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THE EFFECT OF SHOPPING MALL'S COMPOSITION ON STORE REVENUE – AN EMPIRICAL STUDY

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LIST OF ABBREVIATIONS

Ad. R^2	– Adjusted R square;
Area eff.	– Area effectiveness;
Avg.	– Average;
BCG Matrix	– Boston Consulting Group Matrix;
Coef.	– Coefficient;
E.g.	– For example;
Etc.	– Et Cetera;
GLA	– Gross Lettable Area;
H (e.g. H1a)	– Hypothesis;
ICSC	– International Council of Shopping Centers;
m^2	– Square meter
NOK	– Norwegian currency (Krone), 1 NOK = 0.122448933 Euros;
Nr.	– Number;
OLS	– Ordinary Least Squares;
P-P plot	– Probability plot (standardized normal);
R^2	– R square;
Sign.	– Significance;
Sim.	– Simulation;
Std. Dev.	– Standard deviation;
US	– The United States of America;
VIF	– Variance Inflation Factor;
Vs.	– Versus;
&	– And.

ABSTRACT

Purpose – The purpose of this paper is to empirically study the effect of mall composition on store revenues in a shopping mall, in order to serve academic and practical purposes concerning optimal mall composition yielding maximum store revenues.

Design/ Methodology/ Approach – The study has an empirical approach using secondary data; model predicting store revenues in a shopping mall was developed, featuring mall composition and store size as the main predictors. The model was validated, using a sample of 17 shopping malls and 1444 mall stores and employing Linear Regression (OLS) as the statistical method.

Findings – The empirical model proposed is significant, providing that it is possible to quantify mall-composition effects at store level. The effects of two mall-composition components, including store abundance and relative size of tenant categories in a shopping mall are verified, with the latter component being more influential than the former one. The effects of mall composition and store size vary across high-demand versus low-demand tenant categories, and complementary versus substitutable ones in a shopping mall. Moreover, the relative size of high-demand category and the abundance of complementary category exert the most positive effect on mall stores' revenues.

Implications and Originality – The study provides a new approach towards understanding mall-composition effect at store level. It develops a new tenant-store classification tool and studies the variation of mall-composition and store-size effect across tenant categories of low-demand versus high-demand, and complementary versus substitutable stores. The study uses simulation to exemplify its empirical findings. Its best contribution is a set of optimization guidelines that instruct mall operators on how to optimize mall composition to maximize store revenues. A novel strategic tenant-category positioning matrix is also provided, aimed to assist practitioners in resource allocation decisions in shopping mall and similar retail formats.

1. INTRODUCTION

Driven by better economy and shoppers' inclination toward a "one-stop" destination for their shopping purposes, shopping malls are growing rapidly, in both number and size (Gilboa 2009). Massive booming of shopping malls, however, has led to mutual cannibalization among them, tightening the business environment in which shopping malls operate (Tsai 2010). To complicate the matter further, big boxes, discounters, and many other types of retail outlets is continuing to appear, gradually popularizing as alternative venues for shopping, and posing an immediate threat to lure away traditional shoppers and retail tenants of shopping malls. In the new environment, it is no longer enough for a shopping mall to operate in a convenient manner by offering retail tenants with low rent and good location, or providing customers with broad assortment and entertaining shopping experience alone. They will need to come up with new and better strategies to stand out among competitors, in order to sustain current shoppers and retail tenants, and, more importantly, to attract new and more profitable ones.

A prominent reason for shoppers to patronize a shopping mall is to economize on the amount of shopping time by combining purchases from different categories of stores, and making multi-purpose shopping trips (Leszczyc, Sinha, and Sahgal 2004). Retail tenants, on the other hand, increasingly gravitate to shopping malls with the aim to achieving higher sales by enjoying high levels of customer traffic generated by the combination of stores in a shopping mall (Brueckner 1993). The success of a shopping mall, either to its tenants or shoppers, seems to derive greatly from the right composition of stores within it. Mall composition, as a result, should be the primary management tool for planning a shopping mall's strategies, especially in the increasingly competitive context of the business.

Mall composition, also referred to as retail mix or tenant mix, has been studied extensively in former research. It concerns decisions such as how many different store types, or tenant categories, should be presented at a shopping mall, how many stores should be included in each category, and how much lettable area should be distributed to each store or each category. The complexity of mall-composition decisions are justified by their strategic role in attracting customers and altering their behavior once arriving at a shopping mall (Kirkup and Rafiq 1994; Shah and Mrudula 2005; Hunter 2006; Brito 2009; Chebat, Sirgy, and Grzeskowiak 2010). In practice, mall composition has been widely considered

critical to all parties concerned – shoppers, retail tenants, and mall operators (Kirkup and Rafiq 1994) because it is the synergy created by the right grouping of tenants, which together have a greater total effect than the sum of their individual effects (Alexander and Muhlebach 1990).

However, despite considerable effort to study mall-composition effect, former research in the field was typically qualitative, yielding descriptive and ungeneralisable results, which were insufficient to provide major implications for academic and managerial purposes. There is a significant absence of quantitative and scientific models to guide practitioners on how to optimize mall composition (LeHew and Fairhurst 2000; Yiu and Xu 2012); as a result, mall-composition choices have been ineffective, being primarily based on past experience and gut feelings (Kirkup and Rafiq 1989). There is also a lack of theoretical and practical tool to assist managers of retail tenants in a shopping mall in understanding the impact of mall composition on their store revenues. In practice, current research mainly emphasized the effect of mall composition on an overall shopping mall, with very little comment on its impact on individual retail stores within it. Such impact is, indeed, equally important if not more, as the performance of a shopping mall and that of its tenant stores are hardly separated (LeHew and Fairhurst 2000).

Perceiving the significant gaps in the literature of mall composition, we focus our research on the quantitative and scientific aspects of mall composition, aiming to quantify mall-composition effect on revenues of individual stores in a shopping mall. The originality of our study compared to other research in the field is that the study is empirical and quantitative, and that mall-composition effect will be studied at store level, instead of mall level as commonly found in former qualitative research. Our empirical approach is valuable in the sense that it is able to provide findings that are predictive rather than descriptive, which is necessary to develop actionable guidelines to achieve optimal mall composition. Moreover, the study being focused on mall-composition effect at store level is more practical, as it offers prediction of the profitability of retail stores in a shopping mall, which is one of shopping mall's most critical issues but not sufficiently studied in previous research. Finally, the study's outcomes promise to provide mall operators with suggestions to improve their competitive edge in the new challenging business environment.

2. RESEARCH QUESTION AND OBJECTIVES

The study is conducted to fill the gap in literature of shopping mall in general and mall composition in particular. The specific research question it concerns is:

- *"How do different mall-composition components influence the revenues of individual stores in a shopping mall?"*

Answering this basic question is essential to further understand:

- *"How to use knowledge about a shopping mall's composition to effectively maximize its tenant stores' revenues?"*

The research will empirically examine different components of mall composition as well as specify relevant store-specific determinants of store revenues, in order to formulate reliable model presenting the effect of mall composition on store revenues. It will discover a new tenant-store classification tool to assist the study of mall-composition effect at store level. The main objective is to provide a better understanding of mall-composition effect to serve academic purposes and come up with actionable guideline to optimize mall composition and maximize store revenues in a shopping mall.

3. LITERATURE REVIEWS

The research has a duo perspective: mall-composition effect at store level and drivers of store revenues in shopping mall format. As such, we find literature on the topics of mall composition and drivers of store revenue particularly relevant.

MALL COMPOSITION

Mall composition is the combination of factors, including the proportion of space and number of units by different retail tenants, as well as the relative placement of the retail tenants in a shopping mall (Dawson 1983). This concept describes stores, or retail tenants, in a shopping mall by their size, general location, and the type of goods they offer (Bean et al. 1998).

Having a good mall composition means having a variety of tenants that work well together to enhance the performance of the entire shopping mall and that of its individual businesses (Greenspan 1987). Brueckner (1993) found that the allocation of space to certain tenant categories in a shopping mall would likely cause externalities[1] and result in desirable or undesirable sale performance of all

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[1] *Externality refers to the cost or benefit that affects mall stores, which do not choose to incur that cost or benefit.*

stores in the shopping mall. Eppli and Shilling (1993) elaborated the ideas, finding that the rents of anchor[2] tenants were normally lower due to their positive externalities on non-anchors in a shopping mall. Furthermore, tenant variety, which refers to the number of tenant categories in a shopping mall and the abundance of stores within each category, was found to affect the amount of time shoppers spent in a shopping mall and their patterns of movement (Brown 1991; Khare and Rakesh 2011). Tenant variety also alters shoppers' perception of the shopping mall's image (Finn and Louviere 1996; Hunter 2006), and has strong influence on their excitement within the shopping mall (Wakefield and Baker 1998). Different components of mall composition such as the size and the store abundance of a number of tenant categories in a shopping mall contribute greatly to the "cumulative attraction" of the whole shopping mall (Nelson 1958; Abratt et al. 1985; Greenspan 1987; Alexander and Muhlebach 1989-1990; Brown 1992; Kaufman and Lane 1996; Ibrahim et al. 2003; Teller and Reutterer 2008).

Overall, a substantial volume of studies has underscored the importance of mall composition. However, the majority of them are qualitative, yielding findings of low predictive value, and primarily based on customer-survey data that are greatly context-dependent (LeHew and Fairhurst 2000). The existence and strength of the mall-composition effect are difficult to measure and current literature does not explicitly provide an approach to measure them (Teller and Schnedlitz 2012). Furthermore, former studies on the topic of optimal mall composition have not been generalized for future use, due to the fact that a proper composition of stores in a shopping mall depends greatly on the shopping mall's external specifications such as location, size, and demographic profiles (Institute of Real Estate Management 1990). An optimal composition for one shopping mall could be a mistake for another shopping mall (Casazza and Spink 1985; Alexander and Muhlebach 1992). Due to these obstacles and difficulties perceived by researchers, the optimization of mall composition has not been studied scientifically; and no guideline actually exists to provide mall practitioners with information regarding how to obtain synergy of stores in their shopping malls (LeHew and Fairhurst 2000). Additionally, current research on the effect of mall composition seems to focus on indirect mall-performance aspects such as shopping mall's attractiveness, mall shopping experiences, and shoppers'

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[2] *Anchor stores are major retail tenants, e.g. department stores or grocery stores, used to drive business to smaller retailers, or non-anchors, in agglomeration type of retail format.*

patronage behaviors. Although studying these aspects is meaningful to evaluate the success of a shopping mall from shoppers' point of view, it does not provide direct implications about the profitability of tenant stores within the shopping mall, which is obviously more important from the management perspective. After all, improving the bottom line of a shopping mall and its retail tenants is what matters the most, and current research seems ineffective in assisting it.

DRIVERS OF STORE REVENUE

Past research has identified a number of factors that influence revenues of a retail store. These include store-specific factors such as store size, assortment, types of products offered, promotion, and level of service (Walters and Rinne 1986; Walters and MacKenzie 1988; Reinartz and Kumar 1999), consumer demographic factors such as income, population, age, or occupations (Clawson 1974, Ingene and Lusch 1980, Hoch et al. 1995), store's location (Kotler 1971; Cottrell 1973; Clawson 1974; Stanley and Sewall 1976; Ingene and Lusch 1980), and competition-related factors such as number of competitors (Kotler 1971; Ghosh 1984), discount competition (Cottrell 1973), and shopping alternatives (Hoch et al. 1995), etc.

With regards to retail stores that present in a shopping mall, store-specific factors, particularly store size, are often identified as the most important driver of store revenues. Brueckner (1993) found that the sizes of retail stores in a shopping mall increased traffic at mall level, which finally raised the sales of all stores in the shopping mall. The author further proposed in the same study that the revenue of a store in a shopping mall increased at a decreasing rate as its area increased. Yiu and Xu (2012) confirmed a positive log-relationship between store revenue and store size in a shopping mall. More importantly, in a shopping mall, store size was found closely tangled with the shopping mall's composition (Cohen and Lewis 1967; Kirkup and Rafiq 1994; Yiu and Xu 2012); and both significantly contribute to the success of a shopping mall as well as that of its tenant stores (Nicholls et al. 2002; Teller and Reutterer 2008). This suggests a study of mall-composition effect at store level also need to account for the effect of store size on store revenues in a shopping mall.

Another factor that influences the revenue of a retail store in a shopping mall is store type, or the type of goods that the store offers. Prior research, such as Harvey (1987) and Gerbich (1998), supported the proposition that the type of a

store should proxy for its sales volume. Bean et al. (1998) found that percentage of sales, or average rent, of a retail store depends on the store's type. In shopping mall format, Brueckner (1993) particularly proposed that the attractiveness of a shopping mall to customers, which in turn influenced on the revenues of its tenant stores, greatly relied on the sizes and types of stores it contained. Moreover, De Juan (2004) and Simonson (1999) claimed that it made no sense to consider a customer's patronage behavior towards a shopping mall, or towards a retail store in the shopping mall, without considering these behaviors based on the products customers chose to acquire. As such, it is necessary to study the effect of store size, as well as that of mall composition, across different store types in a shopping mall, because these effects were claimed to alter shoppers' behaviors. Store type, like store size, is close element of mall composition (Bean et al. 1998), and should be the relevant store-specific determinant of store revenue in a shopping mall.

As far as we examine current literature, we have found no research that explicitly studies store-size or mall-composition effect across store types in a shopping mall. This gap in the literature is possibly due to a lack of proper mall-store classification that can effectively demonstrate the variation of mall-composition and store-size effect on store revenues in a shopping mall. Current literature does provide a number of ways to classify retail stores, such as by functions, by shopping trip purpose, by size, or by store ownership, etc. (Guy 1998), but does not illustrate how these classifications may contribute to understanding possible variance in stores' performance across categories. In shopping mall format, retail stores are often grouped into categories based on the functional uses of the goods they offer (Yiu and Xu 2012); meanwhile, these categories may or may not be heterogeneous in their responses to mall-composition and store-size effect. Therefore, it may be necessary to examine different store classification systems and specify a proper classification tool to assist our study of mall-composition and store-size effect at store level.

CONCLUSION

The first body of literature suggests that mall composition, mostly in terms of space allocation and store abundance of tenant categories in a shopping mall, significantly influences the success of the overall shopping mall. However, the literature is lacking in research that explicitly studies the impact of mall composition at individual store level. Literature on the drivers of store revenue, on

the other hand, specifies store size and store type as the relevant store-specific determinants of store revenues in a shopping mall, but fails to demonstrate how the store-size effect varies across different store types presented at a shopping mall. Furthermore, both bodies of literature are in shortage of quantitative empirical studies, thus, lacking the ability to provide researchers and practitioners with generalizable findings and practical managerial implications.

Our study seeks to fill these theoretical and managerial gaps by attempting to quantify mall-composition effect at store level. In order to do so, we will provide a conceptual model and framework featuring mall composition and store size as the two main drivers of store revenues in a shopping mall. The study also attempts to discover a tenant-store classification tool that is most effective to demonstrate the variances of mall-composition and store-size effect across store types in a shopping mall. These will enable the study to effectively complement current research on mall-composition effect and make considerable contribution to literature concerning drivers of store revenue. Most importantly, the research promises to yield actionable and managerial relevant outcomes, suggesting how to optimize mall composition and maximize store revenues in a shopping mall.

4. THEORETICAL FRAMEWORK AND HYPOTHESES
THEORETICAL FRAMEWORK

First, different tenant categories in a shopping mall need to be specified before we can introduce our theoretical framework. We propose a tenant-category classification where stores in a shopping mall are classified along two dimensions: the level of demand for a store's goods and the joint-utility of consuming multiple units of the type of goods that the store offers. On the demand-based dimension, mall stores are classified into *high-demand* versus *low-demand* stores, based on criteria such as purchase frequency and degree of penetration of the goods the stores offer. *Frequency* is the average number of times per year a certain type of goods is purchased, and *penetration* refers to the percentage of households that purchase a certain type of goods (Dhar, Hoch, and Kumar 2001). On the utility-based dimension, mall stores are classified into *complementary* and *substitutable* stores, based on the premise that the joint utility of consuming two complementary goods is higher than the joint utility of consuming two substitutable goods (Mungale 1997). *Complementary* goods are those tended to be consumed jointly in order to satisfy particular needs of shoppers; *substitutable*

goods are those satisfying the same needs and supposed to be consumed separately by shoppers (Bass, Pessemier, and Tigert 1969). The two classification dimensions are sufficiently supported in extant studies such as Krugman (1965), Fader and Lodish (1990), Dhar, Hoch, and Kumar (2001), and Low, Lee, and Cheng (2013), which introduced related elements of the demand-based classification, and Luce (1959), McFadden (1981), and De Juan (2004), which verified utility as the latent variable for store choices. In addition, the demand-based dimension may suggest the level of customer footfall in stores of a tenant category, which mainly generate planned sales within the stores (Fader and Lodish 1990; Inman, Winer, and Ferraro 2009). The utility-based dimension, on the other hand, possibly indicates unplanned purchases, which occur via shoppers' processing of information about the level of complementarity (or substitutability) of certain goods or stores during their shopping trip (Park, Iyer, and Smith 1989; Punj 2011). The two classification dimensions specify four conceptual tenant categories in a shopping mall, which are clearly exhibited in Figure 1.

Figure 1

CONCEPTUAL CLASSIFICATION OF STORES IN A SHOPPING MALL

Utility-based categorization	*Demand-based categorization*	
	Low-demand	High-demand
Complementary	- Low-frequency, low-penetration goods - High inter-product (or inter-store) joint utility	- High-frequency, high-penetration goods - High inter-product (or inter-store) joint utility
Substitutable	- Low-frequency, low-penetration goods - Low inter-product (or inter-store) joint utility	- High-frequency, high-penetration goods - Low inter-product (or inter-store) joint utility

Frequency is the average number of times per year a certain type of goods is purchased.

Penetration is the percentage of households that purchase a certain type of goods.

Inter-product joint utility is the utility of consuming two products in the same category.

Inter-store joint utility is the utility of purchasing from two stores in the same category.

Next, we present our theoretical framework, which are built upon the central idea that mall composition and store size influence the revenues of individual stores in a shopping mall, and that the strength and significance of these effects vary across tenant categories in the shopping mall.

The two mall-composition components exhibited in the framework are store abundance and relative size of the four tenant categories specified in earlier classification. Store abundance of a tenant category in a shopping mall refers to the number of stores in that tenant category, while relative size of a tenant category is the proportion of the shopping mall's space being allocated to all stores in that tenant category. Former research specified three direct components of mall composition, namely the number of tenant categories present at a shopping mall, the number of stores in each tenant category, and the relative size of each category. However, the number of tenant categories in a shopping mall is often pre-determined by the shopping mall's fixed area and is rarely a variable for mall-composition management (Ooi and Sim 2007; Yiu and Xu 2012). For this reason, our framework displays only store abundance and relative size of the four tenant categories in a shopping mall as constructs of mall-composition effect. A tenant category may occupy large space in a shopping mall, but may not, at the same time, contain a lot of stores. To illustrate, a single supermarket in a shopping mall may be as large as thirty clothing boutiques[3]; this possibly makes the category of foods and drinks stores large in size but low in store abundance compared to other categories. The two components of mall composition, therefore, have different essence and may influence mall stores' revenues in different manners.

In the framework (Figure 2), "Store Size" is store-specific characteristic, which means it refers to a single focal store, while "Store abundance" and "Relative size" concern all stores of the same tenant category in a shopping mall.

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[3] *Example is taken from our empirical data about Norwegian shopping malls.*

Figure 2. THEORETICAL FRAMEWORK
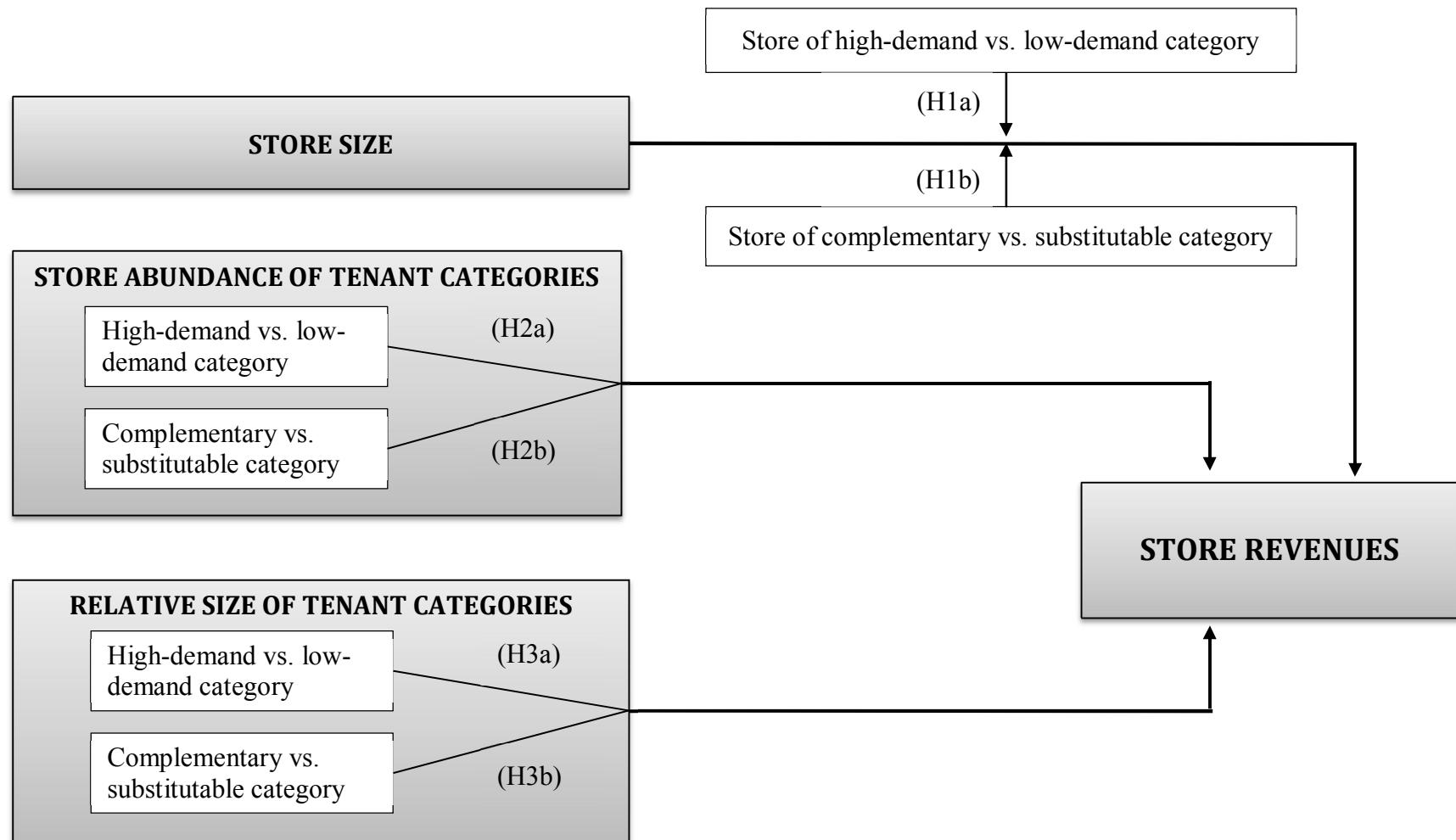
HYPOTHESES

Effect of store size across tenant categories in a shopping mall

A number of studies have confirmed the positive effect of store size on store revenue, providing that large stores are able to generate higher revenues than smaller stores selling the same types of goods (Arnold et al. 1983; Louviere and Gaeth 1987; Broniarczyk et al. 1998; Hoch et al. 1999; Arentze, Oppewal and Koelemeijer 2005; Oppewal and Timmermans 2005, etc.). However, whether and how store-size effect varies across stores of different categories in a shopping mall has not yet been studied. Our first set of hypotheses concerns this issue, proposing that the effect of store size on store revenues varies across high-demand versus low-demand stores (*Hypothesis 1a*) and across complementary versus substitutable ones (*Hypothesis 1b*).

Firstly, it is intuitive that stores of high-demand goods generate higher customer footfall than stores of low-demand goods; high-demand stores are, therefore, more crowded than low-demand stores of the same size. Crowdedness is an unpleasant shopping experience (Michon et al. 2005, Li et al. 2009); perception of high level of crowdedness may lead to shoppers' lower intentions to enter a store (Kim and Runyan 2010), reduced shopping time (Michon et al. 2005), limited purchases (Dion 2004), leaving without making a purchase (Noone and Mattila 2009), or avoidance of the store in future shopping trips (Harrell et al. 1980, Eroglu and Machleit 1990; Kim and Runyan 2010). We propose in *Hypothesis 1a* that the positive effect of store size on store revenues is stronger on high-demand stores compared to that on low demand stores because high-demand stores are often more crowded; thus, increase in store size, which reduces the level of store crowdedness, will be more visible and regarded as more beneficial by shoppers of high-demand stores versus those of low-demand stores.

Hypothesis 1a: The effect of store size on store revenue is more positive for high-demand versus low-demand stores in a shopping mall.

Secondly, large store size enables having more diversity of goods within a store, which is perceived as utility to shoppers (Oppewal and Koelemeijer 2005; Dhar, Hoch, and Kumar 2001). Higher perceived utility draws traffic to a store and induces more positive shopping responses from shoppers within the store, such as longer shopping time, higher money spending (Brown 1991; Khare and Rakesh 2011), and higher level of shopping excitement (Wakefield and Baker 1998). On

the other hand, Mungale (1997) found that the joint utility of two complementary goods is larger than the joint utility of two substitutable goods. As a result, the diversity within stores of complementary goods offers higher utility than the diversity within stores of substitutable goods, which is evaluated by shoppers. We propose in *Hypothesis 1b* that store size, which enables more diversity of goods in a store, exerts more positive effect on revenues of complementary stores versus substitutable ones.

Hypothesis 1b: The effect of store size on store revenue is more positive for complementary versus substitutable stores in a shopping mall.

Effect of store abundance of tenant categories in a shopping mall

The abundance of stores in a tenant category refers to the number of stores in that category in a shopping mall. Current research has provided that shoppers are drawn to retailers with abundance of shopping options as they often have multiple needs that cannot be fulfilled by a single store or single product category (Huff 1963; Kaufman and Lane 1996; De Juan 2004; Reimers and Clulow 2009). Hanson (1980) reported that 61% of all shopping trips are multipurpose; O'Kelley (1981) also provided that 63% of grocery trips and 74% of non-grocery trips were multipurpose. Obviously, store abundance implies to shoppers that the shopping mall is effective at meeting all of their needs; thus, it enhances the shopping mall's overall attractiveness. However, store abundance of different types of goods in a shopping mall may generate unanimous effects on the shopping mall's attractiveness, thus influences its tenant stores' revenues in different ways. The second set of hypotheses proposes that the effects of store abundance on store revenues vary across high-demand versus low-demand (*Hypothesis 2a*) and complementary versus substitutable category (*Hypothesis 2b*) in a shopping mall.

Firstly, store abundance of high-demand and low-demand tenant category exerts unidentical effect on store revenues, due to the fact that the abundance of high-demand and low-demand stores may positively or negatively influence the level of crowdedness in a shopping mall. As stores from different tenant categories are simultaneously presented in a shopping mall, each store is perceived by shoppers not in an isolated state but rather as part of the shopping mall's experience. If a large number of stores with heavy traffic exist, customers may perceive the overall shopping mall as being crowded and response negatively (Kim and Runyan 2010). Having many high-demand stores, which plays the role of driving

traffic to the shopping mall, possibly has counter effect on shoppers' shopping experience, and will, more or less, diminish the shopping mall's store revenues. On the opposite side, the presence of low-demand stores in a shopping mall may contribute to creating a less-crowded shopping experience, possibly delighting shoppers and manipulating positive shopping responses from them. These arguments suggest *Hypotheses 2a*:

Hypothesis 2a: The abundance of low-demand stores in a shopping mall exerts more positive effect on mall stores' revenues than the abundance of high-demand stores does.

Secondly, the effect of store abundance of complementary category is dissimilar to that of substitutable one, due to differences in the joint utility of stores within the two categories. As we mentioned earlier, the joint utility of two complementary items is perceived as higher than the joint utility of two substitutable items (Mungale 1997). If stores in a category are highly substitutable for one another, shoppers may not consider having an abundance of stores in that category as higher utility. Due to the fact that goods offered by substitutable stores serve very similar needs, the abundance of these stores ends up raising competition among them rather than increasing the utility of their overall category (Brueckner 1993). On the opposite side, if stores in a category are highly complementary to one another, shoppers will be more likely to perceive the abundance of stores in that category as higher utility, and response positively by, for instance, making unplanned purchases, in addition to planned purchases, among complementary stores. The discussions suggest *Hypotheses 2b*:

Hypothesis 2b: The abundance of complementary stores in a shopping mall exerts more positive effect on mall stores' revenues than the abundance of substitutable stores does.

Effect of relative size of tenant categories in a shopping mall

The relative size of a tenant category in a shopping mall is the percentage of the shopping mall's space being allocated to all stores of that tenant category. Intuitively, the relative size of a tenant category determines, or is determined by, the number of stores and the size of each store in the category. Previous hypotheses provide that both store size and store abundance of a tenant category influence mall stores' revenues; thus, the relative area of a tenant category is also expected to exert impact on mall stores' revenues.

If the relative size of a tenant category in a shopping mall is high, it may suggest that stores in that category are larger than stores of other categories, or that the category contains more stores than other categories, or both. From the first perspective, the relative size of high-demand tenant category may exert more positive effect on mall stores' revenues in comparison to the relative size of low-demand category, because store-size effect is more positive among high-demand versus low-demand stores (*Hypothesis 1a*), and an attractive store can draw traffic at mall level and benefit all stores in the shopping mall (Brueckner (1993):

Hypothesis 3a: The relative size of high-demand tenant category in a shopping mall exerts more positive effect on mall stores' revenues than the relative size of low-demand category does.

Meanwhile, from the second perspective, the relative size of low-demand category may contribute more positively to mall stores' revenues, compared to that of high-demand category, because the abundance of low-demand stores exerts more positive effect on mall stores' revenues than that of high-demand stores does, (*Hypothesis 2a*). We provide a competing hypothesis of 3a in order to account for the two different perspectives on a category's relative size:

Hypothesis 3a': The relative size of low-demand tenant category in a shopping mall exerts more positive effect on mall stores' revenues than the relative size of high-demand category does.

From both perspectives, the effect of relative size of complementary category is always more positive than that of substitutable category, because store size exerts stronger effect on complementary versus substitutable stores (*Hypothesis 1b*), and the abundance of complementary stores also provides more positive effect on store revenues than that of substitutable stores (*Hypothesis 2b*):

Hypothesis 3b: The relative size of complementary category in a shopping mall exerts more positive effect on mall stores' revenues than the relative size of substitutable category does.

The two mall-composition components specified in our hypotheses have a close relationship; increase in a category's relative size may also lead to increase in the number of stores in that category. However, there are also cases when the relative size of a tenant category does not directly suggest its level of store abundance. For example, the category of foods and drinks may have very large size but low store

abundance because it may contain very big tenant stores such as supermarkets and wine stores, of which store areas can be as large as 9,000 square meters; while the category of service stores may occupy much less space, but may contain more stores within it because service stores are often small, some even smaller than 20 square meters (examples from Norwegian shopping malls)[4]. Furthermore, it is uncertain whether store abundance of a tenant category or its relative size is more effective in influencing store revenues in a shopping mall. The effects of the two mall-composition components may also vary in different ways across the four tenant categories we specified. For these reasons, it is necessary to study both components of mall composition, with the knowledge that they are, more or less, correlated but apparently not identical.

5. DATA AND PRE-ANALYSIS

The data used in our research are provided by one of the leading shopping mall operators in Scandinavian countries. The data contain information of 1444 stores in 17 Norwegian shopping malls, in a two-year period from 2010 to 2011. An overview of the shopping malls and their tenant stores is provided below.

OVERVIEW OF THE SHOPPING MALLS UNDER STUDY

The 17 shopping malls are operated independently and exist for at least several years. They vary in size, ranging from small, medium to large shopping malls - with reference to the ICSC's International Standard for European Shopping Center Types (ICSC 2006). The 17 malls are scattered across different parts of Norway, but all are located in urban areas easily accessible by the local residents (Appendix 1). Due to the fact that Norway has a high level of equalization in income, population, and density across its territory (Statistics Norway 2010-2011), differences in the shopping malls' external environment are more or less controlled. Table 1 provides a statistical summary of the 17 shopping malls, in terms of gross lettable area, total number of stores, and annual revenue, which were all calculated as average of 2010 and 2011. Gross lettable area (GLA) refers to the total floor space for tenant occupancy of a shopping mall. The positive skewness statistics indicate that the majority of shopping malls under study are small-sized, a few are medium-sized, and very few are large-sized. Furthermore, smaller shopping malls tend to contain less tenant stores and yield lower revenues than larger ones.

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[4] *Examples are taken from our empirical data.*

Table 1

STATISTIC SUMMARY OF SHOPPING MALLS' GLA, NUMBER OF
STORES, AND ANNUAL REVENUES (2010 – 2011)

	Minimum	Maximum	Mean (N=17)	Std. Deviation	Skewness
GLA	7465	43822	23013.94	12586.436	0.372
Nr. of stores	28.00	191.00	86.1176	44.43096	0.604
Revenues	178.01	1827.01	822.1800	480.49096	0.373

With regards to the retail tenants in these shopping malls, there are in total 1444 retail stores, originally grouped into one of the 4 functional categories and 16 subcategories in accordance with formal functional classifications such as the US Classification of Tenant Stores in Shopping Mall (Urban Land Institute 2008) and the Statistical Classification of Economic Activities in the European Community (Table 2). Among the 1444 stores, 621 (or 43% of the total stores) are stores of Clothing, Footwear, & Accessories, 489 (or 33.9%) are stores of Home & Household goods, 110 (or 7.6%) are stores of Foods & Drinks; the remaining 224 stores (or 15.5%) are Service stores.

Table 2

FUNCTIONAL CLASSIFICATION OF STORES IN A SHOPPING MALL

Composite categories	Subcategories
(1) Clothing, Footwear & Accessories	(1.1) Women's apparel and accessories (1.2) Men's apparel and accessories (1.3) Children's apparel and accessories (1.4) Full-range apparel and accessories (1.5) Footwear (1.6) Watches and jewellery
(2) Home & Household goods	(2.1) Electrics & Electrical applications (2.2) Furniture, Decoration, & Textiles (2.3) Leisure and Hobby (music, photo, books, games, toys, and pet shops) (2.4) Health & Beauty (cosmetics, drug stores, glasses, & sport equipment)
(3) Foods & Drinks	(3.1) Supermarkets (3.2) Kiosks (3.3) Specialty food stores
(4) Services	(4.1) Foods and Drink serving (4.2) Entertainment facilities (4.3) Other services

In addition, we calculated the area effectiveness of each functional category by dividing a category's total revenue by its respective area in the shopping mall it

presents. The average area effectiveness values seem to vary largely across functional categories, being estimated at NOK[5] 35736.77 per square meter for stores of Clothing, Footwear, & Accessories, NOK 53434.88 per square meter for stores of Home & Household goods, NOK 67056.50 per square meter for stores of Foods & Drinks, and NOK 87516.41 per square meter for Services stores. The area effectiveness also varies considerably across subcategories (Appendix 2). Overall, store revenues seem to differ across functional categories even when other factors such as store size and mall-composition are the same. This is compliant with findings by Harvey (1987) and Gerbich (1998) that the type of a store should proxy for its sales volume, and may suggest that controlling for the profitability differences across these categories is necessary in order to obtain higher predictive power of any model aiming to estimate store revenues in a shopping mall.

CLASSIFICATION OF STORES INTO CONCEPTUAL CATEGORIES

In order to group the functionally classified stores in the original dataset into four conceptual tenant categories of high-demand or low-demand, complementary or substitutable stores, we examine the frequency and penetration of each functional category, as well as the inter-product and inter-store utility of each category. Former studies provided that durable goods such as home and household items were purchased infrequently (Dellaert et al. 1998; Phau and Sui 2000); meanwhile, convenience goods such as foods and drinks were frequently purchased and demanded by the most shoppers (Guy 1998; Phau and Sui 2000; Dhar, Hoch, and Kumar 2001; Sprott, Manning, and Miyazaki 2003). Clothing items have high involving nature, which implies they are frequently purchased by the majority of shoppers (Pan and Zinkhan 2005). In addition, search goods such as foods and drinks and clothing are purchased more frequently than experience goods such as services due to the easy to evaluate search goods prior to their purchase and consumption (Nelson 1970-1974; Hsieh, Chiu, and Chiang 2005).

With regards to inter-product utility, there is a great difference in assumptions about product substitutability and complementarity in extant studies (Coughlan 1987). In shopping mall format, the category of clothing, footwear, and accessories is more likely to be complementary rather than substitutable, as products in the category are often used in conjunction with one another

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[5] *NOK: Norwegian Currency - Kroner*

(Henderson and Quandt 1958). For instance, a complete outfit requires not only clothing items (top and bottom), but also shoes and other accessories. The same logic applies to the category of home and household goods, as a full set of furniture, for example, often involves a number of complementary or inseparable items (e.g. tables and chairs). Furthermore, stores of clothing, footwear, and accessories, or that of home and household goods, do not completely exclude one another, because goods in these categories, even if serving the same needs, are unidentical due to factors such as brands and styles. Stores of foods and drinks, on the other hands, tend to exclude one another; because their offerings satisfy very basic needs of shoppers, factors like brands are less important, and same-category stores are considered almost identical. We assume stores of foods and drinks are more substitutable in comparison to stores of goods such as clothing and furniture. In addition, service stores were sustainably found not complementary (Tubridy 1998) and not possessing positive compatibility index (Brown 1992).

The four functional categories seem to fit into our conceptual classification in the way that Clothing, Footwear & Accessories and Home & Household goods are complementary stores of high demand and low demand, respectively; and Foods & Drinks and Services are substitutable stores of high demand and low demand, respectively. With regards to the specific subcategories, current research provides very little evidence to classify them along the two classification dimensions we have specified. Our conceptual classification, as a result, is done at the composite category level instead of specific subcategory level (Figure 3).

Figure 3

CLASSIFICATION OF STORES INTO CONCEPTUAL CATEGORIES

Inter-product categorization	*Customer-based categorization*	
	Low-demand	High-demand
Complementary	Homes & Household goods	Clothing, Footwear, & Accessories
Substitutable	Services	Foods & Drinks

In order to provide an overview of the mall composition with regards to the four conceptual tenant categories, Figure 4 and Figure 5 illustrates the relative store number and the relative size, respectively, of the four categories across 17

shopping malls. We calculated the relative number of stores by dividing the number of stores in a category by the total number of stores in the shopping mall it presents; meanwhile, the relative size of a category was calculated by dividing the area of the category in the shopping mall they present by the shopping mall's GLA. Although the 17 shopping malls contain the same categories and subcategories, they may follow different tenant-mix strategies in terms of the abundance of stores in each category and the relative size of each category, which makes these shopping malls particularly suitable for the purpose of our research. Furthermore, the pattern of relative number of stores is different from the pattern of relative size across categories across shopping malls, which confirms our claim that the two mall-composition components contain different information.

Figure 4

RELATIVE NUMBER OF STORES OF EACH TENANT CATEGORY ACROSS SHOPPING MALLS

Figure 5

RELATIVE SIZE OF EACH TENANT CATEGORY ACROSS SHOPPING MALLS
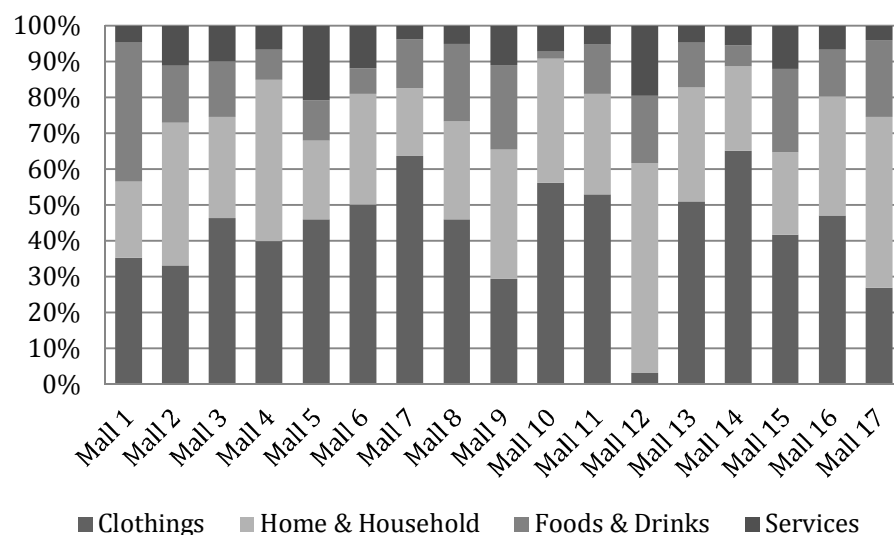
6. EMPIRICAL MODEL

On the basis of preceding discussions and the availability of our empirical data, we specify in the following a model equation and several variable sets, aiming to empirically examine the hypotheses and the framework we proposed. The definitions, logics, and how the model's equation and components were developed will be discussed in details.

VARIABLES AND MEASUREMENTS

Dependent variable

The dependent variable we aim to estimate is mall stores' revenue. Revenues of all stores were calculated as the average revenue in 2010 and 2011 in order to take into account store performances in both years, and to reduce errors resulted from missing values in the original dataset. Because the distribution of average store revenue was strongly screwed, we transformed store revenue into logarithm form in order to achieve a more normally distributed variable, which is necessary for it to serve as dependent variable in subsequent statistical tests (Figure 6).

Figure 6

DISTRIBUTION OF DEPENDENT VARIABLE

Mean = 11.6948
Std. Dev. = 26.53496
N = 1.199

Mean = 1.8685
Std. Dev. = 0.95799
N = 1.198
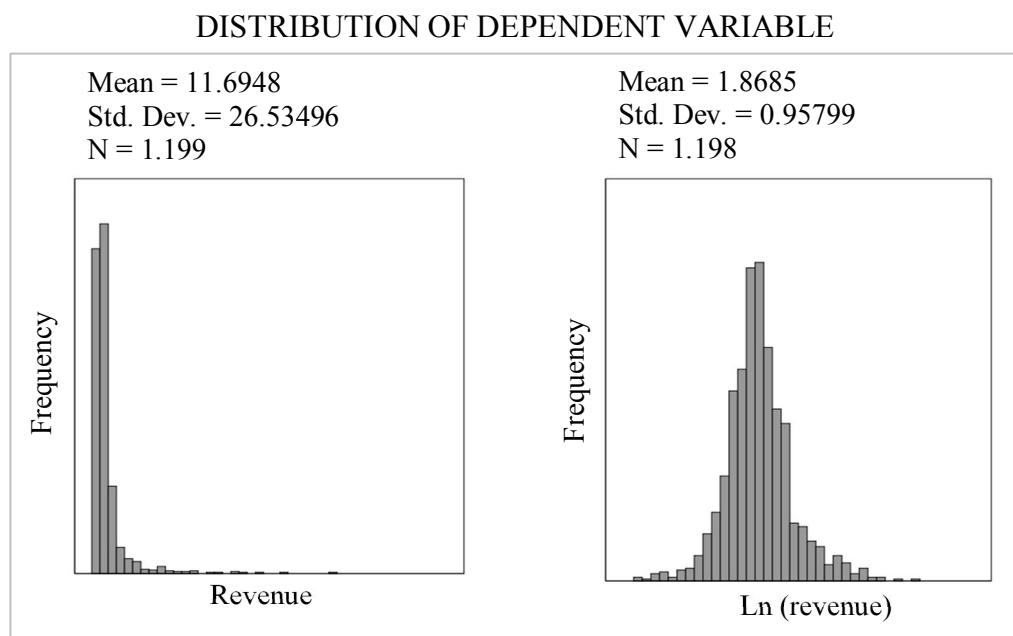
Independent variables

Tenant category indicator variables

The four conceptual tenant categories in a shopping mall are specified by three dummy variables. These dummy variables are particularly necessary to demonstrate the categorical moderation effect, which moderates the effect of store size on store revenues across four conceptual categories in a shopping mall.

Preceding analysis provided that revenues of stores in a shopping mall varied across categories even when other factors such as store size and mall composition were the same (Appendix 2). This variance is more likely due to the functional differences of the categories' goods, rather than their conceptual characteristics. Therefore, we computed 15 dummy variables representing 16 functional subcategories to account for the variance in store revenues across store types and independent of the effect of store size and mall composition. Including this type of variable, though not necessarily important to explain our hypotheses, is expected to improve the overall predictive power of the model.

Store-size variables

Store size is described in logarithm form in our subsequent model equation. Brueckner (1993) found that the revenue of stores in a shopping mall increase at decreasing rate as their area increases; thus, a log-log regression model (where both store revenue and store size are in logarithm form) will be better at capturing the relationship between store size and store revenues. In our particular dataset, the scatter plots of store revenue against store size indicate a more linear relationship when store size is transformed into logarithm form (R^2 Linear = 0.442 with logarithm store-size variable versus 0.320 with normal variable) and when squared logarithm of store size is also estimated (R^2 Quadratic = 0.461 versus R^2 Linear = 0.442) (Figure 7). Both logarithm and square-logarithm of store size will serve as store-size variables in our subsequent model, in order to achieve more flexible and accurate estimation of the store size – store revenue relationship.

Figure 7

PLOTING STORE SIZE AGAINST STORE REVENUE
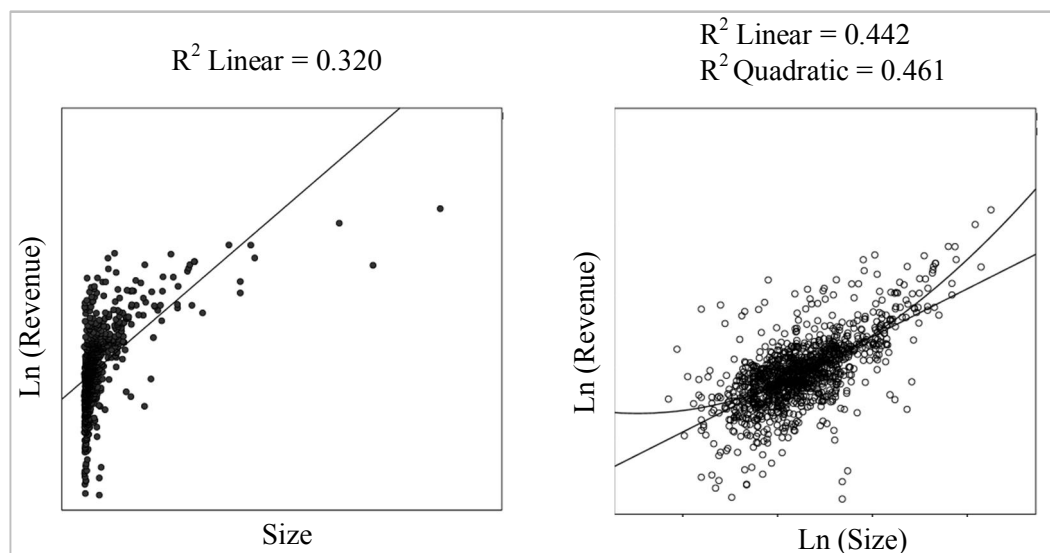
Moreover, the variation of the store-size effect across four tenant categories in a shopping mall is illustrated by the interaction terms of store size and store's conceptual category. These interaction terms are calculated by multiplying the store-size variables with the three dummy category indicator variables.

Store-abundance variables

The effect of store abundance is described in terms of the number of stores in each tenant category in one area unit of a shopping mall. The way the variable is constructed allows for taking into consideration differences in the GLAs of the 17 shopping malls under study. This is important because the number of stores in a category is inseparably intertwined with the physical size of its shopping mall (Cohen and Lewis 1967; Ooi and Sim 2007); and a mere increase in the number of stores without taking into account the mall's size constraint will not help achieving optimal mall composition (Yiu and Xu 2012). The variables of store abundance we constructed not only suggest the number of stores in each category, but also indicate the density of certain store types in one area unit of a shopping mall, which may imply the level of shopping mall's crowdedness. For this reason, the constructed store-abundance variables are more suitable to our particular framework in comparison to other alternatives that also imply store abundance, such as the absolute number of stores in a tenant category or the relative number of stores in a tenant category as a percentage of the total number of mall stores.

Relative-size variables

The relative size of a category is calculated by dividing the category's total area by the GLA of the shopping mall it presents at. High relative size of a category may suggest that stores of that category are larger, or that there are more stores in the category compared to other categories in a shopping mall, or both. In our dataset, the Pearson correlation between a category's relative size and the average size of its stores is 0.067 (p-value = 0.012); while the Pearson correlation between the category's relative size and its store abundance is 0.511 (p-value = 0.000). The simple test confirms that large-sized category not only has more stores than small-sized category, but also contains larger stores; thus, studying both *Hypothesis 3a* and *3a'* is necessary. Furthermore, although the correlation between relative size and store abundance of a category is not particularly strong, multicollinearity may happen if both types of variables are tested simultaneously in one model. Thus, multicollinearity test is required to validate possible findings that we may obtain.

MODEL SPECIFICATIONS

Model equation

$$
\begin{aligned}
\ln(revenue_{i,j}) = {} & \alpha + \sum_{k=1}^{15} \beta_k type_{i,j}^k + \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j}) h\_demand_{i,j} \\
& + \gamma_c \ln(size_{i,j}) comp_{i,j} + \gamma_{hc} \ln(size_{i,j}) h\_demand_{i,j} comp_{i,j} \\
& + \sigma_0 \left[\ln(size_{i,j}) \right]^2 + \sigma_h \left[\ln(size_{i,j}) \right]^2 h\_demand_{i,j} \\
& + \sigma_c \left[\ln(size_{i,j}) \right]^2 comp_{i,j} + \sigma_{hc} \left[\ln(size_{i,j}) \right]^2 h\_demand_{i,j} comp_{i,j} \\
& + \mu_{hc} abund_j^{h\_demand,comp} + \mu_{lc} abund_j^{l\_demand,comp} \\
& + \mu_{hs} abund_j^{h\_demand,sub} + \mu_{ls} abund_j^{l\_demand,sub} \\
& + \theta_{hc} rel\_size_j^{h\_demand,comp} + \theta_{lc} rel\_size_j^{l\_demand,comp} \\
& + \theta_{hs} rel\_size_j^{h\_demand,sub} + \theta_{ls} rel\_size_j^{l\_demand,sub} + \xi_{i,j}
\end{aligned}
$$

Denotations

Dependent variables

$\ln(revenue_{i,j})$: Logarithm of the revenue (in million NOK) of store i in mall j.

Tenant category indicator variables

$type_{i,j}^k$: Indicator variable of the functional subcategory of store i in mall j,

$type_{i,j}^k = 1$ if store i in mall j belongs to subcategory k (k = 1 to 15), and 0 otherwise;

$h\_demand_{i,j}$: Indicator variable of the demand-based category of store i in mall j, $h\_demand_{i,j} = 1$ if store i is high-demand & 0 if it is low-demand;

$comp_{i,j}$: Indicator variables of the utility-based category of store i in mall j, $comp_{i,j} = 1$ if store i is complementary & 0 if store i is substitutable.

Store-size variables

$\ln(size_{i,j})$: Logarithm of the size (in 100m^2) of store i in mall j;

$\left[\ln(size_{i,j}) \right]^2$: Square logarithm of the size (in 100m^2) of store i in mall j.

Store-abundance variables

$abund_j^{h\_demand,comp}$: Number of high-demand complementary stores in 1 area unit of mall j;

$abund_j^{h\_demand,sub}$: Number of high-demand substitutable stores in 1 area unit of mall j;

$abund_j^{l\_demand,comp}$: Number of low-demand complementary stores in 1 area unit of mall j;

$abund_j^{l\_demand,sub}$: Number of low-demand substitutable stores in 1 area unit of mall j.

Relative-size variables

$rel\_size_j^{h\_demand,comp}$: Relative area of all high-demand complementary stores in mall j;

$rel\_size_j^{h\_demand,sub}$: Relative area of all high-demand substitutable stores in mall j;

$rel\_size_j^{l\_demand,comp}$: Relative area of all low-demand complementary stores in mall j;

$rel\_size_j^{l\_demand,sub}$: Relative area of all low-demand substitutable stores in mall j.

$\xi_{i,j}$: Residual error

Coefficients

In the model, γ_0 and σ_0 are the coefficients of store size's main effect, which we expect to be significant and positive. More importantly, the interaction terms between store size and three dummy category indicator variables are estimated by coefficients γ_h and σ_h, γ_c and σ_c, and γ_{hc} and σ_{hc}. If γ_h and σ_h are found significant, store-size effect is confirmed to vary across high-demand versus low-demand stores; and γ_h being positive will support *Hypothesis 1a* about the stronger effect of store size on high-demand stores. Meanwhile, if γ_c and σ_c are significant, store-size effect varies across complementary versus substitutable stores; and γ_c being positive will support *Hypothesis 1b* about the stronger effect of store size on complementary stores. Additionally, γ_{hc} and σ_{hc} being significant also suggests that store-size effect varies across different store types in a shopping mall.

μ(s) are the coefficients of store abundance of tenant categories in a shopping mall. Each of these coefficients being significant indicates that store abundance in the corresponding category influences mall stores' revenues. μ_{hc} and μ_{hs} being significantly larger than μ_{lc} and μ_{ls}, respectively, suggests that the effect of store-abundance is more positive in high-demand versus low-demand category, confirming *Hypothesis 2a*. Meanwhile, μ_{hc} and μ_{lc} being significantly larger than μ_{hs} and μ_{ls}, respectively, implies that store-abundance effect is more positive in complementary versus substitutable category, confirming *Hypothesis 2b*.

θ(s) are the coefficients of relative size of tenant categories in a shopping mall. Each of these coefficients being significant implies that relative size of the corresponding category influences store revenues. If θ_{hc} and θ_{hs} are significantly larger (smaller) than θ_{lc} and θ_{ls}, respectively, the effect of category relative size is more (less) positive in high-demand versus low-demand category, confirming *Hypothesis 3a* (*3a'*). Meanwhile, if θ_{hc} and θ_{lc} are significantly larger than θ_{hs} and θ_{ls}, respectively, relative size of complementary category has more positive effect on store revenues than that of substitutable category, confirming *Hypothesis 3b*.

Finally, β(s) are the coefficients of dummy variables indicating stores' functional subcategory in a shopping mall. These coefficients being significant and different from one another implies that store revenues vary across subcategories, independent of the effect of store size and mall composition.

Table 3 summarizes the main variables that are directly related to our hypotheses and the expected signs/ values of their coefficients.

Table 3

INDEPENDENT VARIABLES EXPLAINING THE EFFECTS OF STORE SIZE AND MALL COMPOSITION

Effect	Variables	Definition/ Meaning	Coef.	Expected values/ Interpretation
Store size	$\ln(size)h\_demand$	Interaction term between store size and high-demand stores	γ_h	+ : Increase in store size benefits high-demand stores more than it does to low-demand stores (H1a)
	$\ln(size)comp$	Interaction term between store size and complementary stores	γ_c	+ : Increase in store size benefits complementary stores more than it does to substitutable stores (H1b)
Abundance of stores in tenant categories	$abund^{h\_demand,comp}$	Number of high-demand complementary stores in 1 unit of shopping mall's area	μ_{hc}	$\mu_{hc} < \mu_{lc}$ and $\mu_{hs} < \mu_{ls}$: The abundance of low-demand stores in a shopping mall influences mall stores' revenues more positively than the abundance of high-demand stores (H2a).
	$abund^{h\_demand,sub}$	Number of high-demand substitutable stores in 1 unit of shopping mall's area	μ_{hs}	
	$abund^{l\_demand,comp}$	Number of low-demand complementary stores in 1 unit of shopping mall's area	μ_{lc}	$\mu_{hc} > \mu_{hs}$ and $\mu_{lc} > \mu_{ls}$: The abundance of complementary stores in a shopping mall influences mall stores' revenues more positively than the abundance of substitutable stores (H2b).
	$abund^{l\_demand,sub}$	Number of low-demand substitutable stores in 1 unit of shopping mall's area	μ_{ls}	
Relative size of tenant categories	$rel\_size^{h\_demand,comp}$	Relative size of high-demand complementary category in shopping mall	θ_{hc}	$\theta_{hc} > \theta_{lc}$ and $\theta_{hs} > \theta_{ls}$: The relative size of high-demand category in a shopping mall influences mall stores' revenues more positively than the relative size of low-demand category (H3a).
	$rel\_size^{h\_demand,sub}$	Relative size of high-demand substitutable category in shopping mall	θ_{hs}	
	$rel\_size^{l\_demand,comp}$	Relative size of low-demand complementary category in shopping mall	θ_{lc}	$\theta_{hc} < \theta_{lc}$ and $\theta_{hs} < \theta_{ls}$: The relative size of low-demand category in a shopping mall influences mall stores' revenues more positively than the relative size of high-demand category (H3a').
	$rel\_size^{l\_demand,sub}$	Relative size of low-demand substitutable category in shopping mall	θ_{ls}	$\theta_{hc} > \theta_{hs}$ and $\theta_{lc} > \theta_{ls}$: The relative size of complementary category in a shopping mall influences mall stores' revenues more positively than the relative size of substitutable category (H3b).

STATISTICAL METHOD

The statistical method we used to examine our model and hypotheses is linear regression. In more specific, we used Ordinary Least Square (OLS) method to estimate the coefficients and significances of the variables in our model. We then performed Likelihood-Ratio Test and F-test concerning the full model and several nested models. The purpose of these tests is to check whether the two classification dimensions we proposed effectively demonstrate the variance of store-size and mall-composition effect across categories.

In order to justify the use of linear regression method, we check the validation of the four assumptions: Linearity of the relationship between dependent and independent variables, Independence of residual, Homoscedasticity of the residuals versus predictions, and Normality of residual distribution. The histogram in Appendix 3A and P-P plot in Appendix 3B show that our model satisfies the Normality test; while the scatter plot in Appendix 3C meets the Linearity, Independence, and Homoscedasticity requirements. Thus, the use of regression technique, specifically OLS, for our dataset and model specifications is justified.

In general, regression method is reliable and objective. The only subject choice we made is when we treat the missing values that present in our original dataset. In most of the cases, we ignore the missing values, which is the best option available because we do not have enough information to infer or impute them.

7. FINDINGS AND DISCUSSIONS

EMPIRICAL RESULTS AND INTERPRETATIONS

Effect of store size

The coefficient γ_0 and σ_0 illustrating the main effect of store size on store revenue are both significant at 1% level ($\gamma_0 = 0.395$, p-value = 0.000 and $\sigma_0 = -0.129$, p-value = 0.005). This confirms existent studies, suggesting that a positive log-relationship exists between store size and store revenue. More importantly, all the interaction terms between store-size variables and category indicator variables, except for γ_c, are significant, implying that the effect of store size on store revenues varies significantly across high-demand versus low-demand stores, and complementary versus substitutable ones. Specifically, in our log-log regression model, coefficients $\gamma(s)$ of ln(*size*) indicate the elasticity of store revenue, or the expected percentage change in store revenue, when store size increases by 1% and

$\ln(size)$ equals 0 (or store size equals 100 square meter equivalently)[6]. When store size increases by 1%, the revenue of a 100-square-meter high-demand store will increase by 0.705% if it is complementary and 1.09% if it is substitutable; meanwhile, the revenue of a same-size low-demand store will increase by 0.395% regardless of whether it is complementary or substitutable (Table 4).

Table 4

ELASTICITY OF STORE REVENUE AGAINST CHANGES IN STORE SIZE

Store's category	*% change in store revenue due to 1% increase in store size (given* $\ln(size) = 0$*)*
High-demand, complementary	$\gamma_0 + \gamma_h + \gamma_{hc} = 0.395 + 0.695 - 0.385 = 0.705$ (γ_c is insignificant)
High-demand, substitutable	$\gamma_0 + \gamma_h = 0.395 + 0.695 = 1.09$
Low-demand, complementary	$\gamma_0 = 0.395$ (γ_c is insignificant)
Low-demand, substitutable	$\gamma_0 = 0.395$

Overall, the effects of store size on revenues of high-demand stores are greater than that on revenues of low demand stores, confirming *Hypothesis 1a*. Among low-demand stores, increase in store size can lead to higher increase in revenues of complementary versus substitutable stores (γ_c is insignificant but $\sigma_c = 0.227$, p-value $= 0.000$, is strongly significant), confirming *Hypothesis 1b*. However, among high-demand stores, the effect of store size on substitutable stores is greater than that on complementary ones, which does not confirm *Hypothesis 1b*. The result may be explained by the conflict between store size and the number of stores in a tenant category (Kirkup and Rafiq 1994), which implies trade-off between the variety at store level and that at category level, due to a shopping mall's size constraint. In the case of high-demand complementary stores, variety at category level implies higher utility, thus plays important role in attracting customers to the shopping mall and, subsequently, to these stores. Meanwhile, variety within high-demand substitutable stores is less likely to be perceived as higher utility, making variety at store level more important than variety at category level, and revenues of these stores more sensitive to store size in comparison to that of high-demand complementary stores. Additionally, in the low-demand category, the trade-off between variety at store level and that at category level is less likely to happen. Due to the relatively small size of low-

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[6] *Differentiate both sides of the model equation with regards to* $\ln(size)$*, the variable* $\left[\ln(size_{i,j})\right]^2$ *disappears, and γ(s) indicates the elasticity of store revenue against change in store size given* $\ln(size) = 0$ *or size = 1unit.*

Example: $\ln(revenue) = \alpha + \gamma \ln(size) + \sigma \left[\ln(size)\right]^2 \Rightarrow d[\ln(revenue)] = \gamma + 2\sigma \ln(size)$

demand stores in a shopping mall, reducing a certain amount of their store size is unlikely to lead to a considerable increase in the perceived variety at the category level. This may explain why *Hypothesis 1b* partially holds among low-demand stores.

In order to further examine whether our classification based on the demand-based and utility-based criteria effectively explains for variance of store-size effect across categories, we performed F-test and Log-Likelihood Ratio test comparing the full model with a nested model where no interaction terms present. Results verify the joint significance of all interaction terms[7], again confirming that store-size effect vary significantly along the high-demand versus low-demand and complementary versus substitutable dimension. In addition, all the coefficients σ(s) of the quadratic terms $\left[\ln(size)\right]^2$ are significant, indicating that the elasticity of store revenue not only varies across store types, but also is inconstant across changes in store size. In general, improvement in revenue of a high-demand store is more consistent across changes in its store size, while improvement in revenue of a low-demand store tends to decrease faster as its store size keeps increasing (Appendix 4). This may suggest that an increase in store size of a high-demand store is more rewarding than that of a low-demand one.

Overall, the results of store-size effect are very robust that when we re-test the model on each shopping mall separately, the coefficient estimations and their patterns are more or less the same: high-demand substitutable stores are always the most sensitive to changes in store sizes, followed by high-demand and low-demand complementary stores, while low-demand substitutable stores are constantly the least sensitive to changes in store size. There seems to exist a unanimous powerful relationship pattern between store size and store revenue across stores of complementary versus substitutable category, and high-demand versus low-demand category in a shopping mall, regardless of the different composition strategies the shopping mall may employ.

More detailed results are reported in Table 5:

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[7] *F-statistic comparing the full model with a nested model containing only main effect of store size (no interaction terms) was calculated as 14.13 > 2.10; while -2LogLL of the two models is 36.065 >12.59 (2.10 and 12.59 are corresponding critical values at 5% level).*
→ *Both statistics reject the tested restriction.*

Table 5

RESULTS OF THE REGRESSION ANALYSIS

		Estimations		Model fit	
Variables	Symbols	Coef.	Sign.	R^2 change	R^2
Constant	α	-0.526	0.138		
Differences among subcategories					
$type_k$ (k=1 to 16)	β_k			0.187***	0.187
The effect of store size					
Main effect of ln(size)	γ_0	0.395	0.000***	0.353***	0.541
Interaction effect on stores of:					
High-demand goods	γ_h	0.695	0.000***		
Complementary goods	γ_c	0.070	0.377		
High-demand, complementary goods	γ_{hc}	-0.385	0.005***		
Main effect of $[\ln(size)]^2$	σ_0	-0.129	0.005***	0.009***	0.55
Interaction *effect on stores of:*					
High-demand goods	σ_h	0.121	0.029**		
Complementary goods	σ_c	0.227	0.000***		
High-demand, complementary goods	σ_{hc}	-0.225	0.001***		
The effect of store abundance					
High-demand, complementary	μ_{hc}	0.058	0.000***	0.028***	0.578
High-demand, substitutable	μ_{hs}	0.032	0.393		
Low-demand, complementary	μ_{lc}	0.023	0.039**		
Low-demand, substitutable	μ_{ls}	-0.036	0.114		
The effect of relative size					
High-demand, complementary	θ_{hc}			0.012***	0.590
High-demand, substitutable	θ_{hs}	2.606	0.000***		
Low-demand, complementary	θ_{lc}	1.495	0.001***		
Low-demand, substitutable	θ_{ls}	0.783	0.326		

Notes: Dependent variable: Ln (revenue); Method: OLS; Number of observations: 1444; *Significant at 10% (two-sided); **Significant at 5% (two-sided); ***Significant at 1% (two-sided)

Effect of store-abundance of tenant categories

Results of the store-abundance effect will be interpreted along two dimensions:

- On the high-demand versus low-demand category dimension:

In complementary category, the abundance of high-demand stores exerts more positive effect on store revenues than that of low-demand stores (both μ_{hc} and μ_{lc} are significant and $\mu_{hc} = 0.058 > \mu_{lc} = 0.023$). Meanwhile, in substitutable category, the store abundance of high-demand stores is not statistically different from that of low-demand stores (both μ_{hc} and μ_{lc} are not significant). These results do not support *Hypothesis 2a* about the more positive effect of store abundance in low-demand category versus that in high-demand category.

- On the complementary versus substitutable category dimension:

Both store-abundance coefficients of complementary category (μ_{hc} and μ_{lc}) are significant and positive, while both store-abundance coefficients of substitutable category (μ_{hs} and μ_{ls}) are insignificant, supporting *Hypothesis 2b* about the more positive effect of store abundance in complementary versus substitutable category.

A second step in the evaluation of the results is to examine the joint significance of multiple store-abundance variables, using F-statistic and Log-Likelihood Ratio test. In order to examine whether the effect of store abundance significantly varies across categories along the demand-based dimension, we compute F-statistic comparing the full model containing four store-abundance variables with a nested model where only two utility-based store-abundance variables present. The F-statistic is significant at 5% level, confirming the tested restriction and suggesting that the high-demand versus low-demand category dimension is not effective in explaining for the variation of store-abundance effect. Equivalent Log-Likelihood Ratio test also suggests the same conclusion[8]. *Hypothesis 2a* about the stronger effect of store abundance of low-demand category compared to that of high-demand category is refused.

Similarly, in order to examine whether the effect of store abundance significantly varies across categories on the utility-based dimension (complementary versus substitutable), we compare the full model with a second nested model where only two demand-based store-abundance variables present. Both the F-statistic and log-likelihood ratio are not significant at 5% level, rejecting the tested restriction[9]. This suggests that the complementary versus substitutable dimension effectively explain for the variance of store-abundance effect on store revenues. Together with the two significant store-abundance coefficients, particularly $\mu_{hc} = 0.058$ and

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[8] *Nested model 1: F-statistic = 2.484 < 3.002; -2LogLL =2.201 < 5.99 (3.002 and 5.99 are corresponding critical values at 5% level) → Both statistics support the tested restriction.*

Nested model equation:

$$\ln(revenue_{i,j}) = \alpha + \sum_{k=1}^{15}\beta_k type_{i,j}^k + \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j})h\_demand_{i,j} + \gamma_c \ln(size_{i,j})comp_{i,j}$$
$$+ \gamma_{hc}\ln(size_{i,j})h\_demand_{i,j}comp_{i,j} + \sigma_0\left[\ln(size_{i,j})\right]^2 + \sigma_h\left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}$$
$$+ \sigma_c\left[\ln(size_{i,j})\right]^2 comp_{i,j} + \sigma_{hc}\left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}comp_{i,j} + \mu_c abund_j^{comp} + \mu_s abund_j^{sub}$$
$$+ \theta_{hc}rel\_size_j^{h-demand,comp} + \theta_{lc}rel\_size_j^{l-demand,comp} + \theta_{hs}rel\_size_j^{h-demand,sub} + \theta_{ls}rel\_size_j^{l-demand,sub}$$

Where:

$$abund_j^{comp} = abund_j^{h-demand,comp} + abund_j^{l-demand,comp} \,; abund_j^{sub} = abund_j^{h-demand,sub} + abund_j^{l-demand,sub}$$

[9] *Nested model 2: F-statistic = 12.512 > 3.002; -2LogLL =12.51 >5.99 → Both statistics reject the tested restriction. Nested model equation:*

$$\ln(revenue_{i,j}) = \alpha + \sum_{k=1}^{15}\beta_k type_{i,j}^k + \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j})h\_demand_{i,j} + \gamma_c \ln(size_{i,j})comp_{i,j}$$
$$+ \gamma_{hc}\ln(size_{i,j})h\_demand_{i,j}comp_{i,j} + \sigma_0\left[\ln(size_{i,j})\right]^2 + \sigma_h\left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}$$
$$+ \sigma_c\left[\ln(size_{i,j})\right]^2 comp_{i,j} + \sigma_{hc}\left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}comp_{i,j} + \mu_h abund_j^{h-demand} + \mu_l abund_j^{l-demand}$$
$$+ \theta_{hc}rel\_size_j^{h-demand,comp} + \theta_{lc}rel\_size_j^{l-demand,comp} + \theta_{hs}rel\_size_j^{h-demand,sub} + \theta_{ls}rel\_size_j^{l-demand,sub}$$

Where:

$$abund_j^{h-demand} = abund_j^{h-demand,comp} + abund_j^{h-demand,sub} \,; abund_j^{l-demand} = abund_j^{l-demand,comp} + abund_j^{l-demand,sub}$$

μ_{lc} = 0.023, the model supports *Hypothesis 2b* about the stronger effect of store abundance in complementary versus substitutable category in a shopping mall.

Overall, results of store abundance effects are quite solid. We also tested a submodel where store-abundance variables were the sole mall-composition variables (relative-size variables were excluded to avoid multicollinearity if any); results show that the coefficient estimates and their patterns were more or less the same (Appendix 5). F-statistics and Log-Likelihood Ratio test performed on the submodel also confirm that the effect of category store abundance varies significantly across the utility-based classification dimension (complementary versus substitutable), but not significantly across the demand-based dimension (high-demand versus low-demand).

Effect of relative-size of tenant categories

As the relative size of the four tenant categories in a shopping mall sum up to 1, their corresponding variables are perfectly correlated. The variable indicating the relative size of high-demand complementary category ($rel\_size_j^{h-demand,comp}$) is excluded from the estimation and serves as a benchmark variable. Among the four category relative-size coefficients, θ_{hs} and θ_{lc} are significant and positive (θ_{hs} = 2.606, p-value = 0.000 and θ_{lc} =1.495, p-value = 0.001), implying that the relative size of high-demand substitutable category and that of low-demand complementary category exert more positive effect on store revenues than the relative size of high-demand complementary category does. Meanwhile, coefficient θ_{ls} is reported insignificant, suggesting that the relative size of low-demand substitutable category exerts no different effect from that of high-demand complementary category. The results of category relative-size effect will be further interpreted along two dimensions:

- On the high-demand versus low-demand category dimension:

In complementary category, relative size of low-demand store type exerts more positive effect on store revenues than that of high-demand one (θ_{lc} =1.495>0 means θ_{lc} > θ_{hc}), confirming *Hypothesis 3a'*. Meanwhile, in substitutable category, relative size of high-demand store type exerts more positive effect on store revenues than that of low-demand one (θ_{hs} = 2.606 and θ_{ls} is not significant), confirming *Hypothesis 3a*. This may suggest that large relative size of complementary category implies a higher abundance of stores rather than bigger

stores within the category, while large relative size of substitutable category tends to imply the opposite. This represents the two different perspectives on a category's relative size that we previously discussed in the Hypothesis section.

- On the complementary versus substitutable category dimension:

In low-demand category, the relative size of complementary store type exerts more positive effect on store revenues than the relative size of substitutable store type ($\theta_{lc} > 0$ and θ_{ls} is not significant), confirming *Hypothesis 3b*. However, in high-demand category, relative size of substitutable store type has more positive effect on store revenues than that of complementary store type ($\theta_{hs} > 0$ means $\theta_{hs} > \theta_{hc}$), not supporting *Hypothesis 3b*. As previously suggested, large relative size of substitutable category suggests bigger tenant stores in the category, while store size has strongest positive effect on stores of high-demand substitutable category. These together explain for the strong effect of this category's relative size. Meanwhile, large size of complementary category tends to imply a higher number of stores within the category; and the abundance of high-demand complementary stores, though positive, is considerably weaker ($\mu_{hc} = 0.058$ is relatively small).

Further analyses were undertaken to examine the joint significance of multiple category relative-size variables. Firstly, we computed F-statistic and Log-Likelihood ratio to examine whether the effect of category relative size is significantly different across categories on the demand-based dimension. A nested model containing only two utility-based relative-size variables was compared with the full model where all four relative-size variables presented. Both the F-statistic and Log-Likelihood statistics are not significant, implying that the full model is more significant than the nested model, and that the demand-based category dimension effectively demonstrates the variance of category relative-size effect[10].

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[10] *Nested model 3: F-statistic = 13.189 > 3.002; -2LogLL =11.599 >5.99 → Both statistics reject the tested restriction. Nested model equation:*

$$\ln(revenue_{i,j}) = \alpha + \sum_{k=1}^{15} \beta_k type_{i,j}^k + \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j})h\_demand_{i,j} + \gamma_c \ln(size_{i,j})comp_{i,j}$$

$$+ \gamma_{hc} \ln(size_{i,j})h\_demand_{i,j}comp_{i,j} + \sigma_0 \left[\ln(size_{i,j})\right]^2 + \sigma_h \left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}$$

$$+ \sigma_c \left[\ln(size_{i,j})\right]^2 comp_{i,j} + \sigma_{hc} \left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}comp_{i,j}$$

$$+ \mu_{hc} abund_j^{h-demand,comp} + \mu_{lc} abund_j^{l-demand,comp} + \mu_{hs} abund_j^{h-demand,sub} + \mu_{ls} abund_j^{l-demand,sub}$$

$$+ \theta_c rel\_size_j^{comp} + \theta_s rel\_size_j^{sub}$$

Where: $rel\_size_j^{comp} = rel\_size_j^{h-demand,comp} + rel\_size_j^{l-demand,comp}$;

$rel\_size_j^{sub} = rel\_size_j^{h-demand,sub} + rel\_size_j^{l-demand,sub}$

Secondly, another nested model where only two demand-based relative-size variables presented was compared with the full model in order to examine whether the effect of category relative size varies across category of complementary versus substitutable stores[11]. Results of both F-test and Log-Likelihood Ratio test reject the tested restriction, which means the utility-based classification dimension effectively demonstrates the variation of category relative-size effects in a shopping mall.

We also tested a submodel where category relative sizes were the sole variables of mall-composition effect (all store-abundance variables were excluded to avoid multicollinearity if any). Results show that the coefficients and their significance are similar to the full model (Appendix 6). F-statistics and Log-Likelihood Ratio test performed on the submodel also confirm that the effect of category relative-size varies significantly across both the demand-based and utility-based dimension. Therefore, the results of category relative-size effect are solid.

Conclusion

Significance and strength of the variables

The significance of the R-square changes reported in Table 5 indicates that all the sets of variables in the full model are significant to explain the variance of store revenues in a shopping mall. Store size (including linear and quadratic terms) seems to be the most important set of variables, explaining for 36.2% of the revenue differences across stores across shopping malls. Between the two sets of mall-composition variables, store-abundance variables seem to be more effective in explaining differences in store revenues, in comparison to category relative-size variables; as R^2 change contributed by the former set of variables is 2.8% versus 1.2% of the latter set. However, with regard to the strength of the effect on mall stores' revenues, relative size of tenant categories in a shopping mall is more

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[11] *Nested model 4: F-statistic = 20.936 > 3.002; -2LogLL =18.337 >5.99→ Both statistics reject the tested restriction. Nested model equation:*

$$\ln(revenue_{i,j}) = \alpha + \sum_{k=1}^{15}\beta_k type_{i,j}^k + \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j})h\_demand_{i,j} + \gamma_c \ln(size_{i,j})comp_{i,j}$$

$$+\gamma_{hc}\ln(size_{i,j})h\_demand_{i,j}comp_{i,j} + \sigma_0\left[\ln(size_{i,j})\right]^2 + \sigma_h\left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}$$

$$+\sigma_c\left[\ln(size_{i,j})\right]^2 comp_{i,j} + \sigma_{hc}\left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}comp_{i,j}$$

$$+\mu_{hc}abund_j^{h\_demand,comp} + \mu_{lc}abund_j^{l\_demand,comp} + \mu_{hs}abund_j^{h\_demand,sub} + \mu_{ls}abund_j^{l\_demand,sub}$$

$$+\theta_c rel\_size_j^{high} + \theta_s rel\_size_j^{low}$$

Where: $rel\_size_j^{h\_demand} = rel\_size_j^{h\_demand,comp} + rel\_size_j^{h\_demand,sub}$;

$rel\_size_j^{l\_demand} = rel\_size_j^{l\_demand,com} + rel\_size_j^{l\_demand,sub}$

influential than store abundance within these categories, as the coefficients θ(s) of category relative-size variables are much larger than all coefficients μ(s) of category store-abundance variables.

In addition, the utility-based category dimension (complementary versus substitutable) is effective in demonstrating the variation of store-abundance effect across categories; while both the demand-based and utility-based dimensions effectively explain for the variation of category relative-size effect across categories. Overall, high-demand complementary category contributes the most to improving mall stores' revenues in terms of store abundance; while high-demand substitutable category is the most positive contributor with regards to its relative size. Low-demand complementary stores contribute weakly to stores in shopping malls with regards to both its store abundance and relative size; while low-demand substitutable category, both in terms of store abundance and relative size, does not contribute significantly to mall stores' revenues.

Table 6 summarizes results of testing our hypotheses:

Table 6

SUMMARY OF HYPOTHESES TESTING

Effect	Hypotheses	Results
Store-size	*Hypothesis 1a:* Effect of store size on store revenue is stronger for high-demand versus low-demand stores	Confirmed
	Hypothesis 1b: Effect of store size on store revenue is stronger for complementary versus substitutable stores	Confirmed for low-demand category
Store abundance in tenant categories	*Hypothesis 2a:* Store abundance in low-demand category is more positive than store abundance in high-demand category.	Rejected
	Hypothesis 2b: Store abundance in complementary category is more positive than store abundance in substitutable category.	Confirmed
Relative size of tenant categories	*Hypothesis 3a:* Relative size of high-demand category is more positive than relative size of low-demand category.	Confirmed for substitutable category
	Hypothesis 3a': Relative size of low-demand category is more positive than relative size of high-demand category.	Confirmed for complementary category
	Hypothesis 3b: Relative size of complementary category is more positive than relative size of substitutable category.	Confirmed for low-demand category

Goodness of fit test

The regression model yields R-square of 59% and adjusted R-square of 57.9%, which means the chosen set of variables explains for nearly 60% of the variance in store revenues in the shopping malls under study. On the other hand, besides mall composition, stores size, and store types, which are explicitly examined in our model, there are other factors that also account for the variance of mall stores' revenues in a shopping mall, such as the shopping mall's layout and architecture (Martineau 1958); marketing focus including advertising and promotion (Martineau 1958; Lindquist 1974-1975; Ghosh 1990; Singh and Sahay 2012), merchandise and assortment (Lindquist 1974-1975; Bearden 1977; Shah and Mrudula 2005; Hunter 2006; Brito 2009; Chebat, Sirgy, and Grzeskowiak 2010), service availability (Lindquist 1974-1975; Khare and Rakesh 2011), physical facilities (Lindquist 1974-1975; Bearden 1977; Singh and Sahay 2011), price (Bearden 1977; Ghosh 1990; Bodkin and Lord 1997), and mall's location (Bearden 1977; Ghosh 1990; Simmons 1992; Ownbey et al. 1994; Forgey et al. 1995; Shah and Mrudula 2005), etc. This makes our model with R-square of 59% a proper fit given the small set of variables it uses.

Reliability and Multicollinearity check

The regression technique that we employ does not involve subjective intervention on our parts, which enables higher reliability of the model's estimates. However, we are concerned about multicollinearity problem in our model where we include the two sets of correlated mall-composition variables. Multicollinearity may increase standard errors of the model's estimates, thus, may have negative effect on the model's reliability. In order to examine multicollinearity problem (if it occurs), we calculate the Tolerance values (indication of the percent of variance in the predictor that cannot be accounted for by other predictors) and VIFs (Variance Inflation Factor) of all variables in our full model. Results show that the Tolerance and VIFs do not excess acceptable ranges, so both sets of mall-composition variables can be used simultaneously to predict store revenues. The signs of the two sets of mall-composition variables are almost the same when they are examined separately in the submodels (Appendix 4 and 5) or together in the full model (Table 5), which also implies that multicollinearity may not happen. For these reasons, our model and its empirical results are reliable.

WHAT-IF SIMULATIONS USING EMPIRICAL RESULTS

We use simulation to verify findings explored by our empirical models and to illustrate how to use these findings to optimize mall composition and maximize store revenues in a shopping mall.

Mall-composition simulations

Firstly, we attempt to improve the composition of one shopping mall among the 17 shopping malls in our dataset. The shopping mall chosen is a medium-sized shopping mall, having the lowest area effectiveness among similar-sized shopping malls. (A shopping mall's area effectiveness is calculated by dividing the shopping mall's annual revenue by its GLA.) As the low area effectiveness possibly implies that the chosen shopping mall was having suboptimal composition of tenant stores, we aim at improving the shopping mall's composition by adjusting the number of stores in certain tenant categories and/ or reallocating the shopping mall's space among certain categories within it. The mall-composition features and the revenues of four tenant categories in the chosen shopping mall are first reported in Table 7.

Table 7

OVERVIEW OF THE SHOPPING MALL IN SIMULATION

Store categories	Nr. of stores	Nr. of stores per 100m^2 area	Relative area (%)	Avg. area per store (m^2)	Avg. area effectiveness
High-demand, complementary	43	0.1509	0.4179	283	796531.75
High-demand, substitutable	10	0.0343	0.2320	677	1636786.54
Low-demand, complementary	34	0.1166	0.2296	197	1166557.11
Low-demand, substitutable	23	0.079	0.1205	153	1303469.24
Total	110			29164 (*GLA)*	

Overall, the presence of low-demand substitutable category of stores in the chosen shopping mall is too strong: it has 23 stores, even more than the number of stores in the low-demand complementary category; and it accounts for 12.1% of the total shopping mall's GLA. In fact, both the store abundance and the relative size of this tenant category in the shopping mall we examine is highest among 17 shopping malls in our dataset. This implies unfavorable mall composition given the fact that both store abundance and relative size of low-demand substitutable category contribute no externality to mall stores' revenues. In order to improve the shopping mall's composition, either the number of stores or the relative size of

low-demand substitutable category, or both, should be reduced. We developed four sets of mall-composition simulations based on this judgment. Furthermore, there are two assumptions upon which the simulations are preceded (Table 8).

Table 8

MALL-COMPOSITION SIMULATIONS & ASSUMPTIONS

Simulations	
Simulation 1	Replacing one low-demand substitutable store with a store of the same size and from another tenant category.
Simulation 2	Reduce the size of each low-demand substitutable store in order to add a store of another tenant category to the shopping mall.
Simulation 3	Remove one low-demand substitutable store and allocate the spared space to another tenant category, so that the size of each store in that category increases by 1%.
Simulation 4	Reduce the size of each low-demand substitutable store and allocate the spared space to another tenant category, so that the size of each store in that category increases by 1%.

Assumptions

Assumption 1: The total size (or GLA) of the shopping mall is constant in all simulations.

Yiu and Xu (2012) provided that the overall size of a shopping mall significantly influenced the performance of the shopping mall and its tenant stores, thus keeping the mall's size constant is necessary to guarantee that any change in the shopping mall's store revenues caused by our simulations is merely resulted from changes in store sizes and mall composition in that simulation. On the other hand, it is also not realistic to change the GLA of an established shopping mall.

Assumption 2: Any store that is added to or removed from the shopping mall in a simulation has the average area effectiveness of the tenant category it belongs to.

In the examined shopping mall, the area effectiveness varies considerably across the four tenant categories. Taking the area effectiveness variation into consideration will enable achieving more realistic estimates of revenues at mall level when a store is added to or removed from the shopping mall, while this does not necessarily affect the estimates at store level.

Simulation procedure

Using the model's equation and estimates, we calculated the expected store revenues across four tenant categories. By taking the sum of all the store revenues, we obtained estimate of the shopping mall's revenue. These were calculated for each simulation we proposed. The store revenues and mall revenue in each simulation were then compared with their original values when no change in the mall composition was simulated. This allows us to evaluate the impact of each simulation on the shopping mall's revenue and its tenant stores' revenues.

Simulation 1

The first set of simulations involves replacing a low-demand substitutable store with a store of the same size from another tenant category, either high-demand

complementary (*simulation 1a*), low-demand complementary (*simulation 1b*), or high-demand substitutable (*simulation 1c*). Results show that by replacing a low-demand substitutable store with a high-demand complementary store ceteris paribus, the revenues of all stores in the shopping mall are improved by 0.519% (*simulation 1a*); the improvement is 0.349% if the low-demand substitutable store is replaced with a low-demand complementary store (*simulation 1b*), and 0.526% if it is replaced with a high-demand substitutable store (*simulation 1c*). The store-abundance effect is positive and strongest in simulation 1a; it is also positive in *simulation 1b*, but is negative in *simulation 1c*. This illustrates the empirical findings providing that the store abundance of complementary tenant category exerts more positive effect on store revenues than that of substitutable category. The effect of category relative-size is, on the other hand, strongest in *simulation 1c*, slightly weaker in *simulation 1a*, and weakest in *simulation 1b*. This also verifies the empirical findings about the stronger effect of relative size of high-demand category compared to that of low-demand category.

Table 9

CHANGES IN STORE REVENUES & MALL REVENUE IN SIMULATION 1

	Simulation 1		
	Sim. 1a	Sim. 1b	Sim. 1c
Change in store revenues due to store-abundance effect	+ 0.006% >	+ 0.004% >	- 0.017%
Change in store revenues due to relative-size effect	+ 0.513% >	+ 0.345% <	+ 0.543%
Total change in store revenues	+ 0.519% >	+ 0.349% <	+ 0.526%
Total change in mall revenue	+ 0.455%	+ 0.470%	+ 0.845%

Notes:

Simulation 1a: Replacing one low-demand substitutable store with one **high-demand complementary** store of the same size.

Simulation 1b: Replacing one low-demand substitutable store with one **low-demand complementary** store of the same size.

Simulation 1c: Replacing one low-demand substitutable store with one **high-demand substitutable** store of the same size.

Furthermore, the overall revenue of the shopping mall is increased by 0.455% in *simulation 1a*, 0.470% in *simulation 1b*, and 0.845% in *simulation 1c*. The improvement in the shopping mall's revenue is different from the improvement in its store revenues because the revenue of the removed low-demand substitutable store is not the same with that of the added store (*Assumption 2*). In *simulation 1a*, the level of profitability (implied by area effectiveness) of the replacing high-demand complementary store is lower than that of the replaced low-demand

substitutable store, thus, the increase in mall revenue is lower than the increase in store revenues. The opposite is true in *simulation 1b* and *1c*. Overall, the changes in mall composition specified by the first set of simulations are beneficial because the replacement of a low-demand substitutable store, which generates no externality to mall stores, causes no harm; meanwhile, the addition of a store from another tenant category increases the store abundance and relative size of that category, which generates additional externality to all the mall's stores. In real life, depending on the actual size of the replaced or added store, one simulation may be more beneficial than another. For example, if the size of the store supposed to be replaced is large, it may be most beneficial to replace that store with a high-demand substitutable store because increase in the relative size of high-demand substitutable category exerts the strongest positive effect on mall stores' revenues. If the replaced store, on the other hand, is rather small-sized, it may be more beneficial to replace it with a high-demand complementary store, because increases in both store abundance and relative size of high-demand complementary category generate additional externality to mall stores.

Simulation 2

The second set of simulations involves reducing the size of all low-demand substitutable stores in order to add one average-sized store from another tenant category, either high-demand complementary (*simulation 2a*), low-demand complementary (*simulation 2b*), or high-demand substitutable (*simulation 2c*). Results show that the addition of a high-demand store, either complementary or substitutable (*simulation 2a* and *2c*), is highly profitable, improving the revenues of all stores, except for low-demand substitutable ones, by approximately 0.7%. Low-demand substitutable stores experience approximately 1.2% deduction in revenues because their sizes are cut down to afford an additional high-demand store in these simulations. Low-demand complementary store seems to be less favorable than any high-demand store, as the addition of a store this type (*simulation 2b*) contributes less to the shopping mall' stores, improving the revenues of stores other than low-demand substitutable stores by 0.465%, while reducing revenues of each low-demand substitutable store by 1.47%. Furthermore, the overall revenue of the shopping malls is increased by around 1% in *simulation 2a* and *2b*, and 1.5% in *simulation* 2c. Improvements in the mall's revenue are relatively higher compared to the first set of simulations because in these simulations, the shopping mall contains one more tenant store that generates

revenues for it, while in the first set of simulations, the number of stores in the shopping mall is constant.

Table 10

CHANGES IN STORE REVENUES & MALL REVENUE IN SIMULATION 2

| | Simulation 2 | | |
	Sim. 2a	Sim. 2b	Sim. 2c
Change in revenues of stores other than low-demand substitutable stores	+ 0.692% >	+ 0.465% <	+ 0.709%
Change in revenues of low-demand substitutable stores	- 1.251%	- 1.473 %	- 1.233 %
Total change in mall revenue	+ 1.000%	+ 1.015%	+ 1.520%

Notes:

Simulation 2a: Reduce the size of each substitutable low-demand store to add one **high-demand complementary** store.

Simulation 2b: Reduce the size of each substitutable low-demand store to add one **low-demand complementary** store.

Simulation 2c: Reduce the size of each substitutable low-demand store to add one **high-demand substitutable** store.

Simulation 3

In the third set of simulations, a low-demand substitutable store is removed in order to increase by 1% the size of each store in another tenant category, either high-demand complementary (*simulation 3a*), low-demand complementary (*simulation 3b*), or high-demand substitutable (*simulation 3c*). Results show that the simulation where all high-demand complementary stores are enlarged by removing a low-demand substitutable store (*simulation 3a*) creates the highest benefit to all stores in the shopping mall, improving the revenues of high-demand complementary stores by 1.115% and that of all other stores by 0.418%. *Simulation 3c* where all high-demand substitutable stores are enlarged also yields high benefits to all stores in the shopping mall, improving the revenues of high-demand substitutable stores by 1.148% and that of all other stores by 0.245%. *Simulation 3b*, though having a weaker impact on mall stores' revenues compared to the other two simulations, still raises revenues of all low-demand substitutable stores by 0.722% and increases revenues of all other stores by 0.154%. High-demand complementary stores seem to be the most favorable store type in a shopping mall because they generate the highest positive externality to all the mall stores. However, due to the fact that the level of profitability of high-demand complementary stores is lowest while that of high-demand substitutable stores is highest among mall stores, *simulation 3c* yields higher improvement in the mall

revenue than *simulation 3a* does (0.365% versus 0.28%), even when the mall stores in general benefit more in *simulation 3a*.

Table 11

CHANGES IN STORE REVENUES & MALL REVENUE IN SIMULATION 3

| | Simulation 3 | | |
	Sim. 3a	Sim. 3b	Sim. 3c
Change in revenues of high-demand complementary stores	+ 1.115%	+ 0.154%	+ 0.245%
Change in revenues of high-demand substitutable stores	+ 0.418%	+ 0.154%	+ 1.148%
Change in revenues of low-demand complementary stores	+ 0.418%	+ 0.722%	+ 0.245%
Change in revenues of low-demand substitutable stores	+ 0.418% >	+ 0.154% <	+ 0.245%
Total change in mall revenue	+ 0.280%	+ 0.105%	+ 0.365%

Notes:

Simulation 3a: Remove one low-demand substitutable store to increase the size of each **high-demand complementary** store by 1%.

Simulation 3b: Remove one low-demand substitutable store to increase the size of each **low-demand complementary** store by 1%.

Simulation 3c: Remove one low-demand substitutable store to increase the size of each **high-demand substitutable** store by 1%.

Simulation 4

In the last set of simulations, the sizes of all low-demand substitutable stores are reduced in order to increase by 1% the size of each store in another category, either high-demand complementary (*simulation 4a*), low-demand complementary (*simulation 4b*), or high-demand substitutable (*simulation 4c*). Mall-composition effects on revenues of stores other than low-demand substitutable stores are the same as in the third set of simulations, as both the store abundance and relative size of low-demand substitutable category has no effect on mall stores' revenues. The difference is in the revenues of low-demand substitutable stores; due to their smaller size, these stores suffer reduction in revenues, which is -0.76% in *simulation 4a*, -0.508% in *simulation 4b*, and -0.418% in *simulation 4c*. Furthermore, mall revenue is improved by 0.515%, 0.23%, and 0.49% in *simulation 4a*, *4b*, and *4c*, respectively. Improvements in mall revenue in general are higher that that in the third set of simulations because in the preceding set of simulations, the shopping mall has one less retail store, while the number of stores in the current set of simulations is the same as in the original mall composition.

Table 12

CHANGES IN STORE REVENUES & MALL REVENUE IN SIMULATION 4

| | Simulation 4 | | |
	Sim. 4a	Sim. 4b	Sim. 4c
Change in revenues of high-demand complementary stores	+ 1.115%	+ 0.154%	+ 0.245%
Change in revenues of high-demand substitutable stores	+ 0.418%	+ 0.154%	+ 1.148%
Change in revenues of low-demand complementary stores	+ 0.418%	+ 0.722%	+ 0.245%
Change in revenues of low-demand substitutable stores	- 0.758%	- 0.508%	- 0.418%
Total change in mall revenue	+ 0.515%	+ 0.230%	+ 0.490%

Notes:

Simulation 4a: Reduce the size of each low-demand substitutable store to increase the size of each **high-demand complementary** store by 1%.

Simulation 4b: Reduce the size of each low-demand substitutable store to increase the size of each **low-demand complementary** store by 1%.

Simulation 4c: Reduce the size of each low-demand substitutable store to increase the size of each **high-demand substitutable** store by 1%.

Conclusion

Overall, high-demand complementary stores seem to be the most favorable stores in terms of generating high externality to other stores in a shopping mall, which illustrates empirical findings about the positive impacts of both this category's store abundance and relative size. High-demand substitutable stores also generate high externality to other stores in a shopping mall; relative size of this category considerably improves revenues of other stores, which makes up for the negative impact of its store abundance. Low-demand complementary stores, though obviously more favorable than low-demand substitutable ones, do not generate as much externality as any high-demand store does. Furthermore, simulations which increase the total number of stores in shopping mall seems to yield the highest externality (e.g. simulation 2); while those that decrease the total number of mall stores yields the least benefit (e.g. simulation 3). The impact of changes in mall-composition on mall's overall revenue and that on its stores' revenues can be different, implying that conflict of interest between a shopping mall and its retail tenants may happen. For instance, in the third set of simulations, simulation 3a benefits mall stores more than simulation 3b; however, mall operators may prefer the latter simulation because it improves mall revenue more than the former does.

In real practice, which simulation to follow in order to improve an existing shopping mall may depend largely on the original composition or structure of the

shopping mall being considered, as well as the amount of change the shopping mall affords to make. The one to be chosen should considerably increase mall revenue and its stores' revenues without forcing too much change in its structure, as this will be, more or less, involved with costs.

Store-size simulations

In addition to the mall-composition simulations, we also illustrate the effect of store size on store revenues by performing several what-if simulations. In these simulations, we calculated changes in store revenues resulted from 1% increase in store size, with regards to stores of the four tenant categories. These simulations are performed in the same shopping mall where previous mall-composition simulations took place. Results show that store size exerts considerably stronger effect on stores of high demand versus low demand tenant category; the average improvement in the revenue of high-demand stores nearly doubles the average improvement in the revenues of low-demand stores (Table 13). Moreover, store-size effect is strongest among high-demand substitutable stores (elasticity > 1) and weakest among low-demand substitutable stores, as expected from our empirical results. Both the empirical findings and the simulations seem to suggest that among different stores in a shopping mall, stores of high-demand substitutable category, e.g. supermarkets, should have very large size, followed by high-demand complementary stores, e.g. clothing boutiques; meanwhile, stores of low-demand complementary category, e.g. pharmacy, should be of smaller size, and service stores, e.g. post office, should have smallest sizes.

Table 13

ESTIMATES OF STORE-SIZE EFFECT IN WHAT-IF SIMULATIONS

Tenant categories	Average % increase in store revenue resulted from 1% increase in store size	
High-demand, complementary	+ 0.76%	} 0.91% in average
High-demand, substitutable	+ 1.05%	
Low-demand, complementary	+ 0.61%	} 0.47% in average
Low-demand, substitutable	+ 0.33%	

8. MALL-COMPOSITION PLANNING - INSIGHTS & GUIDELINES

The significant results of our empirical models, together with simulations that verify these results enable us to draw insights about the role of each tenant
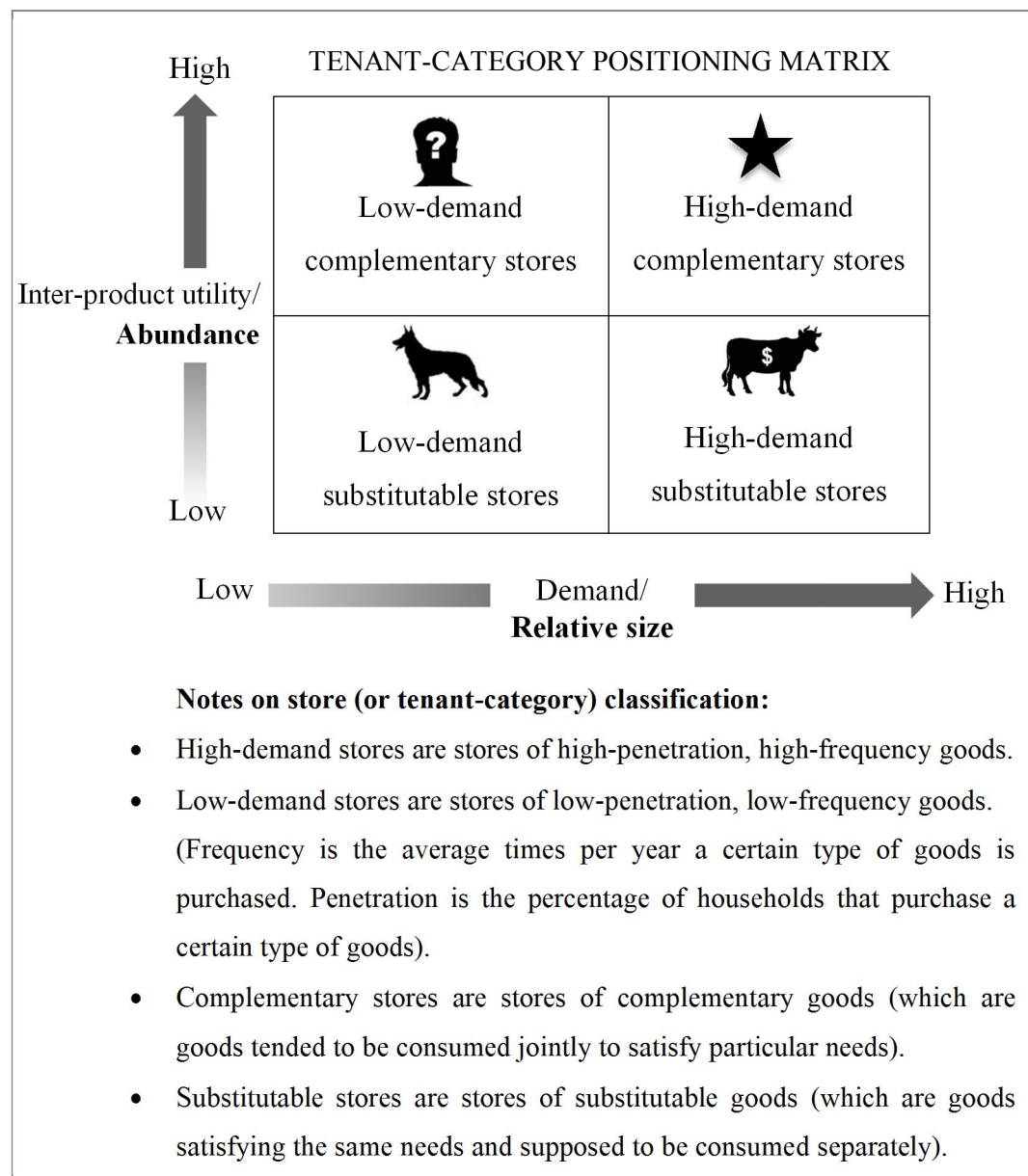
category and suggest managerial guidelines to optimize mall composition and maximize store revenues in a shopping mall.

STRATEGIC TENANT – CATEGORY POSITIONING

We propose in this section a tenant-category positioning matrix that demonstrates the strategic positions of the four tenant categories in a shopping mall. The positioning matrix was developed based on our empirical findings and simulations and with reference to the Boston Consulting Group (BCG) matrix of strategic portfolio planning (Henderson, 1970).

Figure 8

STRATEGIC TENANT-CATEGORY POSITIONING

Notes on store (or tenant-category) classification:

- High-demand stores are stores of high-penetration, high-frequency goods.
- Low-demand stores are stores of low-penetration, low-frequency goods. (Frequency is the average times per year a certain type of goods is purchased. Penetration is the percentage of households that purchase a certain type of goods).
- Complementary stores are stores of complementary goods (which are goods tended to be consumed jointly to satisfy particular needs).
- Substitutable stores are stores of substitutable goods (which are goods satisfying the same needs and supposed to be consumed separately).

Planning the composition of stores in a shopping mall is indeed managing a portfolio of stores from different product-categories; thus, the BCG matrix offers a relevant framework. However, different from the BCG matrix which positions a portfolio's products based on their market share and growth potential, our tenant-category positioning matrix determines the tenant categories' roles based on the level of customer demand and the joint utility of categories' stores and goods. The level of customer demand for a particular category may indicate the share of customers that the category occupies in relation to that occupied by other categories in a shopping mall; thus, the demand-based dimension in our tenant-category positioning matrix is comparable to the market-share dimension in the BCG Matrix. On the other hand, while the level of customer demand for a certain tenant category is more likely to imply planned sales of the category's goods rather than unplanned sales, the inter-product or inter-store joint utility of a category possibly indicates spontaneous sales potential, which makes the utility-based dimension in our matrix comparable to the growth-potential dimension in the BCG matrix. The application of the BCG matrix's logic into our tenant-category positioning matrix is, therefore, justified.

In the tenant-category positioning matrix, high-demand complementary category is the Star tenant category in a shopping mall: stores of this category may have high planned sales as well as potential unplanned sales. In fact, both the store abundance and relative size of this category positively contribute to mall stores' revenues as suggested by our empirical findings and illustrated in previous simulations (e.g. simulation 1a, table 9). Similar to Star products in the BCG matrix, Star tenant category in a shopping mall should receive the most resource, which, in the shopping mall context, mostly refers to the shopping mall's space. The Star tenant category, which is placed at the high end of both utility- and demand-based positioning dimensions, should be prominent in the shopping mall, both in terms of its relative size and store abundance.

The Cash-cow tenant category in a shopping mall is high-demand substitutable category: the relative size of this category exerts strong and positive effect on mall stores' revenues but its store abundance does not (e.g. simulation 1b, table 9). Stores in the Cash-cow category may generate high planned sales but not as many unplanned sales. Similar to Cash-cow products in the BCG matrix, the Cash-cow category is an important tenant category in a shopping mall, and mall operators

should manage them well in order to attract traffic to their shopping mall and boost sales of the Star tenant category. As it is placed at the high end of the demand-based positioning dimension but low end on the utility-based dimension, Cash-cow category should occupy large mall's space but should not be abundant.

Low-demand complementary category is the Question Mark tenant category in a shopping mall. The store abundance and relative size of this category contributes weakly to mall stores' revenues and it often involves unplanned sales in addition to low planned sales. Just like in the case of Question Mark products in the BCG matrix, there are different ways to manage the Question Mark tenants in a shopping mall, either minimizing their relative size and store number in order to save space for Star and Cash-cow tenants that generate higher planned sales, or keeping a certain number of its stores in hope that they generate high level of unplanned sales or that they contribute to creating a less-crowded shopping experience in the shopping mall that delights shoppers. Overall, stores of this tenant category can be abundant in the shopping mall but the relative size of this category should not be too large, as it is placed at the low end of the demand-based dimension.

Obviously, Dog – the most unfavorable tenant category in a shopping mall, is low-demand substitutable category, because neither its store abundance nor relative size contributes to improving store revenues in a shopping mall. Dog products in the BCG matrix are often removed from their portfolio, but this may or may not be applied to the Dog tenant category in a shopping mall. Although both the planned and unplanned sales of this category are low compared to that of other tenants, it is necessary that a shopping mall contain stores of all tenant categories including Dogs', as this may imply to shoppers that the shopping mall is effective at meeting all of their needs. The Dog tenants may also be helpful in the sense that they can fill unfavorable space in a shopping mall where no other tenants want to locate (Tubridy 1998). Dog tenants should be the least abundant category and occupy the least of mall space.

Furthermore, there is an important distinction between the BCG matrix and our tenant-category positioning matrix. In the BCG matrix, the classification of a portfolio's products into the four categories may not be static; for example, Star products may become Cash Cows, and Question Mark products may advance to become Stars. Meanwhile, the tenant-category positioning matrix that we propose

is rather consistent, which means the role of a store in a shopping mall once being classified will be unlikely to change. This highlights the benefit of using the proposed tenant-category positioning matrix to make the right decisions concerning mall composition and mall stores positioning from the very beginning, as such decisions and their consequences will last long.

Overall, the tenant-category positioning matrix assists mall practitioners in making critical resource allocation decisions once different tenant categories are classified. Moreover, it also offers store managers with a reference to bargain for rental cost or favorable location in a shopping mall. As, for example, stores of high-demand complementary category (Star tenants) contribute the most to the shopping mall, they may ask for lower rental rate and better location within a shopping mall; meanwhile, as stores of low-demand substitutable category (Dog tenants) only benefit from the traffic generated by other stores in the shopping mall without creating much externality to other stores, they may have to pay higher rental rate, or be presented at unfavorable location. The tenant-category positioning matrix we propose, which is an elevation of the BCG matrix in the shopping-mall context, can also be used in a number of other retail formats that compose of bundle of retail stores such as department stores, shopping centers, and mega stores, etc. This makes the proposed tenant-category positioning matrix a valuable strategic tool with wide application and usage.

MALL-COMPOSITION OPTIMIZATION GUIDELINES

Given the strategic positions of the four tenant categories discussed in previous matrix, we propose a set of guidelines to optimize mall composition in order to maximize store revenues in a shopping mall. The guidelines can be used by mall developers to plan new shopping malls, by mall operators to restructure existent shopping malls, and by managers of any store in a shopping mall to predict and evaluate performances of their stores across different mall-composition specifications and strategies.

Figure 9

MALL-COMPOSITION OPTIMIZATION GUIDELINES

General guidelines:

> Guideline 1. Complementary tenant category should be abundant in shopping mall.

> Guideline 2. High-demand tenant category should occupy the majority of space in shopping mall.

More specific guidelines:

> Guideline 3. High-demand complementary stores should be abundant and should be of large size.

> Guideline 4. High-demand substitutable stores should not be abundant, but should be of large size.

> Guideline 5. Low-demand complementary stores can be abundant, but should not be of large size.

> Guideline 6. Low-demand Substitutable stores should be neither abundant nor of large size.

9. THEORETICAL AND MANAGERIAL IMPLICATIONS

THEORETICAL IMPLICATIONS

The objective of our research is to empirically study the effect of mall composition on store revenues in a shopping mall. Much research has been devoted to the topic of shopping mall's composition; however, no former research seems to attempt to quantify mall-composition effect, or to examine it at store level. Common in the current literature of shopping mall is the belief that it is difficult to study mall composition quantitatively due to a lack of empirical data, and that it is impractical to generalize studies on the topic due to a strongly context-dependent tendency of shopping mall's design and composition. These left important gaps in theories predicting mall performance and store performance in a shopping mall. With significant results, our empirical study demonstrates that it is possible to construct quantitative models to estimate store revenues in a shopping mall, using mall-composition features as one of the main predictors. Moreover, the conceptual classification of stores in a shopping mall that we proposed and the theoretical framework that was built upon it illustrates that it is feasible to draw generalizable rules to optimize mall composition and maximize

mall stores' revenues. By studying the effect of mall composition and drawing relevant implications at a conceptual level rather than at an operational level like most former research did, our study is not explicitly bound to external context specifications such as location and demographic profiles. In more specifics, our study verifies the significance of two mall-composition components, and between them, points out that relative size of mall's tenant categories is more influential than store abundance of these categories in influencing store revenues in a shopping mall. Moreover, the study is the very first one to explore that the effects of the two mall-composition components vary across categories of high-demand versus low-demand, and complementary versus substitutable stores in a shopping mall. The exploration and employment of a new tenant-stores classification tool, indeed, demonstrates our new approach to understanding mall-composition effect, which is different from traditional approaches built upon functional classifications of stores in a shopping mall.

The study not only fills important gaps in the shopping mall literature in general, it also sheds more light on the effect of store size on store revenue in particular. Although much research has been conducted to examine the effect of store size on the revenue of a store, either as an independent unit or as part of a shopping mall, no research has attempted to study the variance of the effect across different categories of stores. Our findings indicate that the effect of store size on store revenues do vary consistently across high-demand versus low-demand, and complementary versus substitutable stores in a shopping mall. The research also extends the study by Brueckner (1993), which provided that a store's revenue always increased at a decreasing rate as its store size increased (or elasticity is always smaller than one). We, on the other hand, find that the elasticity of store revenue is inconstant across changes in store size; it can even reach one at some level of change in store size, e.g. in the case of high-demand substitutable stores. Overall, new understandings about the known effect of store size proposed in our study complement current literature of store-size effect and possibly suggest fresh ideas for future studies.

MANAGERIAL IMPLICATIONS

Mall composition has long been a familiar topic in the literature of shopping mall; however, due to the fact that it has not been studied empirically, extant literature offers very few practical managerial implications regarding how to optimize mall

composition and maximize store revenues in a shopping mall. Meanwhile, mall practitioners often have to face with critical decisions regarding which tenant categories should be the most abundant in their shopping malls, which categories should they allocate the most space to, and how to modify the current composition of stores in their shopping malls in order to improve mall stores' revenues in the most effective way. If these decisions go wrong, it will be difficult and costly to fix them, because mall-composition decisions are often inflexible, involving time, financial costs, and external parties such as managers of stores in the shopping mall. In order to assist mall practitioners in their decision-making, our empirical study comes up with a significant model to predict store revenues in a shopping mall, using mall composition and store size as the main predictors. The model's results allow us to draw critical insights to develop a tenant-category positioning matrix and propose actionable guidelines to assist mall practitioners in their decisions concerning optimal mall composition. Once the positioning matrix and optimization guidelines are practically validated, using them will reduce unproductive decisions on the part of mall practitioners, which benefits all parties involved. In the new challenging environment, these strategic tools will prove to be even more valuable, enhancing the competitive edge of shopping malls and retail tenants in an original way. Finally, since the effect of mall composition and store size can be seen as generic in every kind of bundling store formats (Teller and Schnedlitz 2012), our study as well as the managerial implications and strategic tools it proposes can be applied to even wider retail context.

10. LIMITATIONS & FUTURE RESEARCH

Our study exhibits several limitations and suggests ample opportunities for future research. *First*, the classification of stores in shopping malls proposed in the study was made at a composite level, where each category of stores to be classified contains several different types of goods. Classification criteria such as degree of penetration and purchase frequency are evaluated generally for the whole composite categories rather than specifically for each subcategory, due to lacking of evidence at subcategory level. While the classification criteria are reliable and sufficiently supported by current studies, our classification built upon them may not be optimal due to the heterogeneity existing among stores of each composite category. We encourage future research to study relevant features of subcategories (e.g. by conducting customer surveys) to replicate our study and classification at

the subcategory level, as this may enable obtaining more homogeneous categories of stores, and possibly provide more accurate results and implications.

Second, our study and the tenant-category positioning matrix it proposes indicate that some tenant categories are more beneficial than others. This raises the question of whether it is advisable for a shopping mall to include only the most beneficial categories, and, for example, exclude the Dog tenants. With regards to our current classification, it seems that we cannot completely exclude stores of any tenant category. Due to the fact that each category is specified at the composite level and represents a whole class of functional goods, the presence of each one is important for a shopping mall to satisfy multiple needs of shoppers. This implies another limitation of our tenant-category classification at composite level. If the tenant categories are, instead, classified at subcategory level, each of them may contain different functional goods that have the same level of customer demand and joint utility. Then, removing completely a certain category may not affect a shopping mall's ability to satisfy shoppers with multiple needs. Once tenant categories are classified at subcategory level, the question of whether it is possible to remove an unfavorable tenant category to make the shopping mall more effective will become more interesting. Further research can attempt to answer the question by conducting similar empirical studies using classification at specific subcategory level, rather than at the composite level as in our study due to lacking of relevant data.

Third, for the reason that customer data are not available, it is not possible for us to empirically test the latent variables of crowdedness and utility perception, which we assumed to be antecedents of store revenues in a shopping mall. Although the concepts of utility and crowdedness are mentioned in diverse studies and are confirmed to be influential to store performances, no research attempts to study them quantitatively in shopping mall format. Future research can fill this gap by conducting customer-survey based research aiming to quantify the effect of crowdedness and utility perception on store revenues in a shopping mall or any other bundling retail format. Such research will verify our study's reasoning and, more importantly, have potential to suggest managerial relevant implications to improve store venues in different retail settings.

Fourth, the classification of stores in a shopping mall we proposed takes into account the inter-product or inter-store relationship, in terms of complementarity

and substitutability, within a certain functional category. However, goods and/or stores from different categories may also complement or substitute one another. In fact, there have not many studies devoted to studying cross-category relationships, leaving us with very little evidence to incorporate them into our study. It was, indeed, interesting, and perhaps instructive, to study about the underlying structure of these relationships (Bass, Pessemier, and Tigert 1969). Future research may shed more light on this issue and improve our classification of stores in a shopping mall to be even more complete.

Fifth, our study empirically examines the effect of mall composition and store size on store revenues in a short-term perspective. Meanwhile, mall composition and store size may have long-term effect on shoppers' loyalty for the shopping mall and its stores, as well as their lifetime value. We suggest future research try to quantify the effect of mall composition on customer lifetime values, or that on customers' loyalty, as this will offer deeper knowledge about the effect of mall composition and will contribute new understanding to the literature of consumer behaviors in shopping mall and similar retail formats.

Sixth, the effect of mall composition we account for in our research comprises of two components: store abundance and relative size of tenant categories in a shopping mall. Even when these components are equal, a shopping may be perceived differently from another shopping mall if their store layouts are not identical. Kim and Runyan (2010), for example, suggested that crowded stores (kiosks in their research) should be grouped together in one place not close to the entrance in order to increase shoppers' freedom of movement and mitigate their perception of the shopping mall's crowdedness. This suggests that store layout of a shopping mall may affect shoppers' crowdedness perception, which is a latent antecedent of store revenues in our study. In other words, store layout possibly moderates the effect of mall composition on store revenues in a shopping mall. We find store layout and its possible moderation effects very interesting topic for future research, as studying about them elevates our study and further complement literature of shopping mall's design and composition.

Finally, besides mall composition and store size, there exist other factors that influence the revenues of a shopping mall and its tenant stores, such as the shopping mall's location and geographic profiles, architectural designs and ambience, marketing efforts and service people, and operational policies, etc. Due

to unavailability of data and similarity of our samples on most location factors, our study does not take into consideration these factors, which is another limitation. Future researchers may try to incorporate these factors into their studies of store performance in a shopping mall by, for example, introducing models with random shopping-mall intercepts, or including external location factors as independent variables to estimate store revenues. This will add to the realism and accuracy of their research and possibly strengthen our current study.

FINAL CONCLUSION

With an empirical approach using secondary data, our research examines the effect of mall composition and store size on store revenues in a shopping mall. It studied 17 shopping malls of different sizes and locations and 1444 mall stores from different product categories. The significant results verify the effect of two mall-composition components, namely store abundance and relative size of tenant categories in a shopping mall. Together with the proposal of a new tenant-store classification tool, the research effectively demonstrates the variation of mall-composition and store-size effect across categories of high-demand versus low-demand and complementary versus substitutable stores in a shopping mall. These provide fundamentals to develop a strategic tenant-category positioning matrix and mall-composition optimization guidelines that the study presents. Finally, as mall-composition and store-size effect can be seen as generic to every kind of bundling retail store formats, findings from the research are valuable for retail practitioners in general, and not limited to the shopping mall format.

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APPENDICES

APPENDIX 1.

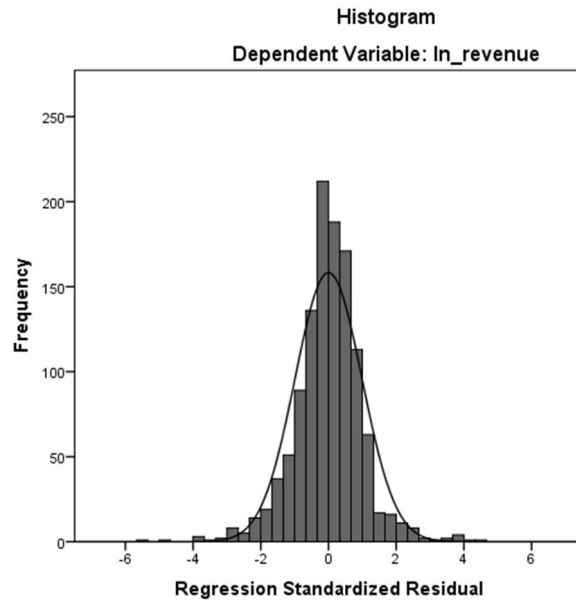MAP OF THE 17 SHOPPING MALLS UNDER RESEARCH

APPENDIX 2

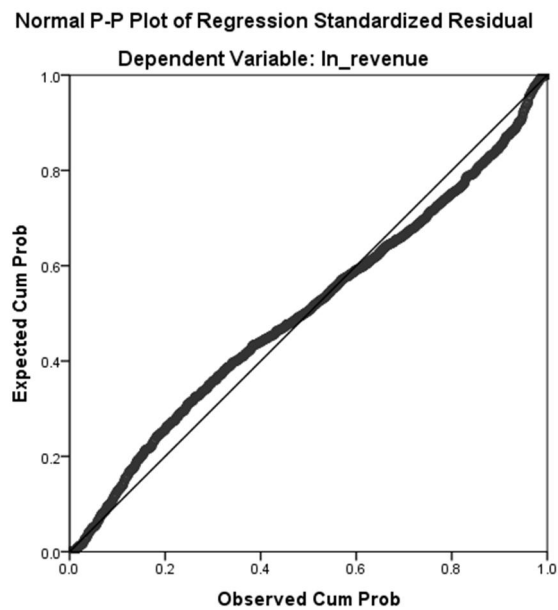## STATISTIC SUMMARY OF THE AREA EFFECTIVENESS OF MALL STORES ACROSS COMPOSITE- AND SUBCATEGORIES

Composite categories	Area eff. (mean)	Std. Deviation	Skewness
(1) Clothing, Footwear & Accessories	35736.77	10785.120	-0.387
(2) Home & Household goods	53434.88	19041.764	0.096
(3) Foods & Drinks	67056.50	26993.704	0.879
(4) Services	87516.41	101394.90	2.985

Subcategories	Area eff. (mean)	Std. Deviation	Skewness
(1.1) Women's apparel and accessories	36748.24	11943.70	0.07
(1.2) Men's apparel and accessories	37682.47	17099.28	1.07
(1.3) Children's apparel and accessories	22758.05	18942.66	-0.04
(1.4) Full-range apparel and accessories	28354.07	11693.14	-0.44
(1.5) Footwear	30495.38	12169.03	-0.50
(1.6) Watches and jewellery	69945.77	39244.57	0.04
(2.1) Electrics & Electrical applications	73922.34	58236.03	0.11
(2.2) Furniture, Decoration, & Textiles	32900.26	12085.19	0.10
(2.3) Leisure and Hobby (music, photo, books, games, toys, and pet shops)	40406.00	15964.07	-0.20
(2.4) Health & Beauty (cosmetics, drug stores, glasses, & sport equipment)	248260.60	269700.60	1.50
(3.1) Supermarkets	43537.30	18350,40	-0.52
(3.2) Kiosks	49202.65	24814.19	0.93
(3.3) Specialty food stores	88428.43	49384.22	0.60
(4.1) Foods and Drink serving	39854.97	17339.63	0.45
(4.2) Entertainment facilities	4584.29	11282.72	2.45
(4.3) Other services	130938.62	168094.25	2.59

APPENDIX 3

(6A)

Histogram
Dependent Variable: ln_revenue

(6B)

Normal P-P Plot of Regression Standardized Residual
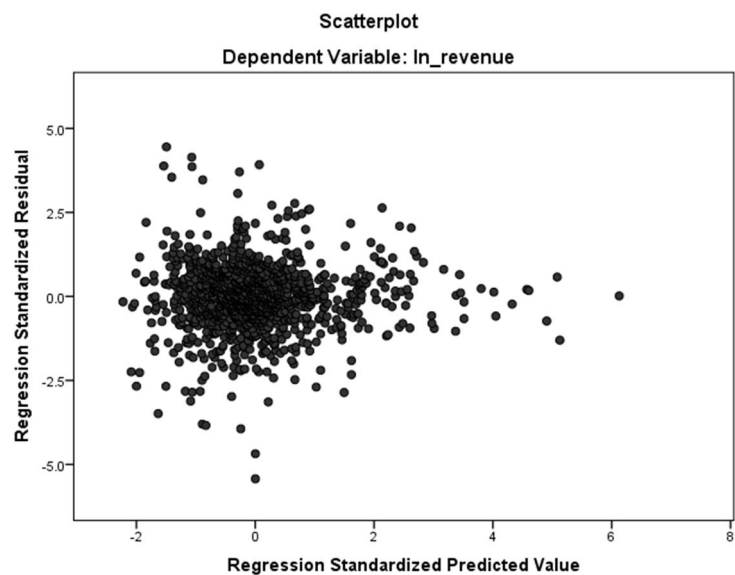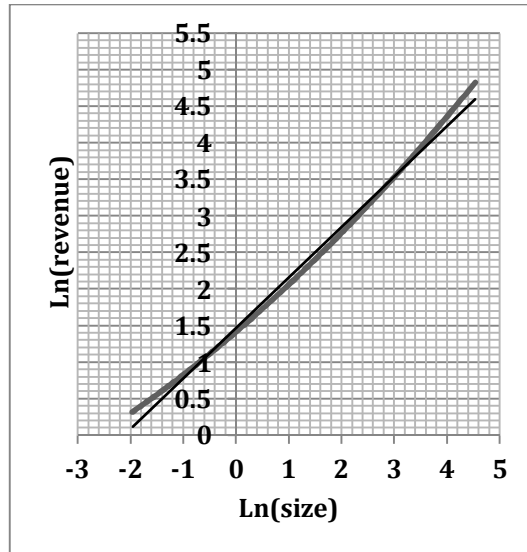Dependent Variable: ln_revenue

(6C)

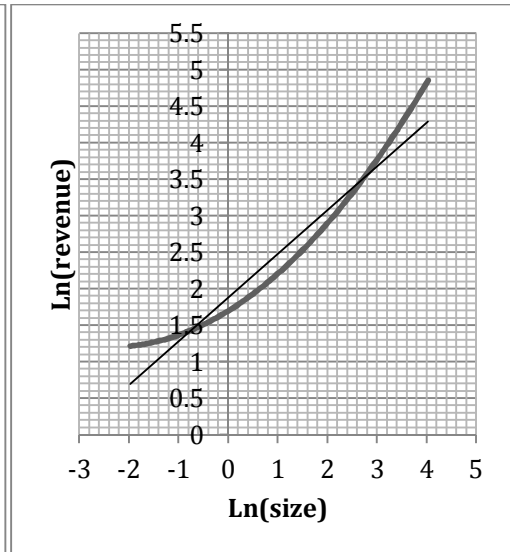Scatterplot
Dependent Variable: ln_revenue

APPENDIX 4

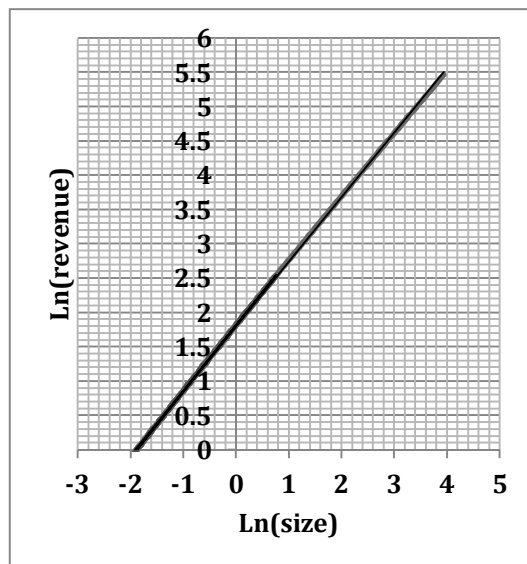PLOTS OF CHANGES IN STORE SIZE AGAINST CHANGES IN REVENUES
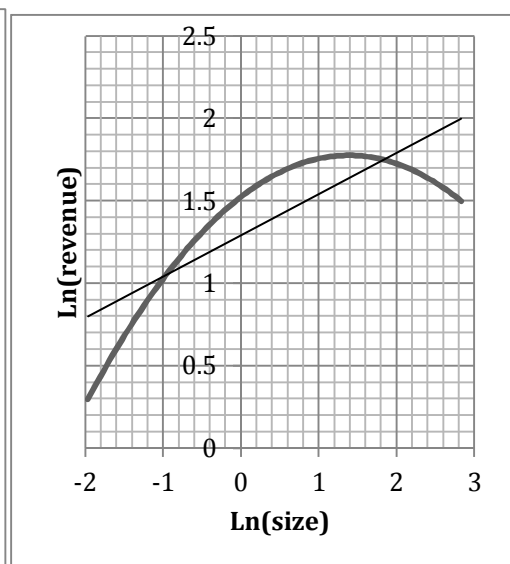
High-demand complementary

Low-demand complementary

High-demand substitutable

Low-demand substitutable

APPENDIX 5

MODEL TESTING STORE-ABUNDANCE EFFECT SEPARATELY

Model equation

$$\ln(revenue_{i,j}) = \alpha + \beta_h h\_demand_{i,j} + \beta_c comp_{i,j} + \beta_{hc} h\_demand_{i,j}\beta_c comp_{i,j}$$

$$+ \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j})h\_demand_{i,j}$$

$$+ \gamma_c \ln(size_{i,j})comp_{i,j} + \gamma_{hc} \ln(size_{i,j})h\_demand_{i,j}comp_{i,j}$$

$$+ \sigma_0 \left[\ln(size_{i,j})\right]^2 + \sigma_h \left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}$$

$$+ \sigma_c \left[\ln(size_{i,j})\right]^2 comp_{i,j} + \sigma_{hc} \left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}comp_{i,j}$$

$$+ \mu_{hc} abund_j^{h\_demand,comp} + \mu_{lc} abund_j^{l\_demand,comp}$$

$$+ \mu_{hs} abund_j^{h\_demand,sub} + \mu_{ls} abund_j^{l\_demand,sub}$$

Results

Variables	Symbols	Coefficients	Significance
Constant	α	0.877	0.000***
High-demand stores	β^h	0.301	0.004³**
Complementary stores	β^c	0.139	0.056**
High-demand and complementary stores	β^{hc}	-0.586	0.000***
The effect of store size:			
Main effect of ln(size)	γ_0	0.382	0.000***
Interaction effect on stores of:			
- High-demand goods	γ_h	0.573	0.000***
- Complementary goods	γ_c	0.050	0.512
- High-demand, complementary goods	γ_{hc}	-0.370	0.005***
Main effect of $[\ln(size)]^2$	σ_0	-0.123	0.010***
Interaction effect on stores of:			
- High-demand goods	σ_h	0.116	0.042**
- Complementary goods	σ_c	0.223	0.000***
- High-demand, complementary goods	σ_{hc}	-0.189	0.005***
The effect of store abundance:			
High-demand, complementary goods	μ_{hc}	0.032	0.000***
High-demand, substitutable goods	μ_{hs}	-0.100	0.000***
Low-demand, complementary goods	μ_{lc}	0.022	0.032**
Low-demand, substitutable goods	μ_{ls}	0.025	0.502
Model fit	R^2	0.543	0.000***
	Ad. R^2	0.537	

Notes: Dependent variable: Ln (revenue); Method: OLS; Number of observations: 1444; *Significant at 10% (two-sided); **Significant at 5% (two-sided); ***Significant at 1% (two-sided)

APPENDIX 6

MODEL TESTING CATEGORY RELATIVE-SIZE EFFECT SEPARATELY

Model equation

$$\ln(revenue_{i,j}) = \alpha + \beta_h h\_demand_{i,j} + \beta_c comp_{i,j} + \beta_{hc} h\_demand_{i,j}\beta_c comp_{i,j}$$

$$+ \gamma_0 \ln(size_{i,j}) + \gamma_h \ln(size_{i,j})h\_demand_{i,j}$$

$$+ \gamma_c \ln(size_{i,j})comp_{i,j} + \gamma_{hc} \ln(size_{i,j})h\_demand_{i,j}comp_{i,j}$$

$$+ \sigma_0 \left[\ln(size_{i,j})\right]^2 + \sigma_h \left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}$$

$$+ \sigma_c \left[\ln(size_{i,j})\right]^2 comp_{i,j} + \sigma_{hc} \left[\ln(size_{i,j})\right]^2 h\_demand_{i,j}comp_{i,j}$$

$$+ \theta_{hc} rel\_size_j^{h-demand,comp} + \theta_{lc} rel\_size_j^{l-demand,comp}$$

$$+ \theta_{hs} rel\_size_j^{h-demand,sub} + \theta_{ls} rel\_size_j^{l-demand,sub} + \xi_{i,j}$$

Results

| Variables	Symbols	Coefficients	Significance
Constant	α	1.910	0.000***
High-demand stores	β_h	0.298	0.004³**
Complementary stores	β_c	0.148	0.045**
High-demand and complementary stores	β_{hc}	-0.579	0.000***
The effect of store size:			
Main effect of ln(size)	γ_0	0.388	0.000***
Interaction effect on stores of:			
- High-demand goods	γ_h	0.574	0.000***
- Complementary goods	γ_c	0.042	0.586
- High-demand, complementary goods	γ_{hc}	-0.383	0.005***
Main effect of $[\ln(size)]^2$	σ_0	-0.135	0.005***
Interaction effect on stores of:			
- High-demand goods	σ_h	0.122	0.035**
- Complementary goods	σ_c	0.227	0.000***
- High-demand, complementary goods	σ_{hc}	-0.190	0.005***
The effect of relative size:			
High-demand, complementary goods	θ_{hc}		
High-demand, substitutable goods	θ_{hs}	0.115	0.639
Low-demand, complementary goods	θ_{lc}	-0.649	0.004***
Low-demand, substitutable goods	θ_{ls}	-1.986	0.000***
Model fit	R^2	0.526	0.000***
	Ad. R^2	0.520	

Notes: Dependent variable: Ln (revenue); Method: OLS; Number of observations: 1444; *Significant at 10% (two-sided); **Significant at 5% (two-sided); ***Significant at 1% (two-sided)

APPENDIX 7

THE BCG MATRIX OF STRATEGIC PORTFOLIO PLANNING

"The BCG matrix is a chart that was created by Bruce D. Henderson for the Boston Consulting Group in 1970 to help corporations to analyze their business units, that is, their product lines. This helps the company allocate resources and is used as an analytical tool in brand marketing, product management, strategic management, and portfolio analysis".
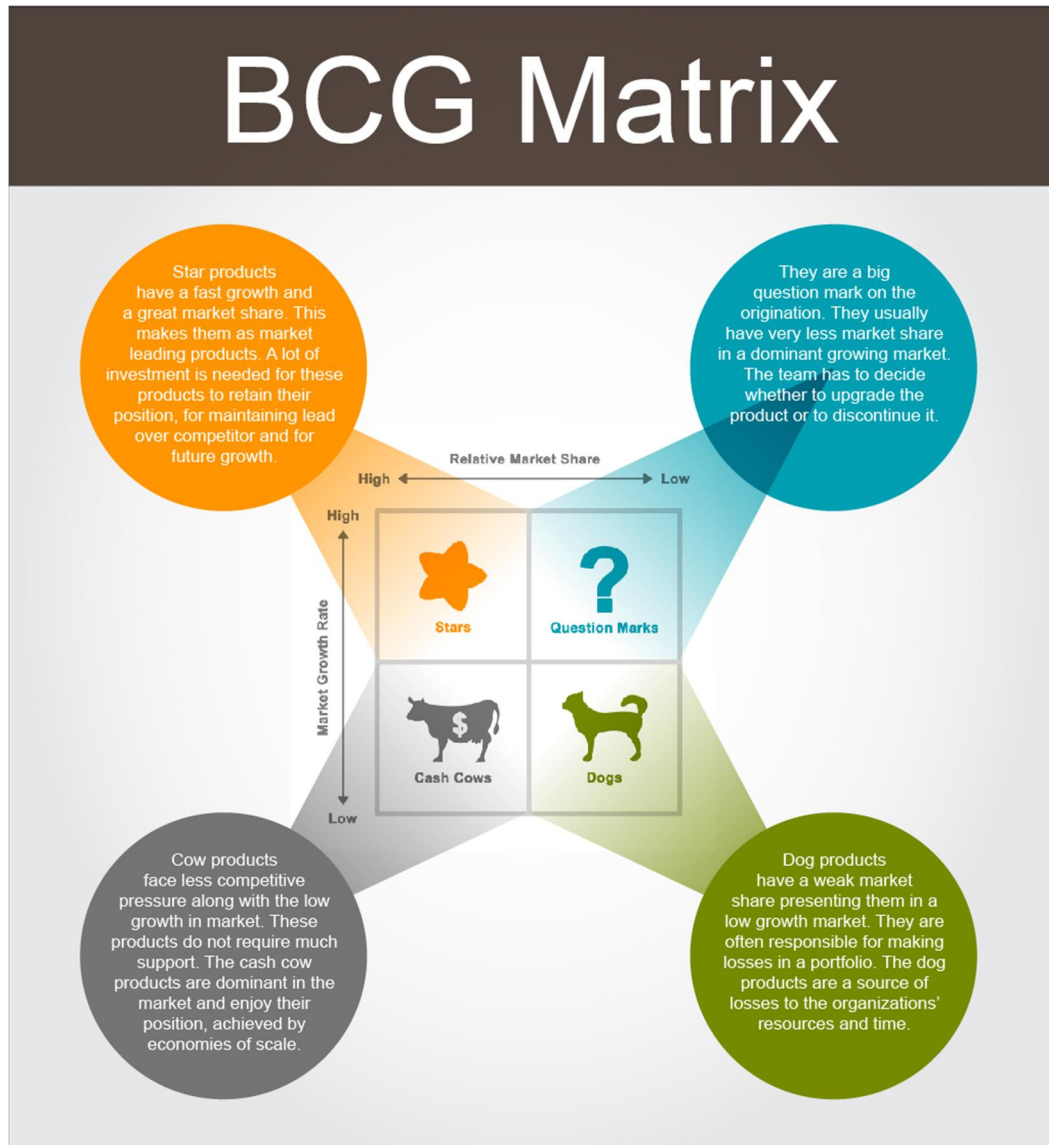
(Source: http://en.wikipedia.org/wiki/Growth–share_matrix

http://www.cooldailyinfographics.com/post/bcg-matrix

https://www.bcgperspectives.com/content/classics/strategy_the_product_portfolio/)

APPENDIX 8

PRELIMINARY THESIS REPORT

PRELIMINARY THESIS REPORT

**Optimizing the Composition of Stores in Shopping Malls
– An Empirical Study of Shopping Malls in Norway**

TABLE OF CONTENT

INTRODUCTION TO THE RESEARCH TOPIC

Shopping malls are growing rapidly throughout the European landscape (Gilboa 2009; ICSC 2009, cited in Avello et al. 2011) both in number and size. New malls add fiercer competition in terms of sales and traffic, making it more challenging for a mall to compete among its rivals, and, at the same time, affecting the level of performances among individual stores that are presented in mall. In the new environment, it is no longer enough for shopping malls to operate in a convenient manner by offering customers with broad assortment, low pricing, or shopping experience alone. They will need to come up with new and better strategies to be standout among the ever more aggressive competitors, effective to their potential tenants, and appealing to the increasingly demanding shoppers.

In our final thesis as part of the study in Strategic Marketing Management at BI Norwegian Business School, we wish to study particularly the topic of shopping malls, more specifically, the factors altering shopping malls' attractiveness that in turns having major impacts on the performances of individual stores presented in malls. Our thesis will be aimed at providing guideline for shopping malls to optimize the composition of the malls' stores in order to enhance their competitive edge, and at the same time, offering tenant stores within malls with handy tools to evaluate and predict their performances, using information about the mall's store composition.

Store composition of malls, also being referred to as store assortment, mall composition, or tenant mix in extant research, is well recognized to be a very important element for the success of a shopping mall (Chung and Sherry 2009). The complexity of store composition decisions such as how many different stores, or tenant species, should be included in the malls, and how much lettable area should be distributed to different tenant species is justified by their strategic role in attracting customers and altering their behaviors once arriving at the malls (Lindquist 1974-75, Bearden 1977, Brito 2009, Hunter 2006, Shah and Mrudula 2005, Stephan Grzeskowiak 2009, Kirkup and Rafiq, 1994). Especially in the context of growing competition, not only among malls themselves but also from similar retail concepts such as department stores and mega centers, store composition is an effective mean of differentiating one mall from others and

making it appealing to multipurpose-shopping and store-switching segments, which assists in generating high traffic and sales among these customers and many others. In fact, store composition has been widely considered critical to all parties concerned – shoppers, retail tenants, and mall operators (Kirkup and Rafiq, 1994) because it is the synergy created by the right grouping of tenants, which together have a greater total effect than the sum of their individual effects (Alexander and Muhlebach, 1990, cited in Chung and Sherry 2009). Given these high stakes, it is important to understand and carefully manage store composition, particularly in the increasingly competitive context of shopping malls.

On the other hand, even though shopping malls' store composition in terms of assortment and mix of tenants has been studied extensively in the marketing literature; most studies in these fields are typically qualitative and based primarily on experience and gut feelings. In practice, there is a significant absence of quantitative and scientific models for determining an optimal store composition in shopping malls (Chung and Sherry 2009, LeHew and Fairhurst 2000, Kirkup and Rafiq 1989). This academic gap leaves mall managers, who have to make crucial decisions concerning a bundle of tenants and stores simultaneously and continuously, with little insight into how to obtain the store composition synergy in their malls. Meanwhile, malls' tenants have no applicable tools to understand the impact of the malls' store composition on the performances of their own stores. A major purpose of our thesis research is to shed more light onto these issues and to fill the academic and managerial gaps proposed by them by concentrating on the exploration of the major constructs that determine the synergy of stores in shopping malls, and more importantly, the influence of such synergy on the performances of malls' individual stores.

In doing so, we specifically focus our thesis research on the quantitative and scientific aspects of shopping malls' store composition, which are evidently lacking in current literature. Not only store composition is the very important element of a shopping mall's attractiveness which alters the performance of its tenant stores, it is also the most demanding in terms of retailer decisions. Shopping malls typically comprise a large number of stores and tenant species, with complex cross-category and among-category relationships. In composing a shopping mall's stores and tenant species, three composition decisions may need to be examined. The first decision concerns the number of tenant species, or store

types, to be included in the shopping malls. The second problem is to determine the size of each tenant species, probably in terms of lettable areas. The first two decisions may imply important trade-offs between synergy and competition among same-species stores, and between synergy and variety among stores of different tenant species. More stores of the same species presented in a shopping mall may emphasize the combined appearance of such store types but may also arouse severer competition among them. Meanwhile, increasing the number of different species of stores in a shopping mall creates an advantage of diversity, but the individual appearances of each store types may be subtle, thus ineffective in impressing customers. Last but not least, shopping malls may have to decide upon the emphasis to be placed on the number of stores within certain tenant species or the total size of the tenant species as the more determining factors of the malls' attractiveness. This matter is further complicated by the fact that the effectiveness of shopping malls' store composition may be moderated by local characteristics such as the socio-demographic profiles of particular malls' shoppers. For example, the Institute of Real Estate Management (1990) opined that there may be no single optimal tenant mix for shopping malls, since the tenant mix of an individual mall should be tailored to meet specifications like location, size, demographic profile of the catchment area, and customer needs. In fact, the extant literature leaves shopping mall managers and future researchers with little to go on, such that more research is needed to fill the academic and managerial gaps proposed.

Given these current research gaps, our thesis wishes to examine the following issues. First, we want to formulate an applicable formula to decide the effectiveness of a mall's store composition, and from this, suggest the optimum store composition in term of store number and size. Second, we want to develop and empirically test hypotheses on how changes in malls' composition of stores, in terms of the number of stores within tenant species and the size of tenant species, affect the malls' individual store performances. Third, we may want to identify location-specific moderator variables and other external factors that may alter the effectiveness of the composition of malls' stores among different shopping malls. It is noted that the final content of our thesis research may not fully cover all of the mentioned issues, as this is also dependent on the suitability and richness of the empirical data that we actually have.

Finally, within the scope of our thesis, we will study the chosen topic in the context of Norwegian shopping malls. According to the International Council of Shopping Centers (ICSC, 2013), Norway is a mature market where shopping centers (including shopping malls) and retail warehouse formats are well developed. Thus, studying the topic of shopping malls in the context of Norway is both eligible in terms of data availability and suitability, and valuable in terms of generalization potential of the results from our research.

THEORETICAL BACKGROUND, RESEARCH QUESTIONS AND RESEARCH OBJECTIVES

Literature Review

Literature review is an important part of this preliminary report, as it provides us with essential background to evaluate the potentials and eligibility of our research topic and suggests proble directions to approaching our chosen subject.

Our thesis aims at studying how a mall's composition of different stores influences the mall's attractiveness, thus modifies the performances of its tenant stores. As such, we find literature on the determinant factors of shopping malls' attractiveness and literature on store assortment and tenant mix highly relevant.

At the first analysis, there are a number of studies that have attempted to identify and analyzed the determinant factors of shopping mall's attractiveness. On the whole, four mains approaches need to be considered; some approaches may share common determinant factors with one another. First, the cost-minimization approach suggests that customers choose shopping malls that minimize travel cost (from home to malls) and offer lower prices at which goods are sold. Followers of this approach include Hyson and Hyson (1950); Parr (1997); Holtelling (1929); Reinhardt (1973); Lentnek, Harwitz and Narula (1981); Huff (1963); Huff and Rust (1984); Adler and Ben Akiva (1976), and Bacon (1998). The second approach focuses on the commercial attractiveness of the shopping malls, which results from a combination of a wide range of factors such as layout and architecture (Martineau 1958); marketing focus such as advertising and promotion

(Martineau 1958, Lindquist 1974-75, Singh and Sahay 2011, Ghosh 1990), merchandise and assortment (Lindquist 1974-75, Bearden 1977, Brito 2009, Hunter 2006, Shah and Mrudula 2005, Stephan Grzeskowiak 2009), service availability (Lindquist 1974-75, Arpita Khare and Sapna Rakesh 2010), physical facilities (Lindquist 1974-75, Bearden 1977, Singh and Sahay 2011), price (Bearden 1977, Ghosh 1990, Bodkin and Lord 1997), location (Bearden 1977, Ghosh 1990, Simmons 1992, Ownbey et al. 1994, Forgey et al. 1995, Shah and Mrudula 2005), and opening hour (Kaufman 1996), etc. The third approach directs to entertainment, suggesting that creation of entertainment experience in shopping malls play an essential role in enhancing the shopping mall's competitive edge. This is supported by Wakefield and Baker 1998, Wilhelm and Mottner 2005, Biba et al. 2006, Backstrom 2006, Bellenger and Korgaonkar 1980, Talmadge 1995, Kim et al. 2005, Nisco and Napolitano 2006, Ooi and Sim 2007, Sirpal and Peng 1995, Wong and Yu 2003, etc. The fourth and last approach, on the other hand, considers the shopping experience that a mall offers as the major driver of mall attractiveness. Bloch, Ridgway, and Dawson (1994) proposed that not only shoppers consume products and services in a variety of ways within the mall; the mall itself offers experiences that are consumable and emotionally influential. A variety of constructs have been linked to the term "experience" in the shopping mall context, such as music (Greg et al. 2008, Singh and Sahay 2011, Mattila and Wirtz 2001, Wakefield and Baker 1998, Solomon 1994, Peter and Olson 1994), scent (Michon, Chebat, Turley 2003, Singh and Sahay 2011, Mattila and Wirtz 2001, Hunter 1995, Lehrner et al. 2005, Lovelock and Wirtz 2011, Mattila and Wirtz 2001), lighting (Singh and Sahay 2011, Wakefield and Baker 1998), color (Solomon 1994, Peter and Olson 1994), temperature (Singh and Sahay 2011, Wakefield and Baker 1998). A detailed summary of all the mentioned literature on the shopping malls' attractiveness factors is presented in Appendix 1. Briefly, current literature suggests that most important attributes creating shopping malls' attractiveness include convenience (location and cost), commercial attractiveness, entertainment orientation, and shopping ambience (or shopping experience). We find this very relevant to our research which assumes a relationship between malls' store composition and their attractiveness. Stores of different tenant species may strengthen, at high or low level, some of the attributes that add to the attractiveness of the shopping malls. For example, Ismail El-Adly (2006) found that shoppers give great important to supermarket existence in the

malls, thus malls that include supermarket will be likely to satisfy the convenience need of their shoppers. Another example is that tenant species such as food courts, art exhibits, restaurants, video arcades, movie theatres, and hair salons, etc. add to the entertainment appeal of shopping malls (Kim 2002, Sirpal and Peng 1995). Furthermore, global-name stores (Brown 1993) and 'anchor tenant (Finn and Louviere 1996; Konishi and Sandfort 2003; Ibrahim and Galven 2007) significantly improve the commercial attractiveness of shopping malls. As a result, it is very likely that different malls with different compositions of stores and tenant species will present different level of attractiveness, thus more positively or less influence the performances of tenant stores within the shopping malls. The first review of shopping malls' attractiveness factors is valuable in the sense that it provides us with important theoretical foundation to move on with our chosen subject of shopping malls' store composition. It is also worthy to note that most of the research on shopping mall's attractiveness factors are qualitative or based primarily on customer-based surveys, lacking the integration and analysis of real-life data. Our research, which is supposed to be empirical and quantitative, using data from performing shopping malls in Norway, potentially offers more objective outcomes and outcomes that have not been suggested by extant qualitative research. For example, one research proposed that the inclusion of supermarket add to shopping malls' convenient attractiveness (Ismail El-Adly 2006), however, how many supermarkets to add to be considered effective was not studied due to lack of empirical data. With a quantitative approach, our research hopes to fill this gap in the current literature of shopping malls.

At the second analysis, we are concerned with research on the topic of tenant-mix, particularly in the context of shopping malls. Tenant mix is the relationship between the percentages of shop areas occupied by different store types in a shopping mall (Dawson, 1983). It influences the attractiveness of a shopping mall as a right group of tenants attracts more customers, thus increasing sales for the tenant stores (Abratt et al., 1985; Greenspan, 1987; Alexander and Muhlebach, 1989, 1990; Brown, 1992; Ibrahim et al., 2003; Teller and Reutterer, 2008; Kaufman and Lane 1996). Unfortunately, almost all the studies on tenant mix are qualitative and intuitive as highlighted by LeHew and Fairhurst (2000). Tenant mix choices are considered by Kirkup and Rafiq (1989) a very difficult task due to "a lack of empirical research to guide developers in their planning, and much is

therefore based on past experience and intuition". Furthermore, extant studies on the topic have not yet been generalized for future use due to the fact that a proper mix of tenants varies dependent on mall specifications such as location, size, and demographic profiles (Institute of Real Estate Management 1990), thus an optimum mix for one mall could be a mistake for another mall (Casazza and Spink 1985, Alexander and Muhlebach 1992). With such difficulty perceived by practitioners, the optimization of the tenant mix has not been studied scientifically. Among those who attempted to investigate the effect of tenant-mix, Brueckner (1993) empirically found that the allocation of space to certain tenant types would likely cause externalities and result in undesirable sale performance for tenant stores in the mall as a whole. Eppli and Shilling (1993) elaborated the ideas, finding that the rents of anchor tenants were normally lower due to their positive externalities on non-anchors. These findings are supported by Gerbich (1998), Casazza and Spink (1985); Bean et al. (1988); and de Bruwer (1997). Other empirical studies have shown that tenant variety affects the time consumers spend in the mall and their patterns of movement (Brown 1991; Khare and Rakesh 2011), the mall image (Finn and Louviere 1996), and have a strong influence on mall excitement (Wakefield and Baker 1998). Chung and Sherry's (2009) found that tenant mix strategies are governed by two principles: the number of tenant species is related to the mall size; and the tenant species' area allocation follows a geometric distribution, which implies that the area of a tenant species is determined upon its ranking of abundant in the mall. To summary, if the first review of shopping malls' attractiveness factors provides us with theoretical foundation, the second review of tenant mix in shopping malls seems to offer both theoretical and empirical evidence that tenant mix, in other words the store composition in malls, indeed contributes to the attractiveness of shopping malls. Even though, empirical literature is also not plentiful; more importantly, most emphasize on the impact of mall's store composition on the attractiveness and performance of the mall as a whole, disregarding the important effect of the mall's store composition on the performances of individual tenant stores within mall. On the other hand, a study of such an effect is considerable important to both mall managers and tenant stores' managers. Managers of individual tenants stores will be able predict their level of performance across different malls and adjust their strategy such as inventory and pricing strategy accordingly; they can also compare their expected performances in different malls of different store composition

pattern to decide whether to enter a mall or which malls the most beneficial one to enter among malls in their selection list. Meanwhile, managers of the malls should be concerned about the impact of their malls' store composition on the performance of individual tenant stores, as the performances of those stores decide the performance of the mall as a whole. Understanding of such impact also assists mall managers in decisions such as whether to include or exclude a tenant store or a tenant species, as this probably alters the performances of other stores and in turn relects in the mall's performance. Furthermore, an empirical research on the impact of mall composition on tenant stores' performance will be academically valuable as it fills the gaps in the current literature of shopping mall in general and tenant mix in particular, with potential to provide future research with new information and ideas to progress.

In summary, current literature on the topics of shopping malls' attractiveness factors and tenant mix provide relevant arguments supporting the impact of mall composition on the malls' attractiveness without underlining the potential effect of mall composition on the performances of individual stores within malls. Furthermore, most of the studies adopted qualitative and intuitive approaches using mainly customer-based survey data. As such, we believe there is a research opportunity to quantitatively study the effect of store composition of shopping malls on the individual tenant stores' performances, aiming at generating highly relevant managerial implications.

Research Questions and Objectives

The research questions that we want to examine in our final thesis concerns whether and how shopping malls' composition in terms of different stores and tenant species influence the performances of individual tenant stores presented in the malls. We also want to study the moderator effects of socio-demographic factors such as shoppers' income and distance from shopping malls location which may change the effect of mall composition on the performance of stores.

Using real data collected from several shopping malls across Norway, we aim at formulating reliable quantitative models that can present the effects of shopping malls' store composition in a systematic way, which are useful in extracting

relevant theoretical and managerial implications. Outcomes that we expect to come out with include a statistically significant model to predict store's performances within a mall given information about the mall' tenant species, the number of stores in each species, and the area allocated to each store species. From such a model, it may be possible to (1) identify store species that are more beneficial than others to be included in shopping malls, (2) inspect whether the number of stores within a tenant species or the total size of species (in terms of areas allocated to that species) is more important in influencing the performances of tenant stores, and (3) reveal the mechanism under which adding stores of a particular tenant species is likely to improve or weaken the performances of same- and different-species stores. If these objectives are fulfilled, we will be able to suggest to mall developers efficient ways of selecting different tenant species and calculating the number of stores of each species as well as the total area allocated to each species, or in other words, we may provide mall managers with tools to create the right grouping of stores in their shopping malls. The benefit of this will be the shopping malls achieving the highest synergy from their store composition, and succeeding in boosting their performance as well as the performances of their tenants. Furthermore, we hope to generalize possible results from our study of shopping malls in Norway to a global context, as the study indeed has good backup from current theoretical literature.

INTRODUCTION TO THE DATASET

Data collection

In order to study shopping malls' optimum store composition, we use data collected from 1519 stores in 18 major shopping malls in Norway, in the period from 2010 to 2011. The data was provided by one of the biggest shopping malls owners in Norway, Sweden, and Denmark.

In detail, the 18 shopping malls under study are from different regions across Norway and do vary in sizes and facilities available. In order to decide the shopping malls' type and their suitability for research, we refer to the definition

and classification of shopping centers by the Norwegian Center Statistics (NOSS). According to NOSS, shopping center or mall is *a group of retail and other commercial establishments that is planned, developed, owned, and managed as a single property*. This definition is compatible with the ICSC's pan-Europe definition of shopping centers[1]. Furthermore, NOSS breaks down shopping centers into three categories:

- ◆ Community Centre (Lokalsenter)

  Customers live in the area, i.e., within walking distance and the stores cover the basic daily/weekly needs for goods and services. No discounters are present. In the city this type of center will be located on the ground floor of an apartment building; outside the cities, community centers will be located at the center of a village or small town, and will be a separate building. Some parking is necessary.

- ◆ District Center (Områdesenter)

  Customers live in the municipality or in more than one city district. The stores provide a wide offer of goods and services, with limited discounters. In the city, it will be located in or close to a major apartment complex. In smaller towns, it will be located in or close to the center of town. Parking is necessary in small towns and villages, and some parking is needed in the city.

- ◆ Regional Center (Regionsenter)

  Customers come from several municipalities, from all over town or from a whole region. The stores offer a wide selection of goods and services and will normally include several discount stores. The big centers are all located in districts close to the most populated areas of the country. A few are located in the center of Oslo, close to major commuter stops such as the railway station. Large parking areas are required. The centers in the city of Oslo do not rely on parking.

Based on these definition and classification, 17 out of the 18 centers are qualified as shopping centers (including shopping malls). The only one shopping mall not

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[1] ICSC's pan-Europe definition of Shopping center
A shopping center is a scheme that is planned, built and managed as a single entity, comprising units and "communal" areas, with a minimum gross leasable area (GLA) of 5,000 square meters (m^2).

qualified has area smaller than 5000 sqm, which does not satisfy ICSC's definition of shopping center (Footnote 1).

Table 3.1 briefly presents information of the 18 shopping malls under study. Their names have been denoted as Mall 1 to Mall 18

Table 3.1 List of shopping malls

Shopping malls	Store number	Store area (sqm)
Mall 1	81	23483
Mall 2	177	42444
Mall 3	158	33767
Mall 4	**12**	**3358**
Mall 5	124	40398
Mall 6	34	9841
Mall 7	110	19949
Mall 8	33	9669
Mall 9	79	21941
Mall 10	114	43852
Mall 11	50	8840
Mall 12	77	17494
Mall 13	30	8007
Mall 14	32	7465
Mall 15	95	19975
Mall 16	118	29164
Mall 17	94	18827
Mall 18	101	37339

Data overview

The original data provided contains the following information:

- List of 18 the shopping malls in Norway
- List of the stores in each shopping malls
- Classification of the stores into 8 categories:

  1. Foods & Drink
  2. Specialty retailers
  3. Household goods
  4. Services
  5. Serving
  6. Clothing, Footwear & Travel goods
  7. Other retailers
  8. Other activities

- NACE (Statistical Classification of Economic Activities in the European Community) codes of the stores in each shopping malls. The NACE code

is a European industry standard classification system which is officially used in many research and document.

- ◆ Area allocated to each store in the shopping malls
- ◆ Revenues of each stores in 2010 and 2011
- ◆ We calculate the Area Effectiveness indexes of the shopping malls' stores in 2010 and 2011 by dividing the stores' revenue by their allocated areas in order to construct a performance variable for the stores taking into account the size of the stores.

The advantage of this dataset is that it is considerably updated (year 2010, 2011) and reliable, since it is provided by a major company in the shopping mall business. Furthermore, the data provide relevant information about the malls' store composition in terms of stores' NACE codes and allocated areas, and mall performance in terms of revenues and area effectiveness. Such information is critical inputs for later statistical analyses that aim at exploring the effect of shopping malls' store composition on the performances of individual stores within the malls.

On the other hand, the data are also limited. The number of stores under research is large (1518 stores); however, the number of shopping malls is actually small – only 18 malls are included in the study. Thus, prospective analyses performed on the provided dataset are more suitable at the store level, instead of mall level, making it difficult to connect analyses at store-level to mall-level. Furthermore, the dataset is not complete, some values are missing (marked with zero values); while achieving them on our own is difficult due to the limitation of resources and the sensitivity of the data type. We also do not know whether these are true missing values or indications of the stores leaving the malls. Furthermore, the data contain only internal information of the malls; we may need to obtain external information, for example, the socio-demographic profiles of the malls' shoppers (e.g. income) and other characteristics of the malls (e.g. reputation) in order to build more reliable statistical models and to reasonably explain for the potential results. All of these will be taken into consideration when we choose the final methodology to deal with our provided dataset.

Data pre-analysis and treatment

At the first analysis, there are some missing values in the dataset. Missing values (or values equal to 0) are presented in performance variables such as revenues in 2010 and revenues in 2011, and also in store areas. Clearly, stores missing both the 2010 and 2011 revenue values will have to be treated in order to contribute to this research. We can delete these stores; obtain the missing information from other sources, or imputing the missing data using proper methods. The last suggestion may be the best one to follow, as deleting stores may affect the original composition of the shopping malls, which we want to avoid; while obtaining the actual missing data requires enormous efforts and is probably an impossible task given the sensitivity of some data. In this preliminary report, the purpose is to get a general ideal of what the data may suggest, thus, we simply delete stores where both 2010 and 2011 revenue values are missing (21 stores). In the later analyses that are included in our final thesis, we will impute the missing data, instead of deleting stores with missing values.

Furthermore, stores in Mall 4 whose area smaller than 5000 sqm and all the revenue values in 2011 are missing can also be deleted from the dataset (12 stores). After refining the dataset, there are 1486 stores of 17 shopping centers left to perform potential analyses.

At the second analysis, as the research focuses on the store composition of shopping malls, an easy and reasonable classification of stores is necessary to understand the dataset. In this preliminary report, we decide to group the 8 original store classifications into 6, based on their NACE classification and store's similarity, namely: (1) Foods & drink; (2) Clothing, footwear & travel goods; (3) Home & household equipment; (4) Other goods in specialized stores; (5) Other store types; and lastly, (6) Services. The detailed classification is provided in table 3.2 below.

Table 3.2 Classification of stores in shopping malls

	Classifications	*NACE*	*Details*
1	Foods & Drink	47.1…	Non-specialized stores with food, beverages or tobacco predominating
		47.2…	Specialized stores of food, beverages, and tobacco
2	Clothing, Footwear & Travel goods	47.71…	Specialized stores of clothing (men, women, children)
		47.72…	Specialized stores of footwear and leather goods
		47.77…	Specialized stores of watches and jewelry
3	Home and household equipment		
	3.1. Information & Communication equipment	47.410	Specialized stores of computers, peripheral units, and software
		47.430	Specialized stores of audio and video equipment
	3.2. Cultural & Recreation goods	47.610	Specialized stores of books
		47.630	Specialized stores of music and video recordings
		47.649	Specialized stores of sport equipment
		47.650	Specialized stores of games and toys
		47.781	Specialized stores of photo
	3.3. Other household equipment	47.510,	Specialized stores of textiles
		47.52…	Specialized stores of hardware, paints, and glass
		47.53…	Specialized stores of carpets, rugs, wall, and floor coverings
		47.59…	Specialized stores of furniture, lighting equipment and other household articles
		47.782	Specialized stores of glasses
4	Other goods in specialized stores	47.730	Dispensing chemist/ Pharmacies
		47.750	Cosmetics and toilet articles
		47.760	Plants, seeds, fertilizers, pet animals and pet foods
		47.789	Pets
5	Other store types	45.112	Wholesale and retail stores and repair stores of
		45.401	motor vehicles and motorcycles
		47.990	Goods not in stores, stalls, or markets
		14.190	Manufacture of wearing apparel and accessories other than leather clothes, workwear, outerwear, and underwear
6	Services (Non-wholesale or retail stores)	53.100	Postal and courier activities
		56.1…	Restaurants and mobile food service activities
		56.3…	Beverage serving activities
		68.209	Real estate activities
		79.110	Travel agency and tour operator activities
		92.000	Gambling and betting activities
		95.230	Repair of computers, personal & household goods
		96…	Other personal service activities

Based on this new classification, the store composition of each shopping mall in terms of fractions of store species is summarized in Table 3.3. The fractions are calculated as the number of stores within each species divided by the total number of stores in shopping malls, and as the total area allocated to each species divided by the total area of the shopping malls.

Table 3.3 The store composition of the 17 shopping malls (%)

Shopping malls	Food & Drink (1)		Clothing, Footwear, Travel goods (2)		Household & Home goods						Other goods in specialized stores (4)		Other store types (5)		Service (6)	
					(3.1)		(3.2)		(3.3)							
	number	area	number	area	number	area	number	area	number	area	number	area	Number	area	number	area
Mall 1	3.85	23.01	52.56	34.86	3.85	12.80	10.26	6.25	8.97	8.51	8.97	12.25	0.00	0.00	11.54	2.32
Mall 2	9.20	16.37	36.21	33.21	2.87	6.99	11.49	10.34	16.09	17.30	6.90	4.64	0.00	0.00	17.24	11.14
Mall 3	6.58	17.05	44.74	41.48	2.63	1.31	9.21	9.95	13.82	14.34	7.89	5.09	0.00	0.00	15.13	10.79
Mall 5	6.61	8.65	42.15	40.44	4.96	8.25	9.09	16.32	15.70	15.27	8.26	4.34	0.83	1.54	12.40	5.20
Mall 6	11.76	11.22	41.18	45.97	0.00	0.00	8.82	9.16	5.88	6.18	17.65	6.66	0.00	0.00	14.71	20.82
Mall 7	11.93	6.76	40.37	49.81	2.75	0.85	7.34	11.65	11.93	15.52	4.59	3.66	0.00	0.00	21.10	11.75
Mall 8	6.06	13.65	48.48	63.13	3.03	1.49	9.09	7.01	9.09	7.00	12.12	3.93	0.00	0.00	12.12	3.79
Mall 9	7.59	21.67	44.30	45.98	3.80	0.92	8.86	7.20	12.66	14.06	12.66	5.21	0.00	0.00	10.13	4.96
Mall 10	4.39	23.58	44.74	29.35	4.39	2.03	8.77	14.71	14.91	17.17	5.26	2.21	0.88	0.07	16.67	10.87
Mall 11	6.12	2.65	51.02	56.14	4.08	2.18	8.16	14.77	10.20	10.18	12.24	7.50	0.00	0.00	8.16	6.57
Mall 12	5.26	13.80	51.32	53.07	5.26	1.31	9.21	6.87	15.79	15.89	6.58	3.91	0.00	0.00	6.58	5.14
Mall 13	13.33	18.81	6.67	3.18	3.33	23.35	3.33	2.49	20.00	27.06	13.33	5.57	0.00	0.00	40.00	19.53
Mall 14	6.25	12.50	43.75	51.09	0.00	0.00	9.38	10.21	15.63	14.68	15.63	6.76	0.00	0.00	9.38	4.76
Mall 15	10.75	6.04	48.39	65.17	5.38	2.05	7.53	8.10	5.38	6.83	9.68	6.50	0.00	0.00	12.90	5.31
Mall 16	9.32	23.20	39.83	41.79	4.24	2.92	8.47	6.14	8.47	9.73	8.47	4.17	0.00	0.00	21.19	12.05
Mall 17	7.45	13.03	44.68	46.82	4.26	1.50	7.45	9.31	12.77	18.86	8.51	3.94	0.00	0.00	14.89	6.53
Mall 18	9.00	21.45	39.00	26.34	3.00	6.48	9.00	5.94	16.00	32.69	7.00	1.86	2.00	1.62	15.00	3.63

An initial observation from the dataset is that the numbers of tenant species in the 17 shopping malls are quite consistent; meanwhile the fractions of different tenant species among the shopping malls, in terms of numbers of stores within species and areas allocated to species, are varying. Furthermore, the pattern of the fractions in terms of number of store within tenant species is different from the pattern of fractions in terms of total area distributed to species. These can be seen in figure 3.1 and 3.2 presenting the two types of fractions across 17 shopping malls. We may infer from this simple analysis that the store compositions of the 17 shopping malls are different from each other, which is good news as it indicates that the data may be suitable for studying the store composition effect on the performance of tenant stores.

It is noted that in the final thesis report, a more complicated classification of store types will be employed, and the store composition across shopping malls will be different in the final thesis report. From figure 3.1 and 3.2, we see that category-2 species (Clothing, Footwear, and Travel Goods) is too large compared to the rest of the tenant species. It will be more suitable to break this large species into several smaller ones. We included in Appendix 3 the US classification of tenant species which are commonly adopted in literature of tenant mix, such as Chung and Sherry 2009, and which we intend to adopt in our latter analyses.

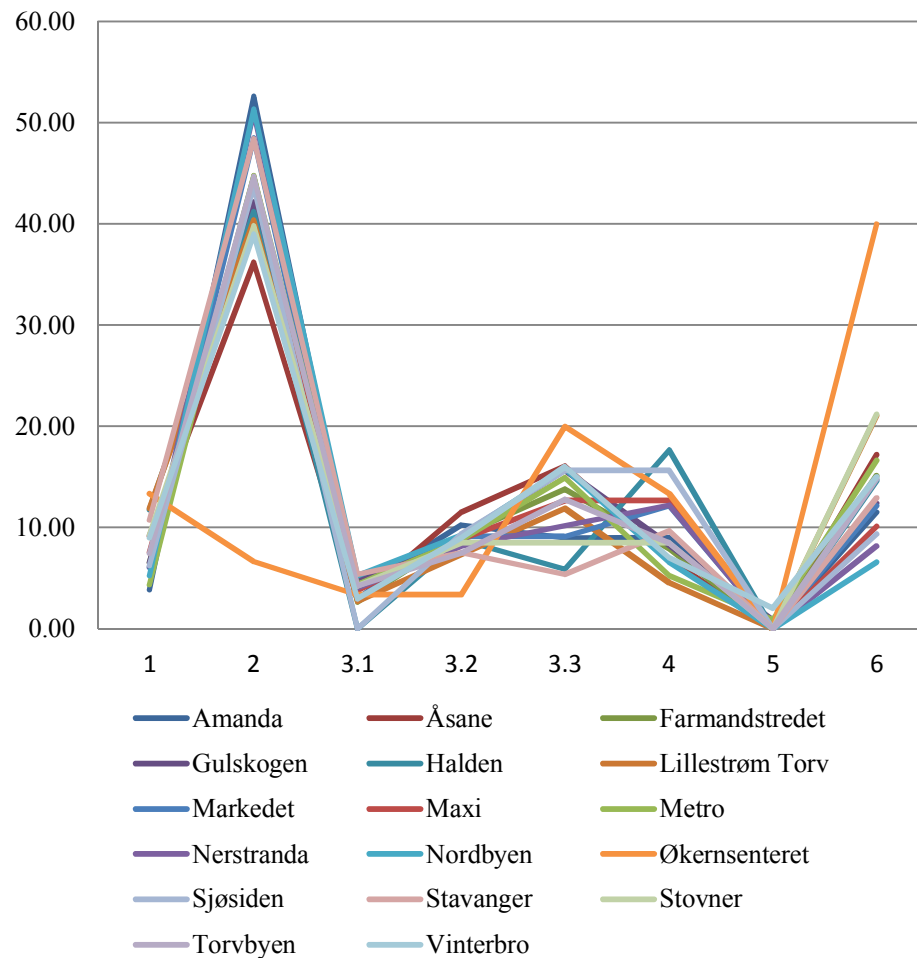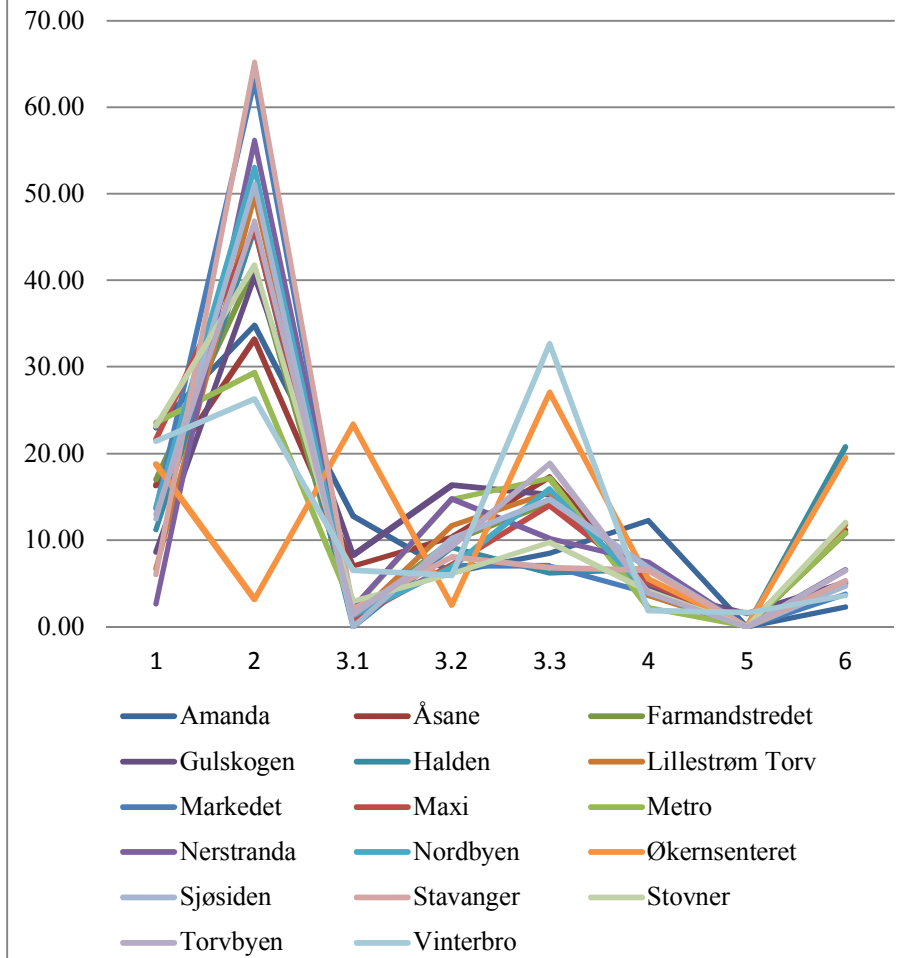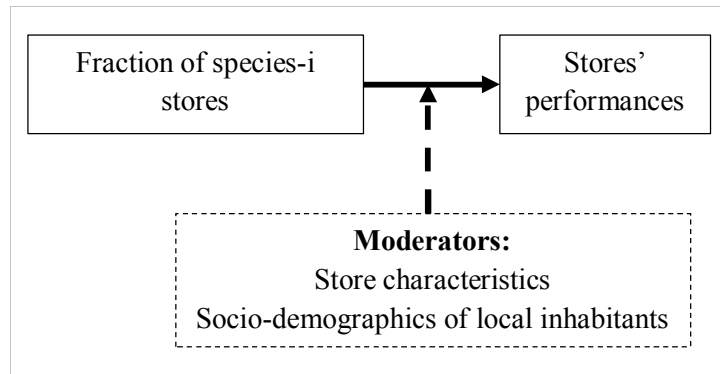Figure 3.1. Fraction of numbers of stores within types

Figure 3.1. Fraction of area of types

Research Methodology

After briefly studying the dataset, we attempt to come up with possible analyses that are suitable to the dataset and relevant to the research questions. A simple theoretical framework guiding the choice of our research methodology is presented in figure 3.3 below.

Figure 3.3. Theoretical framework

In this preliminary framework, mall composition in terms of fractions of the numbers of stores within each tenant species (as percentage of the total number of stores in malls) and in terms of areas allocated to each tenant species (as percentage of the malls' total areas) act as the independent variables that explain for the dependent variables representing the tenant stores' performances. The performance index we choose is the Area Effectiveness index (revenue of a store divided by area allocated to it) as this index takes into account the stores' allocated areas. In building the model and formula, we may need to control for moderator effects specialized by the socio-demographic profiles of the malls and the individual characteristics of each tenant species. One thing missing from the simplized theoretical framework is the possible interaction terms among independent variables of the model. In fact, there are few suggestions from current literature on the interactions of different tenant species; the most studied one involves the positive effect of anchor tenants on all other tenant species (Eppli and Shilling 1993, Gerbich 1998, Casazza and Spink 1985; Bean et al. 1988; and de Bruwer 1997). In our final thesis report, we will need to test many interaction effects among the independent variables in order to decide which effects are significant to be included in the models. The theoretical framework will be modified accordingly after this try-and-error process.

With regards to our data, a regression model may be the most suitable one. We expect the relationship between dependent variables and independent variables is different to straight-line relationship, as adding stores of one tenant species may improvement store's performance due to the increased synergy of that species' appearance; however such improvement will slow down once the fractions of that tenant species reach a certain value because it may decrease customer perception of diversity. Thus we may have to transform the independent variables, for example to logarithm form, in order to capture such relationship. A simplized formula presenting these ideas may look like the following:

$$AE_{ij} = \alpha + \beta^m_j M_{i,j} + \beta^s_k S_{i,k} + \beta^c_k \ln(X_{i,k}) + \varepsilon_i$$

Where

AE_{ij} is the area effectiveness of store i^{th} in Mall j^{th};

$M_{i,j}$ is dummy variable with value 1 if store i^{th} presented in Mall j^{th} & 0 otherwise

$S_{i,k}$ is dummy variable with value 1 if store i^{th} belong to species k^{th} & 0 otherwise

$X_{i,k}$ is fraction of the numbers of stores within the species k^{th}, or fraction of the area allocated to the species k^{th}

ε_i is the error terms specific to each individual store

The model will be tested on all stores in the dataset (instead of separately for stores of each shopping mall). Fractions of store species in terms of number of stores within species and total areas allocated to tenant species can be tested separately in two different models or at the same time in integrated model. The latter approach may possibly impose a problem concerning the collinearity between variables representing the two types of fractions, as this is remarked by Cohen and Lewis (1967) that a clear relationship among number of stores, store species and sizes does exit.

The proposed model is simplized versions of what we may perform in our final thesis. In the actual analyses, we may need to take into consideration external factors of individual shopping malls, such as their socio-demographic profiles, as well as the characteristics of individual stores presented in malls. We can probably control local factors concerning the socio-demographic profiles of the shopping malls by comparing stores of the shopping malls that close to each other in term of geographic location. With regards to the characteristics of the individual stores, we may analyze the performances of the same stores across different malls; this is

feasible since many stores are indeed presented in more than one shopping malls. A problem may arise is that the data we actually have are not rich enough, leading to insignificant results. In fact, more efforts and resources are required in order to construct the right models that are both statistically fit and theoretically meaningful. The future methodology and approach that are presented in our final thesis may be different from the one proposed in this preliminary report, as this will depend, for the most part, on the nature of our dataset.

A PLAN FOR THESIS PROGRESSION

Timeline

1st March   : Data analyses

1st April   : More data collection & Data analyses

1st June   : Thesis draft 1 – Focus on Methodology

1st July   : Thesis draft 2 – Focus on Analysis

1st August   : Thesis draft 3 – Focus on Interpretation of results

1st September : Final thesis and Submission

Progression

20%	40%	60%	70%	80%	90%	100%
15th Jan	1st March	1st April	1st June	1st July	1st Aug	1st Sept
Preliminary report submission	Data initial analyses	More data collection & Final data analysis	First draft with focus on methodology	Second draft with focus on Analysis	Third draft with focus on Intepretation	Final thesis & submission

Planned outline

A planned outline for our final thesis is included in Appendix 4

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APPENDIX

Appendix 1: Summary of literature on determinants of store choice decision

Approaches	Authors	Key findings
Cost-minimization	Hyson and Hyson (1950) Parr (1997) Holtelling (1929)	Household had to buy a fixed amount of good, and the two factors determining store choice are the costs of travel to the alternative centers, and the price per unit at which the good is sold (travel costs are independent of the amount purchased). The household then chooses that center which minimizes the total cost of purchasing.
	Reinhardt (1973); Lentnek, Harwitz and Narula (1981)	Generalize the above model to take into account of the endogeneity of the frequency of purchase.
	Huff (1963) Huff and Rust (1984) Adler and Ben Akiva (1976)	At a given location relative to two (or more) shopping centers, the proportion of trade going to each center is a function of the distance and attractiveness of the centers
	Bacon (1998)	Where household has a choice between two (or more) centers then, when a lower price center is more distant, it can be optimal to visit the closer, higher price center to purchase small bundles, and more distant, lower price center for larger bundles. The variation of household behavior is produced by the variation in the needs of shopping trips produced by random demand and the inventory strategy adopted.
Commercial attractiveness	Martineau (1958)	Four determinants of store image which influence store attractiveness are: Layout and Architecture; Symbols and Colors; Advertising; and Sales Personnel
	Lindquist (1974-75)	Combined models from 19 studies and came up with nine different elements: Merchandise, Service, Clientele, Physical facilities, Promotion, Store atmosphere, Comfort, Institutional and Post-transaction satisfaction.
	Bearden (1977)	Price, Quality of the merchandise, Assortment, Atmosphere, Location, Parking facilities, and Friendly personnel.

Singh and Sahay (2011)	Ambience, Physical infrastructure, Marketing focus, Convenience, and Safety and security. Developers should focus more on improving convenience and creating ambience because disproportionate expenditure on adding to physical infrastructure is not expected to yield matching dividends.
Ghosh (1990)	Location, Merchandise, Store atmosphere, Customer service, Price, Advertising, Personal selling and Sales incentive programs. The merchandise of a retailer is the most important element in the retail mix.
Brito (2009)	Store selection and Retail-mix hold the key in shaping image of a mall which in turn encourages consumer' patronage of a certain shopping mall.
Hunter (2006)	An ideal tenant mix is the first major criterion for a good mall image.
Simmons (1992) Ownbey et al. (1994) Forgey et al. (1995)	In relation to the location of the shopping mall, accessibility and visibility are the two determinants which are important for shopping at malls
Kaufman (1996)	Operating hours and time taken to reach the retail outlet are one of the main criteria which the consumers look for while selecting a shopping outlet.
Loudon and Bitta (1993)	Consumers prefer to shop at location where sales personnel behavior towards them is cordial and courteous.
Bodkin and Lord (1997)	The main reason of consumer choosing a shopping mall is because of attractive service and pricing.
Shah and Mrudula (2005)	Quality, Variety, Operating time, Attitude of salesmen, Location and stock replenishment are major factors influencing consumers" decision toward choosing a particular store.
Jean-Charles Chebat, M. Joseph Sirgy, Stephan Grzeskowiak (2009)	Effect of Access, Store atmosphere, Price and promotion, Cross-category assortment, and Within-category assortment in on mall attitude, mall patronage, and word-of mouth communications.
Arpita Khare and Sapna Rakesh (2010)	Mall management, Ambience, Service and Entertainment facilities.
Teller and Reutterer (2008)	Identify 10 factors of mall attractiveness and found that tenant mix is one of the most important determinants to the attractiveness of a mall.

Other studies supporting similar ideas:
Gautschi (1981), Nevin and Houston (1980), Wee (1986), McGoldrick (1992),, Hauser and Koppelman (1979), Gentry and Burns (1977-78), Stoltman, Gentry and Anglin (1991) and Howell and Rogers (1980), Baker and Haytko (2000), Cockerham, 1995

Entertainment orientation	Wakefield and Baker (1998) Wilhelm and Mottner (2005) Biba et al. (2006) Backstrom (2006)	Creation of entertainment experience may play an essential role in enhancing the shopping mall's competitive edge.
	Bellenger and Korgaonkar (1980) Talmadge (1995) Kim et al., (2005).	A large proportion of retail shoppers (69%) fall in the category of recreational shoppers. Retailers and mall developers should make shopping an entertaining experience to differentiate themselves and to increase their market share
	Nisco and Napolitano (2006)	Empirically, there is a positive link between entertainment orientation and performance outcomes of a shopping mall.
	Ooi and Sim (2007)	Show empirically that a Cineplax could enhance the magnetism of a shopping mall.
	Sirpal and Peng (1995) Wong and Yu (2003).	Food court can attract and can enhance consumers visit to shopping malls
Shopping experience	Michon, Chebat, Turley (2003)	Ambient odors
	Singh and Sahay (2011)	Music, Odor, Lighting, General hygiene, Temperature control, Landscaping
	Mattila and Wirtz (2001)	Music, Scent
	Wakefield and Baker (1998)	Architecture and overall design, Temperature control, Lighting, Music
	Venkateswarulu and Uniyal (2007)	Appeal and convenience, Amenities and atmospherics, Ambience
	Solomon (1994) Peter and Olson (1994)	Combination of music and color
	Greg et al. (2008)	Music
	Hunter (1995), Lehrner et al. (2005), Lovelock and Wirtz (2011), Mattila and Wirtz (2001)	Odors
	Ebster and Garaus (2011)	Music, Color, Orders, Scent, Lighting, Density

Appendix 2: The US classification of tenant species

Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
Goods	Clothing, footwear, and Accessories	Adult and youth apparels Adult and youth accessories Child apparels and accessories Sportswear and equipment Footwear	Services	Financial services	Banks/loan and mortgage Currency exchange Securities and investment brokerage Property management
	Books, toys, and gifts	Toys, novelties, souvenirs and gifts Electronics and electrical appliances Watches, jewelry, and ornament Books and magazines Records, tapes, CDs and DVDs		Real estate	Decoration/interior design Real estate agency
	Electrical appliances	Stationery and paper products TV and computer games Electronics and telecommunication products Computers and peripheral products		Tailors and shoemakers	Fashion designer and tailors Shoemakers Costume rental
	Watches and clocks			Health services	Clinics and health centers Dentistry Acupuncture and aromatherapy
	Health and beauty	Jewelry, goldsmith and ornament Arts and antiques Health and beauty products/ cosmetics Pharmacy Physical fitness equipment/massage equipment		Education	Schools/learning centers for academic purposes Learning centers for interest purposes Overseas education admission services Child care centers Car driving schools
	Daily merchandise	Equipment or assistance devices for the elderly or disabled Optician Convenience stores Personal goods Supermarkets/hypermarkets Metal works		Personal services	Barber and beauty parlours Physical fitness centers, figure saloons and gymnasia Fortune tellers Massage and spa Employment agency Telecommunication services
	Home furnishings & household goods	Furniture, beddings, and furnishings Kitchen and sanitary fittings Flower and plant Aquariums and pets Musical instruments Collectable		Travel	Photo-taking and film development Printing and photocopying Car rentals Hotels, guesthouses and holiday bungalows Travel agency
	Specialty stores	Religious goods Automobiles Department stores Discount stores		Housekeeping	Delivery services Repair services and pest control Laundry and cleansing Maid agency
	Foodstuffs	Meat, fruits and vegetables Snacks and bakery Specialty food Wine cellars		Government, institution, or Community	Community services Public utilities
	Food and beverage	Restaurants (other than fast food) Fast food Light refreshments		Entertainment	Cinemas and theatres Disco/karaoke Sports Gambling centers Game centers Photo-sticker taking Internet bars Rentals of books, vcds, dvds and videotapes

Source: Cited in Chung and Sherry 2009

Appendix 3: Planned outline of the thesis

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