Tenant Placement Strategies within Multi-Level Large-Scale Shopping Centers

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Abstract

This paper argues that tenant placement strategies for large-scale multi-unit shopping centers differ depending on the number of floor levels. Two core strategies are identified: dispersion and departmentalization. There exists a trade-off between three income effects: basic footfall effects, spillover effects, and an effective floor area effect, which varies by the number of floor levels. Departmentalization is favored for centers with more than four floors. Greater spatial complexity also points to a higher degree of departmentalization. Optimal placement strategies are determined by the physical features of the center as a whole, and not by the features of individual levels.

Keywords: space allocation, agglomeration economies, spillover effect, high-rise retail property

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1. Introduction

This paper aims to shed light on the factors that determine tenant placement strategies within a multi-unit large-scale shopping center. The central question posed here is: should retail tenants of the same type be widely distributed ("dispersed") within the center, or they should be clustered, “departmentalizing” the tenants, as observed in some Asian cities? Our results suggest that implementation of placement strategies based on dispersion or departmentalization depends on the physical characteristics of the shopping center and, in particular, on the height of the mall.

A shopping center or mall is an agglomeration for various retail tenants; in general, the higher the product variety, the higher the mall’s productivity (Arakawa, 2006). Spatial retail concentration, then, forms an important aspect of this agglomeration effect (Yuo, et al, 2010; Des Rosiers et al, 2009; Yuo et al, 2004). However, retail concentration has further layers that are still of interest to researchers.

In order to maximize the operational performance of a shopping mall, total floor area must be used effectively and efficiently. In prior research (largely on suburban or out of town shopping centers), there is some consensus on some basic location and space allocation principles:

i. The floor plan configuration should allow the maximum number of customers to pass the maximum number of shops;
ii. To maximize footfall, malls should be dumbbell-shaped or extended to I, L, Y, X, or Z shapes, with anchor stores at the mall ends and standard/smaller tenants along the corridors that connecting those anchors;
iii. Non-anchor stores of the same type should be distributed throughout the mall rather than being clustered in a single location.

However, there appears to be some difficulty in applying these principles to malls in Taiwan and other city or urban-based countries with high population density, such as Hong Kong, Singapore and China, because of their multi-level structures. Yiu, et al. (2008) have observed multi-level development of shopping centers in most Asian cities. Shopping establishments in these areas exhibited similar characteristics: in-city locations with high land prices, unusual land shapes, and often mixed-use development with other uses such as metro or railway stations. The outcome of these features can be seen in Taiwan. In 2008, the average number of floor levels for seventy multi-unit large-scale retail centers was ten, with some centers as many as nineteen levels. Comparing these numbers to the UK, Yuo (2004) found that in 2002 the average floor height of 148 regional shopping centers was just two levels, and the maximum total floor levels was only four.

For the complex physical features observed in Asian in-city malls, it will be difficult to maintain the first two operational principles. The requirement that the design should allow the maximum number of customers to pass by the highest number of stores is likely to be frustrated by the need for vertical movement and way-finding problems (Hölscher et al, 2006), unless a strong motivation existed - such as that caused by the creation of purposive shopping destinations. The dumbbell-shaped mall configuration (or its variants) is also near impossible, given the multi-level distribution of total floor area.
In this research, it is argued that the choice of tenant placement strategy is influenced by the height and the complexity of shopping centers. Here we focus on examination of the third principle proposed for tenant placement strategies: the idea that, in general, non-anchor stores in the same retail category should be dispersed – widely distributed – rather than clustered within shopping malls. This dispersion placement strategy is very widely observed in large-scale out-of-town shopping malls in the US and other western countries and is frequently advanced as a preferred strategy for managers. By contrast, it does not seem to be the general pattern seen in the shopping centers of many highly populated areas in Asian cities. Here, tenants in the same retail categories are normally found clustered in “departments” – akin to a giant department store. This paper suggests that this results from the demand for multi-level retail development and the use of more complex spatial layouts to increase flexibility in floorspace allocation – for example through use of multiple corridors or grids.

First, we review the literature on tenant location within shopping malls. We then set out a model that relates shopping center structure to the distribution of tenants. The model suggests that, as the total floor levels increases, so spatial concentration of stores of the same retail category is favored as a solution to the complexity generated by the vertical distribution of floor space. It is argued that there is a trade-off between increasing the basic footfall/revenue effects and decreasing the combination of positive spillover effects and effective floorspace effects. We suggest that there will be a threshold or “indifference floor level” above which clustering is favored and below which a strategy of dispersion will be preferred. Next, we detail empirical analysis using data from large-scale shopping centers in the US, UK, Taiwan, Singapore, Hong Kong, Malaysia, and Shanghai. In total, 129 detailed floor plans from seventeen shopping centers were digitized using a geographical information system (GIS) that is able to provide detailed physical features combined with non-spatial information such as retail categories. These data are used to investigate whether tenant placement strategy relates to mall structure, what factors favor a departmentalization strategy and the extent to which effective floor area is affected by the number of floors in a mall. Finally conclusions are drawn and implications discussed.
2. Literature Review

Shopping centers or malls have been described as “the most successful retail establishments of the twentieth century” (Carter, 2009). Through its planned nature, a shopping center can create a highly controlled shopping environment to achieve the highest retail agglomeration benefits for retailers (Yuo, 2004). Determining product variety (Arakawa, 2006) and space location/allocation strategies (Carter and Vandell, 2005) are the means to achieve maximum profits and to establish equilibrium amongst mall owners, retail tenants and consumers (Arakawa, 2006). Product variety and diversity from firms clustering, homogeneously or heterogeneously, has a close positive relationship with consumption and consumer preferences (Fischer and Harrington, Jr, 1996; Eaton and Lipsey, 1979; Dixit and Stiglitz, 1977). Hence a key problem is how to allocate the total floor area to accomplish the optimal outcome.

Prior research has suggested that the main objective for a mall configuration plan is “to ensure that the maximum number of people pass the maximum number of shops...” (Morgan and Walker, 1988). Further, the owner should carefully consider the “placement of the key or anchor tenants, which must be positioned so that they draw shoppers between them and past other tenants” (ULI, 1999). Fong (2003) suggested that, using morphological analysis, a dumbbell shape (or its extension) is the optimal basic configuration of mega-shopping malls. Thus, the basic mall configuration for a shopping center should be linear with anchor stores at each end of the mall with similar anchoring arrangement in extended formats, such as I, L, Y, X, or Z shapes (Morgan and Walker, 1988; ULI, 1999; Carter and Vandell, 2005; Carter, 2009). Further, following bid rent theory, the rental level of a store within a mall should relate to the store’s distance from the mall ‘center’, normally the spot with the highest pedestrian flow, as retailers compete for the optimum location (see Carter and Vandell, 2005). Carter and Haloupek (2002), developing work by Ingene and Ghosh (1990) on consumer and producer behavior in planned shopping environments, produce a theoretical model and empirical tests of the clustering of units of the same shopping type within a mall. While, in general, dispersion is favored, clustering of certain types of stores – particularly comparison goods outlets – at various locations within the mall is shown to be rational and observed in their sample.

All the principles for optimising spatial characteristics outlined above have one ultimate objective: to obtain the highest shopping center synergy (Anikeeff, 1996). “Shopping center synergy” could also be termed shopping center attraction or image (Finn and Louviere, 1996), which is a benefit arising from the collective presence and activities of all tenants within the center. It also forms the basis of the drawing power of the center that, in turn, determines total footfall (Yuo, 2004). The interaction of various spillover effects between tenants enhances total agglomeration economies. Bruckner (1993) called these ‘inter-store externalities’ and Eppli and Benjamin (1994) termed them ‘retail demand externalities’. The main spillover effect identified in research is from anchor stores to non-anchor stores: hence anchor store attraction and location are emphasized as highly significant factors in the center management literature (Mejia and Benjamin, 2002; Pashigan and Gould, 1998; Finn and Louviere, 1996; Gatzlaff et al.1994). In Carter and Vandell’s (2005) store location model, the location relative to anchor stores is used to identify the center of the mall. Other than anchor stores’ customer drawing power from, spillover effects between mall stores could also come from other sources: store compatibility (Nelson, 1958), sales efforts
(Miceli and Sirmans, 1995), and the creation of “atmosphere” such as excitement (Wakefield and Baker, 1998) and uniqueness (Burns and Warren, 1995). Optimizing the floor plan for pedestrian flows and shoppers’ circulation is another tool for achieving maximum positive spillover effects between tenants (Spilková and Hochel, 2009; Bitgood and Dukes, 2006; Fong, 2003; Brown 1991a; 1991b). When the spatial complexity of the shopping environment increases, wayfinding problems and the mental map of consumers may become a major concern (Chebat et al. 2005; Brown, 1999). Wayfinding problems become even more severe in multi-level buildings where vertical movement is inevitable. Hence, specific strategies to direct and influence pedestrian flows become crucial (Hölscher et al. 2006). In this paper, we argue that spatial complexity in both horizontal and vertical movements increases wayfinding problems, and the costs of searching for and comparing products. In order to identify spatial complexity, O’Neill (1991) established a measure of topological floor plan complexity called Inter-Connection Density (ICD), which is the average number of connections per decision choice point for the floor plan. In the empirical section, this concept of ICD will be used to develop a space-weighted complexity index.

Yiu et al. (2008) observed the recent boom in high-rise malls in Asian countries such as Taiwan, Japan and Hong Kong. In their research, stores in three high-rise shopping malls in Hong Kong were examined for their lettable floor area, the floor on which they were located, and their retail category. The results suggested that larger stores and tenants with non-impulse trade products are more likely to be found on upper floors. However, research in multi-level retail properties is still incomplete, both academically and for practitioners. This paper aims to fill some gaps in store location theory for multi-level shopping centers.
3. Maximum Spillover Effects, Efficient Space Usage and Store Location

Much of the existing research on tenant placement strategies focuses on US or European shopping malls with, typically, only one or two floor levels. For example, Carter and Haloupek (2002), in their discussion of dispersion of shopping stores, exclude multi-level malls from their empirical analysis “because of the difficulty in equating horizontal and vertical distances”. Carter and Haloupek present a theoretical model that draws on central place theory and distance minimization algorithms to analyze the rationale for clustering and dispersion of store types. They conclude that “a basic location framework based on the concept of dispersion of stores selling competing goods has been shown to be useful in explaining location of non-anchor stores in shopping centres”. While their empirical work notes a number of clusters of same-type comparison goods within their malls, the idea of dispersal of shops around the mall to maximize spillover effects seems embedded in North American and European practice.

The goal of maximizing mall turnover (which can be captured by the mall owner in rental income) depends on a number of effects that are internal to the mall. Here we focus on the impact of the customer search process. Spillover effects from shoppers purchasing goods in different types of stores suggest that a dispersion strategy will be effective in maximizing the footfall across all store types generating cross-type positive externalities. However, positive benefits from agglomeration may occur for particular types of retailer, particularly those selling comparison goods, implying benefits from a clustering or departmentalization strategy. Hence, the objective for store placement strategies is to generate higher spillover effects and maximizing agglomeration benefits, which may be achieved either by dispersion or by clustering. We argue that the optimal strategy depends on the physical structure and configuration of the center.

To generate maximum inter-store spillover effects, the standard dispersion strategy requires particular conditions: a simple mall configuration and route plan, and low spatial complexity. With such conditions in place, it is easy for shoppers to pass a significant proportion of the stores in the mall; as shoppers circulate, their comparison and search costs are low. Figure 1 show floor plans of major shopping centers in the UK and UK with simple configurations and shopping routes. On each floor, by following the main circulation route, shoppers will pass by almost all retail outlets. As a result, spillover effects can easily result even where shoppers are searching for particular goods and services.

By contrast, for shopping malls in high population density areas, where increasing spatial complexity and total floor levels become inevitable (as in the mall floorplans shown in Figure 2), a tenant placement strategy based on dispersal of similar stores would raise the shopping cost entailed in product search and comparison. Hence, departmentalization for retailers of the same type could reduce shopping costs and reduce wayfinding problems, generating higher turnover.

<Figure 1 About Here>

<Figure 2 About Here>
Figure 3 compares two representative cases, with common scaling, Bluewater (near London, UK) with two levels and a total of 1,600,000sq ft in gross leasable area (GLA); and Miramar (Taipei, Taiwan) with eight levels and a total of 1,352,192sq ft GLA, with the shading representing different store types. It is clear that spatial complexity and vertical movements in Miramar would create difficulties for shoppers if products of the same type were widely dispersed. Hence departmentalization for retailers of the same type – the pattern that is observed - would reduce shopping costs and reduce the wayfinding problem. The relatively simpler structure of Bluewater permits a greater degree of dispersion.

The retail manager’s objective is to maximize the shopping center’s performance and/or operational value. The performance of a shopping center is influenced by the purposive footfall or sales for retail category i, and the spillover effects generated from the purposive footfall for other retail categories j, that spillover from i. The footfall and sales figures are also influenced by the search and comparison costs of customers as they seek merchandise and services. Further, the center manager has to allocate space within the center and maximize the effective floor area – that is, the area which could directly generate rent. Total floorspace includes effective floorspace and “non-productive” floorspace, which supports the operation of the center, through provision of services and common space, or is not directly lettable.

The rental income of the center consists of fixed rents (and hence is a function of effective floorspace) and percentage or turnover rents (which is a function of effective footfall). The total basic purposive footfall effect derives mainly from the mix of retail categories and outlets planned by the center manager. The value of this term results from the variety and attractiveness generated by the outlets in the mall. Spillover effects derive from retail agglomeration economies within the center and will be influenced by the positioning of outlets of different retail categories. Finally, the effective floor area of the center depends on decisions on the location of common services and the configuration of the mall.

Formally, then, we identify two broad tenant placement strategies that could be implemented by a center manager for a certain retail category:

**Strategy 1**, a *dispersion* strategy: to disperse retail stores of the same retail category around the center; or

**Strategy 2**, a *departmentalization* strategy: to cluster the stores of the same retail within a certain location and area in the mall, in effect, to departmentalize the retail categories within the shopping center.

We test our assumption that choice of strategies depends, critically, on the height and configuration of the mall. Managers of low rise malls with standard and simple configurations will favor a dispersion strategy; managers of high rise and complex malls will favor a departmentalization strategy. A low-rise, planned shopping center, typically, will have large footplates and a relatively simple configuration, maximizing effective floor area. Since shoppers’ search costs are small and since customer flows...
are simple (particularly for a dumbbell or cross-shaped mall), the center manager can maximize spillover effects by dispersing units of particular retail categories throughout the mall, without damaging purposive footfall and sales. Clustering shops of the same type might mean that customers head directly for their target store type, damaging spillover effect sales. However, as the number of levels in the mall increases, and/or as the mall structure becomes more complex, shopper search costs increase and there are growing wayfinder problems. As a result, a dispersion strategy will increasingly damage purposive sales volumes – without generating major gains from spillover sales. Furthermore, effective floor area is likely to reduce as common services must be duplicated across floors.

There are three major reasons for these decreasing spillover and effective floor area effects in centers with a higher total number of floor levels:

- First, vertical movement obstacles: the obstacles come from the change in connection between shopping nodes from purely horizontal to horizontal and vertical movement, disrupting pedestrian flow. Unless there are significant incentives, vertical movement will always prove to be an obstacle in high-rise buildings where staircases, elevators, and escalators are the only ways to move (Turner, 1999). The greater the number of floor levels, the more customers face vertical movement decisions with no (or limited) visual clues. Unless there exist strong incentives, customers have less motivation to move upward from lower levels;
- Secondly, customer utility exhaustion: this occurs due to increasing shopping costs: with a dispersed tenant placement pattern, the customer experiences greater difficulty in searching for and comparing targeted merchandise from one floor level to the next;
- Thirdly, indivisibility of services: in vertical structured malls, each level requires its own supportive floor area for indivisible facilities (e.g. washroom facilities, storage/preparation space, escape routes and fire protection facilities) eroding effective floorspace.

The consequences of these effects are shown diagrammatically in figure 4. Panel A shows the total rental value derived from a dispersion strategy, set against the number of levels in the center. As can readily be seen, rental value falls rapidly as the number of floor levels rises, shopping costs rise dramatically, damaging both purposive and spillover sales. Panel B shows total rental value resulting from a departmentalization strategy. For low floors and simple configurations, total rental value is lower than for a dispersal strategy, due to loss of spillover effects. However, as the floor levels in the mall increase, the departmentalization strategy the departmentalization and defined spatial grouping of retail categories and shopping destinations will tend to decrease shopping costs relative to a dispersed strategy, increasing the efficiency of shopping environment for customers and, hence, benefiting both center attractiveness and turnover. Panel C combines the two rental value curves. The crossover point defines the floor level at which dispersion and departmentalization strategies generate equivalent income. We term this floor level the “indifference level”. Below that level, dispersion is favored. Above it, center managers should pursue a strategy of departmentalization.
Our empirical research seeks to explore these relationships. We have two principal objectives. The first seeks to identify the relationship between the degree of departmentalization and the physical features of shopping malls; the second seeks to identify the “indifference level” – the floor height at which a mall owner is indifferent between the two placement strategies identified above.
4. Empirical Findings

4.1 The Data

We utilize a complex dataset which includes detailed spatial and physical features and leasing activities. To test the physical features and placement strategies within shopping centers, the database needs to provide a wide range of variables derived from mall floor plans. As a result, a non-spatial database would be unable to meet the analytic demands. Therefore, a GIS-based database was created which enables the generation of specific and accurate spatial information (Figure 5): for example each unit size, shape, location, total floor area and net/gross leasable area.

The geography information system (ArcGIS 9) used in this research has the ability to combine spatial data with non-spatial information such as retail category or brand name; and its powerful spatial analysis capability can also reveal more spatial characteristics, such as space complexity and the results from extract, overlay, proximity of points, lines or polygons of our floorplans. Google Earth was used to establish the scaling.

The data were collected from public domain sources: shopping guides issued to general public and the tenant lists and floorplans showed on the websites of shopping centers. The final dataset used in the empirical study contained twenty six shopping centers from the US (five cases), UK (six cases), Taiwan (six cases), Singapore (four cases), Hong Kong (two cases), Malaysia (one case), and Shanghai (two cases). In total, 129 floorplans were digitized into detailed spatial data, covering 7,374 retail store units and some 38 million square feet of gross lettable floor area (GLA). The dataset contains shopping centers of varying heights ranging from a single level to fifteen floors. This wide range in total floor levels allows us to test the impact of building height on the configuration of shopping malls.

We note a key assumption in our analysis: that, in aggregate, the floor plans in the centers studied, resulting from the tenant placement strategies of managers, tend towards an optimal allocation for the center, due to market pressures. Rental income statistics from the malls were not available: in any case, given the international nature of the study, there would be considerable difficulty in assessing the investment worth of rent per square foot across national boundaries with significant differences in land and construction costs, capital values and per capita disposable income. While acknowledging that this is a simplifying assumption, we note that the twenty six malls selected are, by most measures “flagship” malls run by experienced and successful mall operators.

4.2 Research Design

The main purpose of empirical analysis is to examine the relationship between degree of departmentalization and total floor levels in each mall. We define two variables
that capture the floor configuration and positioning decisions of mall managers. The first variable is the tendency for retailers of the same category to cluster – our measure of the degree of departmentalization. The measurement of departmentalization (DEPARTMENT) is based on the proximity of similar types of stores to an individual (using a distance of five meters as the threshold) and is defined as:

$$DEPARTMENT_{kj} = \frac{\Sigma f_{5ij}}{F_j}$$ (1)

Where

**DEPARTMENT_{kj}**: The index measuring the degree to which units in the same retail categories i agglomerate within floor j of shopping mall k.

**f_{5ij}**: The total floor area where there are more than three stores of the same retail category i clustered within five metres within floor j (as shown in Figure 6). ArcGIS is used to calculate the distance capturing the proximity between stores and the total selected floor area to provide this measure of clustering.

**F_j**: Total floor area for floor j

The second variable is an index measuring the degree of complexity of each floor plan. This measurement is constructed based on the concept of Inter-Connection Density (ICD) suggested by O’Neill (1991). However, in this paper we refine the index into a complexity index. The measurement is defined as:

$$COMPLEXITY_j = \frac{P_j \times D_j}{F_j}$$ (2)

Here, the **COMPLEXITY_j**: is the complexity index of floor j; **D_j**: represents the total number of links in the floor j; **P_j**: is the total number of decision points in floor j; and **F_j**: is the total floor area of floor j.

Other variables in the model were generated through digitizing the floor plans and recording non-spatial features such as name of retailers and retail categories.

First, we attempt to identify the “indifference level” - the number of levels in the center above which a departmentalization strategy is preferred and below which a dispersion strategy is favored by the mall managers. By using a series of ANOVA models, we test for the indifference level (L*) as that level that breaks the centers into two groups with the greatest cross-group difference in mean degree of departmentalization. The null hypothesis for the ANOVA is $$\mu_a = \mu_b = \mu_s$$, where $$\mu_a$$ and $$\mu_b$$ are the mean degree of departmentalization of the cases with the number of total floor levels above and below the indifference level respectively and $$\mu_s$$ is the mean degree of departmentalization of all floor levels. $$L^*$$ is set, progressively from
two to seven floors and ANOVA performed. We identify $L^*$ as the number of floors in
the model that generates the greatest differences in departmentalization between two
group above and below the mall height set.

The second stage of empirical analysis uses a multiple regression approach to test the
basic hypotheses that, for a multi-unit large scale retail center, the number of floor
levels determine the likely retail placement strategy. Specifically: the fewer the total
floor levels in the center, the larger the single floor area, and the less complex the
pedestrian routes are, the more likely retail tenants of the same type are to be
dispersed or, equivalently, the greater the number of floor levels in the center, the
smaller the individual floorplate area, and the more complex are pedestrian routes,
the more likely it is that retail tenants of the same type will be placed via
departmentalization. A dispersal strategy is intended to stimulate circulation of
shoppers and generate high inter-store externalities, while a departmentalization
strategy seeks to increase basic footfall revenue. In both cases, the goal for the
manager is to maximize rental values and the mall structure and configuration
determines which strategy is most appropriate.

The basic model for the multiple regression is to examine the impact of the three
elements of the physical features of the mall on tenant placement strategies suggested
in the hypotheses: the overall floor levels in the center, the size of individual floors,
and spatial complexity within each floor. With the measurement of
departmentalization (DEPARTMENT) as the dependent variable, the independent
variables used in the models include: the total number of floors in the shopping center
(TOTALLEVEL), the level of the current floor within the shopping center (LEVEL),
the number of units on each floor level (UNITS), the total number of units within the
shopping center (TOTALUNITS), the size of the shopping center in GLA
(TOTALGLA), the size of the floor level in GLA (LEVELGLA), the ratio of NLA to
GLA of the floor level (NLARATIO), and finally, our measurement of spatial
complexity of the floor level (COMPLEXITY). The definitions and expected sign for
each variable are summarized in Table 1. The basic model for the multiple regression
analysis is thus defined as:

$$\text{DEPARTMENT} = f(\text{TOTALLEVEL}, \text{LEVEL}, \text{TOTALGLA}, \text{LEVELGLA}, \text{UNITS}, \text{TOTALUNITS}, \text{NLARATIO}, \text{COMPLEXITY})$$  (3)

Empirically, many of these variables are functionally related and to test the effects of
floor levels on the degree of departmentalization, two variables were considered:
“TOTALLEVEL” and “LEVEL”. We expect a positive relationship between these
two variables and the degree of departmentalization. For a vertical mall, it is more
likely that a departmentalization strategy will be followed, while the higher up the
mall a floor is, the more likely tenants of a particular type are to be clustered. Since
our research focuses on large-scale centers, we expect that the smaller the size of
individual floor levels in a project, the more floor levels are required; the total degree
of complexity may also increase. Consequently, “LEVELGLA” – the floorspace on an
individual level - should be negatively related to the dependent variable. The
underlying model suggests that the greater spatial complexity favors a strategy of
departmentalization, so as to clearly define retail areas for shoppers and reduce their
search and comparison shopping costs. Therefore, the number of units within the
whole shopping center, “TOTALUNITS”, the number of units on the individual floor
level, “UNITS”, and the degree of spatial complexity “COMPLEXITY”, are all expected to be positively related to the degree of departmentalization.

We examine two further variables as more general controls. “NLARATIO” is a measurement of effective floorspace, which can have a significant influence on aggregate center value. While the ratio of effective floor area is likely to be influenced by the number of floors in the shopping center, it is not directly related to the degree of departmentalization; further, low effective floor area ratios are likely to be associated with floor complexity. We thus anticipate a negative relationship between departmentalization and NLARATIO. Finally, “TOTALGLA”, the total size of the whole shopping center is included as a general control for center size. We have no prior expectation as to the direction of impact. This variable was included to see if any systematic relationship emerged with placement strategies.

Preliminary tests of the variables indicated that the basic model needed to be separated into sub-models to avoid multicollinearity problems with the independent variables. In each case, the degree of departmentalization (DEPARTMENT) is the dependent variable.

Model 1 is defined as:

\[ Y_1 = \alpha + \beta_1(TOTALLEVEL) + \beta_2(TOTALUNITS) + \beta_3(LEVELGLA) + \beta_4(COMPLEXITY) + \epsilon_i \] (4)

Model 2 is defined as:

\[ Y_1 = \alpha + \beta_1(TOTALLEVEL) + \beta_2(LEVEL) + \beta_3(UNITS) + \beta_4(TOTALGLA) + \beta_5(NLARATIO) + \beta_6(COMPLEXITY) + \epsilon_i \] (5)

As there were no major distributional issues, the models were run using standard ordinary least squares procedures, having checked for potential heteroskedasticity issues. We report VIF statistics for the models as a precaution against the presence of excess levels of collinearity. Standard tests for serial correlation and spatial autocorrelation are inappropriate given the nature of the data, although we note that the mall level statistics apply to all floors within that center.

A final empirical analysis uses ANOVA to examine the relationship between effective floor area and total floor levels in the shopping center. In the model set out above, it was suggested that as floor levels in the mall increase, so effective floor area falls, affecting center returns due to decreased pedestrian flow on higher levels and the indivisibility of services. To test the relationship between overall center height (total floor levels) and effective floor space, we test the null hypothesis that \( \mu_{la} = \mu_{lb} = \mu_{ls} \), where \( \mu_{la} \) and \( \mu_{lb} \) are the mean degree of NLA ratio of the cases with the number of total floor levels above and below the indifference level respectively and \( \mu_{ls} \) is the mean NLA ratio of all groups.

Descriptive statistics for the variables used in the regression models are shown in Table 2.
4.3 Results

4.3.1 The Indifference Level

The results of the first stage empirical analysis using one-way ANOVA to identify the optimal floor height separating dispersion and departmentalization tenant placement strategies are shown in Table 3. The results indicate that the greatest difference in the mean degree of departmentalization and the maximum F statistic is found for a center height of four floors. Tests for total floor height of two, three, five, six, and seven levels produce lower F values, Table 4 demonstrates that, for shopping centers with fewer than four floor levels, the average degree of departmentalization is only 27.7% but, for cases with more than four floors, the average degree of departmentalization is 80.9%. With a strongly significant F value (196.8) and the least square means shown in Table 4, the results strongly suggest that for shopping centers with total floor height below four levels, a dispersion strategy is favored, while for shopping centers with total floor levels greater than four, center managers prefer a departmentalization strategy clustering together retailers of the same type.

Figure 7 further shows the distribution of the degree of departmentalization for observations. Panel A of Figure 7 confirms the trend that the greater the number of floor in the center, the higher the degree of departmentalization. Panel B, shows the distribution of the average degree of departmentalization on different levels situated within the shopping centers. It is clear that only 1st and 2nd levels have a low rate of departmentalization. For observations located at basement levels one (-1) to three (-3), departmentalization increases. In most instances, the presence of basements will normally signify a high-rise building, hence explaining the higher average degree of departmentalization. In addition, the basements may exhibit clustering due to the presence of food halls (particularly in US malls), multiplex cinemas (notably in Taiwan) or food supermarkets (for example in Taiwan or the UK). This departmentalization in the basement area has a similar impact to the presence of major stores on upper floors identified by Yiu et al. (2008): to draw shoppers to those lower floors.
4.3.2 Center Structure and Tenant Placement Strategy

The results from multi-regression models generally confirmed the priors from the research hypotheses: the greater the center’s total floor height, the smaller the individual floor area, and the more complex the pedestrian routes, the more likely it is that retailers were clustered in a departmental format, providing clarity in the retail area for shoppers. However, the analysis provides more detailed clarification of these relationships.

As noted above, the basic regression model was split into sub-models in order to avoid collinearity problems. The sub-models contain all nine independent variables of the basic model. The results in Table 5 show that in Model 1 and Model 2 “TOTALLEVEL”, and in both models “COMPLEXITY”, are positively and significantly related to the departmentalization variable. Hence the results confirm that, the higher the number of total floor levels; and with higher degree of spatial complexity, the higher the degree of departmentalization. Another proxy for spatial complexity, the total number of retail units in the shopping center “TOTALUNITS”, is also positive and significant, which means that centers with a high number of retail units require a higher degree of departmentalization to reduce shopping costs.

“NLARATIO” is negatively and significantly related to departmentalization. We had no strong prior for “NLARATIO”. The interpretation of this negative relationship links back to the underlying model that suggests that the return effect of effective floor area decreases with total floor levels. Therefore, a low NLA ratio are linked to higher center floor levels and, hence, to departmentalization. We examine this further below.

To test the influence of scale, “LEVELGLA” and “TOTALGLA” were used. As expected, the variable representing the individual floor level size, “LEVELGLA”, is negatively significant, which means that the smaller the individual floor, the greater the degree of departmentalization. As noted above, however, there is a relationship between individual floor size and center height. The variable “TOTALGLA”, did not appear to be significant, even when transformed in different ways or placed in combination with other variables. In no specification could a significance level stronger than 10% be found. The analysis, then suggests that the overall physical size of a shopping center has no direct influence on tenant placement strategies – rather, it is the mall configuration that matters.

Table 6 provides confirmation, regressing the average level of departmentalization of each mall against total levels in the mall, average floor area (mean LEVELGLA for
all floors in a mall), and average floor complexity (mean COMPLEXITY for each mall). Mean LEVELGLA is not significant (in any transformation); however, the total floor levels in the mall and the mean complexity of floor configuration are both significantly positive.

<Table 6 About Here>

4.3.3 Decreasing Effective Floor Area

As a final analysis, we examine the relationship between floor levels in the mall and the net lettable area ratio. As mall height increases, effective floor area decreases, since services must be accommodated on each (smaller) floor. One way ANOVA, grouping floors into fourth level and below and above forth level – the indifference level identified above – strongly rejects the null hypothesis that net floor level ratios are equal across groups (Table 7). Using a regression approach, Table 8 shows that the mean effective floor area ratio is 64% for floors that are below the fourth level, but falls to just 47% for floors above the fourth level. This is illustrated in Figure 8.

<Table 7 About Here>

<Table 8 About Here>

<Figure 8 about here>
5. Conclusions

The development concepts used in a vertically-organized multi-unit large-scale retail centers are markedly different from those of “conventional” horizontal layouts. This suggests that management principles developed for low-rise out-of-town centers may not be appropriate for vertical projects, either in pedestrian flow strategy or management of physical features. Three basic tenets for the management of shopping centers to generate maximum retail agglomeration economies have been advanced: first, that the floor plan configuration should allow maximum number of customers pass the maximum number of shops; second, that centers should be dumbbell shaped or extended to I, L, Y, X, or Z configurations, with anchor stores at the mall ends and standard/smaller tenants along the single corridors that connecting the anchors; and third, that non-anchor stores of the same type should be dispersed within the center. This research broadly confirms that these principles are suitable for a suburban planned shopping center with no physical restriction in lot size and shape, a low number of floor levels and a simple geometrical pedestrian flow. However, for cases in highly populated areas where land is precious or where more physical flexibility is required to fuse a shopping center within a complex building, then vertically structuring is an inevitable outcome. Under those conditions, different management principles may apply.

In this research, the main focus is on the third principle, the relationship between total floor levels and the spatial distribution of retailers of the same type. Much of the industry and academic literature suggests that shopping center performance is enhanced by managers dispersing units of the same retail category throughout the mall. However, although our findings agree with this dispersion principle in low-rise shopping centers, we argue that the main reason for this dispersion is not simply to minimize total distance but to enhance inter-store externalities of the whole center.

Where a retail project has a vertical structure and the shoppers’ circulation is highly complex, center managers need to reduce complexity by clustering or departmentalizing stores of the same type, transforming the floor plan into purposive zones. Hence, shoppers are able to identify their target type of outlet, wayfinding difficulties are reduced and, as a result, shopping costs can be reduced. Positioning of favored retail types within the vertical mall might draw customers up (and down) the mall from the entrance, creating some spillover effects – but the main driver is to ensure no diminution of purposive shopping turnover.

The empirical analysis uses indices to measure the degree of departmentalization of retail stores of the same type, the degree of complexity for floor plans, along with other characteristic variables generated from a GIS system. From micro-spatial data collected from seventeen major shopping centers in the UK, US, Taiwan, and Singapore, a total of 129 floor plans and some 7,400 retail units were examined in detail. The empirical results show clearly that, the greater the total floor height of the center, the greater the degree of departmentalization. Where there is greater floor complexity and more retail units, the degree of departmentalization is also higher. The critical floor height – the “indifference level” was found to be four levels: below this, a dispersion strategy is favoured; above this, departmentalization predominates. Other than total floor levels, higher spatial complexity also required a higher degree of departmentalization.
We emphasize that the choice of placement strategies is determined by the physical features of the shopping center as a whole, and not by the features of each single level. While further work is needed to focus on geographical and cultural factors in shopping patterns, the results suggest that shopping center tenant management strategies need to be sensitive to these physical configuration factors and not be applied mechanically.
References

Anikeeff, M. Shopping Center Tenant Selection and Mix: a review. in J. D. Benjamin (ed.), Megatrends in Retail Real Estate, 215-238, International Council of Shopping Centers and American Real Estate Society, 1996


Chebat, J.-C., C. Gélinas-Chebat, K. Therrien. Lost in a mall, the effects of gender, familiarity with the shopping mall and the shopping values on shoppers’ way finding processes, Journal of Business Research, 2005, 58, 1590-1598.


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Tables

Table 1: The Variables for multi-regression model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPARTMENT</td>
<td>Degree of departmentalization</td>
<td>N/A</td>
</tr>
<tr>
<td>TOTALLEVEL</td>
<td>Total number of floor levels in the shopping center</td>
<td>+</td>
</tr>
<tr>
<td>LEVEL</td>
<td>The floor level within the shopping center</td>
<td>+</td>
</tr>
<tr>
<td>TOTALUNITS</td>
<td>The total number of retail units within the whole shopping center</td>
<td>+</td>
</tr>
<tr>
<td>UNITS</td>
<td>Number of units on the floor level</td>
<td>+</td>
</tr>
<tr>
<td>TOTALGLA</td>
<td>The size of the shopping center in GLA</td>
<td>Uncertain</td>
</tr>
<tr>
<td>LEVELGLA</td>
<td>The size of the floor level in GLA</td>
<td>–</td>
</tr>
<tr>
<td>NLA/RATIO</td>
<td>The ratio of NLA to GLA of the floor level</td>
<td>–</td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>The spatial complexity of the floor level</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 2: Descriptive statistics of variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPARTMENT</td>
<td>129</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.65</td>
<td>0.32</td>
</tr>
<tr>
<td>TOTALLEVEL</td>
<td>129</td>
<td>14</td>
<td>1</td>
<td>15</td>
<td>7.48</td>
<td>4.10</td>
</tr>
<tr>
<td>LEVEL</td>
<td>129</td>
<td>15</td>
<td>-3</td>
<td>12</td>
<td>2.68</td>
<td>2.99</td>
</tr>
<tr>
<td>TOTALUNITS</td>
<td>129</td>
<td>847</td>
<td>66</td>
<td>913</td>
<td>347.03</td>
<td>214.37</td>
</tr>
<tr>
<td>UNITS</td>
<td>129</td>
<td>212</td>
<td>1</td>
<td>213</td>
<td>57.16</td>
<td>46.82</td>
</tr>
<tr>
<td>TOTALGLA*</td>
<td>129</td>
<td>288313</td>
<td>31855</td>
<td>320168</td>
<td>135390</td>
<td>80095</td>
</tr>
<tr>
<td>LEVELGLA*</td>
<td>129</td>
<td>144361</td>
<td>3310</td>
<td>147671</td>
<td>27565</td>
<td>24768</td>
</tr>
<tr>
<td>NLA/RATIO</td>
<td>129</td>
<td>0.82358</td>
<td>0.1764</td>
<td>1</td>
<td>0.52</td>
<td>0.15</td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>129</td>
<td>29.6808</td>
<td>0.0022</td>
<td>29.683</td>
<td>5.66</td>
<td>6.08</td>
</tr>
</tbody>
</table>

Note: * measured in square meters

Table 3: Floor Level and Tenant Placement Strategy

<table>
<thead>
<tr>
<th>Source</th>
<th>2 levels</th>
<th>3 levels</th>
<th>4 levels</th>
<th>5 levels</th>
<th>6 levels</th>
<th>7 levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Square</td>
<td>Model</td>
<td>Error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F Value</td>
<td>70.763</td>
<td>186.996</td>
<td>196.840</td>
<td>188.039</td>
<td>121.610</td>
<td>36.497</td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The table shows the results for the general linear model procedure for degree of departmentalization and the number of total floor levels (dependent variable Y=DEPARTMENT)
Table 4: Degree of departmentalization of different total floor levels

<table>
<thead>
<tr>
<th>Floor Levels in Mall</th>
<th>N</th>
<th>Least square means</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4 levels</td>
<td>90</td>
<td>0.2765</td>
<td>0.2267</td>
</tr>
<tr>
<td>&gt; 4 levels</td>
<td>39</td>
<td>0.8093</td>
<td>0.1845</td>
</tr>
<tr>
<td>All levels</td>
<td>129</td>
<td>0.6482</td>
<td>0.3151</td>
</tr>
</tbody>
</table>

The table shows the mean departmentalization score for floors in centers grouped by height of mall, separated into (a) four floors or lower; (b) more than four floors, as per Table 3.

Table 5: Floor Level Departmentalization and Mall Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Model1</th>
<th>Model2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef</td>
<td>SE</td>
</tr>
<tr>
<td>(Constant)</td>
<td>.374</td>
<td>.064</td>
</tr>
<tr>
<td>TOTALLEVEL</td>
<td>.026***</td>
<td>.007</td>
</tr>
<tr>
<td>TOTALUNIT</td>
<td>.0004***</td>
<td>.0001</td>
</tr>
<tr>
<td>LEVELUNIT</td>
<td>-.001*</td>
<td>.001</td>
</tr>
<tr>
<td>TOTALGLA*10^6</td>
<td>-.417***</td>
<td>-.110</td>
</tr>
<tr>
<td>NLRATIO</td>
<td>.009***</td>
<td>.003</td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>.546</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>.749</td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>.560</td>
<td></td>
</tr>
<tr>
<td>Adj-R square</td>
<td>.546</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>39.514</td>
<td></td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>

Note: *** significant at 1 per cent level, ** significant at 5 per cent level, * significant at 10%. Both N=129.

The table analyses the variables influencing the degree of departmentalization or clustering at floor level within the shopping malls in the sample.

Table 6: Mall Level Influences on Departmentalization

<table>
<thead>
<tr>
<th></th>
<th>Coef</th>
<th>SE</th>
<th>T</th>
<th>Sig</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>.156</td>
<td>.087</td>
<td>1.791</td>
<td>.087</td>
<td></td>
</tr>
<tr>
<td>Mall TOTALLEVEL</td>
<td>.045***</td>
<td>.011</td>
<td>4.275</td>
<td>.000</td>
<td>1.823</td>
</tr>
<tr>
<td>Mean LEVELGLA*10^-5</td>
<td>.145</td>
<td>.117</td>
<td>-1.238</td>
<td>.229</td>
<td>1.499</td>
</tr>
<tr>
<td>Mean COMPLEXITY</td>
<td>.034***</td>
<td>.008</td>
<td>4.008</td>
<td>.001</td>
<td>1.542</td>
</tr>
<tr>
<td>R-square</td>
<td>.833</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adj R-square</td>
<td>.811</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>36.645</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *** significant at 1 per cent level, ** significant at 5 per cent level, * significant at 10%. N=26.

The table analyzes, at mall level, the impact of total center height, floor complexity and average floor size on the mean level of departmentalization in each center.
Table 7: Effective Floor Area and Mall Level - ANOVA

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean square</th>
<th>F value</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>1</td>
<td>.787</td>
<td>.787</td>
<td>43.933</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>127</td>
<td>2.274</td>
<td>.018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>128</td>
<td>3.060</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table explores the relationship between NLA ratio and floor level using the general linear model (GLM) procedure (dependent variable $Y=NLARATIO$).

Table 8: Effective Floor Area and Mall Level

<table>
<thead>
<tr>
<th>Floorplans</th>
<th>N</th>
<th>Least square means</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below(incl.) 4 levels</td>
<td>39</td>
<td>.63801734</td>
<td>.146947551</td>
</tr>
<tr>
<td>above 4 levels</td>
<td>90</td>
<td>.46799154</td>
<td>.127785685</td>
</tr>
<tr>
<td>Total</td>
<td>129</td>
<td>.51939469</td>
<td>.154627599</td>
</tr>
</tbody>
</table>

The table shows average NLA/GLA ratio and total floor levels based on bivariate regressions, with dependent variable $Y=NLARATIO$.)
Figure 1: Shopping centers with simple mall configurations and routes
Figure 2: Shopping centers with complex configurations and routes
Figure 3 Comparison of Miramar (Taiwan) and Bluewater (UK) in correct scaling
The figure shows total rental value for a shopping center (V), relative to the number of floors in the mall (L). Panel A shows rental value for a dispersion strategy; Panel B shows rental value for a departmentalization strategy; Panel C combines the curves. The crossover point defines the “indifference level” $L^*$ - the floor level at which either strategy generate the same rental income.
a) Floor plan shown in ArcMap b) Attributes links to the floor plan

Figure 5: The GIS-based database established for empirical study

Figure 6: Aggregate polygons for retailers of the same type (more than 3 stores) clustering in 5m for Mirama 1F (Taiwan) and Bluewater 1F (UK)

Panel A. For total floor levels
Panel B. Individual level

Figure 7: The average degree of departmentalization
Endnotes:

1 For “large-scale” we follow the ULI (1999) definition of regional shopping centers defined as having over 300,000 sq ft. gross leasable area (GLA). By “multi-unit”, we exclude those retail spaces over 300,000 sq ft that comprise individual megastores such as Ikea, other hyper-stores with only few retail outlets, and retail parks. Normally, large scale multi-unit malls will have over 100 retail units. We thus include shopping centers, mega-department stores with independently operated merchandise outlets, and other complex multi-tenanted retail buildings.

2 The layers of this retail tenant mixture include at least four basic elements (Yiu, 2004): type, size, number, and placement of retail tenants within a shopping center. Also see Bean et al. (1988) for a discussion.

3 See, for example, Morgan and Walker, 1988; ULI, 1999; Carter and Haloupek, 2002; Fong, 2003; Carter and Vandell, 2005.

4 In Yiu et al.’s (2008) research on high rise shopping malls in Hong Kong, larger
shops and non-impulse trade outlets were more likely to be located on upper floors to draw customers upwards.

5 That is footfall or sales from shoppers seeking a particular type of good within the shopping centre.

6 Or downwards if the entry level is on upper floors – as might be the case with retail centers set beneath office buildings, or where a transport-interchange takes place at a higher level.

7 A mathematical derivation of the rental value curves is available from the authors.

8 The choice of five meters reflects typical store frontage sizes. Ignoring anchors, these generally fell between one to ten meters, but for the majority of Asian cases (the largest group in the sample) were three to five meters. If the distance chosen is too great, too many store units of the same type that are not adjacent will be treated as departmentalized. Other distances, from three to twelve meters were tested, with five meters giving the most robust results.

9 A decision point or node occurs when a shopper must choose a direction: a link is a path from each node. Consider a floor with four entries central to each wall and corridors in the form of a cross. There are five decision points – the four entry doors and the intersection of the corridors in the center of the floor. Each of the door nodes has one link (to the center); the intersection has four links (one to each door), giving eight in total. Thus the numerator would be 5*8 = 40.

10 The subscripts indicate “above” and “below”.

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