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.

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? The 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, Crosby, Lizieri, and McCann, 2004; Des Rosiers, Thériault, and Lavoie, 2009; Yuo, Lizieri, McCann, and Crosby, 2011). 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: (1) the floor plan configuration should allow the maximum number of customers to pass the maximum number of shops; (2) 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 connect those anchors; and (3) 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, Xu, and Ng (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 70 multi-unit large-scale retail centers was ten, with some centers as many as 19 levels. Comparing these numbers to the United Kingdom, 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 hindered by the need for vertical movement and way-finding problems (Hölscher, Meilinger, Vrachliotis, Brösamle, and Knauff, 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 nearly 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 (i.e., widely distributed), rather than clustered within shopping malls. This dispersion placement strategy is very widely observed in large-scale shopping malls in the United States 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 (e.g., through use of multiple corridors or grids).

First, we review the literature on tenant location within shopping malls. We then describe 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 U.S., U.K., Taiwan, Singapore, Hong Kong, Malaysia, and Shanghai. In total, 129 detailed floor plans from 17 shopping centers were digitized using a geographical information system (GIS). This system 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.

**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 (Dixit and Stiglitz, 1977; Eaton and Lipsey, 1979; Fischer and Harrington, 1996). 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” (Urban Land Institute, 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; Urban Land Institute, 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’s ‘center,’ normally the spot with the highest pedestrian flow, as retailers compete for the optimum location (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 optimizing 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. Brueckner (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 (Gatzlaff, Sirmans, and Diskin, 1994; Finn and Louviere, 1996; Pashigan and Gould, 1998; Mejia and Benjamin, 2002). 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, 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 (Brown 1991a, 1991b; Fong, 2003; Bitgood and Dukes, 2006; Spilková and Hochel, 2009). When the spatial complexity of the shopping environment increases, wayfinding problems and the mental map of consumers may become a major concern (Brown, 1999; Chebat, Gélinas-Chebat, and Therrien, 2005). 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, as well as 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, Xu, and Ng (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
suggest 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.

**Maximum Spillover Effects, Efficient Space Usage, and Store Location**

Much of the existing research on tenant placement strategies focuses on U.S. 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.” The authors 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 comparative goods, implying benefits from a clustering or departmentalization strategy. Hence, the objective for store placement strategies is to generate higher spillover effects and maximize 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. Exhibit 1 shows floor plans of major shopping centers in the U.S. and U.K. 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 floor
Exhibit 1 | Shopping Centers with Simple Mall Configurations and Routes

Bluewater (UK)

Trafford Centre (UK)

Four Seasons (US)
plans shown in Exhibit 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.
Exhibit 3 compares two representative cases, with common scaling: Bluewater (near London, U.K.) with two levels and 1,600,000 sq. ft. in gross leasable area (GLA) and Miramar (Taipei, Taiwan) with eight levels and 1,352,192 sq. 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, which is 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: (1) a dispersion strategy to disperse retail stores of the same retail category around the center; or (2) a departmentalization strategy to cluster the stores of the same retail type 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 the 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 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 are strong incentives, customers have less motivation to move upward from lower levels. Secondly, customer utility exhaustion occurs due to increasing shopping costs. When there is 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, where each level requires its own supportive floor area for indivisible facilities (e.g., washrooms, storage/preparation space, escape routes, and fire protection facilities) erodes effective floorspace.

The consequences of these effects are shown diagrammatically in Exhibit 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,
Exhibit 5 | The GIS-based Database Established for Empirical Study

(a) Floor plan shown in ArcMap
(b) Attributes links to the floor plan

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 the 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 explores these relationships. We have two principal objectives. The first objective is to identify the relationship between the degree of departmentalization and the physical features of shopping malls. The second objective is to identify the “indifference level,” which is the floor height at which a mall owner is indifferent between the two placement strategies identified above.

Empirical Findings

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 (Exhibit 5) was created to enable the generation of specific and accurate spatial information (e.g., for each unit size, shape, location, total floor area, and net/gross leasable area).
The geography information system (ArcGIS 9) we used has the ability to combine spatial data with non-spatial information such as retail category or brand name. Its powerful spatial analytical 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 floor plans. 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 floor plans showed on the websites of shopping centers. The final dataset used contained 26 shopping centers in the U.S. (five), U.K. (six), Taiwan (six), Singapore (four), Hong Kong (two), Shanghai (two), and Malaysia (one). In total, 129 floor plans were digitized into detailed spatial data, covering 7,374 retail store units and some 38 million sq. ft. of GLA. The dataset contains shopping centers of varying heights ranging from a single level to 15 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, the 26 malls selected are, by most measures, “flagship” malls run by experienced and successful mall operators.

**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, which is 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:

\[
DEPARTMENT_{kj} = \frac{\sum_{i} f_{sij}}{F_j}, \quad (1)
\]

where \(DEPARTMENT_{kj}\) is the index measuring the degree to which units in the same retail categories \(i\) agglomerate within floor \(j\) of shopping mall \(k\); \(f_{sij}\) is the
total floor area where more than three stores of the same retail category \( i \) are clustered within five meters\(^8 \) within floor \( j \) (Exhibit 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. The total floor area for floor \( j \) is \( F_j \).

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 \( j \).\(^9 \) 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,” which is 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\(^{10}\) 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 groups 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. In addition, 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. Finally, 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 the 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 Exhibit 7. The basic model for the multiple regression analysis is:

\[
DEPARTMENT = f(TOTALLEVEL, LEVEL, TOTALGLA, LEVELGLA, UNITS, TOTALUNITS, NLARATIO, COMPLEXITY).
\]  (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:
**Exhibit 7** | The Variables for Multi-regression Model

<table>
<thead>
<tr>
<th>Variable</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>NLARATIO</td>
<td>The ratio of NLA to GLA of the floor level ( NLARATIO ) ( = \frac{\text{NLA}_i}{\text{GLA}_i} ) )</td>
<td>–</td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>The spatial complexity of the floor level</td>
<td>+</td>
</tr>
</tbody>
</table>

**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**, which is the floor space 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** and **TOTALGLA**. **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**. **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:

\[
Y = \alpha + \beta_1(TOTALLEVEL) + \beta_2(TOTALUNITS) + \beta_3(LEVELGLA) + \beta_4(COMPLEXITY) + \varepsilon_i. \tag{4}
\]

Model 2 is defined as:

\[
Y = \alpha + \beta_1(TOTALLEVEL) + \beta_2(LEVEL) + \beta_3(UNITS) + \beta_5(TOTALGLA) + \beta_7(NLARATIO) + \beta_8(COMPLEXITY) + \varepsilon_i. \tag{5}
\]

As there were no major distributional issues, the models were run using standard ordinary least squares (OLS) procedures, having checked for potential heteroscedasticity 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 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 models 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 the 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 Exhibit 8.

**Results**

*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 Exhibit 9. The results
Exhibit 8 | Descriptive Statistics of Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Range</th>
<th>Min.</th>
<th>Max.</th>
<th>Average</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPARTMENT</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.65</td>
<td>0.32</td>
</tr>
<tr>
<td>TOTALLEVEL</td>
<td>14</td>
<td>1</td>
<td>15</td>
<td>7.48</td>
<td>4.10</td>
</tr>
<tr>
<td>LEVEL</td>
<td>15</td>
<td>-3</td>
<td>12</td>
<td>2.68</td>
<td>2.99</td>
</tr>
<tr>
<td>TOTALUNITS</td>
<td>847</td>
<td>66</td>
<td>913</td>
<td>347.03</td>
<td>214.37</td>
</tr>
<tr>
<td>UNITS</td>
<td>212</td>
<td>1</td>
<td>213</td>
<td>57.16</td>
<td>46.82</td>
</tr>
<tr>
<td>TOTALGLA(^a)</td>
<td>288,313</td>
<td>31,855</td>
<td>320,168</td>
<td>135,390</td>
<td>80,095</td>
</tr>
<tr>
<td>LEVELGLA(^a)</td>
<td>144,361</td>
<td>3,310</td>
<td>147,671</td>
<td>27,565</td>
<td>24,768</td>
</tr>
<tr>
<td>NLARATIO</td>
<td>0.82</td>
<td>0.18</td>
<td>1</td>
<td>0.52</td>
<td>0.15</td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>29.68</td>
<td>0.002</td>
<td>29.68</td>
<td>5.66</td>
<td>6.08</td>
</tr>
</tbody>
</table>

Notes: The number of observations is 129.
\(^a\) Measured in square meters.

Exhibit 9 | 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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>4.546</td>
<td>7.567</td>
<td>7.723</td>
<td>7.584</td>
<td>6.215</td>
<td>2.836</td>
</tr>
<tr>
<td>Error</td>
<td>0.064</td>
<td>0.040</td>
<td>0.039</td>
<td>0.040</td>
<td>0.051</td>
<td>0.078</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>

Notes: The table shows the results for the general linear model procedure for degree of departmentalization and the number of total floor levels. The dependent variable is \(Y = \text{DEPARTMENT} \).

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, Exhibit 10 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 Exhibit 10, 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.
Exhibit 10 | Degree of Departmentalization of Different Total Floor Levels

<table>
<thead>
<tr>
<th>Floor Levels in Mall</th>
<th>N</th>
<th>Least Squares Means</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4 levels</td>
<td>39</td>
<td>0.277</td>
<td>0.227</td>
</tr>
<tr>
<td>&gt; 4 levels</td>
<td>90</td>
<td>0.809</td>
<td>0.184</td>
</tr>
<tr>
<td>All levels</td>
<td>129</td>
<td>0.648</td>
<td>0.315</td>
</tr>
</tbody>
</table>

Notes: 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 Exhibit 9.

Exhibit 11 further shows the distribution of the degree of departmentalization for observations. Panel A 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. It is clear that only the first and second 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 U.S. malls), multiplex cinemas (notably in Taiwan), or food supermarkets (e.g., Taiwan or U.K.). This departmentalization in the basement area has a similar impact to the presence of major stores on upper floors identified by Yiu, Xu, and Ng (2008), which is to draw shoppers to lower floors.

Center Structure and Tenant Placement Strategy. The results from the regressions 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.

As noted above, the basic 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 Exhibit 12 show that in Models 1 and Model 2, TOTALLEVEL and 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
Exhibit 11 | The Average Degree of Departmentalization

Panel A: For Total Floor Levels

Panel B: Individual Level
Exhibit 12 | Floor Level Departmentalization and Mall Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>Constant</td>
<td>0.374</td>
<td>0.064</td>
</tr>
<tr>
<td>TOTALLEVEL</td>
<td>0.026***</td>
<td>0.007</td>
</tr>
<tr>
<td>LEVEL</td>
<td>0.002</td>
<td>0.007</td>
</tr>
<tr>
<td>TOTALUNIT</td>
<td>0.0004***</td>
<td>0.0001</td>
</tr>
<tr>
<td>LEVELUNIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALGLA*10^-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEVELGLA*10^-5</td>
<td>-0.417***</td>
<td>0.110</td>
</tr>
<tr>
<td>NLARATIO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>0.009***</td>
<td>0.003</td>
</tr>
<tr>
<td>R</td>
<td>0.749</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.560</td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.546</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>39.514</td>
<td></td>
</tr>
<tr>
<td>Pr &gt; F</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

Notes: In both models, the number of observations is 129. The dependent variable is DEPARTMENT (of each floor level). The table analyses the variables influencing the degree of departmentalization or clustering at floor level within the shopping malls in the sample.

* Significant at the 10% level.
*** Significant at the 1% level.
Exhibit 13 | Mall Level Influences on Departmentalization

<table>
<thead>
<tr>
<th>Coeff.</th>
<th>SE</th>
<th>t-Stat.</th>
<th>Sig.</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.156</td>
<td>0.087</td>
<td>1.791</td>
<td>0.087</td>
</tr>
<tr>
<td>Mall TOTALLEVEL</td>
<td>0.045***</td>
<td>0.011</td>
<td>4.275</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean LEVELGLA*10⁻⁵</td>
<td>−0.145</td>
<td>0.117</td>
<td>−1.238</td>
<td>0.229</td>
</tr>
<tr>
<td>Mean COMPLEXITY</td>
<td>0.034***</td>
<td>0.008</td>
<td>4.008</td>
<td>0.001</td>
</tr>
<tr>
<td>R²</td>
<td>0.833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.811</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>36.645</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pr &gt; F</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 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. The dependent variable is the mean of DEPARTMENT for each center. ***Significant at the 1% level.

Exhibit 14 | 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>0.787</td>
<td>0.787</td>
<td>43.933</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>127</td>
<td>2.274</td>
<td>0.018</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>

Note: The table explores the relationship between NLA ratio and floor level using the general linear model (GLM) procedure. The dependent variable is \( Y = \text{NLARATIO} \).

Links back to the underlying model that suggests that the return effect of effective floor area decreases with the total number of levels. Therefore, a low NLA ratio are linked to higher center floor levels and, hence, to departmentalization.

LEVELGLA and TOTALGLA were used to test the influence of scale. 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. Thus the overall physical size of a shopping center
Exhibit 15 | Effective Floor Area and Mall Level

<table>
<thead>
<tr>
<th>Floor Plans</th>
<th>N</th>
<th>Least Square Means</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below (incl.) 4 levels</td>
<td>39</td>
<td>0.6380</td>
<td>0.1469</td>
</tr>
<tr>
<td>Above 4 levels</td>
<td>90</td>
<td>0.4680</td>
<td>0.1278</td>
</tr>
<tr>
<td>Total</td>
<td>129</td>
<td>0.5194</td>
<td>0.1546</td>
</tr>
</tbody>
</table>

Note: The table shows average NLA/GLA ratio and total floor levels based on bivariate regressions, with dependent variable being $Y = \text{NLARATIO}$.

Exhibit 16 | Effective Floorspace by Floor Level

appears to have no direct influence on tenant placement strategies. It is the mall’s configuration that matters.

Finally, no strongly significant relationships at individual floor level for the two variables $\text{LEVEL}$ and $\text{LEVELUNITS}$ were found, despite a priori expectations. Reviewing the data and the results from Panel B of Exhibit 4, our interpretation is that tenant placement strategy is determined by the physical features of the
entire shopping center, not by the location of each individual level and the number of units in any one level. The lack of significance of these variables helps confirm that it is the height and complexity of the whole project that determines strategy.

Exhibit 13 provides confirmation, regressing the average level of departmentalization of each mall against total levels in the mall, average floor area (mean $LEVELGLA$ for all levels), and average floor complexity (mean $COMPLEXITY$ for each mall). Mean $LEVELGLA$ is not significant (in any transformation); however, the total levels in the mall and the mean complexity of floor configuration are both significantly positive.

*Decreasing Effective Floor Area.* As a final analysis, we examine the relationship between floor levels 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, strongly rejects the null hypothesis that net floor level ratios are equal across groups (Exhibit 14). Using a regression approach, Exhibit 15 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 (Exhibit 16).

**Conclusions**

The development concepts used in 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: (1) floor plan configuration should allow a maximum number of customers to pass the maximum number of shops; (2) 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 (3) 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 centers 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 the inter-store externalities of the whole center.

Where a retail project has a vertical structure and the flow of people 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, people 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 people up (and down) the mall from the entrance, creating some spillover effects, but the main driver is to ensure no diminution of purposive shopping.

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 17 major shopping centers in the U.S., U.K., 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 favored; 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.

Endnotes

1 For “large-scale” we follow the Urban Land Institute’s (1999) definition of regional shopping centers defined as those having over 300,000 sq. ft. of gross leasable area (GLA). For “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 (Yuo, 2004): type, size, number, and placement of retail tenants within a shopping center. Also see Bean, Noon, Ryan, and Salton (1988) for a discussion.

In Yiu, Xu, and Ng’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.

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

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.

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

The choice of five meters reflects typical store frontage sizes. Ignoring anchors, these generally fell between one to ten meters, but 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.

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.


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