(0.08)
dOMXSth	-	-	-0.30*	(0.07)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXHel	-	-	-0.45*	(0.07)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXCop	-	-	-0.19*	(0.07)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXBaltic	-	-	-0.41*	(0.10)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXLarge	-	-	-	-	0.27*	(0.02)	-	-	-	-	-	-	-	-	-	-
dOMXSmall	-	-	-	-	0.57*	(0.02)	-	-	-	-	-	-	-	-	-	-
dOMXLarge – Sth	-	-	-	-	-	-	-0.18*	(0.04)	-	-	-	-	-	-	-	-
dOMXMiddle – Sth	-	-	-	-	-	-	-0.41*	(0.02)	-	-	-	-	-	-	-	-
dOMXSmall – Sth	-	-	-	-	-	-	-0.12*	(0.03)	-	-	-	-	-	-	-	-
dOMXLarge – Hel	-	-	-	-	-	-	0.58*	(0.05)	-	-	-	-	-	-	-	-
dOMXMiddle – Hel	-	-	-	-	-	-	-0.18*	(0.04)	-	-	-	-	-	-	-	-
dOMXSmall – Hel	-	-	-	-	-	-	-0.73*	(0.13)	-	-	-	-	-	-	-	-
dOMXLarge – Cop	-	-	-	-	-	-	-0.38*	(0.04)	-	-	-	-	-	-	-	-
dOMXMiddle – Cop	-	-	-	-	-	-	-0.24*	(0.03)	-	-	-	-	-	-	-	-
dOMXSmall – Cop	-	-	-	-	-	-	0.19*	(0.04)	-	-	-	-	-	-	-	-
dOMXLarge – Baltic	-	-	-	-	-	-	0.66*	(0.13)	-	-	-	-	-	-	-	-
dOMXMiddle – Baltic	-	-	-	-	-	-	-0.56*	(0.08)	-	-	-	-	-	-	-	-
dOMXSmall – Baltic	-	-	-	-	-	-	3.76*	(0.11)	-	-	-	-	-	-	-	-
dOMXPos. size dist	-	-	-	-	-	-	-	-	-0.39*	(0.02)	-	-	-	-	-	-
dOMXNeg. size dist	-	-	-	-	-	-	-	-	-0.31*	(0.01)	-	-	-	-	-	-
dOMXFor. sales	-	-	-	-	-	-	-	-	-	-	-0.01	(0.01)	-	-	-	-
dOMXF. sale - Large	-	-	-	-	-	-	-	-	-	-	-	-	0.28*	(0.02)	-	-
dOMXF. sale - Medium	-	-	-	-	-	-	-	-	-	-	-	-	-0.08*	(0.01)	-	-
dOMXF. sale - Small	-	-	-	-	-	-	-	-	-	-	-	-	-0.28*	(0.05)	-	-
dOMXF. sale - Sth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	(0.02)
dOMXF. sale - Hel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.02	(0.02)
dOMXF. sale - Cop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.03	(0.02)
dOMXF. sale - Baltic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MC	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)	-0.01*	(0.00)
GDPCapita	3.16*	(0.11)	3.99*	(0.22)	2.71*	(0.11)	0.35*	(0.12)	2.99*	(0.11)	1.72*	(0.25)	1.51*	(0.25)	1.39*	(0.31)
Constant	-26.32*	(1.02)	-33.87*	(2.02)	-22.42*	(1.02)	-1.15	(0.99)	-24.68*	(1.02)	-11.70*	(2.22)	-9.94*	(2.22)	-8.84*	(2.80)
F-test	481.23		381.37		516.20		450.73		468.13		282.43		271.02		239.31	
Nr. firms	411		411		411		411		411		286		286		286	

\*Significance level: p<0.05. Newey-West robust standard errors in parenthesis. Fixed and time specific effects are included in all models.

talization,  $MC_{it}$ ), the prevailing market condition measured by  $GDP_{Capita,t}$  as well as firm- and time-specific fixed effects. The estimated effect from the mergers on the value of the  $JS$  statistic is negative (-0.32) and significant at the 5 percent level, i.e. the mergers have had a significantly negative effect on the  $JS$  statistic for an average firm. This indicates that information efficiency for an average firm on the consolidated market has increased due to the mergers. This result is consistent with the prior expectation that a merger on average increases the number of investors following a stock and that deviations from a fair price becomes less likely. The effect of firm size ( $MC_{it}$ ) indicates that a higher market capitalization, on average, is associated with a higher degree of information efficiency in terms of a lower  $JS$ . Also this result is in line with prior expectations since many institutional investors favor analyzing and following large firms. The estimated coefficient for  $GDP_{Capita,t}$  indicates that market efficiency is on average increasing for relatively lower values of GDP per capita. This result is broadly in line with the findings of e.g. Hoque et al. (2007), Kim and Shamsuddin (2008), and Kim et al. (2011). To examine possible asymmetric effects from the mergers, we in model 2-8, Table 4 analyze the effect on different groupings of firms based on location, size, and foreign sales.

#### 4.2.1 Effects distributed over firm locations

We study the potential heterogeneous merger effects distributed over pre-merger stock exchange listings of firms. In Model 2, Table 4 the results for merger effects, estimated by firms pre-merger listing location, are reported. As can be seen, the results indicate that the information efficiency for an average firm listed in Helsinki and the Baltic stock markets has received the largest improvement (although not statistically different from each other), while this improvement (a lower  $JS$  statistic) is smaller for an average

firm listed in Stockholm and Copenhagen (significantly lower improvement than the former). Given that Stockholm is the largest market measured in terms of equity market capitalization, followed by that in Helsinki, Copenhagen and the Baltic countries, these results (although indicating heterogeneous merger effects between listing locations) do not indicate any distinct pattern with respect to the firms' pre-merger listing location. Thus, the hypothesis that post-merger trading concentrates to the largest markets (Pagano, 1989; Chowdhry and Nanda, 1991; Portes and Rey, 2005), does not seem to be supported at this level of analysis.

To study these location based results in more detail, we in Model 4, Table 4 report a further division based on size. Here the results pertain to the 10 percent largest, the middle sized, and the 10 percent smallest firms in terms of market capitalization at the end of the pre-merger period. Overall, the results do not convey a clear picture. A comparison between locations among each size grouping (large, middle, and small firms) does, however, reveal that among the large firms, those listed on the smallest market (the Baltic) have experienced the most unfavorable merger effects (information efficiency has worsened the most), and a similar pattern is also found among the smaller firms, i.e. firms listed on the two smallest markets (the Baltic and the Copenhagen stock exchanges) have had the most unfavorable merger effects compared with firms listed on the relatively larger Stockholm and Helsinki markets (where information efficiency has increased due to the mergers). For middle sized firms these patterns are absent. Taken together these results suggest that the arguments put forward by Pagano (1989), Chowdhry and Nanda (1991) (who argue that if transaction costs are reduced, then trading will concentrate to a few markets), and Portes and Rey (2005) (who find that a key determinant of asset flows is market size) indicating a flight to liquidity effect, may potentially hold for smaller and

larger, but not middle sized firms, with respect to the firms' pre-merger listing locations.

An interesting effect not in line with the flight to liquidity argument is that the largest increase in information efficiency for middle sized firms takes place on the Baltic market. A possible explanation for this result is that if the mergers have led to an overall increase in the total investor base, it has increased proportionally more on the smallest market (the Baltic market). Thus, in this case an increased investor attention seems to have been directed towards middle sized Baltic firms.

#### 4.2.2 Effects distributed over pre-merger firm size

To study the potential heterogeneous effects of stock exchange mergers distributed over firm size, the effects are separated for the 10 percent largest and 10 percent smallest firms (at the local markets) at the end of the pre-merger period.<sup>24</sup> The results, reported in Model 3, Table 4, indicate a non-significant effect on the information efficiency for an average large firm. The net marginal merger effect on the *JS* statistic for large firms is -0.09 (s.e. 0.07), a positive significant (at the 5 percent level) effect on the information efficiency for an average middle sized firm (-0.36), and a significantly negative effect on the information efficiency for an average small firm (here the net marginal merger effect on the *JS* statistic is 0.21 (s.e. 0.07)). These results indicate that smaller firms may have found it harder to compete for foreign investor attention in the post-merger period than middle sized firms. These results are in contrast to those in Nielsson (2009), who finds no effect on liquidity for small and middle sized firms but a positive and significant effect for large firms, due to the consolidation of stock exchanges.

Returning to Table 4 in Model 4, the results indicate that within location listings

(Stockholm, Helsinki, Copenhagen and the Baltic markets), the information efficiency improves (worsens) the least (the most) for small firms compared with middle and large sized firms listed in Stockholm (Copenhagen and the Baltic markets). This supports a flight to liquidity effect from small to middle and large sized firms. The results are, however, contradicted by those for firms listed on the Helsinki stock market where the information efficiency is reduced for large firms but improves for small firms.

To further explore size-related merger effects, we also look at changes in firm's ranking in the pre- and post-merger size distribution. The cumulative proportion of the firm-size distribution corresponding to the firm ranking is estimated in the pre-merger period on the domestic market and compared with the corresponding ranking in the post-merger period on the fully merged market. The difference in ranking then indicates whether the firm has become relatively larger or smaller on the fully consolidated market. To test for differences in merger effects based on these changes, dummies indicating whether the relative size position of the firm has increased or decreased are created. In Model 5, Table 4 the estimation results for a specification which includes these dummies for the firms with the 10 percent largest and the 10 percent smallest changes in the firm size distribution are reported. The results (significant at the 5 percent level) show an increase in information efficiency both for firms that improve, as well as worsen, their ranking in the post-merger size distribution. The effect is, on average, relatively larger (significant at the 5 percent level) for firms receiving a higher rank in the firm-size distribution in the post-merger period, i.e. firms that become relatively larger on the fully merged market receive a relatively larger increase in infor-

<sup>24</sup> Note here that we control for direct effects of firms size through  $\gamma$ . This is included to control for improvements in information efficiency driven by growth in firm size (likely to be positively correlated with growth in investor attention), rather than being an outcome of the mergers.

mation efficiency (-0.72 versus -0.64). This indicates that changes in the relative firm size in the pre- and post-merger size distribution may be a potentially important factor in the competition for post-merger investor attention.

### 4.2.3 Effects distributed over pre-merger foreign visibility

To study the heterogeneous effects of the stock exchange mergers based on a firm's level of pre-merger foreign visibility, we follow Nielsson (2009) and use pre-merger foreign sales as a proxy for pre-merger foreign visibility. Here firms more active on foreign markets in the pre-merger period are assumed to be more known by foreign investors. In Model 6, Table 4, results pertaining to a separation of merger effects between those with and without pre-merger foreign sales are presented. The

results indicate that information efficiency has increased significantly due to the mergers for both groups. This indicates that there does not seem to have been any proportional shift in investor attention post-merger between firms with or without previous foreign visibility.

To further investigate this issue, we in Model 7, Table 4 present results separating merger effects between those with and without pre-merger foreign sales, here separated with respect to firm size. The results indicate that information efficiency has increased significantly both for firms without pre-merger foreign visibility (-0.76), as well as for large (-0.48), middle (-0.84), and small (-1.04) firms with pre-merger foreign visibility. These result are interesting since they indicate that the firms which were best known on foreign markets pre-merger, i.e. large firms and firms with

**Table 5:** Estimation results for panel regression with fixed firm specific effects – turnover.

TURNOVER RATE	MODEL 1		MODEL 2		MODEL 3		MODEL 4		MODEL 5		MODEL 6		MODEL 7		MODEL 8	
	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.
dOMX	0.52*	(0.09)	-	-	0.49*	(0.09)	-	-	0.56*	(0.09)	0.26*	(0.06)	0.27*	(0.06)	0.17*	(0.06)
dOMXSth	-	-	0.37*	(0.09)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXHel	-	-	0.34*	(0.09)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXCop	-	-	0.21*	(0.09)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXBaltic	-	-	-0.08	(0.13)	-	-	-	-	-	-	-	-	-	-	-	-
dOMXLarge	-	-	-	-	0.19*	(0.02)	-	-	-	-	-	-	-	-	-	-
dOMXSmall	-	-	-	-	0.37*	(0.02)	-	-	-	-	-	-	-	-	-	-
dOMXLarge – Sth	-	-	-	-	-	-	0.21*	(0.05)	-	-	-	-	-	-	-	-
dOMXMiddle – Sth	-	-	-	-	-	-	0.06*	(0.03)	-	-	-	-	-	-	-	-
dOMXSmall – Sth	-	-	-	-	-	-	0.32*	(0.04)	-	-	-	-	-	-	-	-
dOMXLarge – Hel	-	-	-	-	-	-	0.28*	(0.07)	-	-	-	-	-	-	-	-
dOMXMiddle – Hel	-	-	-	-	-	-	0.03	(0.06)	-	-	-	-	-	-	-	-
dOMXSmall – Hel	-	-	-	-	-	-	0.21	(0.17)	-	-	-	-	-	-	-	-
dOMXLarge – Cop	-	-	-	-	-	-	0.10*	(0.05)	-	-	-	-	-	-	-	-
dOMXMiddle – Cop	-	-	-	-	-	-	-0.12*	(0.04)	-	-	-	-	-	-	-	-
dOMXSmall – Cop	-	-	-	-	-	-	0.60*	(0.05)	-	-	-	-	-	-	-	-
dOMXLarge – Baltic	-	-	-	-	-	-	-0.28*	(0.16)	-	-	-	-	-	-	-	-
dOMXMiddle – Baltic	-	-	-	-	-	-	0.23*	(0.11)	-	-	-	-	-	-	-	-
dOMXSmall – Baltic	-	-	-	-	-	-	-0.26*	(0.14)	-	-	-	-	-	-	-	-
dOMXPos. size dist	-	-	-	-	-	-	-	-	-0.05*	(0.02)	-	-	-	-	-	-
dOMXNeg. size dist	-	-	-	-	-	-	-	-	0.12*	(0.02)	-	-	-	-	-	-
dOMXFor. sales	-	-	-	-	-	-	-	-	-	-	0.05*	(0.01)	-	-	-	-
dOMXF. sale - Large	-	-	-	-	-	-	-	-	-	-	-	-	0.14*	(0.01)	-	-
dOMXF. sale - Medium	-	-	-	-	-	-	-	-	-	-	-	-	0.01	(0.01)	-	-
dOMXF. sale - Small	-	-	-	-	-	-	-	-	-	-	-	-	0.48*	(0.03)	-	-
dOMXF. sale - Sth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.12*	(0.01)

foreign sales, seem to have lost investor attention primarily to middle sized and small firms with pre-merger foreign sales. Moreover, the results are interesting because they partly confirm the findings in Nielsson (2009), who finds liquidity gains (usually positively correlated with improved information efficiency) for firms with foreign sales. Splitting merger effects between those with and without pre-merger foreign sales over different locations (Model 8, Table 4) indicates no significant pattern.

#### 4.2 Liquidity and stock exchange mergers

Given that a stock's liquidity may be seen as a proxy which captures changes in investor attention towards a stock, we complement our analysis with a study of how the stock exchange mergers affect liquidity (c.f. Nielsson, 2009) to better understand potential causes for changes in information efficiency. In Table 5 results for the corresponding model specifications (as for information efficiency) are reported with the stocks' turnover rate (the proportion of outstanding stocks traded) as the dependent variable.

In line with Nielsson (2009), the results in Model 1 indicate that turnover for an average firm increases significantly (at the 5 percent level) due to the mergers. This increased investor attention may explain the previous finding that the information efficiency for an average firm overall increases (see Model 1, Table 4). The results in Model 2 show that the average firm turnover increased significantly for firms listed on the Stockholm, the Helsinki, and the Copenhagen stock markets, while being unchanged for firms listed on the Baltic stock markets (the increase in turnover for an average firm listed in Stockholm is significantly larger than for firms listed in Copenhagen and the Baltic states, respectively, but not compared with an average firm listed in Helsinki). This indicates a potential flight to liquidity effect with respect to turnover.

Relating these results to those for information efficiency (Model 2, Table 4) indicates that the size of investor attention (as measured by firm turnover) may explain parts, but possibly not all, of our efficiency results. Although the relatively large increases in turnover found for average firms listed in Stockholm and Helsinki may explain their relative improvement in information efficiency compared with an average firm listed in Copenhagen (where turnover have increased relatively less), it does not explain the increase in efficiency for an average firm listed on any of the Baltic stock markets. This indicates that changes in the composition of traders (informed versus uninformed investors), even for unchanged levels of investor attention (turnover), may potentially matter for the understanding of information efficiency effects from the mergers.

Looking at the merger effects on turnover over firms' sizes (results reported in Model 3, Table 5) indicates a significant increase for all sizes. In relation to the information efficiency results (Model 3, Table 4), these results favor the interpretation that changes in the composition of investor attention matters for merger effects. Notably, despite having the largest increase in turnover, information efficiency worsens for small firms but information efficiency improves the most for middle sized firms (even though they have the smallest increase in turnover).

In Model 4, Table 5, we report results separated with respect to size and location. A comparison of the location effect for each size group (large, middle, and small firms) indicates that among the group of large and small firms, those listed on the smallest market (the Baltic) have experienced a significant decrease in turnover, while large and small firms listed in Stockholm, Helsinki, and Copenhagen have experienced a significant increase in turnover. Comparing these turnover effects with those for information efficiency (Model 4, Table 4) explains the reduction of information efficiency

for an average firm listed on the Baltic markets, but does not explain the changes for an average firm on the other markets. For the middle sized firms, turnover has increased (significant at the 5 percent level) the most. Taken together these results indicate a flight to liquidity effect among the large firms (increased turnover for firms listed in Stockholm and Helsinki compared to those listed on the relatively smaller Copenhagen and Baltic stock markets), and to some degree for smaller firms, but not among middle sized firms. These results lend some support to the idea that trading will be concentrated to a few markets after a merger (Pagano, 1989; Chowdhry and Nanda, 1991; Portes and Rey, 2005).

When it comes to changes in the firm size distribution, a comparison between the firms' pre- and post-merger positions (Model 5, Table 5) shows that for firms with the 10 percent largest improvements, turnover has increased the least, while for the 10 percent firms with the largest worsening of their position, turnover has increased the most (all changes are significant from each other at the 5% level). These results are interesting if we relate them to the corresponding model specification for information efficiency (Model 5, Table 4). While information efficiency improves most for the 10 percent of firms improving their position in the firm size distribution, these firms experience the smallest relative increase in turnover. This is an additional indication on that merger effects may be driven by other factors than by changes in investor attention (turnover), e.g. by changes in the composition of informed versus uninformed investors.

As for potential asymmetric merger effects on turnover based on pre-merger foreign visibility, we in Model 6, Table 5 present results separating effects between firms with and without pre-merger foreign sales. The results indicate that turnover has increased significantly more among firms with pre-merger foreign visibility (0.31 versus 0.26, statistically different at the 5 percent level). This asymmetric effect is in line

with results in Nielsson (2009) concerning turnover, but it is not in line with our results regarding information efficiency (Model 6, Table 4, where the information efficiency increases by the same size for both groups). Thus, despite the asymmetric merger effects on turnover, the impact on information efficiency does not seem to be asymmetrically affected.

In Model 7, Table 5 we display how the foreign visibility in the pre-merger period influences turnover. The results indicate that the average small firm with pre-merger foreign visibility has experienced the largest increase in turnover (0.75) after the mergers, followed by large firms with pre-merger foreign visibility (0.41). For medium sized firms with pre-merger foreign visibility and firms without pre-merger foreign visibility merger the effects are similar and smaller in size (0.28 and 0.27). In relation to the asymmetric merger effects on information efficiency (Model 7, Table 4), the change in turnover (investor attention) may explain most of the improvement in information efficiency for small firms with foreign pre-merger visibility, but not for middle and large size firms with pre-merger foreign visibility. These results indicate that small firms with pre-merger foreign visibility have gained the most, both in terms of efficiency and in terms of turnover. For the large firms, the results show that those with pre-merger foreign visibility have had the second largest increase in turnover but the smallest gain in information efficiency. This indicates that for large firms, it is both changes in the level of investor attention (turnover) as well as potential changes in the composition of investors which may explain the changes in information efficiency. Dividing the merger effects between those with and without pre-merger foreign sales over different locations (Model 8, Table 5), the results show that turnover increased most (significant at the 5 percent level) for firms with pre-merger foreign sales listed in the Copenhagen, followed by the Helsinki stock market while the merger effects on turnover for firms with pre-merger foreign

visibility listed in Stockholm and in the Baltic stock markets were unchanged.

Apart from the separate analysis of turnover, we have also re-estimated the models in Table 4 conditioning on firm turnover. Overall, the results from this analysis (unreported here, but available upon request) indicate that signs, sizes and significance levels of parameter estimates are similar to those reported in Table 4. These results provide further evidence that merger effects not only depend on changes in the level of investor attention (turnover), but also depend on other mechanisms, e.g. changes in the composition of informed versus uninformed investors following stocks.

#### 4.2 Robustness of results

To test the sensitivity of our results, a number of robustness tests have been performed. First, the reported results within the paper pertain to *JS* statistics calculated on moving sub-sample windows of two years, i.e. 500 trading days. To test the sensitivity of our results to this choice the analysis has been repeated based on *JS* statistics calculated on moving sub-sample windows of 400 and 600 trading days. Results were similar in terms of signs and significance. Second, an analysis using the Chow and Denning (1993) multiple *VR* test (*CD*) confirm our reported results based upon the *JS* statistic.

Finally, we note that a possible drawback of interpreting the *JS* statistic as a direct measure of the relative level of information efficiency is that the impact of these test statistics on market efficiency is non-linear (Lagoarde-Segot, 2009) and that the statistic in itself is a random variable. The later comprises a problem, especially when using overlapping moving sub-period windows to generate a relatively smooth evolution of the *JS* series. In a comparison of successive values,

one has to be careful in interpreting a slightly lower sub-period *JS* test statistic as an improvement in terms of information efficiency because it may comprise a comparison of two random variables that are not significantly different from each other. Because of this, we complement our analysis by studying the probability of observing a sub-period deviation from a random walk. To model the probability of a deviation from a random walk, an indicator variable is generated based on the *JS*-test statistic, where this variable indicates whether the null hypothesis of a random walk, for the given sub-sample *t*, for firm *i*, is rejected or not. The binary indicator variable,  $W_{it} \in (0,1)$ , takes the value one for periods with a significant (at the 5 percent level) deviation from a random walk, and zero otherwise. In the second stage analysis, a conditional logit model with fixed effects is utilized when modelling the probability of observing a sub-sample period deviating from a random walk.<sup>25</sup> The model is specified as

$$\Pr(W_{it} = 1|X_{it}) = \frac{\exp(\alpha_i + x_{it}\beta)}{1 + \exp(\alpha_i + x_{it}\beta)}, i = 1, 2, \dots, N, t = 1, 2, \dots, T,$$

where the vector  $x_{it}$  contains covariates while  $\alpha_i$  are the stock specific unobserved fixed effects. Note here that this modelling approach excludes firms that are either informationally efficient, or inefficient throughout the whole sample period, i.e. that only have zeros or ones and thus lack within-firm variation in the dependent binary variable. This is in contrast to the models based directly on the *JS* test statistic where inference is also drawn from the relative variation, in terms of improved or worsened information efficiency, also for firms that are efficient or inefficient throughout the whole sample period. In all, 71 firms are excluded from the analysis when modelling the probability of observing a sig-

<sup>25</sup> Both random and fixed effects models were initially considered. Hausman tests did, however, favor the fixed effects specification since the unobserved stock specific effects were in general found to be correlated with the regressors.

**Table 6:** Estimation results for panel conditional logit with fixed firm specific effects.

PR(DEV. FROM RANDOM WALK)	MODEL 1		MODEL 2		MODEL 3		MODEL 4		MODEL 5		MODEL 6	
	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.
dOMX	-1.113*	(0.265)	-	-	-1.132*	(0.266)	-	-	-2.770*	(0.343)	-2.696*	(0.341)
dOMX <sub>Sth</sub>	-	-	-1.184*	(0.272)	-	-	-	-	-	-	-	-
dOMX <sub>Hel</sub>	-	-	-1.527*	(0.277)	-	-	-	-	-	-	-	-
dOMX <sub>Cop</sub>	-	-	-0.102	(0.277)	-	-	-	-	-	-	-	-
dOMX <sub>Baltic</sub>	-	-	-3.305*	(0.350)	-	-	-	-	-	-	-	-
dOMX <sub>Large</sub>	-	-	-	-	0.277*	(0.079)	-	-	-	-	-	-
dOMX <sub>Small</sub>	-	-	-	-	1.151*	(0.066)	-	-	-	-	-	-
dOMX <sub>Pos. size dist</sub>	-	-	-	-	-	-	-1.021*	(0.266)	-	-	-	-
dOMX <sub>Neg. size dist</sub>	-	-	-	-	-	-	-0.818*	(0.272)	-	-	-	-
dOMX <sub>For. sales</sub>	-	-	-	-	-	-	-	-	0.290*	(0.054)	-	-
dOMX <sub>Large and f. sale</sub>	-	-	-	-	-	-	-	-	-	-	1.094*	(0.093)
dOMX <sub>Small and f. sale</sub>	-	-	-	-	-	-	-	-	-	-	-1.322*	(0.393)
MC	-0.024*	(0.003)	-0.022*	(0.003)	-0.024*	(0.003)	-0.023*	(0.003)	-0.029*	(0.003)	-0.036*	(0.003)
GDP <sub>Capita</sub>	7.758*	(0.311)	17.557*	(0.698)	7.325*	(0.315)	7.803*	(0.313)	-2.557*	(0.782)	-2.156*	(0.749)
LR $\chi^2$	3625		4103		3926		3650		2494		2616	
Nr. firms	371		371		371		371		250		250	

\* Significance level:  $p < 0.05$ . Newy-West robust standard errors in parenthesis. Fixed and time specific effects are included in all models.

nificant deviation from a random walk due to firms being informational efficient for all sub-sample periods. In Table 6 we report estimation results for the conditional logit model.<sup>26</sup>

The results confirm the earlier analysis with an overall and on average significant (at the 5 percent level) improvement in information efficiency. Regarding asymmetrical merger effects over different groupings of firms, the results are mainly in line with the previous results. One exception is the distribution over different locations. Here the results indicate that information efficiency has increased significantly (at the 5 percent level) for all listed firms, except in the Copenhagen market.

### 5. Conclusions

In this paper, we contribute to the literature with new empirical evidence on the effects

of stock exchange mergers upon weak-form market efficiency. Our first main result indicates that for an average firm, information efficiency has increased as a result of the mergers. The result is robust towards conditioning on confounding factors affecting information efficiency and is consistent with the hypothesis that a consolidation of markets, on average, increases the pool of investors available for each stock, thereby making deviations from fundamental values less likely. Initial analysis of turnover (liquidity as a proxy for investor attention) supports this conclusion, indicating a significant increase, on average, in turnover following the mergers. Conditioning the analysis of information efficiency on liquidity does not change our results. This lends support to the possibility that increased information efficiency may be driven by an increase in the proportion of informed investors following an average

<sup>26</sup> Since the estimation of the conditional logit model is based on a smaller sample similar model specifications as in model 7 and 8 in Table 4 were not possible to identify.

firm. Although we can not determine the precise underlying mechanism for the merger effects on information efficiency, our results strengthen previous findings reported in Khan and Vieto (2011), who study the Portuguese stock exchange and Euronext merger. Our aggregated result for the effect on liquidity is also consistent with the results reported in Nielsson (2009) that mergers tend to increase the turnover for an average stock.

Our second main result indicates that the merger effects are asymmetrically distributed over firms. Even if the patterns are somewhat blurred, we find a tendency for a flight to liquidity effect, both with respect to firm pre-merger listing location and pre-merger size. In relation to location, it is found that among the group of larger and smaller firms (10 percent largest and smallest at the end of the pre-merger period) there is a tendency that those listed on the smallest stock markets (the Baltic and the Copenhagen stock markets) have experienced an adverse effect on information efficiency, while those listed on the larger markets (Stockholm and Helsinki) have gained in information efficiency. As for firms' pre-merger size, evidence also point towards a potential flight to liquidity effect, with an adverse merger effect on information efficiency for smaller firms but an improved effect for medium and large firms.

In terms of pre-merger foreign visibility, the results indicate that larger firms with pre-merger foreign sales seem (post-merger) to have lost investor attention towards small and middle sized firms with pre-merger foreign sales. A potential explanation may be that the firms which were most visible before the merger (large and with foreign sales) were already traded cross-border (before the

merger). Thus, as the availability of foreign stocks increased as a result of the stock market mergers, the firms which were most visible before the merger stood out relatively less than firms which were less visible in the pre-merger period. Overall, the corresponding models for asymmetric turnover effects indicate that changes in turnover (investor attention) explain some, but not all of the changes in information efficiency, lending support to other explanations, e.g. that merger effects are also driven by changes in the composition of informed versus uninformed traders.

Given the scarcity of research concerning the effects on market quality from changes in stock trading market structures, and given that market structures for stock trading is in a state of change, as indicated by the Oslo stock exchange acquisition of the MTF Burgundy in 2012, the results in this paper are of importance both for the understanding of effects from future mergers, as well as an input in the implementation process of new mergers. Of particular interest is the understanding of the asymmetrical distribution of merger effects since this may affect the process about how to pursue mergers of multiple markets.

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# Competition as a Driving Force among Institutional Investors: The Case of Swedish Pension Funds

Naufal Alimov

## Abstract

*This paper studies whether competition between pension funds enhances fund performance. Sweden conducted a large-scale experiment in the pension system reform finalised at the turn of the millennium. A central feature of the Swedish pension system is to encourage competition among pension funds (AP 1-4 buffer funds). An essential question is to what extent there is actual competition for performance between these funds. Instead of competing, they may simply be following each other into and out of the same securities. This paper documents a portfolio overlap of 60-85 percent in Swedish pension funds' domestic equity portfolios during the period 2001-2012. The results also indicate significant co-movements in pension funds' equity portfolios.*

*JEL Classification:* G11, G23, G28, G30, G38, M21

## Key words:

*Institutional investors, pension funds, competition, portfolio choice, investment decisions*

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## 1. Introduction

It has been argued that competition between institutional investors is a driving force for their better performance because asset managers compete to achieve higher remuneration (Brown et al., 1996; Agarwal, et al. 2004) or better career prospects (Chevalier & Elison, 1999). Competitive pressure may also encourage institutional investors to improve the quality of the corporate governance of firms in their portfolios (Black, 1992). On the other hand, competitive pressure reinforced by the fact that asset managers are subject to agency problems, excessive regulation, and evaluation on an annual basis against predetermined benchmarks (Black, 1992; Lakonishok, 1992), and the constant performance judgement by public scrutiny may result in fund managers following each other into and out of the same securities at the same time (Lakonishok et al., 1992; Nofsinger & Sias, 1999; Bushee, 2001; Sias, 2004; Fong et al., 2011; Jame, 2011).

Sweden has an interesting example of establishing a framework with a number of public pension funds (AP buffer funds) that have similar mandates and the same history. One of the main reasons for creating more than one buffer fund was to stimulate competition among them alongside other reasons, such as reducing their market impact, diversifying managerial risk, and diminishing political influence (Björkmo & Lundbergh 2010).

In this study, I investigate whether the Swedish pension system has indeed been successful in encouraging competition between buffer funds in contrast to their moving into and out of the same securities. I focus the analysis on AP funds' domestic equities because they manage these portfolios actively and internally, whereas their foreign securities are mostly indexed or managed externally<sup>1</sup>.

During the sample period 2001-2012, the AP 1-4 funds demonstrated similar patterns of

performance change in terms of returns generated both in general and in Swedish equity portfolios. There is therefore a good reason to compare their portfolios' composition to test whether there has been a tendency for them to have similar portfolios over time (Björkmo & Lundbergh 2010). In using the measure suggested by Cremers & Petajisto (2009), and Petajisto (2013), I find a 60-85% portfolio overlap between Swedish AP 1-4 equities. Their portfolio overlap appears to have increased somewhat during the later sample period, and especially after the financial crisis.

On further analysis, I find co-movements within the Swedish equity portfolios of the AP 1-4 funds. Co-movements in AP funds' share trades are observed both in purchases and sales. One of the funds was followed more intensively by other AP funds. I find evidence that AP funds execute their strategic investment policy during more than one quarter, which could partly explain the co-movements.

I go a step further and test whether the co-movements are also the result of their selling stocks with a low return and buying ones with a high return at intensified rate during the last quarter, i.e. "window dressing" (Lakonishok, 1991). Window dressing behaviour designed to avoid questions from the authorities would be a clear evidence of "bad" competition. I do not find clear-cut evidence in my analysis of "window dressing" behaviour by AP funds that would explain the co-movements in their portfolios.

I conclude that the co-movements within AP funds' Swedish equity portfolios could have resulted from a combination of different factors, such as stringent investment rules for AP funds, reputation concerns by fund managers, and AP funds' investment decision policy carried out over more than one quarter. However, the most plausible explanation for the co-movements is that there is a small

<sup>1</sup>At least until the end of the sample period 2001-2012, the in-house management of foreign securities has increased between 2012 and 2015.

market for liquid shares in Sweden, and AP fund base their decisions on the same information sources.

Next, I outline the literature and state my hypotheses. In the analysis that follows I start with a performance comparison of AP funds before measuring their portfolio similarities. In the subsequent sections I outline the results of testing co-movement and window-dressing hypotheses. I conclude with a discussion of perspective changes in the system in the context of my findings.

## 2. Literature and Hypotheses

Brown et al. (1996) note the importance of competition between asset managers. They compare the mutual fund market to a tournament in which asset managers compete for higher remuneration, the “winning” of which depends on better relative performance. At the same time the authors suggest that such competition has implications for their portfolio management, which is not always desirable, as “losers” take a short-term view and re-focus on projects with a higher risk than “winners” do, even at shareholders’ expense.

Chevalier & Ellison (1999) claim that career concerns and competition between asset managers has an impact on their portfolio decisions. They find that managerial turnover is related to past performance. Their findings show that younger asset managers, who are more likely to lose their jobs, tend to be risk-averse. This argument is consistent with the notion that young asset managers act in line with others or index their portfolios.

Bushee (2001) also supports the view that competition between institutional investors may force them to take relatively short-term gains. He argues that competitive pressures and the frequent evaluation of fund managers compel them to invest in firms that demonstrate high near-term earnings at the expense of long-term value. He finds that institutional investors with a high portfolio turnover and

diverse portfolios with a near-term investment horizon prefer near-term earnings.

It is documented that institutional investors move in and out of the same securities at the same time for reasons other than competition for better performance. In the literature such behaviour is labelled broadly as herding (Sias, 2004). As the literature explains (Sias, 2004; Choi & Sias, 2009), herding among institutional investors may occur if institutional investors: (1) follow correlated signals –investigative herding, (2) infer information from each other’s trades –informational cascades (Bikhchandari et al., 1992; Sias, 2004); (3) have reputational and remuneration penalties for acting differently – reputational herding (Scharfstein & Stein 1990; Chevalier & Ellison, 1999); (4) are attracted to stocks with specific characteristics – characteristic herding (Sias, 2004); (5) enter the same industries – fads (Choi & Sias, 2009). A stricter definition of herding would encompass reasons 3-5, because the first two reasons fall into the category of informative trading.

Early studies find weak evidence on institutional herding. For example, Lakonishok et al. (1992) claim that US pension funds in the 1980s were more likely to practise positive feedback trading than they were to follow each other into the same securities. Notably, the authors design a herding measure that has been extensively used in subsequent studies of institutional herding.

On the other hand, Sias (2004), who investigates data up to the late 1990s, identifies strong institutional herding. The author finds that institutional investors follow both their own as well as other institutional investors’ last quarter trades. The author concludes that institutional investors move in the same direction because they are momentum traders and infer information from each other’s trades.

Contrary to the existing literature on herding, Fong et al. (2011) use the leader-follower behaviour argument to explain institutional herding. They claim that leaders with

superior market information try to disguise valuable information by executing trade packages through multiple brokers and over several days. In consequence, other institutional investors trade on the same securities and in the same direction as the leaders. The authors support the informational nature of leader-follower behaviour by demonstrating that the number of followers is lower when leaders disguise their trades, and that it is higher when leaders have a strong reputation.

According to Jame (2011) when pension funds are compared to other institutional investors, they are more likely to herd through uninformative trading because they have greater fiduciary responsibilities, less need for performance compensation, and larger reputational costs. Consistent with his argument, he finds that pension fund herding, unlike other institutional herding, is followed by a reversal in stock returns. This effect is stronger in smaller, and hence noisier, stocks, in line with reputational and characteristic herding and in contrast to investigative herding.

Particular attention in the literature has been given to the relationship between institutional investor herding and subsequent stock returns. For example, Nofsinger & Sias (1999) document a positive correlation between annual changes in institutional ownership and contemporaneous returns. They claim that such a relationship arises from institutional investors practising positive feedback trading and also from their being better informed which drives returns. According to Sias (2004) institutional herding has no negative impact on near-term returns—it is weakly positive. More recent studies, however, find a reversal in longer-term stock returns following institutional herding (Gutierrez & Keley, 2009; Dasgupta et al. 2011a; Dasgupta et al. 2011b; Jame, 2011).

As evidenced in the literature, competition has an impact on asset managers' performance. Competitive pressure may also result in institutional investors trading in the same

stock and in the same direction. Such behaviour may have both positive and negative features, depending on whether institutions contribute to information revelation and whether prices are driven down from their intrinsic level because of herding.

In line with the previous literature, it is reasonable to test whether there has been a tendency for AP funds to have similar portfolios over time, and whether they have similar buy and sell strategies within their domestic equity portfolios.

Thus, the following two research hypotheses are tested:

*Hypothesis – 1:*

*AP funds have similar equity portfolio compositions.*

*Hypothesis – 2:*

*AP funds follow similar buy and sell strategies in their equity portfolios.*

Furthermore, correlated trading between AP funds would be undesirable if it resulted primarily from their “window dressing” behaviour at year ends, i.e. the practice of removing stocks that have recently declined sharply in value simply to please public opinion or a controlling agency (Lakonishok, 1991).

With respect to “window dressing”, the following hypothesis is tested:

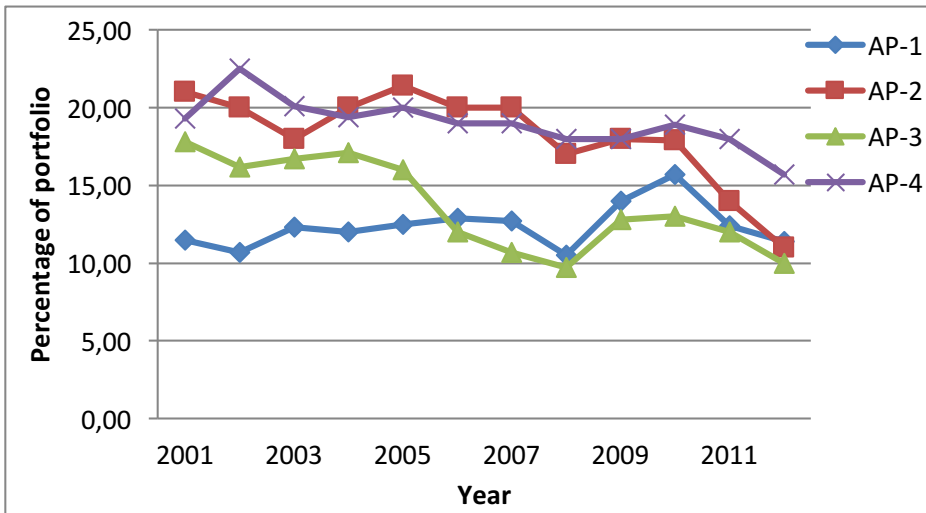
*Hypothesis – 3:*

*There is a specific pattern in AP funds' ownership changes during the last quarter of the year.*

### 3. Data

I collect data on AP funds' Swedish equity portfolios from their financial reports for the period from the last quarter of 2001 to the last quarter of 2012. As financial reports of AP funds are issued on a semi-annual basis, I

Figure 1 Return on the total portfolio before expenses of AP 1-4 funds



fill the missing quarters with data obtained from SIS Ägarservice AB, which has rich and accurate information on ownership data, especially in Swedish companies<sup>2</sup>. Information collected includes the value of holdings in Swedish kronor, as well as the ownership position in a company, such as the number of shares, percentage of cash flow, and voting rights. From the value of holdings for each AP fund and each quarter in the sample, I compute the Swedish equity portfolio weights assigned to each of the securities.

I obtain stock market returns, and ask-bid spreads for a measure of liquidity from the Thomson Reuters One Banker and FactSet databases. These databases have no information on delisted companies. Therefore, missing information is retrieved from Datastream.

#### 4. AP 1-4 Buffer Fund Performance

##### 4.1. Descriptive Statistics

AP buffer funds identified their strategic benchmarks - portfolio weights allocated to equity, and debt instruments. During 2001-2012, AP funds invested about 20% of their funds in Swedish equity, except AP-1, which

allocated about 11-12% of its assets into this category. During later periods, especially after 2010, AP 1-4 funds reduced their ownership of Swedish equity to 11-12%, except AP-4 that had around 16% of its funds in Swedish equity at the end of the period. See Figure-1.

The largest holding in terms of cash flow rights in Swedish companies is observed in AP-4 and is close to 2% (Table 1). Other AP funds have smaller holdings in companies - around 1% by AP-1, and under 1% by AP-3 and AP-2. The holdings of AP-2 are the mostly dispersed.

AP funds' portfolio turnover in terms of sales (Column2 of Table 1) is larger than portfolio turnover in terms of purchases (Column3 of Table 1). This arises from the fact that in the later periods AP funds reduced their Swedish equity holdings, and more data is therefore available from these periods. The largest changes within the Swedish equity portfolios are observed in AP-4.

##### 4.2 Portfolio Management and Performance

AP 1-4 buffer funds all claim to have actively managed their Swedish equity portfolios.

<sup>2</sup> Note that AP fund portfolios include equity of both financial and non-financial companies.

**Table 1** Ownership and portfolio turnover of AP funds

	CASH FLOW RIGHTS <sup>1</sup>	ANNUAL PORTFOLIO TURNOVER (SALES)	ANNUAL PORTFOLIO TURNOVER (PURCHASES)	ANNUAL PORTFOLIO TURNOVER (MIN)
AP-1	1.054 *** (0.003)	13.081*** (2.790)	8.103*** (2.102)	5.589*** (1.108)
AP-2	0.664*** (0.0130)	22.81*** (5.662)	7.972 *** (2.252)	6.521 *** (1.489)
AP-3	0.867*** (0.022)	25.128** (9.212)	10.259*** (2.947)	6.185*** (1.857)
AP-4	1.771*** (0.029)	27.918*** (7.784)	18.647* (10.026)	13.428* (6.706)

AP funds' annual portfolio turnover is computed as a weighted average of changes in cash flow rights in companies; Weighting is based on portfolio weights given by funds to specific securities; Annual portfolio turnover (min) is calculated from a minimum of increase or decrease of cash flow rights in companies. Standard errors are in brackets. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

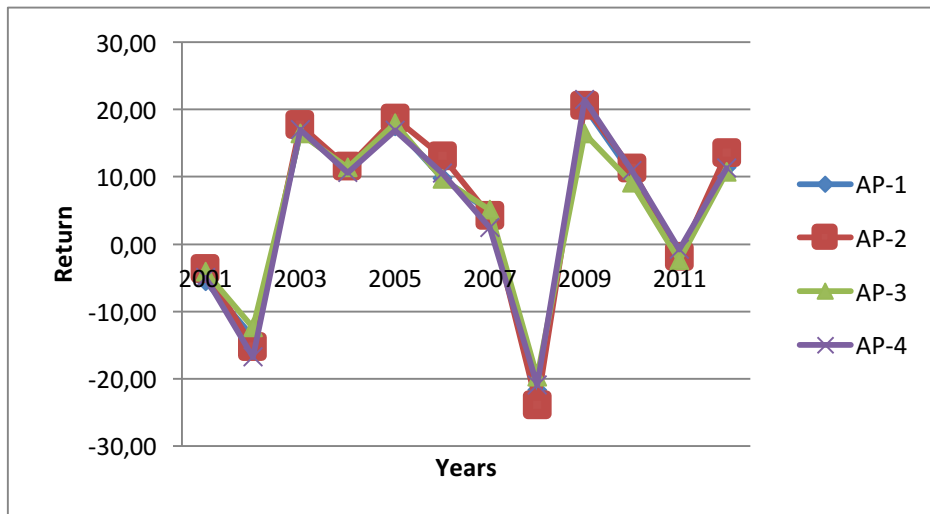
<sup>1</sup>If cash flow rights of the fund >0

Their foreign equity is mostly indexed or managed externally. In the later periods AP funds have also increased their in-house management of foreign equity.

AP 1-4 funds targeted a long-term annual inflation-adjusted real return of 4%. This target is required to maintain the balance between pension contributions and liabilities that are annually adjusted upwards with income growth in Sweden. Note that income grew on average by 3.4% annually between 2001 and 2011 in Sweden.

The performance of all the portfolios of AP 1-4 buffer funds during the sample period is presented in Figure 2. AP buffer funds' performance was hit by three crises: (i) the dot-com bubble at the beginning of the 2000s, (ii) the financial crisis that started in 2007-2008, and (iii) the debt crisis in Europe in 2011. In their 10-year summary reports published in 2011 annual reports, they conceded that they had failed to reach the objective of 4%-real return. Nominal annual return during the 10-year period for the AP 1-4 buffer funds was 4.3%, 3.8%,

**Figure 2** Return on Swedish Equity portfolios (before expenses) of AP 1-4 funds



3.4%, and 4.1%, while average annual inflation in this period was 1-2%.

Figure 3 depicts the performance of the Swedish equity portfolios held by AP funds. Their performance looks very similar, especially when compared to the MSCI Sweden benchmark, which comprises large and mid-caps. The similarity of the Swedish equity portfolio performance of AP 1-4 funds, as well as their proximity to the MSCI Sweden benchmark, has increased since the financial crisis.

### 5. The Similarity of AP 1-4 Funds' Swedish Equity Portfolios

In this section, I aim at identifying the similarity of AP 1-4 buffer funds' Swedish equity portfolios (Hypothesis-1). For the purposes of this section I define AP funds' Swedish equity portfolios as consisting of the weights assigned to stocks by each of the funds (the value of holdings in a company against the total value of the Swedish equity portfolio) during each quarter in the period. To compare portfolios, we need an appropriate measure. The Active Share measure proposed by Petajisto (2013) and Cremers & Petajisto

(2009) is suitable for our purpose.

$$\text{Active Share} = \frac{1}{2} \sum_{i=1}^N |w_{\text{fund},i} - w_{\text{benchmark},i}|$$

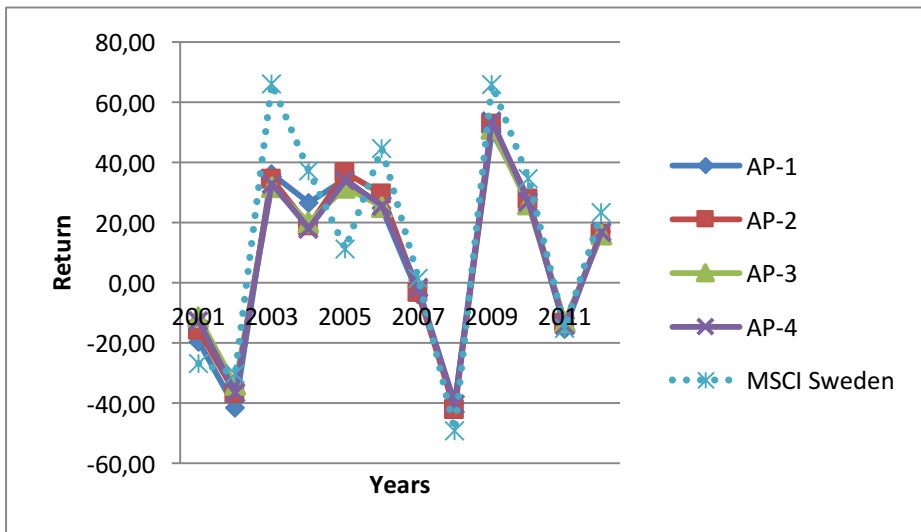
Here,  $w_{\text{fund},i}$  are the portfolio weights of specific equity in the fund,  $w_{\text{benchmark},i}$  are the portfolio weights of specific equity in the fund taken as a benchmark, such as other AP funds, average of other AP funds; and N is the quantity of stock. If there is zero portfolio overlap between a fund under consideration and another fund, the Active Share will be equal to 100. I therefore define the portfolio overlap measure as the following:

$$\text{Portfolio Overlap} = 100 - \text{Active Share}$$

The portfolio overlap measure is between "0" and "100", taking the value "0" if there is no overlap and "100" if there is complete overlap between the portfolios of the funds compared.

I calculate portfolio overlap between each fund against other funds, as well as average portfolio of other funds for each quarter and year during the sample period. The results are given in Tables 2, 3, 4, and 5.

Figure 3 Return on Swedish Equity portfolios (before expenses) of AP 1-4 funds



**Table 2** Overlap of AP-1's Swedish equity portfolio with other AP funds

	AP1 - AP2		AP1- AP3		AP1-AP4		AP1-Benchmark	
	Quarter	Year	Quarter	Year	Quarter	Year	Quarter	Year
2002		74		67		63		70
	69		60		52		63	
	80		73		73		78	
2003		80		74		71		77
	79		75		70		77	
	80		72		71		77	
2004		76		69		69		74
	80		67		70		75	
	72		70		68		73	
2005		71		73		66		75
	69		67		66		72	
	72		80		66		77	
2006		68		80		56		72
	73		82		63		76	
	68		79		59		73	
	63		81		52		70	
2007		70		77		61		73
	69		78		57		70	
	66		79		56		71	
	73		76		60		72	
	78		73		73		78	
2008		71		77		74		78
	75		82		76		83	
	71		74		69		74	
	69		74		79		78	
2009		78		77		79		82
	71		79		74		76	
	75		78		83		84	
	81		81		75		82	
	81		76		82		84	
2010		76		73		75		76
	76		73		78		78	
	77		72		71		76	
	74		72		74		76	
2011		74		72		75		75
	76		70		75		75	
	73		73		76		75	
	73		74		75		75	
	74		71		75		75	
2012		73		72		77		76
	73		77		76		76	
	72		56		76		70	
	74		79		79		79	
	74			78			79	
<b>Total</b>	<b>74</b>		<b>74</b>		<b>70</b>		<b>75</b>	

Portfolio Overlap is computed as following:

$$\text{Portfolio Overlap} = 100 - \frac{1}{2} \sum_{i=1}^N |w_{\text{fund},i} - w_{\text{benchmark},i}|$$

here,  $w_{\text{fund},i}$  are portfolio weights given by a fund to specific security;

$w_{\text{benchmark},i}$  are portfolio weights given to specific security, by a fund taken as a benchmark;

N is the quantity of stock;

Portfolio Overlap measure is between 0, and 100, with 0 for no overlap, and 100 for complete overlap;

AP-1 benchmark is the average holdings of other AP funds.

**Table 3** Overlap of AP-2's Swedish equity portfolio with other AP funds.

	AP2-AP1		AP2-AP3		AP2-AP4		AP2-Benchmark	
	Quarter	Year	Quarter	Year	Quarter	Year	Quarter	Year
2002	69	74	76	77	62	68	75	79
	80		78		73		82	
2003	79	80	81	80	71	72	82	82
	80		80		73		82	
2004	80	76	77	76	73	70	82	79
	72		75		68		76	
2005	69	71	70	71	69	69	75	76
	72		73		68		77	
2006	73	68	76	75	64	60	79	75
	68		77		59		74	
	63		70		60		70	
	69		77		58		77	
2007	65	70	77	76	64	67	75	77
	66		78		63		74	
	73		74		67		79	
	78		77		74		80	
2008	75	71	75	73	74	70	79	74
	71		73		68		73	
	69		66		71		72	
	71		76		68		73	
2009	75	78	67	74	73	76	75	80
	81		80		73		80	
	81		75		81		84	
	74		72		76		79	
2010	76	76	80	83	81	74	84	83
	77		84		71		82	
	74		83		68		81	
	76		84		77		83	
2011	76	74	82	83	79	80	84	83
	73		84		77		82	
	73		84		81		83	
	74		83		82		83	
2012	73	73	88	78	84	83	85	82
	72		64		84		79	
	74		81		83		83	
	74		77		83		82	
<b>Total</b>	<b>74</b>		<b>77</b>		<b>72</b>		<b>79</b>	

Portfolio Overlap is computed as following:

$$\text{Portfolio Overlap} = 100 - \frac{1}{2} \sum_{i=1}^N |w_{\text{fund},i} - w_{\text{benchmark},i}|$$

here,  $w_{\text{fund},i}$  are portfolio weights given by a fund to specific security;

$w_{\text{benchmark},i}$  are portfolio weights given to specific security, by a fund taken as a benchmark;

N is the quantity of stock;

Portfolio Overlap measure is between 0, and 100, with 0 for no overlap, and 100 for complete overlap;

AP-2 benchmark is the average holdings of other AP funds.

**Table 4** Overlap of AP-3's Swedish equity portfolio with other AP funds.

	AP3-API		AP3-AP2		AP3- AP4		AP3-Benchmark	
	Quarter	Year	Quarter	Year	Quarter	Year	Quarter	Year
2002	60	67	76	77	55	62	67	72
	73		78		69		77	
2003	75	74	81	80	73	74	80	80
	72		80		76		80	
2004	67	69	77	76	68	68	74	75
	70		75		68		75	
2005	67	73	70	71	73	72	75	76
	80		73		70		77	
2006	82	80	76	75	67	62	80	79
	79		77		64		80	
	81		70		59		78	
	80		77		60		79	
2007	78	77	77	76	66	67	81	79
	79		78		67		81	
	76		74		69		78	
	73		77		67		76	
2008	82	77	75	73	75	75	81	80
	74		73		73		79	
	74		66		70		74	
	79		76		82		84	
2009	78	77	67	74	72	74	75	78
	81		80		81		85	
	76		75		74		76	
	73		72		70		74	
2010	73	73	80	83	76	73	80	81
	72		84		69		81	
	72		83		72		80	
	74		84		76		83	
2011	70	72	82	83	78	78	79	82
	73		84		77		82	
	74		84		80		84	
	71		83		78		82	
2012	77	72	88	78	84	77	87	79
	56		64		64		64	
	79		81		80		84	
	76		77		78		81	
<b>Total</b>	<b>74</b>		<b>77</b>		<b>71</b>		<b>78</b>	

Portfolio Overlap is computed as following:

$$\text{Portfolio Overlap} = 100 - \frac{1}{2} \sum_{i=1}^N |w_{\text{fund},i} - w_{\text{benchmark},i}|$$

here,  $w_{\text{fund},i}$  are portfolio weights given by a fund to specific security;

$w_{\text{benchmark},i}$  are portfolio weights given to specific security, by a fund taken as a benchmark;

N is the quantity of stock;

Portfolio Overlap measure is between 0, and 100, with 0 for no overlap, and 100 for complete overlap;

AP-3 benchmark is the average holdings of other AP funds.

**Table 5** Overlap of AP-4's Swedish equity portfolio with other AP funds.

	AP4-API		AP4-AP2		AP4-AP3		AP4-Benchmark	
	Quarter	Year	Quarter	Year	Quarter	Year	Quarter	Year
2002		63		68		62		69
	52		62		55		62	
	73		73		69		76	
2003		71		72		74		76
	70		71		73		75	
	71		73		76		78	
2004		69		70		68		73
	70		73		68		74	
	68		68		68		72	
2005		66		69		72		72
	66		69		73		74	
	66		68		70		71	
2006		56		60		62		62
	63		64		67		68	
	59		59		64		63	
	52		60		59		59	
2007		61		67		67		68
	57		64		66		64	
	56		63		67		65	
	60		67		69		69	
	73		74		67		75	
2008		74		70		75		79
	76		74		75		80	
	69		68		73		77	
	79		71		70		80	
2009		79		76		74		83
	74		68		82		79	
	83		73		72		83	
	75		73		81		81	
	82		81		74		85	
2010		75		74		73		77
	77		76		70		83	
	78		81		76		83	
	71		71		69		73	
2011		75		80		78		82
	74		68		72		74	
	76		77		76		79	
	75		79		78		83	
2012		77		83		77		84
	76		84		84		86	
	76		84		64		81	
	79		83		80		85	
2012		77		83		77		84
	78		83		78		85	
<b>Total</b>	<b>70</b>		<b>72</b>		<b>71</b>		<b>75</b>	

Portfolio Overlap is computed as following:

$$\text{Portfolio Overlap} = 100 - \frac{1}{2} \sum_{i=1}^N |w_{\text{fund},i} - w_{\text{benchmark},i}|$$

here,  $w_{\text{fund},i}$  are portfolio weights given by a fund to specific security;

$w_{\text{benchmark},i}$  are portfolio weights given to specific security, by a fund taken as a benchmark;

N is the quantity of stock;

Portfolio Overlap measure is between 0, and 100, with 0 for no overlap, and 100 for complete overlap

AP-4 benchmark is the average holdings of other AP funds.

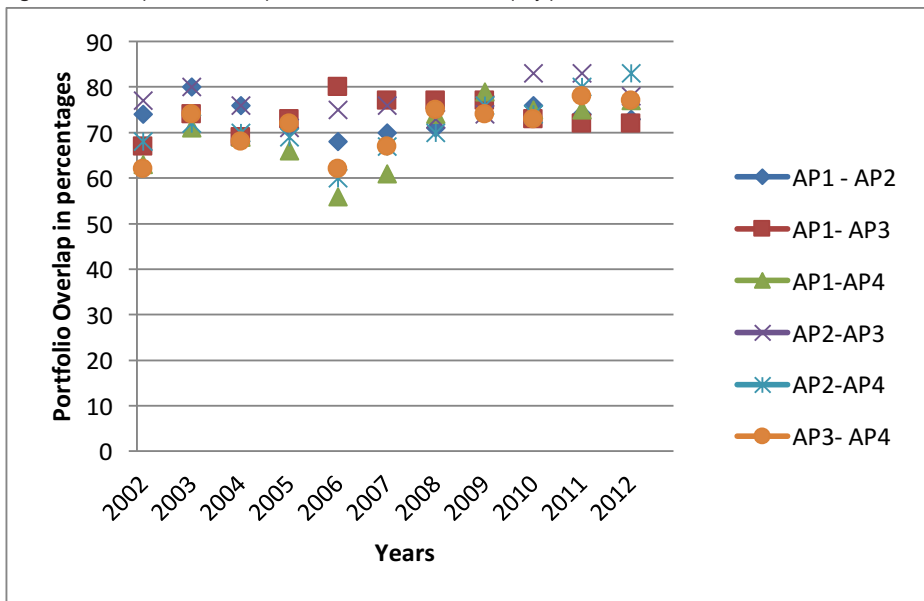
Portfolio overlap measures computed may be better visualized in Figure 4. The portfolio overlap between AP funds' Swedish equity was 60-85% during the different periods. At the beginning of the sample, portfolio overlap between the Swedish equity holdings of AP funds was relatively low and lay between 60-77% in 2002. The highest portfolio overlap during this period was between AP-2 and AP-3 – about 77%, and the lowest between AP-3 and AP-4 – around 62%.

The highest discrepancy in Swedish equity portfolios of AP funds was especially pronounced in 2006, when AP-4's Swedish equity portfolio diverged from other AP funds' portfolios. For example, the portfolio overlaps between AP-4 and AP-1 was only 56%, and with AP-2, 60%.

Since the start of the financial crisis the similarity between AP funds' Swedish equity portfolios has increased slightly. This especially applies to AP-4, which brought its Swedish equity portfolio closer to those of the other AP funds. The highest degree of similarity between AP funds in terms of Swedish equity composition is observed between 2010 and 2012. This is particularly true for AP funds 2-4. For example, portfolio overlap between AP-2 and AP-3 in 2010, and AP-2 and AP-4 in 2012, reached 83%.

Judging the extent of Swedish equity portfolio similarity between the AP 1-4 funds remains a subjective matter. One could also argue that a 20-25% portfolio difference between AP funds has the capacity to generate substantial differences in performance. How-

Figure 4 Annual portfolio overlap of AP 1-4 funds' Swedish Equity portfolios



Portfolio overlap is calculated as follows. For each period, I compute Active Share measure.

$$\text{Active Share} = \frac{1}{2} \sum_{i=1}^N |w_{\text{fund},i} - w_{\text{benchmark},i}|$$

where  $w_{\text{fund},i}$  are portfolio weights given by a fund to specific equity;  $w_{\text{benchmark},i}$  are portfolio weight given to specific security, by a fund taken as a benchmark; and,  $N$  is the quantity of stock.

Finally,

$$\text{Portfolio Overlap} = 100 - \text{Active Share}$$

This measure is between 0, and 100.

**Table 6** Co-movements of AP 1-4 funds within their Swedish equity portfolios: purchases

DEPENDENT VARIABLE:	PURCHASE AP1 <sub>(T+1)</sub> (1)	PURCHASE AP2 <sub>(T+1)</sub> (2)	PURCHASE AP3 <sub>(T+1)</sub> (3)	PURCHASE AP4 <sub>(T+1)</sub> (4)
Purchase -AP1 <sub>(T)</sub>	0.816*** (0.093)	0.391*** (0.077)	0.591*** (0.136)	0.408*** (0.130)
Purchase -AP2 <sub>(T)</sub>	0.203*** (0.063)	0.258*** (0.061)	0.207*** (0.075)	0.099 (0.068)
Purchase -AP3 <sub>(T)</sub>	0.146*** (0.052)	0.051 (0.037)	-0.047 (0.072)	0.061 (0.055)
Purchase -AP4 <sub>(T)</sub>	0.086 (0.053)	0.072* (0.039)	0.122** (0.060)	0.419*** (0.083)
Illiquidity <sub>(T)</sub>	-0.016 (0.022)	0.001 (0.008)	-0.010 (0.014)	-0.002 (0.009)
N	5783	5783	5783	5783
pseudo R <sup>2</sup>	0.043	0.016	0.010	0.017

The regression model is a left-censored Tobit. Purchase -AP variables are from the increase in the cash flow rights of a particular AP fund in a company. The variables are left-censored. *Illiquidity* = (ask price- bid price), which is computed on weekly (end of week) ask and bid prices. Robust standard errors are clustered by firm. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

ever, Figure 3 above shows that the returns generated by AP funds’ Swedish equity portfolios, especially following the financial crisis, were close to identical.

### 6. Co-Movements in AP Buffer Fund Portfolios?

In this section, I test the co-movements of AP 1-4 funds into and out of particular stocks within their Swedish equity portfolios (Hypothesis-2). Co-movements are tested through AP funds’ ownership changes in terms of cash flow rights in companies.

The AP funds under consideration may react dissimilarly to other AP funds’ sales or purchases. I therefore construct two types of variable for each AP fund: “Purchases” characterizing increase in ownership, and “Sales” representing decrease in ownership<sup>3</sup>.

Next, I regress future changes in ownership of a particular AP fund on the past changes in ownership of the other AP Funds. In addition, these regressions include AP funds’ own past changes of ownership to account for the possibility that their strategic decisions are implemented over more than one calendar quarter. Since purchases and sales variables are left-censored, I employ left-censored Tobit regressions to identify co-movements rather than to find causality. I therefore include no other control variables except the liquidity measure.

Table 6 describes the outcome from regressions of future purchases of each AP funds against its own and other AP funds’ past purchases. I include control for stock liquidity measured through ask-bid spread in the regressions.

<sup>3</sup> I multiply the decrease in the ownership variable by “-1”.

Table 6’s results indicate that AP funds continue to purchase shares in specific companies during more than one quarter. This is evidenced by the positively significant coefficients of own past purchase variables. In addition, each AP fund is likely to increase its ownership in a company when one of the other funds increases its ownership. Purchases of AP1 are followed by all funds.

The co-movement argument is even more valid if we examine the sales of AP funds (see Table 7). Note that the coefficients of the Tobit regression do not show linear impact on the dependent variable. However, we can still discuss their relative economic importance. Interestingly, the other AP funds’ reactions are greater in response to the purchases or sales of AP-1. This finding is perhaps unsurprising when we consider that AP-1 performed slightly better than the other AP funds between 2001 and 2011. Note that annual aver-

age nominal return generated by AP-1 during this period was 4.3% , while in AP-2 to AP-4 in was 3.8%, 3.4%, and 4.1% respectively. The difference in performance between funds is economically insignificant, but reputational aspects may have played a role here.

To test the robustness of the results of this section, I construct another set of variables. For each AP 1-4 fund, I construct two sets of dummy variables: (1) a purchase dummy that takes a value of 1 if an AP fund increased its ownership in terms of cash flow rights in a company; (2) a sales dummy that takes a value of 1 if an AP fund decreased its ownership in a company.

I regress the future purchase/sales dummy variable of each AP fund on the last quarter’s purchase/sales dummies, together with a control for stock liquidity.

Results of probit regressions are given in Tables 8 and 9. These results confirm the co-movement of AP funds’ sales within their

**Table 7** Co-movements of AP 1-4 funds within their Swedish equity portfolios: sales

DEPENDENT VARIABLE:	SALES AP1(T+1) (1)	SALES AP2(T+1) (2)	SALES AP3(T+1) (3)	SALES AP4 (T+1) (4)
Sales -AP1 <sub>(T)</sub>	0.958*** (0.089)	0.628*** (0.102)	0.779*** (0.146)	0.987*** (0.201)
Sales -AP <sub>2(T)</sub>	0.203*** (0.052)	0.310*** (0.066)	0.251*** (0.078)	0.256*** (0.081)
Sales -AP3 <sub>(T)</sub>	0.306*** (0.081)	0.310*** (0.082)	0.066 (0.075)	0.427*** (0.105)
Sales -AP3 <sub>(T)</sub>	0.136*** (0.050)	0.185*** (0.064)	0.283*** (0.088)	0.358*** (0.077)
Illiquidity <sub>(T)</sub>	-0.042 (0.037)	-0.013 (0.008)	-0.011 (0.011)	-0.009 (0.008)
N	8649	8649	8649	8649
pseudo R <sup>2</sup>	0.068	0.030	0.026	0.033

The regression model is a left-censored Tobit. Sales -AP variables are from the decrease in cash flow rights of a particular AP fund in a company, multiplied by (-1). The variables are left-censored.

Illiquidity = (ask price- bid price), which is computed on weekly (end of week) ask and bid prices. Robust standard errors are clustered by firm. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

**Table 8** Co-movements of AP 1-4 funds within their Swedish equity portfolios (purchases- robustness)

DEPENDENT VARIABLE:	P_DUM_ AP1 <sub>(T+1)</sub> (1)	P_DUM_ AP2 <sub>(T+1)</sub> (2)	P_DUM_ AP3 <sub>(T+1)</sub> (3)	P_DUM_ AP4 <sub>(T+1)</sub> (4)
P_Dum -AP1 <sub>(T)</sub>	1.583*** (0.099)	0.991*** (0.071)	1.360*** (0.077)	0.929*** (0.067)
P_Dum -AP2 <sub>(T)</sub>	0.713*** (0.065)	0.393*** (0.048)	0.552*** (0.047)	0.274*** (0.045)
P_Dum -AP3 <sub>(T)</sub>	0.804*** (0.061)	0.501*** (0.053)	0.143* (0.075)	0.550*** (0.057)
P_Dum -A4 <sub>(T)</sub>	0.576*** (0.065)	0.528*** (0.045)	0.622*** (0.057)	0.943*** (0.049)
Illiquidity <sub>(T)</sub>	0.008* (0.004)	0.007** (0.003)	0.006** (0.003)	0.009* (0.005)
N	8649	8649	8649	8649
pseudo R <sup>2</sup>	0.663	0.373	0.454	0.449

The regression model is probit. *P\_Dum\_AP* variables are dummy variables taking a value of 1 if there is an increase in the cash flow rights of a particular AP fund in a company. *Illiquidity* = (ask price- bid price), which is computed on weekly (end of week) ask and bid prices. Robust standard errors are clustered by firm. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

**Table 9** Co-movements of AP 1-4 funds within their Swedish equity portfolios (sales- robustness)

DEPENDENT VARIABLE:	S_DUM_ AP1(T+1) (1)	S_DUM_ AP2(T+1) (2)	S_DUM_ AP3(T+1) (3)	S_DUM_ AP4(T+1) (4)
S_Dum -AP1 <sub>(T)</sub>	1.144*** (0.098)	0.498*** (0.060)	0.798*** (0.077)	0.542*** (0.076)
S_Dum -AP2 <sub>(T)</sub>	0.571*** (0.065)	0.506*** (0.051)	0.607*** (0.047)	0.306*** (0.049)
S_Dum -AP3 <sub>(T)</sub>	0.774*** (0.076)	0.537*** (0.053)	0.194** (0.076)	0.603*** (0.057)
S_Dum -AP4(T)	0.176** (0.071)	0.584*** (0.045)	0.631*** (0.058)	0.895*** (0.053)
Illiquidity (T)	-0.058 (0.046)	-0.014 (0.010)	-0.007 (0.008)	-0.006 (0.006)
N	8649	8649	8649	8649
pseudo R <sup>2</sup>	0.254	0.121	0.136	0.162

The regression model is probit. *S\_Dum\_AP* variables are dummy variables taking a value of 1 if there is a decrease in the cash flow rights of a particular AP fund in a company. *Illiquidity* = (ask price- bid price), which is computed on weekly (end of week) ask and bid prices. Robust standard errors are clustered by firm. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

Swedish equity portfolios. Here, we may only judge the likelihood of AP funds having similar buy and sell strategies, and not the magnitude of their ownership changes in reaction to the level of change in other AP funds. Whether AP-1 is being followed by a significantly greater degree of ownership change in other AP funds is not verified here.

The findings in this section suggest that there are indeed co-movements in the Swedish equity portfolios held by AP funds 1-4. The co-movements are in line with AP funds' strategic decision-making being executed over more than one quarter. The fact that one of the AP funds is followed more extensively is consistent with Fong et al. (2011), who suggest a rational and intentional following of the leader with superior information by other institutional

investors, and the leader getting higher return on investment along the co-movement towards price discovery.

### 7. Co-Movements Through Window Dressing?

If the co-movement of AP funds were a result of their selling off low-return stock and buying high-return stock more extensively during the last quarter immediately before reporting their holdings in annual reports to please the controller, which is represented by the state, and public opinion, we would consider especially such co-movement to run counter to competition arguments. In this section, I therefore test AP funds' "window dressing" behaviour (Hypothesis-3).

To this end, I split the sample of firms into five quantiles with regard to their per-

**Table 10** Test of window dressing by AP-1

AP-1 PURCHASES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.293*** (0.062)	0.357*** (0.080)	0.063 (0.110)
2	0.266*** (0.038)	0.541** (0.192)	0.285** (0.120)
3	0.285*** (0.036)	0.285** (0.087)	0.0008 (0.091)
4	0.261*** (0.043)	0.136*** (0.042)	- 0.125 (0.088)
5	0.353*** (0.055)	0.280*** (0.058)	- 0.074 (0.101)
AP-1 SALES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.310*** (0.063)	0.190*** (0.053)	- 0.124 (0.113)
2	0.263*** (0.037)	0.264*** (0.054)	0.002 (0.081)
3	0.249*** (0.033)	0.204*** (0.046)	-0.045 (0.061)
4	0.261*** (0.034)	0.182*** (0.036)	- 0.079 (0.050)
5	0.360*** (0.069)	0.180*** (0.040)	- 0.18** (0.084)

For each quarter, firms are split into 5 quantiles with regard to stock returns. Purchases and sales are from the next quarter trades of the AP fund (the changes in cash flow rights in companies). Standard errors (in brackets) and significance in the first two columns show whether the particular number is different from zero. Standard errors (in brackets) and significance in the third column show whether Quarter 4 trades (purchases/sales) are significantly different from those in Quarters 1-3.

formance in terms of the stock returns for each quarter, and then consider the quarterly changes in ownership by AP 1-4 funds for each performance group. Subsequently, I compare Quarter 1-3 trades with those observed in Quarter 4. The results are given in Table 10 for AP-1 portfolio, Table 11 for AP-2 portfolio, Table 12 for AP-3 portfolio, and Table 13 for AP-4 portfolio. Our main interest here is in the significant difference between Quarter 4 and Quarter 1-3 trades in selling losers and buying winners.

Table 10 shows that AP-1 sells winners less intensively during the fourth quarter, as “window dressing” would lead us to expect. At the same time, however, the fund purchases comparatively underperforming stock - the group of shares second from last in terms of last quarter’s returns during the fourth quarter. The results for AP-1 are not, therefore, completely in line with the window dressing hypothesis.

Contrary to the window dressing hypothesis, AP-2 purchases losers and sells

**Table 11** Test of window dressing by AP-2

AP-2 PURCHASES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.178*** (0.021)	0.258*** (0.036)	0.080** (0.039)
2	0.208*** (.024)	0.156*** (0.022)	-0.051 (0.042)
3	0.198*** (.023)	0.208*** (0.055)	0.010 (0.050)
4	0.205*** (.024)	0.210*** (0.065)	0.004 (0.059)
5	0.304*** (.062)	0.180*** (0.031)	-0.123 (0.085)
AP-2 SALES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.259*** (0.030)	0.493*** (0.177)	0.234** (0.104)
2	0.231*** (0.033)	0.234*** (0.055)	0.003 (0.075)
3	0.230*** (0.040)	0.218*** (0.052)	- 0.013 (0.096)
4	0.175*** (0.021)	0.294*** (0.075)	0.120** (0.055)
5	0.200*** (0.025)	0.227*** ( 0.056)	0.027 (0.059)

For each quarter, firms are split into 5 quantiles with regard to stock returns. Purchases and sales are from the next quarter trades of the AP fund (the changes in cash flow rights in companies). Standard errors (in brackets) and significance in the first two columns show whether the particular number is different from zero. Standard errors (in brackets) and significance in the third column show whether Quarter 4 trades (purchases/sales) are significantly different from those in Quarters 1-3.

**Table 12** Test of window dressing by AP-3

AP-3 PURCHASES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.442*** (0.064)	0.562*** (0.125)	0.120 (0.127)
2	0.350*** (0.057)	0.314*** (0.045)	-0.037 (0.090)
3	0.251*** (0.030)	0.221*** (0.027)	-0.030 (0.047)
4	0.213*** (0.025)	0.245*** (0.031)	0.033 (0.040)
5	0.298*** (0.042)	0.336*** (0.056)	0.038 (0.069)

AP-3 SALES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.357*** (0.034)	0.521*** (0.119)	0.163* (0.092)
2	0.288*** (0.0255)	0.272*** (0.136)	-0.0161 (0.084)
3	0.259*** (0.023)	0.217*** (0.067)	-0.042 (0.064)
4	0.251*** (0.019)	0.159*** (0.036)	-0.091** (0.042)
5	0.339*** (0.033)	0.315*** (0.145)	-0.025 (0.098)

For each quarter, firms are split into 5 quantiles with regard to stock returns. Purchases and sales are from the next quarter trades of the AP fund (the changes in cash flow rights in companies). Standard errors (in brackets) and significance in the first two columns show whether the particular number is different from zero. Standard errors (in brackets) and significance in the third column show whether Quarter 4 trades (purchases/sales) are significantly different from those in Quarters 1-3.

both losers and second group winners more intensively during the fourth quarter (Table 11). AP-3 sells losers, and undersells second group winners, more intensively during the last quarter, which is in line with the window dressing hypothesis (Table 12). AP-4 purchases losers at an accelerated rate during the fourth quarter, which is not in line with window dressing behaviour (Table 13). In summary, there is no clear picture for window dressing in AP funds' purchases and sales that would drive the results of co-movements.

To test the robustness of this section, I run Tobit regression of a *Purchases* variable on a *High\_return* dummy variable, which takes a value of 1 if the stock belonged to the group with the highest return during the last quarter and its interaction with a Quarter 4 dummy, as well as a control for the previous period's liquidity measured through ask-bid spread. If there were window dressing by AP funds, we would expect a positive significant interaction term of *High\_return* with quarter 4. When regarding results from these regressions re-

**Table 13** Test of window dressing by AP-4

AP-4 PURCHASES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.504*** (0.059)	0.910*** (0.169)	0.406*** (0.148)
2	0.386*** (0.057)	0.626*** (0.085)	0.240** (0.101)
3	0.391*** (0.043)	0.550*** (0.101)	0.159* (0.093)
4	0.361*** (0.045)	0.408*** (0.046)	0.047 (0.070)
5	0.381*** (0.066)	0.581*** (0.122)	0.200 (0.128)
AP-4 SALES			
Return (low to high) last quarter	Quarters 1-3	Quarter 4	Difference
1	0.558*** (0.080)	0.433*** (0.116)	-0.125 (0.186)
2	0.375*** (0.062)	0.464*** (0.135)	0.089 (0.137)
3	0.364*** (0.047)	0.206*** (0.039)	-0.158* (0.087)
4	0.312*** (0.039)	0.317*** (0.058)	0.005 (0.076)
5	0.478*** (0.074)	0.285*** (0.046)	-0.193 (0.126)

For each quarter, firms are split into 5 quantiles with regard to stock returns. Purchases and sales are from the next quarter trades of the AP fund (the changes in cash flow rights in companies). Standard errors (in brackets) and significance in the first two columns show whether the particular number is different from zero. Standard errors (in brackets) and significance in the third column show whether Quarter 4 trades (purchases/sales) are significantly different from those in Quarters 1-3.

ported in Table 14, then we can see that the interaction term of *High\_return* with quarter 4 is positively significant only true for AP-3. Next, I re-run the Tobit regression of *Sales* variable against the *Low\_return* dummy variable, which takes a value of 1 if the stock belonged to the group that had the lowest return during the last quarter, and its interaction with the Quarter 4 dummy, as well as controlling for last period liquidity. These results are reported in Table 15. Again, a positively significant interaction term is expected for window

dressing. It is significant but negative for only one of the funds, namely AP-4.

The results reported in this section show that there is no clear-cut window dressing behaviour by AP funds. It is unlikely that window dressing behaviour by AP 1-4 funds would explain co-movements within their Swedish equity portfolios.

### 8. Discussion

The rationale for having more than one AP buffer fund in the Swedish pension system

**Table 14** Window dressing by AP 1-4 funds. Robustness tests for purchases

DEPENDENT VARIABLE:	PURCHASE-AP1(T) (1)	PURCHASE-AP2(T) (2)	PURCHASE-AP3(T) (3)	PURCHASE-AP4(T) (4)
High_return	0.015 (0.048)	0.076* (0.041)	-0.000 (0.048)	-0.087* (0.052)
High_return*Quarter4	0.045 (0.079)	0.053 (0.059)	0.148** (0.074)	-0.041 (0.091)
Quarter4	-0.085** (0.041)	0.110*** (0.029)	0.228*** (0.037)	0.242*** (0.052)
Illiquidity(T-1)	-0.012 (0.022)	-0.001 (0.009)	-0.008 (0.013)	-0.003 (0.010)
N	5838	5838	5838	5838
pseudo R2	0.002	0.006	0.012	0.006

The regression model is a left-censored Tobit.

Purchase -AP variables are from the increase in cash flow rights of a particular AP fund in a company. The variables are left-censored. High\_return is a dummy variable taking the value of 1 if stock belonged to the group with the highest returns (out of 5 groups) during the previous quarter. Quarter 4 is a dummy variable taking the value of 1 for Quarter 4. Illiquidity= (ask price- bid price), which is computed on weekly (end of week) ask and bid prices. Robust standard errors are clustered by firm. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

has been questioned since their establishment. It has been argued that the system is unsuccessful in encouraging competition in performance between buffer funds (Björkmo & Lundbergh, 2010; Buffertkapitalsutredningen, 2012). A team of investigators led by Mats Langensjö (of the Buffer Capital Inquiry - Buffertkapitalsutredningen), which was tasked to evaluate the system by the Finance Ministry Swedish Pension Group, noted the following:

*“The competition between the four AP-funds has if anything had a negative influence. The management of the funds has become much the same. It has been more important that results do not deviate from the other funds in the short term than to implement a deliberate long-term strategy. Competition among the*

*funds has also contributed to a misdirected focus on their internal costs.” (Buffertkapitalsutredningen, 2012)*

In this study, I have found that there is certain similarity in equity portfolios of AP funds. They are also likely to have similar sell and buy strategies in their domestic equity portfolios. However, it is an overstatement to say that competition has been misdirected. These may simply be the result of a small market, low liquidity, and over-regulation of a system that was designed for the realities of 15 years ago – when there were still live discussions about the dot-com bubble.

Indeed, the Buffer Capital Inquiry group suggested that investment rules should be replaced with a less stringent prudent-person rule<sup>4</sup>. Later, a political consensus formed

<sup>4</sup> Prudent-person rule: “A fiduciary must discharge his or her duties with the care, skill, prudence, and diligence that a prudent person acting in a like capacity would use in the conduct of an enterprise of like character and aims.” Galer (2002)

**Table 15** Window dressing by AP 1-4 funds (Sales: robustness)

DEPENDENT VARIABLE:	SALES-AP1(T)	SALES -AP2(T)	SALES-AP3(T)	SALES-AP4 (T)
	(1)	(2)	(3)	(4)
Low_return	-0.050 (0.046)	0.010 (0.040)	-0.036 (0.047)	-0.028 (0.056)
Low_return*Quarter4	-0.115 (0.080)	0.014 (0.091)	0.116 (0.083)	-0.266** (0.114)
Quarter4	0.087*** (0.027)	-0.155*** (0.034)	-0.258*** (0.033)	-0.013 (0.033)
Illiquidity(T-1)	-0.059 (0.052)	-0.013 (0.010)	-0.012 (0.012)	-0.011 (0.010)
N	8449	8449	8449	8449
pseudo R2	0.010	0.006	0.012	0.003

The regression model is a left-censored Tobit.

Sales -AP variables are from the decrease in cash flow rights (multiplied by “-1”) of a particular AP fund in a company. The variables are left-censored. Low\_return is a dummy variable taking the value of 1 if stock belonged to the group with lowest returns (out of 5 groups) during the previous quarter. Quarter 4 is a dummy variable taking the value of 1 for Quarter 4. Illiquidity= (ask price- bid price), which is computed on weekly (end of week) ask and bid prices. Robust standard errors are clustered by firm. Significance level: \* p<.10, \*\* p<.05, \*\*\* p<.01

around this suggestion, as was reflected in the new AP fund regulation (Finansdepartementet, 2015)<sup>5</sup>. However, this regulation suggests a merger of some AP funds, the creation of a unified supervisory board, and the evaluation of funds’ performance against a reference portfolio. These suggestions do not support the fostering of competition, and may result in an even stronger convergence of AP funds.

Such concerns were expressed by Eva Halvarsson, CEO of AP-2, in that fund’s Annual Report for 2014:

“... It is important that there are several independent funds, pursuing different strategies – which is how things are at present. If implemented, the reforms proposed by the Pensions Group will reduce this spread of risk and the relative independence enjoyed by the AP Funds. ... One proposal is that the funds’ ad-

ministrative functions should be centralized. The Second AP Fund has a successful and complex organisation, in which administration and portfolio management work closely together and have been tailored for each other. ... Extracting a single aspect from this concept poses a significantly increased risk – rather like removing the leg from a stool. It’s likely to collapse.” (AP-2, Annual Report 2014, pp. 3)

Furthermore, as Mats Langensjö notes, evaluation by reference portfolio may result in heavy indexation being practised by AP fund managers (in Williams, 2015), which would represent a further step away from competition.

AP funds also states that:

“There are a number of unresolved risks in

<sup>5</sup>In December 2015, deputy finance minister Per Bolund announced that this regulation would be abandoned.

*the Pension group's proposal, including greater risk of standardization, shortsightedness and political influence of the AP funds. ... With an annual evaluation of the AP funds' performance to that of the reference portfolio, together with that the planning process of the reference portfolio and its asset allocation moves from the AP funds to the Pension Authority which increasingly focuses on the Income Index and constraints in the pension system, increases the risk of shortsightedness and consequently nearly passive index management." (AP-4, Interim Report 2015, pp. 13)*

As we can see, there are lessons to be learned from the Swedish pension reform. It is very difficult to set stringent investment rules and expect that institutional investors will be active in the governance of firms in their portfolios. In the most likely scenario asset managers would be restricted to short-term performance, drive their portfolios in a similar manner, and regard corporate governance involvement as too costly.

## 9. Conclusions

Sweden has introduced a competitive structure among several public pension funds (AP 1-4 buffer funds) on reforming its pension system. The main question addressed in this paper is whether those funds compete for performance rather than follow each other into and out of the same securities. While investigating Swedish equities of AP 1-4 funds,

I find that there is 60-85% overlap between their portfolios during the sample period 2001-2012. Further analysis reveals co-movements in their domestic share trades. There is higher reaction to one of the AP fund's share trades by other AP funds. I do not find evidence for window dressing by AP 1-4 funds that can explain co-movements in their Swedish equity portfolios.

The co-movements within AP funds' Swedish equity portfolios are consistent with strategic investment policy implemented over more than one quarter. The finding that one of AP funds is followed more intensely by the other funds makes the co-movements consistent with the leader-follower behaviour by institutional investors observed by Fong et al. (2011). The co-movements are partly explained by the fact that the funds are subject to identical investment rules, state control, and public scrutiny. Furthermore, it may well be that fund managers, as pointed out in the literature on reputation building, are unwilling to deviate from other funds because of their personal career concerns. However, the most important reason is likely to be that the Swedish market is relatively small (few liquid stocks to choose from) and the AP funds base their investment decisions on the same information sources. As a combination of these factors AP funds tend to hold similar domestic equity portfolios, creating co-movements in ownership changes.

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**Lahjoittaminen on tulevaisuuteen sijoittamista – Liikesivistysrahasto tukee apurahoin liikkeenjohtoa palvelevaa tutkimusta, koulutusta ja julkaisutoimintaa.**

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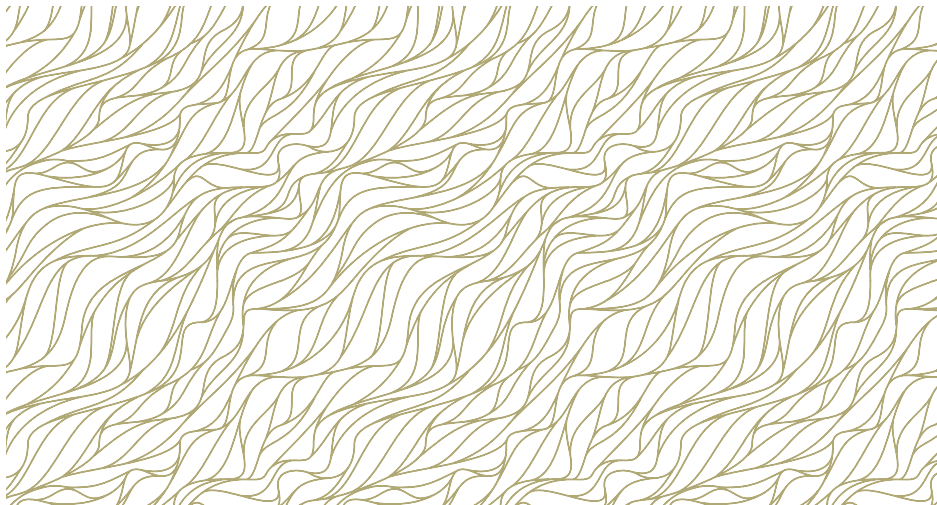
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