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What Makes Mixed-Use Development Economically Desirable?

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Abstract

Mixed-use development has been widely advocated by urban planners as an important planning tool for sustainable urban development. However, despite the fact that mixed land use is commonly observed in cities, it has not been well defined or explained in existing urban economic theories. Although several researchers have attempted to theorize the phenomenon using congestion and agglomeration and externality effects, their efforts are based on highly abstract neoclassical economic models. While these models help to conceptualize mixed land use in theory, the neoclassical approach overlooks the institutional and organizational aspects of the land development process. Moreover, there is an enormous gap between these theoretical models and real-world practices where decisions on mixed-use development must be made on the basis of context-specific considerations. This paper has three objectives. The first is to clarify the concept and develop a typology of mixed land use based on a review of academic and professional publications. The second objective is to review and critique the existing literature aimed at bridging economic theories with mixed-use practices. The third objective is to employ the transaction cost economic theory as an alternative framework to comprehend mixed-use development. The paper can inform future planning and development decisions on mixed land use.

Keywords: mixed-use development, neoclassical land use models, hedonic pricing model, transaction cost economic theory

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What Makes Mixed-Use Development Economically Desirable?

1. Introduction

Mixed-use development has been widely advocated by urban planners as an important planning tool for sustainable urban development (Bernick and Cervero 1997; Berridge Lewinberg Greenberg Ltd. 1991; Calthorpe 1993). The commonly perceived benefits include generating neighborhood diversity and vibrancy (Jacobs 1961), encouraging non-automobile commuting (Cervero 1996) and physical activity (Frank et al. 2004), enhancing accessibility (Tong and Wong 1997), and facilitating stronger neighborhood character (Brown, et al. 2009).

Table 1: A Brief History of Mixed-Use Development

Before 1860s Colonial towns	1860s to 1960s Early zoning	1970s to Early-1990s	Mid-1990s to Present
Most land uses were mixed	Areas were zones into single uses to remove non-conforming uses	Mixed use was widely advocated, but developers were still reluctant to invest due to high risk	Mixed use has slowly gained financial viability

Table 1 summarizes the four historical phases of mixed-use development in North America. Before 1860s, land uses were mostly mixed when the scale of the city was limited by the technology available at the time (Coupland 1997) and government regulations on private uses of land were considered minimal (Hart 1996). From 1980s to 1960s the concerns of planners and public agencies in general were often about zoning areas into single uses, removing non-conforming uses (Coupland 1997; Grant 2002; Schwanke and Flynn 2003) and promoting broad public welfare objectives (Hart 1996). By the 1980s, mixed land use regained favor as part of a strategy for sustainable development as well as a theory of good urban form, with the objectives of economic vitality, social equity, and environmental quality. In addition to the above motivations, various mixed-use policy initiatives in the 1980s and early-1990s have seen in the redevelopment and regeneration of former industrial areas where old buildings and constructions were rehabilitated with new uses (Coupland 1997). In the meantime, departmental stores were re-introduced to the city centers with a collection of mixed commercial and leisure uses. Nevertheless, mixed-use projects, especially suburban projects, were perceived as generally riskier than typical real estate projects by investors and developers (Gyourko and Rybczynski 2000).

For the past two and a half decades, mixed land use has been advocated by many urban planners as a key strategy for increasing economic vibrancy in the city, reducing automobile dependency and energy consumption and emissions, improving public health, and advancing sustainability (Bernick and Cervero 1997; Cervero 1996). The New Urbanism has produced proposals for mixed-use districts in new and existing communities that are less auto-dependent and shorten distances between workplace and residence (The Congress of New Urbanism 2002). Following the ideology shift, a growing number of public financing tools, such as government-sponsored mortgages and tax incentives, have been adopted to help make mixed-use development more financially feasible (Grant 2002; Langdon 2017). As observed by Angotti and Hanhardt (2001), the close physical integration of residential and industrial uses has become both possible and desirable.

Despite the fact that mixed-use development is commonly observed in cities today, the concept of mixed-use has not been well defined and explained in existing literature. Angotti and Hanhardt (2001) notice that the term has been applied to different types of communities where industrial, commercial or residential land uses coexist in close proximity, yet what particular mix of these different uses constitutes mixed use is often unclear. Also ambiguous are the geographic scale and form (building types or activities) in which they are mixed. There are social equity implications of imprecise use of the term. For example, mix of uses is more likely to create serious environmental and health externalities in poor communities. Not all types of mixed use are desirable and the claimed benefits of mixed use cannot be taken for granted. For example, some existing mixed-use communities in the US often experience serious negative health effects of hazardous pollutants, and planners and policy makers must consider these effects. Instead of nostalgia and propaganda, planning for mixed uses must be based on a good understanding of why mixture of land uses becomes desirable in some cases, and why not in other situations.

In retrospect, although mixed uses have many perceived benefits, in real practice the outcomes often include tradeoffs. Therefore, in order to evaluate the overall benefits of mixed uses and, more importantly, to understand what makes mixed-use development economically desirable, it is important to monetarize both the benefits and costs through an economic framework.

However, the concept of mixed-use has not been well defined and explained in existing urban economic theories either. Standard Ricardian rent model typically predicts complete segregation of land use created by transportation friction in a monocentric city (Kantor et al. 2014). Although a small number of studies have attempted to theorize the phenomenon of mixed-use development using congestion and agglomeration externality effects (Kantor et al. 2014; Wheaton 2004), the studies are often based on highly abstract economic models. While these models help to conceptualize mixed land use in theory, the neoclassical economical approach overlooks the institutional and organizational aspects of the land use development process. Moreover, there is

an enormous gap between these theoretical models and planning practices in real world where decisions on mixed-use development must be made based on context-specific considerations.

In the light of the above stated problems, our study has three objectives. The first is to clarify the concept and typology of mixed use through a review of professional documents and academic journal articles. Previous literature categorizes mixed use from different perspectives. A common definition of mixed use is more than two revenue-generating uses (Schwanke and Flynn 2003). However, literature has also described mixed use in terms of its functionality, physical form, and economic institutions. Understanding these aspects will help not only to form a comprehensive conceptual framework of mixed-use development, but also to identify important variables in the evaluation of their outcomes.

The second objective is to review and critique the existing literature, aiming at bridging economic theories with practices in terms of mixed-use development. Previous studies have explored empirical approaches to identifying effects of mixed land use on housing prices (Cao and Cory 1982; Song and Knaap 2004). Other relevant publications have explored the relationship between urban spatial structure and the effects of mixed land use (Anas and Ikki 1996; McDonald 2009). In addition, mixed land use has indirect effects that affect human activities and health outcomes (Moudon et al. 1997; Frank et al. 2004; Jabareen 2006).

The third objective is to employ concepts from the transaction cost economic theory as an alternative framework to comprehend the formation and process of mixed-use development. When located in proximate space, different types of land use generate positive and negative externalities that affect each other. Based on the type of development process, including franchise bidding, private real estate development, government procurement, or public-private participation, the externalities can be allocated differently onto public and private sectors. To understand the underlying economic mechanism, we draw parallels from Williamson's seminal articles (1976; 1985) and some early empirical studies on organization form and its determinants, including value of assets specific to the transaction, uncertainty about the future, complexity of the transaction, and frequency of trade.

This paper aims to identify the gaps in past studies on mixed land use and propose new analytical approaches to bridge economic theories and practices. Its ultimate goal is to provide guidelines for decision making on mixed-use development in urban policy, urban planning, as well as real estate development. The remainder of the paper is organized as follows. Part Two reviews the concepts of mixed land use that are commonly applied in research and practices. Part Three reviews and critiques the neoclassical economic approach to understanding mixed-use development. Based on Part Two and Part Three, Part Four proposes possible expansions in

existing analytical frameworks as well as an alternative approach from the transaction cost economic theory.

2. Mixed Land Use in Practice: Concept and Typology

Despite its ubiquitous existence in virtually all cities, mixed use as a concept remains somewhat ambiguous in scholarly writings and professional documents. A number of researchers have made serious efforts to clarify this concept. Angotti and Hanhardt (2001) notice that the term has been applied to different types of communities where industrial, commercial or residential land uses coexist in close proximity, yet what particular mix of these different uses constitutes mixed use is often unclear. Similarly, Coupland (1997) notes that the definition not only is unclear, but also differs in operational terms between countries. The definition is also different across academic and professional fields. For example, for urban economists, mixed use is typically conceptualized as different types of land uses occupying the same geographic location, where the location can be a parcel, a block, or even a division of a city (Kantor et al. 2014; Wheaton 2004). For developers, however, it is the integration of several types of uses in a single development project (Schwanke and Flynn 2003). In review of the past attempts, studies have characterized mixed use from different perspectives based on the authors' backgrounds and focuses. To integrate the perspectives into a comprehensive framework, we propose to characterize mixed use by three main dimensions: urban functionalities, spatial arrangement and morphology, and last but not least institution and financing.

2.1 Land Use, Economic Functionality, and Human Activity

Mixed use is often defined by the number of primary uses occupying the same geographic location. The Urban Land Institute, for example, has defined mixed-use development as a project with three or more significant revenue-producing uses (Schwanke and Flynn 2003). There are two limitations for such a definition. First of all, while the concept of mixed use defined in this way is straightforward, the actual combination of different uses can produce varying outcomes. For example, as observed by Angotti and Hanhardt (2001), in wealthier communities, mixed uses tend to create relatively few environmental and health problems, but in poor communities, the mixture of residential and undesirable industrial uses is much more likely to create such problems. Therefore, the success of mixed uses cannot be measured by the sheer number of uses mixed but rather the functionalities provided by the combination and interaction of different uses.

From a developer's perspective, based on the functionalities provided by a project, mixed-use development can be further categorized into office, residential, hotel, retail, entertainment,

cultural, public and civic, convention, recreational, and parking, with each function produced by a specific combination of complementary land uses (Schwanke and Flynn 2003). Thus, the selection of land uses in a mixed-use development project can be evaluated based on the demand in local, regional, and transient drive-by market (Schwanke and Flynn 2003). If mixed use is categorized by economic functions, the concept can also extend to one land use type with different functionalities. For example, when Jacobs (1961) argues mixed primary uses as a factor contributing to diversity, she puts an emphasis on the different types of commerce on a same street. Other research has also included single-family and multi-family housing as part of mixed-use development (Song and Rodríguez 2005).

The second limitation of the conventional definition of mixed use is that it overlooks human activities that take place in space. Jacobs (1961) has proposed that the effectiveness of how mixed primary uses can generate diversity depends on whether the uses can attract people to use the same streets as well as the same facilities at different times of a day. More recently, Miranda et al. (2016) explore the variation of activities over different temporal resolutions at the specified location with the concept of “urban pulse”. Based on Flickr activity, the pulses are computed based on the topology of the time-varying scalar function that models the spatiotemporal distribution of the activity corresponding to a city. The article, along with other similar studies (Zhao et al. 2015; Claudio and Yoon 2014; Quercia and Saez 2014), shows the potential of using emerging social and locative media data to understand the temporal patterns of activities on multiple types of land use.

Table 2: Number of Land Use Types versus Diversity of Functions and Activities

	Single Land Use Type	Multiple Land Use Types
Low Function/Activity Diversity	Single use with low diversity	Mixed use with low diversity
High Function/Activity Diversity	Single use with high diversity	Mixed use with high diversity

Table 2 describes the relationship between the number of land use types and the diversity of functionalities and activities. The diversity here is defined by both the types of economic functions and activities and the times when functions are performed and activities take place. Low diversity, therefore, refers to land uses that generate a single type of function and attract activity at only one period of a day. On the contrary, high diversity describes land uses that serve multiple functions and attract a variety of activities through different time periods of a day. Defined by function and activity diversity, a single land use type can also generate high diversity, and thus lead to a mixed use of the space. In contrast, certain multiple land use types, such as a mix of office and commercial space, may only provide low function and activity diversity due to homogenous tenants and space users.

In sum, the concept of mixed uses has often been defined as a project with multiple primary uses. While the definition captures some of the characteristics of mixed uses, it does not provide a much useful analytical framework to evaluate the outcomes since a project with the same number of mixed uses can provide opposite outcomes depending on the types of uses combined. Besides, the definition fails to capture the variations of activity patterns in different times of a day. In review of the past literature, we propose that, in addition to the number of uses in the mix, we should characterize and evaluate mixed-use development based on the level of functionalities and pattern of activities. Thus, the effectiveness of certain combinations of primary uses can be evaluated by comparing the success of two mixed-use projects on serving a similar economic function, or by comparing the activity patterns over a similar temporal resolution.

2.2 Spatial Dimension and Geographical Measurement

The outcomes of mixed-use development are determined not only by the types of uses, but also by the spatial and physical arrangement of these uses. Many of the perceived benefits of mixed use, such as sustainability, increased transit ridership, and walkability, can only be achieved through the physical and functional integration. Additionally, the physical design aspect itself in a mixed-use setting can contribute to, in Lynch's words, a good urban texture and city form through a fine mixed grain (Lynch 1981). There are a number of publications that categorize the spatial and physical configurations of mixed-use development. For example, the Urban Land Institute has summarized the common configurations, including mixed-use towers, integrated multi-tower structures, mixed-use town centers, urban villages, and districts (Schwanke and Flynn 2003).

In a more carefully constructed framework, Hoppenbrouwer and Louw (2005) have developed a typology of mixed use based on Rowley's (1996) conceptual model. The central component in their model consists of the dimensions of mixed use. Dimension describes both the spatial and temporal organizations of mixed uses. There are four dimensions: shared premises, horizontal dimension, vertical dimension, and time dimension. Share premises describe a unit of space with mixed uses, for example, one building. Horizontal dimension describes development where uses are identical in each building but mixed in the horizontal space, for example within a block or along a street. Mixed use in vertical dimension refers to buildings with different uses in different floors. Last but not least, mixed use in temporal dimension describes the phenomenon where a piece of land serves different uses at different times of a day. The authors further combine the dimension component with different geographical scales and urban textures.

In addition to the conceptual framework developed by Hoppenbrouwer and Louw (2005), Song and Rodríguez (2005) categorize various measurements based on three approaches to conceptualizing land use mixture: accessibility (or proximity), intensity (or magnitude), and

pattern (or arrangement). Accessibility is the degree to which mixed land activities are easy to reach by residents; intensity is the volume or magnitude of mixed land uses present in an area; and pattern is the way in which different types of land uses are organized in an area. The synthesis provides a more quantitative framework to measure the spatial organization and characteristics of mixed use. Nevertheless, the proposed measures are based on GIS data, and thus may fail to capture the design aspects of urban form created by mixed-use development, including mixing different uses vertically.

Table 3 compares the dimensions of mixed-use development and the corresponding geographical measurements. Most geographical measurements focus on the horizontal dimension of mixed-use. As for shared premises, it is more of a concern for internal architectural design rather than planning. However, measurements for the vertical dimension and time dimension are conceivably important but largely missing. Intensity only partly captures features of the vertical dimension. Moreover, all geographical measurements are static measures of land use and, therefore, fail to capture the dynamic time dimension of mixed-use development. As mentioned in the previous section, the emerging locative social media data offers an opportunity to capture the spatiotemporal patterns of activities, which could provide better measurements for the time dimension as well as other dimensions.

Table 3. Dimensions of Mixed Use versus Geographical Measurements

Dimensions	Geographical Measurements
Shared Premises	Internal design
Horizontal Dimension	Accessibility, Pattern, Intensity
Vertical Dimension	Intensity, Density
Time Dimension	Spatiotemporal patterns of activity

To summarize, the spatial and physical attributes play an essential role in contributing to the outcomes of mixed use. There are many practical documents as well as academic publications discussing this aspect of mixed use with different focuses. Some have focused on the spatial dimensions with a qualitative approach while others have proposed geographical measurements with a quantitative approach. However, each approach has its own limitations, and most geographical measurements focus exclusively on the horizontal dimension. New data sources, including government open data platform, commercial real estate database, locative social media data, provide opportunities to bridge the gap by better incorporating the vertical and time dimensions of mixed-use development.

2.3 Institution, Organization, and Development Strategy

As mentioned in the introduction, historically, mixed-use developments have been driven by various social, economic, and political forces in different time periods. Each force has influenced the decision of mixed-use development through different institutional arrangements, organization structures, and development strategies. Institution, according to North (1991), is the humanly devised constraints that define and limit the choice set of individuals and organizations. For example, zoning as a tool has long been used by the public agencies to regulate land uses. Organization, on the other hand, is the economic entities for mixed-use development. The process of mixed-use development can take different forms in terms of economic organization, ranging from clusters of small businesses to a single large corporation governing commercial complex buildings and department stores. Strategy is how organizations respond to the institutional constraints and interact with other organizations to achieve their goals. Mixed-use development strategies can be designed for several phases, including identifying ownership and partnership options, finding possible funding sources, and structuring financing (Schwanke and Flynn 2003). Real estate development companies choose different strategies in response to zoning requirements and market trends. Table 4 describes some examples of the institutional constraints, organization structures, and development strategies for mixed-use development.

Table 4: An Institutional Perspective of Mixed-Use Development

Institutional Constraints	Organization Structures	Development Strategies
<i>Formal:</i> Zoning, ordinances, guidelines, approval process	Large development corporation; small individual investors and developers	Ownership and partnership options, funding sources, financing structures
<i>Informal:</i> Market preferences and developer perceptions		

An institutional perspective that incorporates the above factors is essential to evaluate the outcome of mixed-use development, for three reasons. First of all, for any real estate development project, the structure of management and selection of financial tools have always been a key determinant of the types, forms, and sustainability and longevity of the project. Secondly, most mixed-use development projects involve multiple parties from private and public sectors. The result is increased complexity in its intra- and inter-organizational structures and contractual arrangement, which requires special attentions to the institutional aspects of a project. Thirdly, the institutional arrangement determines the distribution of externalities of mixed use. Externality is the cost or benefit that is not reflected in the monetary value of a transaction. Due to its heterogeneous nature, mixed-use development could generate either negative externalities between non-conforming uses or positive externalities that exceed investment return captured by developers and investors. A classic example of the positive externality problem is what Jane Jacobs has described as the self-destruction of diversity (1961). The mixture of local commerce

and residences created attractiveness and economic vitality which was an externality not fully internalized by the local businesses and residents. Such positive externality attracted large business companies that eventually led to a commercial gentrification and replaced the local commerce and residences. This example illustrates that ignorance of the institutional aspects of mixed-use development can undermine its sustainability.

Despite the aforementioned importance of institutions and development strategies, existing literature has remained relatively silent on this front. Nevertheless, evidences of their roles can be found in the history of mixed uses. Coupland et al. (1997) have examined the historical evolution of mixed use in British cities. In the pre-industrial era, without any formal zoning, the merchants used their own houses for a mix of trade and residence. In the 1870s and 1880s, with industrial growth and the emergence of health legislation, local planning policies tended to zone sites for a specific use and group them in the same geographical location to remove non-conforming uses. However, one century later, with increasing concerns about conservation and the need for a more human scale development, developers started to redevelop city centers by introducing a wider mix of activities. In the 1980s and 1990s, in order to regenerate former industrial areas, various government policy initiatives were crafted to support mixed-use development. Taking the opportunity created by the policy shift, Development Corporations introduced new uses through the refurbishment of buildings and through new constructions. As more and more of the social and economic benefits of mixed use were recognized, attitudes towards mixed-use development shifted from negative to positive in both public and private sectors. Since the 1990s, most mixed-use development projects have been invested and developed through public and private partnership.

Table 5: Major Institutional Changes of Mixed-Use Development

	Before 1860s	1860s to 1960s	1970s to 1980s	1990s to present
Institutional Settings	Minimal regulation on private land use	Zoning for single use	Zoning for single use; market trend for mixed use	Policy initiatives to support mixed-use development
Organization Structure	Individual merchants and developers		Development Corporations	Public agencies and private corporations
Strategy	Private financing			Public private partnership

Table 5 summarizes the major institutional characteristics of mixed-use development in different historical phases. The overall institutional environment has gone through a three-stage process of thesis, antithesis, and synthesis. It started from minimal regulations that allow mixed-use development, and then changed to zoning ordinances that prohibit mixed non-conforming uses.

Recently, it shifted back to an ideology that encourages mixed-use development. It is worth noticing that apart from the formal institutional constraints, informal market trends and preferences have played a role in facilitating the early commercial mixed-use development in the 1970s.

The structure of organizations that are responsible for mixed-use development have also changed along with the institutional environment. In the early stages, most mixed-use projects were invested and developed by individual merchants and property owners. As the real estate market became more developed and complex, the large and more specialized Development Corporations started to play the leading roles. More recently, public agencies have become the main advocates for mixed-use development and started to participate in the development process along with their private partners. With more involvement from the public sector, development strategy of mixed use has also transformed from private financing to more public and private partnership.

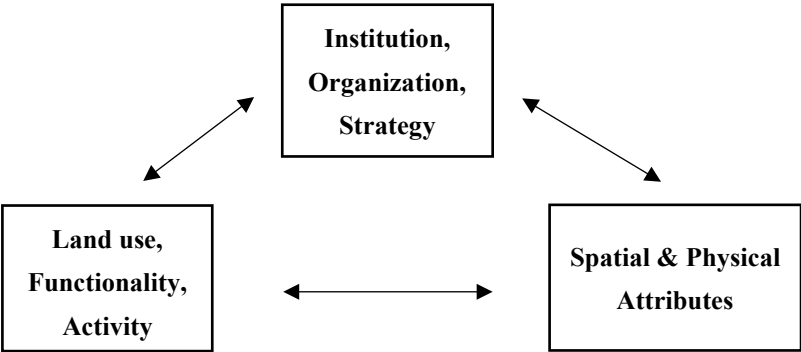
In review of the history, institutional settings, such as zoning ordinances by the government or trends and preferences of the market, define the game rules for mixed-use development. On the one hand, in response to the game rules, investors and developers from public and private sectors form different organizational structures and utilize different strategies correspondingly to achieve their own goals. On the other hand, institution may also change to adapt to the organizations and strategies. All the factors jointly lead to the emergence of mixed-use development, shape its forms and types, and determine its success or failure. An institutional perspective helps to disentangle these factors and understand how they interact with each other.

2.4 An Integrated Framework

Although discussed separately, the three dimensions of mixed-use development are interrelated and should be integrated in one conceptual framework. Figure 1 shows the relationship of the three dimensions of mixed-use development. First of all, driven by different institutional forces, mixed-use development is adopted for different purposes and in different forms in various historical scenarios. Public agencies make policies and plans that encourage mixed use to promote sustainability and economic vitality and, in some cases, to provide affordable housing. For private developers, they undertake mixed use schemes either to comply with certain requirements or regulations by the government or to capitalize on market preferences at that time. On other occasions it is because the preservation of all or part of the development site restricts the possibility of major change, and makes a mix of uses the most viable option. In some examples, the land-owners control the choices for development, and want to see a particular mix of activities.

It is worth noticing that the relationships between institutions and the other two dimensions are not unilateral. While the former determines the latter, the later can also affect the former in many cases. For example, the need for industrial land redevelopment has led to policy initiatives that encourage mixed-use development. Moreover, for each type of mixed-use development, there is only a limited set of suitable institutional arrangements. For instance, in the process of the redevelopment, the physical configuration of the historical site and the uses to be introduced to the existing buildings should determine the selection of development policy and agencies. As illustrated in Jacobs’s (1961) case of the self-destruction of diversity, the mismatch of the institutional arrangement could undermine the sustainability of mixed-use development, and eventually hinder its success in the long term.

Figure 1: The Interrelationships of the Three Dimensions of Mixed-Use Development



To summarize, this part of the paper provides a synthesis of the past efforts in conceptualizing mixed-use development in practice. In review of the existing documents and literature, some gaps can be identified. First of all, mixed-use development is a complex process affected by multiple social and economic factors. However, many studies have simplified such a process by only focusing on one aspect, typically the physical configuration of mixed use. While such an approach helps to narrow down the research questions, it limits the application of research findings in practice.

Secondly, there is a disconnection between the theoretical framework of mixed use and the actual measurement of mixed use. On the one hand, many theoretical frameworks are proposed based on case studies and qualitative analysis, but have not been tested empirically. On the other hand, existing literature on the measurement of mixed use have been mostly driven by the available data and methodologies, but have made limited references to the existing theoretical frameworks. The disconnection has constrained the ability to translate some of the research findings into a more general understanding of mixed-use development. Besides, in the evaluation

of mixed-use development, without proper measurements, it is impossible to quantitatively monetarize the benefits and costs.

Thirdly, though mentioned in studies of the history of mixed-use development (Hart 1996; Coupland 1997), the role of institution has not been explicitly and structurally elaborated in the past literature. As illustrated in this paper, institution determines the types and forms, the sustainability and longevity, and the allocation of impacts of mixed-use development. To take an institutional perspective is to understand the process of mixed-use development through its formal and informal institutional constraints, organizational structures, and development strategies. Due to the heterogeneity of land use and the multiplicity of development process, mixed-use development is constrained by regulations from the government and preferences and perceptions from the private sector. Moreover, compared with other types of development, it involves multiple party engagement and complex contractual arrangements. As a result, to better conceptualize mixed-use development requires more efforts in incorporating its institutional aspect into the economic analysis.

In response to the above gaps, this paper provides a conceptual framework by grouping the different aspects of mixed use into three main categories, namely, the functionality and activity dimension, the spatial and physical dimension, and the institutional dimension. This framework is intended to provide a theoretical foundation for our next step, which is to apply economic theories to evaluate the benefits and costs of mixed-use development.

3. Economics of Mixed-Use Development: Formation and Evaluation

Mixed uses have both advantages and disadvantages. Some of them are definite (e.g. attractiveness and diversity; requirement for active management of property) whereas others possible (e.g. reduction in travel; conflict between activities, such as noise and smell) (Coupland 1997). The advantages and disadvantages of mixed-use development introduce tradeoffs within a development project and externalities at street, neighborhood, or even city level. Existing literature that examines these tradeoffs resolves into three groups, which can be distinguished by the spatial scale of their analytical units and modeling approaches. The first group, rooted in the school of neoclassical economics, tries to identify the overall optimal equilibrium condition of a land use market with the presence of mixed uses at the city level. The second group focuses on the externality of mixed uses on proximate properties at a neighborhood level, with the hedonic model as the most common modeling approach. The third group, mostly conceiving the research question from a developer's perspective, evaluates the investment and return at a project level. This part of the paper provides a critical review of each analytical approach.

3.1 City Level: Equilibrium with Agglomeration and Congestion

The neoclassical economics of land use can be dated back to Alonso's (1964) rent bid theory, in which land price falls gradually from the urban center to the periphery in a monocentric urban configuration. In such a theoretical setting, at each location the land is occupied by the use that yields the highest rent price, and therefore no mixed use is possible, given that different land use types are assumed to produce different rents for any location. While the model may explain the land use pattern in the 1960s, it has been challenged by the increasing number of mixed-use projects ever since. To explain the new phenomenon of mixed-use development, economists have made several revisions and extensions to the original model.

Fujita and Ogawa (1982) examine a model with multiple equilibria and structural transition of non-monocentric urban configurations within the framework of the static microeconomic theory. The paper starts with a critique of the traditional monocentric urban model by stating that a more satisfactory model would yield a spatial structure of the city in which the locations of households and firms are endogenously determined, without assuming the location of either a priori. In their proposed model, the city is treated as a linear city, and economic activities in the city are assumed to be generated by two types of actors: households and business firms. Households supply labor to business firms, and conversely, business firms pay wages to households: such activities may be called the between-sector interactions; business firms interact with each other and obtain agglomeration economies: these activities may be called the within-sector interactions. In addition, activity units in both sectors compete for land (for residential and production use); this competition involves both between-sector and within-sector interactions. These simultaneous interactions take place through labor and land markets driven by the utility maximizing behavior of household and profit maximizing behavior of firms under budget constraints.

After analyzing the conditions of solutions in terms of parameters, numerical explorations are carried out to investigate the specific properties of solutions. Monocentric, completely mixed, incompletely mixed, duocentric, and tricentric urban configurations are analyzed. To compare equilibrium and optimum urban configurations, the paper calculates the total net land rent corresponding to each urban configuration. The results show that it is possible for each urban configuration to dominate depending on the value of exogenous parameters, including the amount of land and labor, number of identical households, and the lot size of each household.

Fujita and Ogawa's paper concludes that the configuration of a city may experience a structural transition when the exogenous parameters dramatically change. The changes may include decreases in the time and cost of commuting, increases in income, or population change. Because

of the emergence of these changes in cities, the conventional monocentric city assumption needs to be reexamined.

In tandem with the above study, Anas and Kim (1996) apply a general equilibrium model to simulate urban land use change in a polycentric city configuration. An urban structure with completely mixed land use is compared with other polycentric structures. Three types of agent, consumer, firm, and transport sector, are simultaneously considered and combined into a general equilibrium formulation. The transactions between firms, as well as between firms and consumers, generate commuting, shopping, and inter-industry freight trips. Traffic congestion and scale economies in shopping are introduced as key variables.

The paper then tests two cases of the general model for a bounded linear city where only one commodity is produced. In the first case, there are no scale economies in shopping and no inter-industry trade. The equilibrium land use pattern shows a monocentric configuration where rent, wage, and commodity price gradients all peak at the center of the linear space. In the second case, scale economies in shopping are in presence. Depending on the relative power of scale economies to the level of traffic congestion, alternative equilibria can emerge where both monocentric and polycentric concentrations of production are possible. When traffic congestion is relative high, a polycentric configuration becomes dominant since reducing average travel cost has higher marginal benefit than increasing agglomeration in production. When the level of congestion is relatively low, a monocentric urban configuration of production yields the highest welfare.

In a more recent study, Kantor and Ommeren (2014) introduce a traffic congestion external effect to the bid rent models elaborated by Fujita and Ogawa (1982) and Lucas and Rossi-Hanseberg (LRH model) (2002). They demonstrate that the presence of this external effect may result in a general type of mixed residence-business land use zone. The introduction of congestion does not invalidate the LRH model feature of the existence of an equilibrium urban structure. This equilibrium structure can exhibit any composition of residences and firms, including classical single use zones (labeled hereafter pure zones), balanced mixed zones, and dominated mixed zones. The theory illustrates how an improvement in road capacity (and the resulting congestion reduction) leads to greater concentration of employment, which, in turn, increases productivity through agglomeration.

Apart from the above studies that try to examine the formation of mixed uses, other economics studies have used mixed use as a part of the modeling assumptions. Observing that in American cities employment is almost as dispersed as residents, Wheaton (2004) introduces mixed land use to model dispersed employment. In a market equilibrium with firms making tradeoffs between central-agglomeration benefits and peripheral-location lower wages due to shorter commutes,

land use can be mixed at any location. It is shown that when the agglomeration force is relatively weak, a fully dispersed employment pattern results. McDonald (2009) estimates a monocentric city model with mixed land use and congestion. The main finding of his study is that a large urban area of 1950s characteristics, with mass transit and decentralized employment but a dominant CBD, is estimated to have had a population density pattern deviated from the theoretically efficient pattern that requires more residents to have been centrally located. Subsequent simulations show that public policies, such as encouraging transit use for commuting and charging congestion tolls during the peak hours, can reduce the required amount of population redistribution to achieve an optimum pattern.

Table 6: Economics of Mixed-Use Development at the City Level

Analytical Approach	Bid rent model
Evaluation Criteria	Total social welfare measured by total rent/profit and utility at equilibria
Benefit of Mixed Uses	Agglomeration economies
Cost of Mixed Uses	Congestion
Impacting Factors	Urban configuration, travel cost, population and employment distribution, public transit service and congestion tolls

In a nutshell, in order to address mixed uses, several extensions have been made to the neoclassical bid-rent model. Congestion and local firm agglomeration are the most common mechanisms used to explain the emergence of mixed uses. Other studies (e.g. Wheaton 2004) simply assumes that mixed use exists and different uses occupy a geographical location in proportion to land rent instead of deterministically by the highest rent. In terms of evaluation, one common approach within the economic framework is to examine the total welfare at the optimum or equilibria. However, few studies evaluate the welfare directly through the model simulations; some suggest conditions that may lead to optimum based on indirect model implications. Road network, transit, household and firm distributions are common factors identified in those studies. Although some of the conclusions are intuitive, the model outcomes may need further validations since none of the above studies calibrates the initial external parameters based on empirical data. Table 6 summarizes the evaluation of mixed-use development at the city level.

3.2 Neighborhood Level: Externality on Housing and Property Value

Different from the above literature that focuses on the city level, the second group of literature examines the effects of mixed uses at the neighborhood level, mainly considering the

externalities. One of the early publications is Cao and Cory's (1982) article, which applies a hedonic model to test the positive and negative externalities of mixed uses on the values of surrounding properties. The principal implication of the model specification is that the effect of non-residential activity on residential property values depends on the relative strengths of the associated positive and negative externalities. The empirical test of the model was conducted for the city of Tucson, Arizona, where it is shown that increasing the amount of industrial, commercial, multi-family, and public land uses in a neighborhood was associated with higher values of surrounding residential properties. The paper then concludes that, in locating future economic activity, an optimal mix of land uses should be sought.

Similar to the above study, Song and Knaap (2004) estimate the effect of proximity to mixed land use on housing values using GIS data for Washington County, OR. The paper defines five types of mixed land uses, namely, neighborhood commercial stores, multi-family residential units, light industrial sites, public institutions, and public parks. Four measures of land mixture are applied: proximity to non-residential land uses, proportions of each non-residential land use, mixture entropy, and relative balance between employment and population within each TAZ. The association between each land use mixture measure and house value is tested in a separate model. While the models with proximity to public parks or commercial land uses and proportion of these land uses within neighborhood show positive effects, the model using the entropy measure yields a negative coefficient, indicating that house value is higher when single-family residential land use is the dominant use in the neighborhood. The study shows that the measurement of land use mixture can affect the evaluation of its effect on property values. However, the study only focuses on single-family units, and there is no exploration of mixtures within one property.

Mixed land use is widely recognized as a common characteristic of transit-oriented development (TOD), and therefore is frequently employed as a variable for assessing the effects of TOD on property values. For example, Shen et al. (2018) examine house price variations in proximate locations of TOD projects built next to four major nodes of the public transit network in the Seattle metropolitan area. Estimating hedonic models that include several measures of land use mixture among the explanatory variables, their regression outcomes indicate that the entropy measure is not statistically significant in predicting housing price. However, their results also show that distance to commercial land is positively associated with house price, suggesting undesirable effects of being close to commercial activities, whereas distance to park has a negative coefficient, which validates the value of proximity to leisure and recreational space.

Additional insights into the neighborhood effects of mixed uses are obtained by Turner (2005), who examines the externality of open space on land prices. Building a dynamic model with sequential arrivals of developers, the study shows that, compared to the static model where

equilibrium land prices reflect the value of open space, equilibrium land prices in the dynamic model do not. As a result, the author concludes that hedonic analyses of housing prices are only reasonable if developers simultaneously arrive. The author explains that the result only applies to those land transactions which set the patterns of development that are to be followed by future development.

Other studies, including the work by Minner and Shi (2017), investigate the effects of mixed uses on local businesses. Prior research on adaptive reuse along commercial strips indicates that as these areas become entertainment destinations, they become more economically desirable for developers due to proximity to restaurants, bars, and retail (Minner 2013). In the more recent study, Minner and Shi find a statistically significant association between new mixed-use projects and existing local business clustering, although the spatial relationship does not appear to be a linear function of proximity. The result suggests that while clusters of remodeled local retail and restaurants may increase the desirability of a commercial strip for redevelopment, the size and configuration of redevelopable parcels and the regulatory context (e.g. zoning regulations and incentives) likely also play significant roles.

Table 7: Economics of Mixed-Use Development at the Neighborhood Level

Analytical Approach	Hedonic model
Evaluation Criteria	Externalities on proximate land value
Benefit of Mixed Uses	Proximity to open space and other functionalities
Cost of Mixed Uses	Proximity to nonconforming uses
Impacting Factors	Land use compatibility, development process, institutional regulations, lifestyles and preferences

In sum, a second group of literature evaluates the externalities of mixed-use development on proximate property values, with the hedonic model as a common analytical approach. The studies find that mixed use can have both positive and negative effects, depending on the compatibility of different uses. For example, proximity to open space tends to have a positive effect on housing value (Turner 2005; Shen et al. 2018). Besides, the presence of mixed uses of retail and services tends to trigger commercial redevelopment (Minner and Shi 2007). On the contrary, mixed uses in a residential neighborhood that causes the dominance of single-family units to diminish could have a negative impact on the housing values (Song and Knaap 2004). In addition to land use compatibility, studies suggest that institutional regulations (Minner and Shi

2017) and development process (Turner 2005) play significant roles in determining the outcomes of mixed-use development, which corresponds with the discussion on the institutional aspect in an earlier part of this paper. However, none of the above studies has integrated the institutional aspect into the modeling framework. Table 7 summarizes the economic evaluation of mixed-use development at the neighborhood level.

3.3 Project Level: Risk Allocation and Investment Return

In the US, the UK, and Europe, property investors and developers have played an important role in shaping the land market. Yet, in the discussion of the economics of mixed-use development, only a small number of studies explore the incentives and rationales of these market agents in the development processes (Coupland 1997; Irwin and Bockstael 2004). Instead, most existing studies either arbitrarily assign a profit-maximizing behavior to the economic agents, which is common in the city-level models, or ignore their role, which is often the case in the neighborhood-level empirical analyses. Nevertheless, aside from the many perceived secondary social and environmental benefits of mixed-use development, the direct return on investment constitutes a primary part of its economic benefits. Thus, understanding the underlying rationale of developers is crucial for guiding mixed-use projects.

Despite the growing popularity of mixed-use development as a strategy for sustainable development, investors and developers in the past have generally avoided such projects (Coupland 1997). This is because investors, from international development corporations to local estate holders and individuals, are often conservative in assessing risk. For them, different tenants have different needs and expectations, which are often manifest in disagreements about service charges. Placing these different demands in the same area increases management responsibilities and thus costs. Since mixed-use schemes reflect a higher risk than a single use, they are often secondary and more likely to be found in non-prime, fringe locations. Risk in pursuing such schemes must be largely internalized by the owner and/or developers. Under such a rationale, a mixed-use development project is only pursued to spread risk among different developers if the initial risk for a single use is relatively high (Coupland 1997).

There are a number of factors that affect the risk of a particular mixed-use project. For example, the Urban Land Institute has suggested a list of positive and negative attributes relative to each potential use in the evaluation of a site. The list includes: proximity to adjacent land uses and nearby activity centers, access and visibility to transport, the physical attributes of the site itself, available services, land use controls, social and political issues and sensitivities, potential uses, landownership, and land cost in relation to the above factors (Schwanke and Flynn 2003). In addition to professional guides, Irwin and Bockstael (2004) have developed a hazard rate model to investigate the factors that affect the optimal timing of development. The study examines

spatial varying policy variables, spatial features (accessibility to urban centers, soil quality, and size), interactions among neighboring landowners' land use decisions due to land use externalities. The results suggest that the restriction on the minimum lot size has a positive and significant effect on the timing of development. Besides, parcels with more nearby undeveloped and medium-density land will be developed sooner, suggesting that there are positive effects associated with both undeveloped land and higher density residential development. The model outcomes provide an empirical evidence of interdependencies among neighboring landowners that influence the timing and pattern of land development.

DeLisle and Grissom (2013), based on an empirical study in Seattle, conclude that understanding the demand of the most likely tenants and the experience of the current and past tenants may be extremely important to locate, design, and develop mixed-use projects that create sustainable solutions in a financially viable way. Tenant composition in mixed-use buildings has significant implication for the design of such buildings as well as how they function in the market. However, projects are sometimes developed without an understanding of these specialized needs and mismatch between the product and the most likely space users is created, which may require difficult and expensive retrofitting. An example of this mismatch is that tenants with health problems are unable to use their "local" health services because of the current state of the health care system. Instead, other patients from outside the market area will often rely on automobiles for travel to the area, creating an extra demand for parking.

In addition to building design and services, tenant experiences can vary by its own category and subcategory. For example, the construction sector as tenants has the highest turnover rate, followed by personal service, professional service, restaurant and retail. Tenant experiences can vary by neighborhood as well. Dense urban areas serve commercial spaces in mixed-use projects the best since they provide a critical mass of customers; axial markets that extended along major traffic corridors can also attract mixed-use projects, but may have higher turnover rates due to a lack of efficient customer flow. Although the study provides insights on factors that affect the efficacy of mixed-use development at the project-level, it raises more questions than it could answer. Moreover, the impacting factors are identified via very basic empirical analysis, and therefore require further validation with more advanced economic models.

Table 8: Economics of Mixed-Use Development at the Project Level

Analytical Approach	Market analysis
Evaluation Criteria	Investment return, turnover ratio, vacancy ratio
Benefit of Mixed Uses	Spread of risk, commercial agglomeration
Cost of Mixed Uses	Higher risk to attract single use
Impacting Factors	Tenant composition and demand, site constraints and features, neighboring land uses and services, zoning, economic organization

Table 8 summarizes the evaluation of mixed-use development at the project level. Market analysis, including site evaluation, portfolio analysis, and investment return calculation, is the common analytical approach to evaluate the economic performance of mixed-use development. Perceived investment return, or profit, is the direct economic benefit of mixed-use development and a key factor that drives the investment decision of investors and developers. Other indicators used to measure the performance and risk of mixed-use projects include turnover ratio and vacancy ratio. It is worth noticing that what drives an investment decision is not the total risk of developing the project but instead, the risk internalized by the investors and developers. Unless mixed-use scheme is part of the policy requirement, developers may choose to avoid mixed-use development if they have to internalize most of the risk in the interim. Besides, in a free land market with individual developers, developing decisions can generate external risk to the neighboring landowners, and therefore influencing the timing and pattern of land development. The allocation of risk raises questions to the role of various economic institutions in the process of mixed-use development. While investors and developers are driven by profit, not all mixed-use projects have economically desirable outcomes. In review of existing professional documents and academic publications, a list of factors, including tenant composition and demand, site constraints and features, neighboring land uses and services, and spatial varying policies, has been identified to affect the success of a development project.

3.4 A Critique of the Existing Analytical Approaches

Hitherto literature that attempts to explain the formation of mixed uses and evaluate the associated economic outcomes revolves into three groups, which are distinguished by the different spatial scales of their analytical approaches. Table 9 lists the principal criteria that are applied to evaluate outcomes and common impacting factors at each spatial level. The standard neoclassical bid-rent approach typically theorizes the process of land development in a model of city scale, and thus draws policy implications based on the total social welfare derived from equilibrium conditions (Fujita and Ogawa 1982; Lucas and Rossi 2002; Wheaton 2004; Kantor et al. 2014). On the other hand, most researchers from the planning field, and some from

economics and real estate, mainly focus on the impact of mixed-use development on the economic, social, and environmental externalities at the neighborhood level (Jacobs 1961; Cao and Cory 1982; Song and Knaap 2004; Minner and Shi 2017; Shen et al. 2018). The third group of studies, undertaken largely by real estate professionals, evaluates the efficacy and success of mixed-used development based on the profitability and perceived risk of a project (Schwanke and Flynn 2003; DeLisle and Grissom 2013). Each group identifies a separate set of impacting factors, ranging from urban configuration to tenant composition, which may affect the outcomes of mixed-use development.

Table 9: Evaluation of Mixed-Use Development at Different Spatial Levels

	City Level	Neighborhood Level	Project Level
Principle Criteria	Total social welfare	Externality	Profitability and risk
Impacting Factors	Urban configuration, travel cost, population and employment distribution, public transit and TDM policies	Land use compatibility, development process, institutional regulations, lifestyles and preferences	Tenant, site constraints and features, neighboring land uses and services, spatial varying policies, economic organization

Although each approach provides some insights that may guide future development, there is a lack of linkage between evaluations at different spatial scales. The spatial disconnection among these different analytical frameworks presents two problems. The first problem is the limited transferability of the findings from one group of literature to another. On the one hand, while the economic models at the city level help to conceptualize mixed land use in theory, they can hardly be utilized to craft guidelines for mixed-use projects. On the other hand, empirical studies at neighborhood and project levels based on local data and practical experience are rarely examined with conceptually rigorous economic models, which limits the generalization of the findings. The second problem is the inconsistency in criteria and findings from different analytical frameworks that may lead to contradictory policy implications. This is because the outcome that is desirable at one level may not be desirable at another. For instance, profitability is a desirable feature at the project level, but a project that yields the highest profit may generate negative externalities to proximate lands, and therefore can be undesirable at the neighborhood level. One example is the case of the self-destruction of diversity (Jacobs 1961). Although a large-scale commercial mixed-use project in an economically vibrant neighborhood would yield high investment return at the project level, it may lead to the destruction of diversity in the whole neighborhood by raising the rents that tenants of other small businesses cannot afford.

Aside from the spatial disconnection, the majority of existing literature adopts an uncritical neoclassical economics perspective, assuming free market conditions and rational agents, which leaves the role of institution and organization in the process of mixed-use development under-examined. Yet, though often illustrated as a side note, the significance of institution and organization in shaping the types and forms of mixed uses can be still recognized from professional documents and academic publications (Jacobs 1961; Coupland 1997; Schwanke and Flynn 2003; DeLisle and Grissom 2013; Minner and Shi 2017). Institution and organization affect mixed-use development in three aspects. First and foremost, institutional constraints, including formal regulations and informal market preferences, define the choice set of mixed-use development (North 1991). In different historical periods, developers and investors make decisions of building or not building mixed-use projects, where to locate the projects, and how to plan, design and build the projects under a set of formal and informal institutional constraints to achieve their own objectives and goals. Without an understanding of these institutional constraints, the assumptions of the economic mechanism of mixed-use development are incomplete and inaccurate, which may result in misleading interpretations of evaluation outcomes.

Secondly, institution and organization determine the allocation of costs and benefits. Mixed-use development is widely advocated by policy makers and planners for its secondary economic, social, and environmental benefits (DeLisle and Grissom 2013). While a number of studies have examined the presence of these secondary benefits (Jacobs 1961; Cervero 1996; Tong and Wong 1997; Brown et al. 2009), few of them have evaluated how these benefits are distributed at the neighborhood level. Without the awareness of the distributional effects, public policy initiatives and investment decisions driven by an overly optimistic view of mixed-use development could lead to projects that only benefit a small group of stakeholders and produce inequitable social outcomes. On the other end of the spectrum, from developers' perspective, the allocation of costs and benefits also affect their investment decisions. The decision to invest in a mixed-use project depends not only on the potential risk, but also on how much risk is internalized. An effective institutional arrangement of public and private partnership can help to spread the risk, and thus encourage private investors and developers to adopt a mixed-use scheme. However, it requires a deeper examination of the role of institution and organization in the development process in order to achieve the most appropriate arrangement that both provides incentives for private developers and protects public interests.

Thirdly, within a project, institution and organization help reduce uncertainty and alleviate risk, and thus facilitate the sustainability and financial viability of a project. In contrast to the assumption in neoclassical economics that every agent in the market is completely rational and provided with perfect information, in reality, developers and investors only possess partial information and bounded rationality, which gives rise to different types of uncertainty and risk

including opportunism and contractual hazards (Williamson 2002). To minimize the uncertainty and risk, firms are formed (Coase 1937) and contracts are sought (Spiller 2008). Mixed-use development, with heterogeneous services and multi-party partnership as its common features, involves various forms of vertically integrated firms and relational contracts. At a given location, for each type of mixed-use project, defined by category of economic functions and scale of a project, only a limited set of contractual arrangements and a defined level of vertical integration can best serve the objectives. Other institutional alternatives may lead to less-than-optimal outcomes where the projects can suffer from extra construction and management cost or fail to capture the full benefits.

Table 10: The Role of Institution and Organization at Different Spatial Levels

	City Level	Neighborhood Level	Project Level
Formal and Informal Constraints	✓	✓	✓
Benefits and Costs Allocation		✓	✓
Uncertainty and Risk Alleviation			✓

Table 10 illustrates the role of institution and organization at different spatial levels. At the city level, institution acts as economic constraints via formal policies and regulations and informal social norms and market preferences. At the neighborhood level, the formal and informal constraints still exist, although most of them become exogenous factors, which, joint with organization structures in the development process, affect the allocation of benefits and costs. At the project level, under the external constraints and existing allocation mechanism, developers choose from alternative organization structures and contractual arrangements to reduce uncertainty and alleviate risk in pursuit of their objectives. Table 10 illustrates the multiplicity and heterogeneity of the institutions that make up the economic process of mixed-use development (Clemens and Cook 1999), which becomes most apparent at the project-level.

To summarize, two major limitations exist in the existing economic studies of mixed-use development. The first is a disconnection between evaluations at different spatial levels, which limits the ability to generalize findings and translate them from one level to another, and leads to inconsistency in evaluation criteria and associated implications. The second limitation is the lack of consideration of the role of institution and organization due to the uncritical adoption of a neoclassical economics perspective. The under-examination of the institutional features deviates the analytical assumptions from the real-world practice and undermines the ability to understand the distributional effects of mixed-use development at the neighborhood level and the factors affecting its efficacy at the project level. To bridge the gap between existing literature and real-world practices requires expansions in conceptual and methodological frameworks of the existing approaches as well as the adoption of alternative perspectives and the development of

new analytical approaches. The next section of this paper will discuss some potential directions for these future efforts.

4. Towards New Analytical Approaches

To satisfactorily answer the question of what makes mixed-use development economically desirable, both expansions of existing frameworks and new perspectives are needed. Expansions can include adding new variables and measurements to the existing models as well as developing new models to build a connection between micro-individual behavior and macro-spatial pattern. In terms of new perspectives, this paper suggests transaction cost economic theory as an alternative approach to understand and evaluate mixed-use development.

4.1 Expansions in the Existing Frameworks

For future empirical studies on mixed-use development, in order to better connect research with practices, a more comprehensive selection of impacting variables and better measurements of mixed uses are needed to refine the existing modeling approaches. First of all, in terms of the selection of variables, most existing empirical studies ignore the institutional factors that make up the economic process of mixed-use development, due to the adoption of a neoclassical economics perspective. The selection of variables in future studies should reflect this missing piece of institutional aspect of mixed-use development. Literature in the field of new institutionalism and organizational science can help provide guidelines to identify useful variables (Scott 2004; Warner 2015).

Secondly, measurements of mixed uses in most existing empirical studies, which were developed and adopted in the past, may not be able to reflect the new features of mixed uses. One example that is commonly observed in cities today is the vertical mixed uses in high-rise buildings, which cannot be effectively captured by the conventional indicators of mixed uses. To measure mixed uses more accurately requires a better inventory of real estate data combined with more advanced spatial statistic methods. Besides the difficulty in capturing the vertical dimension of mixed uses, most measurements are static based on land use data at block or parcel level, which do not reflect the dynamic pattern of activities in a given space. Moreover, the diversity of mixed land uses can be best measured by the distribution of activities across both space and time (Jacobs 1961). The emergence of locative social media data and mobile phone data opens up new possibilities to measure the spatiotemporal patterns of human activities. An example is the recent study by Miranda et al. (2016), which explores urban pulse at different temporal resolutions using Flickr data.

Besides new variables and measurements, another way to advance the current state of research is to develop new modeling approaches. As identified in the critiques, a key limitation in the existing analytical framework is the disconnection of modeling approaches across different spatial levels. There are two potential modeling solutions to overcome this problem. The first is to integrate the multilevel modeling approach with a hedonic model specification. A multilevel model is a statistical model with parameters varying across more than one level. Orford (2000) has tested this approach to incorporate the spatial structure of housing market dynamics using price data from Cardiff. The paper develops a multilevel hedonic model specification with one micro-model and two macro-model to capture the three levels of housing price variation. The first macro-model calculates the contribution of each level to the total variance in house price across all levels. The second macro-model estimates the impact of the structural attributes of sub-markets on this variation. The micro-model estimates the effects of the locational attributes in each sub-market. A procedure of an iterative generalized least-squares algorithm is used to estimate the model.

The second modeling solution is to introduce discrete choice modeling to the existing analytical frameworks. A discrete choice model describes, explains, and predicts an agent’s choice between two or more discrete alternatives, such as choosing between modes of travel. Different from the hedonic model, a discrete choice model assumes that developers make discrete choices about a mixed-use project, rather than continuous choices about characteristics of the development project. There is a number of areas in the research of mixed use where a discrete choice model can be applied to. To begin with, discrete choice modeling can be simply used to identify the factors that affect developers’ decision of undertaking a mixed-use project. The result can help to fill in the gap between practice and economic theory by explaining the emergence of mixed-use development from a behavior perspective. The estimations from the micro-behavior model can then be applied to an agent-based model to explore how agents with heterogeneous behaviors at a micro level form the spatial pattern at a macro level. For example, Waddell (2007) uses discrete models to simulate land use pattern created by the interactions among households, businesses, developers, and governments. However, the simulation does not predict mixed-use development. As a result, further research based on economic theories and real practices is still needed to better represent agent behaviors to simulate real-world pattern. Table 11 summarizes the possible directions to refine the existing approaches.

Table 11: Possible New Directions for Existing Approaches

	Existing Approaches	New Directions
Variable Selection	Geographical and functional	Institutional
Variable Measurement	Horizontal and static	Vertical and dynamic
Modeling Approach	Unilevel of space	Multilevel of space

4.2 A Transaction Cost Economics Approach

Although the new measurement and modeling approaches described above can help to incrementally advance the understanding of mixed-use development, they do not address the limitation embedded in the neoclassical economics framework, which overlooks the institutions that make up the economic process of mixed-use development. To fill in the gap, this paper introduces transaction cost economic theory as an alternative approach to the conventional neoclassical economic theories to explain and evaluate mixed uses.

Transaction cost economic theory (TCE) can be traced back to a series of developments between 1930 and 1970 in the fields of economics (Commons 1932; Coase 1937; 1960; Simon 1951; Arrow 1969), organization theory (Simon 1957), contract law (Llewellyn 1931; Summers 1969), and business history (Chandler 1962). Later, TCE is formalized and extended by Williamson (1976; 1985; 1999; 2000). Compared to the classical and neoclassical economic theory, which represents the science of choice, TCE focuses on contracts as basic analytical units. The neoclassical economics by default assumes a large number of suppliers and consumers in a market with free flow of information and entirely rational agents. Thus, it is all about consumers making choice to maximize their utility and firms making choice to maximize their profits, with the cost of intermediary input to be the only cost considered. However, in the real world, this is not the case because, first of all, most economic activities do not take place in an ideal theoretical equilibrium condition. Instead, economic activities are carried out through different types of transactions with relational contracts and under institutional constraints. Moreover, as all humans suffer from bounded rationality and opportunism, no contract is complete, which gives rise to a cost associated with the transaction itself. Sometimes the cost is allocated to the parties in the transaction as future hazards and ex-post costs, in other cases the cost is paid by third parties outside the transaction as externalities. TCE is an analytical framework to understand the sources of those costs and to minimize them before we make decisions.

There are two pillars in TCE, whose attributes jointly determine the cost of a transaction. The first is transaction features and the second is institutional settings. For transaction features, the key attribute is asset specificity, which is the investment in specialized labor, capital, technology that cannot be transformed into other production activity without cost. Other attributes include uncertainty and frequency of transaction. For institutional arrangement, incentive intensity, administrative controls, and contract laws are the most important attributes. It is important to notice that a study with the transaction cost economic theory is always about comparing one transaction scheme with alternative approaches while holding the type and quantity of goods or services of the transaction as constant.

Hitherto there are several attempts to introduce transaction cost economic theory to the planning field. A most relevant study to the economics of mixed-use development is by Webster and Lai (2003), who discuss how property rights and transaction costs influence the spatial organization of a city. The authors first use bid-rent theory to demonstrate the spatial formation within a city. They argue that the bid-rent model oversimplifies the relation of activities in space; the model falsely assumes perfect competition, perfect knowledge, and negligible transaction costs. The authors then explain transaction costs as the cost of searching for exchange or combination partners, making and policing multi-party contracts, and handling third party interests. However, this is a relatively narrow understanding of TCE within the neoclassical framework, which leads to a search for a market solution for the various problems created by the market itself.

Another discussion of TCE is offered by Alexander (1992), who not only introduces the theory into the planning field, but also attempts to extend the approach from private organizations and economic transactions to public organizations and activities in the political market, and from single organizations to inter-organizational systems. The author sees the public sphere as transaction-specific assets. The local government’s master plan is intended as a frame of reference for its own as well as its residents’ and firms’ location and investment decisions, and for coordinating these decisions in a way the market cannot. This quasi-hierarchical system of public agencies, households, developers, and other interests has come into existence because of the prohibitively high transaction costs in a market of idiosyncratic transactions. Planning, therefore, becomes necessary as part of the response to high market transaction costs and is a property of nonmarket forms of organization. Thus, the real questions are whether the transaction costs of market forms of collective decision making – economic or political – are sustainable and whether the results of such collective decisions are desirable. To plan or not to plan, therefore, is not a decision related to the public intervention; rather, it is a choice between more market-like forms of organization and aggregation of collective decisions, or more hierarchical organizations or inter-organizational systems and the planning that goes with them.

Table 12: Evaluation of Mixed-Use Development with the Transaction Cost Economic Theory

Analytical Approach	Comparative analysis
Criteria	Transaction cost (future hazards, ex-post cost, and externalities)
Impacting Factors:	
<i>Institutional features</i>	Incentive intensity, administrative controls, and contract laws
<i>Organization features</i>	Market-like form versus Hierarchy of collective decisions
<i>Transaction features</i>	Asset specificity, uncertainty, frequency of transaction

Table 12 summarizes the evaluation framework of mixed-use development from a perspective of TCE to answer the question of what makes mixed-use development economically desirable. As mentioned above, TCE is always implemented within a comparative analytical framework, comparing one approach with alternative approaches. For example, Whittington (2012) implements the framework of TCE with a comparative analysis of two very similar highway overpass projects - one design-build and the other bid-build - to evaluate the details of partnership cost-effectiveness for public infrastructure. The approach reveals tradeoffs between different types of partnerships and the transfer of risk from one party to another. Similar comparative analytical framework can be applied to the evaluation of mixed-use development. One example is to compare the efficiency of different arrangements of institutions in providing similar functionalities and achieving similar objectives. Another example is to compare the outcomes of different mixed-use projects with a development process driven by similar institutions. Concepts and typologies developed in this paper can help to categorize functionalities and activities, spatial attributes, and institutional variables of mixed-use development.

5. Conclusion

Mixed uses are widely advocated by planners and commonly observed in cities. However, the urban economic literature remains relatively silent in this topic area, with only a small number of studies discussing its formation and economic outcomes at a highly abstract level. To identify the existing gaps and provide directions for future research, this paper first clarifies the concept and typology of mixed-use development in practice, and then critically reviews the literature that attempts to bridge theories and practices. In the review of past literature and professional documents, the paper concludes with the following principle findings.

First of all, mixed-use development is usually defined as a project or a geographical area with two or more primary revenue-generating land uses. The definition is single dimensional with a narrow focus on static land uses, and therefore, cannot reflect the diversity and complexity of mixed uses in practice. As an alternative, this paper argues that mixed-use development can be categorized based on three aspects, functionalities and activities, spatial arrangement and geographical measurement, and institution and organization. These three aspects not only capture the functional and physical features of mixed uses as an entity, but also reflect the dynamic changes and complexity of mixed uses as a unique development process. The new conceptualization contends that mixed uses should not be blindly chased after, but the selection of its type, form, and development process should be considered simultaneously and treated with greater caution, which requires deeper and broader understanding of the economic, social, and political forces in the local context.

Secondly, distinguished by the three spatial scales - city, neighborhood, and project - of the analytical frameworks, the urban economic literature on mixed-use development resolves into three groups. Each group of literature explains the economic mechanisms that give rise to mixed uses and evaluates the economic outcomes of mixed-use development. However, due to different criteria used at each spatial level, there is a disconnection between studies at one spatial level and those at another, which limits the transferability of the findings and leads to inconsistent implications. Moreover, while institution and organization are found to play a significant role in each level of urban development, most studies overlook these aspects due to an uncritical adoption of the neoclassical economic view.

Finally, based on the limitations identified in existing literature and the gaps between theory and practice, this paper suggests possible directions for refining the existing analytical approaches and proposes TCE as an alternative framework to investigate the effects of institution and organization on the economic outcomes of mixed-use development. The effectiveness of TCE as a relatively new conceptual framework, however, still needs to be demonstrated through empirical studies. Ultimately, the key test will be its ability to identify and explain variables that contribute to desirable or undesirable economic outcomes of mixed-use development in real-world practices. The emerging new data sources, including government open data platform, commercial real estate database, and locative social media data, can help serve this purpose and inform future planning and development decisions on mixed land use.

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