Forecasting Demand for Urban Land

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To this point, the chapters in this volume have focused on land supply. They have addressed issues such as (1) what constitutes buildable land; (2) how environmental constraints, infrastructure and other public policies can affect its buildability; and (3) how to identify land that, though effectively built, can still accommodate new growth through redevelopment. Their assumption has been that there would be some need for a supply of buildable land: in other words, that a demand for buildable land exists. Supply of and demand for buildable land are essentially two sides of the same coin. Assessment of land supply would be incomplete without an assessment of the demand for buildable land. This chapter provides a framework for thinking about the demand for urban land and provides some examples of techniques for estimating that demand.

That land use planning should explicitly address the supply of and demand for urban land is not surprising. Land use planning in the twentieth century United States has always been about forecasting and tinkering with market forces. Land development in the U.S. results from market transactions that occur in the context of public regulations.[1] Municipal and regional governments try to anticipate the demands of growth and to supply the serviced, buildable land to accommodate it. In the U.S., planning occurs in the context of markets. Planning for growth and land use means, inevitably, intervening in the markets for land and development.

If planners think such intervention will make an urban area better (more efficient, aesthetic, satisfying or fair) for the people who live or work there, they must make some assessment of where the market is likely to go with and without a proposed intervention (e.g., a land use regulation). Any evaluation of public policies to manage growth and land development must consider markets, and the accepted paradigm is basic microeconomics: supply and demand.

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[1] There is an ongoing, extensive, unresolved and probably unresolvable debate in the professional literature about the right amount of government regulation of land use and related activities. Most combatants agree that private market transactions in land increase efficiency. The debate is, in our opinion, primarily about the extent of the costs external to those transactions. Free market proponents believe those external costs are small in most cases, and that planning should follow the market rather than attempt to channel it into smart growth (Mills 1999; Staley and Scarlet 1998). Those favoring stronger environmental and land use regulation and planning point to the problems of air and water quality, traffic congestion, sprawl and so on, and believe the opposite. Here, we simply observe that land development has and will continue to be the result of market transactions in the context of land and environmental regulations.

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J.M. Marzluff et al., *Urban Ecology,*

Consider *sprawl*, as urban areas across the nation are doing increasingly. Sprawl has been cited by voters in recent political polls as the most serious problem facing regions such as Denver and San Francisco (Pew Center for Civic Journalism 2000). Yet there remains substantial debate about the causes and effects of sprawl, and about the efficacy of alternative strategies to contain or mitigate its adverse consequences. Planning for smart growth requires an understanding of the determinants of demand for urban land, the interaction of demand and supply within urban land markets, and how government intervention affects the operation of these markets.

Achievement of public policy objectives for metropolitan areas requires balancing individual and community property rights, local control and regional responsibilities. Consumer choices about location and development within metropolitan areas are responding to available alternatives, prices, constraints and incentives that are heavily influenced by government action within local political and economic structures that have never approximated free markets in the U.S. Moreover, social and environmental externalities within urban markets for land and transportation, natural monopoly in the provision of some public infrastructure and services, and concerns regarding the equity of various market outcomes have long provided a basis for market intervention through planning, regulation and infrastructure provision. In short, policy makers, planners and the public must better understand the nature of market demand and supply of urban real estate if they hope to improve the public policies that intervene in those markets.

This chapter has two aims that shape its organization. The first is to present an understandable framework for exploring the nature of demand for urban land, including its interaction with land supply and the effects of governmental interventions in urban land markets. The second is to assess techniques based on the framework for use in planning to achieve growth management goals. We do not extensively review the literature on the factors influencing demand for specific types of real estate. Rather, we focus on the requirements for a useful analytical approach, and provide an example to illustrate the application of the framework.

A Framework for Analyzing Urban Land Markets

Overview of the Demand and Market for Urban Land

An analysis of demand for urban land logically begins with identification of the consumers for urban land. We focus our analysis of demand on households and firms as the final consumers of urban real estate, in the form of housing and commercial and industrial floorspace. We treat land as a component of the demand for housing and nonresidential floorspace to be occupied by households and firms—one of many attributes of the demand for buildings and their associated lots and location characteristics.

There are many ways to categorize urban real estate. Here, we distinguish among residential, commercial and industrial property as broadly representing demand from three types of consumers: households, firms occupying retail and office space and firms occupying industrial and warehouse space. These broad categories do not illustrate the vast complexities of the urban real estate markets, but do highlight some broad differentiation within the market, and can be extended to support more detailed analysis.

Demand for urban real estate operates within a broad framework of urban markets for land, labor and public infrastructure and services. Figure 1, though simplified, shows how complicated the relationships can be, using the housing market as an example.

Households and firms occupy housing and nonresidential floorspace, and in turn, consume urban land. Developers respond to these demands by using land in creating new housing and nonresidential floorspace, or modifying existing real estate to meet changing demands. Households and

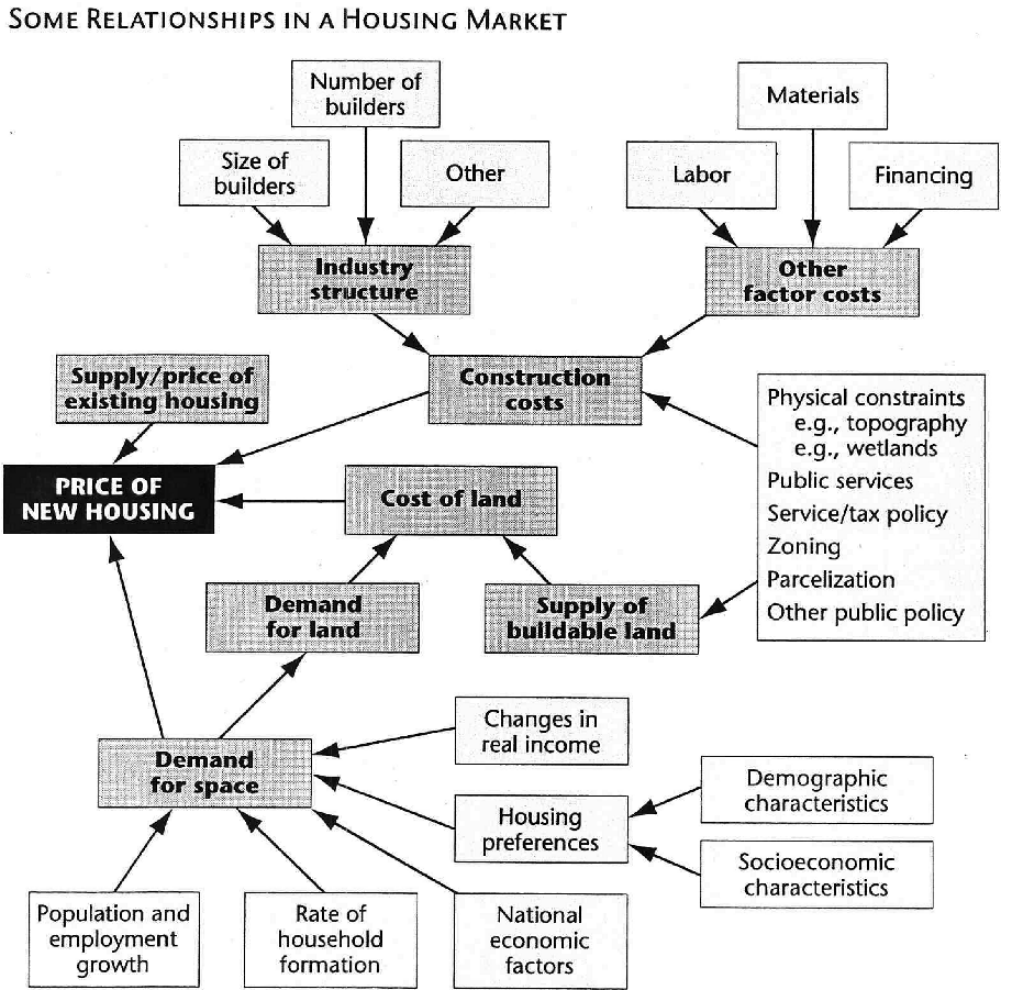

Fig. 1 Some Relationships in a Housing Market

businesses interact through consumer purchases and through the labor market, using transportation infrastructure to access these activities. Governments play an integral role in urban land markets, of course. They build the transportation, water and sewer infrastructures that create opportunities for urban development. They regulate land through zoning, UGBs, environmental regulations and many other mechanisms. They provide public services and facilities such as schools, parks, libraries and police and fire protection. They also levy taxes on property, sales and income, collect fees for various services and offer subsidies for various activities.

Overview of the Analytical Framework That Follows

A fundamental point about the regional demand for land is that it is an aggregation of individual demands for land. Every consumer (as an individual, household, or business) has some preferences for the bundles of services that real estate (both land and structures) can provide, and some ability to pay for those services. In concept, one could think of the demand for land in a metropolitan region as the summation of all these individual demands.

There are two broad approaches to analyzing market demand: one is from the perspective of the individual consumer, which we will refer to as the *disaggregate* approach, and the other is from the perspective of groups of consumers, which we refer to as the *aggregate* approach. There is a continuum between a completely aggregate and a completely disaggregate approach, and moving along this continuum presents trade-offs in terms of analytical requirements and limitations. Aggregate models are simpler to work with and understand, but may obscure important factors that influence demand. Disaggregate approaches require more data and computation, and are inherently more complex. For the purpose of developing a framework for understanding the concepts involved in demand analysis, we begin with an aggregate perspective, and sequentially add details to the analysis to capture important aspects of demand, moving toward the disaggregate perspective in the process.

We begin with a discussion of issues related to real estate demand for a metropolitan region by looking at the aggregate analysis of groups. It is typical for demand analysis to start at a high level of aggregation to get some estimate of the key drivers of real estate demand: expected population and employment growth. That aggregate forecast provides a good starting point, but is not sufficient alone to forecast the demand for real estate products. There are many types of products, consumers and locations; all must be considered to make an informed forecast of demand.

The most simple and aggregate model of demand can be stated as: more people in a metropolitan area (as residents and workers) create more demand for built space, which creates a derived demand for land (a place to put the buildings). That aggregate picture becomes more complicated and disaggregated as one makes it more realistic by considering the following factors:

- *Product differentiation*. There is no single product called "urban land." Rather, there is a demand for many types of real estate products (e.g., residential and commercial; within residential, single-family or multifamily units; within single-family units, different lot and housing sizes; for a given size, different quality and price).
- *Market segmentation*. Consumers of residential, commercial and industrial land have different characteristics, such as income, that cause them to have different preferences for real estate products and, by extension, land. This fact leads to attempts to break large groups into smaller groups to refine the analysis.
- *Location*. The characteristics of a lot may allow the construction of a building, but the characteristics of the neighborhood and larger subarea contribute to value and demand. Location matters.

Following this aggregate treatment of demand, we then look at individual consumer choices and how those choices can be aggregated to get an estimate of regional demand. That discussion has two subsections:

- *Individual preferences and constraints*. Market segmentation deals with differences among large groups. But in urban areas, those groups comprise tens of thousands of individual decision makers who are not homogeneous and who have varied propensities to accept different real estate products.
- *Submarkets*. The variability of products, consumers and locations creates submarkets that are more or less substitutable.

Finally, we consider some factors that complicate any type of analysis of the demand for land in metropolitan areas:

- *Durability of real estate products*. In the residential market particularly, the long life of buildings means that mobility and filtering must be taken into account when forecasting demand.
- *Public policy*. Policy can affect all aspects of market demand and supply relationships. Future absorption cannot be predicted without assumptions—if not explicit, then implicit—about future public policy: will it be about the same and if not, how it will differ from current policy?

- *Interactions of demand and supply*. What people often refer to as "historical demand" is, technically, the intersection of demand and supply factors at some price. In other words, a forecast of housing absorption must result not only from a consideration of demand-side factors (e.g., demographics, income), but also supply-side factors. If geography or public policy strongly limits buildable land, land prices rise and the amount of land (and, by correlation, housing) changes, as demand and supply factors get into equilibrium with the new prices.

Demand From the Perspective of Groups of Consumers

The Fundamental Drivers of Aggregate Demand

An initial assessment of metropolitan demand for residential, commercial and industrial real estate almost always begins at the level of metropolitan area as a whole. At this level, one would not consider demand for locations within the metropolitan area, but would concentrate instead on the overall quantity of demand. Analysis at the metropolitan level might be used to address such policy questions as how much developable land should be included within an urban growth boundary that is intended to accommodate a 20-year supply of land. For reasons we will explain shortly, however, the answers one might generate with this level of analysis will likely be incomplete and perhaps significantly misleading. Nevertheless, an aggregate assessment is a critical starting point for an analysis of the demand for urban real estate. There are two fundamental drivers of demand for urban real estate at this scale of analysis:

1. The macroeconomic growth of the metropolitan economy, as measured by growth in households (or population) and employment.
2. The space used by each household or job.

Clearly, growth in the aggregate number of households should be expected to precipitate growth in the demand for housing units, just as growth in employment would generate demand for nonresidential floorspace. Such macroeconomic changes may result from interactions between local economic structure, national and global economic shifts, changing production technology, migration flows, interest rates and many other factors. Methods for predicting aggregate changes in population and employment have been presented elsewhere (Isserman 1984).

Given a particular prediction of aggregate economic activity and future growth in households and employment, an assessment of demand for real estate requires estimation of the pattern of real estate utilization of households and firms. Most households will occupy a single housing unit; business establishments require a given quantity of square footage of space per employee. If one can reliably estimate these space utilization ratios (one unit per household and N square feet per employee for firms), then one could make a straightforward translation of growth in households and jobs into anticipated new demand for housing units and nonresidential floorspace for any particular period of analysis. To simplify notation, we will refer to households and jobs collectively as *consumers*, and all types of housing and nonresidential space collectively as *real estate*.

$$D = AR$$

Where D = demand for real estate
A = aggregate number of consumers
R = space utilization ratio (quantity of real estate per consumer)

This simple equation is just that: simple. Even if one knew the space utilization ratios for households and employment in the aggregate, the knowledge would be of little help for understanding the demand for different types of real estate, such as apartments or offices.

More detailed analysis (disaggregation) is required, which we add incrementally in the sections that follow. Our objective is to specify demand by subgroups of consumers for specific types of properties at different locations within a metropolitan area. Thus, we add to the basic equation in the next sections to account for the market segmentation of consumers and differentiation of real estate products by type and by location characteristics.

Product Differentiation

The differentiation of real estate products complicates our assessment because it adds a dimension of choice of real estate type to the assessment of demand.

Consider just the residential market, partitioned into different housing types (e.g., single-family, duplex and multifamily). There is no longer a simple translation of the number of net new households predicted for a metropolitan area and numbers of housing units of each type that will be demanded. It will depend on the probability that new households will choose each of these three types of housing. More generally, we could rewrite the initial equation as:

$$D = \sum_i D_i = \sum_i A P_i R_i$$

Where D_i = the demand for real estate of type i
A = the aggregate number of consumers
P_i = the probability that a consumer will choose to occupy real estate type i
R_i = the space utilization ratio for real estate type i

The classification of real estate should be meaningful to consumers and suppliers and to consideration of policy. An analyst does not want the burden of unnecessary detail to complicate or confuse the analysis; nor, however, does she want to generalize across categories of real estate that fundamentally differ in how consumers, suppliers or policy view them. One can examine these products as a set of separate but interdependent real estate markets, sometimes referred to as real estate *submarkets*.[2]

Various classification schemes for urban land and real estate are available and potentially useful for this analysis. Such classifications are developed and used by municipalities, appraisal districts and other local governments for planning. Zoning and land use plan designations provide alternative means to differentiate urban land according to development restrictions. The real estate industry uses different typologies for monitoring market activity. Within the planning and urban design communities there is substantial interest in classifying urban land and real estate in ways that assist in evaluation of and planning for transit and pedestrian access, neotraditional design and more dense and mixed-use neighborhoods (Calthorpe 1994).

It is not our purpose to systematically review these alternative classifications and make conclusive recommendations on a preferred classification. Instead, we offer a simple recommendation for a basic scheme for use in assessment of demand for urban real estate, based on the analysis requirements discussed here, and on general expectations of availability of such data within local administrative records (e.g., tax assessor parcel files).

[2] Note that submarkets may be defined on the basis of the real estate product, on the basis of geographic location or on some combination of these two factors.

Table 1 Real Estate Product Differentiation

Residential	Commercial	Industrial
Single-family detached	Retail	Light manufacturing
Rural density	Strip center	Heavy manufacturing
Low-density	Neighborhood center	Industrial incubator
Mid-density	Power center	Warehouse
High-density	Community center	
Duplex/townhouse	Power center	High-tech/flex space
	Regional mall	Research and development
Condominium	Office	
Low-density	Low-rise	
High-density	Mid-rise	
Apartments	High-rise	
Low-density		
Mid-density	Campus	
High-density		

Table 1 differentiates residential real estate in a way that would support assessment of household demand for housing and land by income and household size. It illustrates the potential problem of distinguishing between structure type and tenure in residential markets (e.g., "condominium" and "apartment" are tenure types, not structure types). Commercial and industrial real estate are differentiated to support assessment of business real estate demand by industry and occupational mix.

This classification scheme would be appropriate for assessing demand for real estate by different types of consumers, but does not address such important aspects as price or location. It could be augmented by cross-classification with price range and location attributes, such as area types defined by density and mix of land uses, but at the cost of additional complexity and data requirements. Many assessor files are not likely to contain this detail of land use classification of commercial and industrial real estate, necessitating some generalization of these categories.

Beyond these characteristics, for purposes of classifying real estate products for analysis, we recognize that many structural attributes of housing and commercial structures are relevant to the demand for real estate. Such housing characteristics as house size, number of bedrooms, style of construction, age, quality of construction and the combination of amenities are all potentially important in influencing household demand. Similarly, the structural characteristics and quality of commercial and industrial buildings will influence demand. These attributes could be examined within disaggregate analysis of individual properties, or through a cross-classification of real estate types and locations, using averages or distributions of the attributes.

Market Segmentation and Market Conditions

The recognition of real estate product differentiation is directly related to the observations that consumers are not identical, and that consumers make substitutions across alternative real estate products based on their attributes and prices. First, examine the composition of consumers for residential real estate. Households differ by income, stage of lifecycle, number of workers, number of children and many other salient features that influence their preferences for housing types. Housing utilization ratios may also be influenced by market conditions. Under tight market conditions with high prevailing rents, households may choose to either double up within a single unit or delay the formation of a new household. In other words, though household characteristics may be correlated with a propensity to choose a certain housing type, those choices are affected by market forces—the same household may choose a different housing product in response to changing market conditions (especially price).

Just as households represent different types of demands for housing, so do businesses vary by industry and occupational composition of the jobs at each establishment, with concomitant variation in their demands for differing types of nonresidential space. At first glance, use of industry as a classification for jobs would seem to provide a valuable tool for predicting the distribution of demand for different types of nonresidential floorspace. Manufacturing sector jobs tend to occupy industrial space, retail sector jobs tend to occupy retail space, and finance and service jobs tend to occupy office space.

It is clear, though, that these generalizations are not robust, and they become problematic when one considers the variation in space utilization geographically. Downtown office buildings usually contain space occupied by headquarters or other administrative functions of firms, classified as manufacturing and other "industrial" sectors. Retail establishments occupy office space and service firms occupy retail space. Using both industry and occupation may provide a more robust, though still limited, means to identify reasonable patterns of space utilization by business establishments.

The space utilization ratio of employees, moreover, is not likely to be fixed, even within a particular type of space, such as an office. The number of square feet per employee may vary among industrial, warehouse, retail and office uses, but there will also be substantial variation in the utilization ratio within each type of real estate, in response to market conditions. Tight markets with expensive lease rates will prompt a decrease in the quantity of space used per employee, as firms economize on an expensive input. Moreover, rates will vary with business cycles. For example, after a long trough it is possible that existing office space has a lot of vacant space, and that many years of expected employment growth could be accommodated with relatively low rates of new construction. In these overbuilt periods, vacancy rates in excess of a normal rate needed to facilitate normal market turnover trigger rent decreases and stimulate businesses to lease more space per employee than they would under tighter market conditions with higher rents.

Technological changes—such as those in production technology or increased use of information technology—may prompt changes in the intensity and nature of space utilization of firms. As manufacturing processes have been transformed over the last several decades, they have altered real estate demand among manufacturing firms toward more horizontal configurations that are more land intensive. In addition, changes in transportation technology favoring truck transport have led to changes in locational requirements toward suburban highway facilities (DiPasquale and Wheaton 1996).

By distinguishing between different types of real estate, an assessment of demand may begin to address the complexities of the market for residential, commercial and industrial development. It raises the possibility of identifying distinctions between different types of consumers that have varying preferences or requirements for these types of real estate. Small households at an early lifecycle stage with relatively low income are likely to demand smaller, less-expensive housing units, as compared to affluent households with large families. Wealthy, empty-nest households may exhibit less demand for large-lot housing than they did at earlier stages in their household's lifecycle, and may opt more frequently for high-quality, in-town condominium housing. These kinds of preference maps are what common sense and observation might suggest, but are not of much value without a systematic means for quantification and analysis.

Our simple model of space demand could account for market segmentation and price effects by adding a component to distinguish types of consumers, and making the probability of choice of a real estate type and the space utilization rates both functions of prices, as follows:

$$D = \sum_i \sum_j D_{ij} = \sum_i \sum_j A_j P_{ij}(\pi) R_{ij}(\pi)$$

Where

D_{ij} = the demand for real estate of type i by consumer type j
A_j = the aggregate number of consumers of type j

$P_{ij}(\pi)$ = the probability that a consumer of type j will choose real estate type i, as a function of prices (π)
$R_{ij}(\pi)$ = the space utilization ratio by consumers of type j for real estate type i, as a function of prices

Like the classification of real estate products, we need to classify the characteristics of real estate consumers salient to the analysis of their demand for real estate. Tables 2 and 3 present market segmentation strategies for households and employment used by the authors in a project to develop models of real estate demand and supply.

Table 2 Market Segmentation of Households

Income	Age of Head	Household Size	Children
Under $10,000	Under 20	1	0
$10,000–24,999	20–49	2	1 or more
$25,000–49,999	50–64	3	
$50,000 or more	65 or over	4, 5, 6 or more	

Table 3 Market Segmentation of Employment by Industry

Two-Digit Standard Industrial Classification	Description
01–14	Resource extraction
15–17	Construction
20–39	Manufacturing
40–51	Transport, communications, utilities, wholesale trade
52–53, 56–57, 59	General retail
54, 58	Restaurants and food stores
55, 75	Auto sales and services
60–62, 67	Finance
63–66	Insurance and real estate
73, 81, 87	Business and professional services
80	Health services
70–72, 76–79, 83–86, 88–89	General services
82, 91–99	Government and education

Location

The first truism of real estate is that location matters. Real estate is unique as a commodity because a building is (generally) inseparable from the land upon which it sits. For example, a housing unit inherits, by virtue of its location, the characteristics of a particular neighborhood and its social composition, and a pattern of accessibility to employment, shopping and other amenities. We address location by adding a location subscript to differentiate demand by each type of consumer for each type of real estate at each location:

$$D = \sum_i \sum_j \sum_k D_{ijk} = \sum_i \sum_j \sum_k A_j P_{ijk}(\pi_k) R_{ijk}(\pi_k)$$

Where

D_{ijk} = the demand for real estate of type i by consumer type j at location k

A_j = the aggregate number of households or employment of type j

$P_{ijk}(\pi_k)$ = the probability that a household of type j will choose housing type i, as a function of prices at location k

$R_{ijk}(\pi_k)$ = the space utilization ratio by consumers of type j for housing type i, as a function of prices at location k

The simple model now contains the elements of a framework with which we can assess spatially distributed demands for different types of real estate by different types of consumers.

Since a building is generally inseparable from its location, demand for real estate is intimately related to demand for location. The assessment of real estate demand in the aggregate may, in fact, be quite biased by unmeasured differences in demand for location. Stagnant overall population levels in a metropolitan area do not necessarily indicate stagnant demand for new construction.

Consider the unfortunate reality many metropolitan areas currently face. The inner core of residential and employment activity may suffer substantial decline while the suburban areas grow rapidly, fueling sprawl in a stagnant overall economy. Causes for this internal redistribution and dispersal of population and employment have been attributed variously to middle-class flight from poor schools and high crime in the inner city, racial prejudice, subsidized suburban infrastructure and fiscal competition (Orfield 1997). In these cases, there is substantial mismatch between aggregate economic growth and aggregate demand for new urban land consumption. Failure to recognize this pattern could lead to a serious underestimation of the actual rate of urban land conversion. More significantly, failure to understand and address the causes of this pattern could undermine an otherwise solid growth management strategy.

How should one measure location? What aspects of location are important, and how do they inform a program of monitoring or planning for smart growth? To begin, one could consider several alternative units of analysis for location effects on demand: an individual parcel; zones, e.g., traffic analysis zones; a neighborhood or employment center; a city or county; an arbitrary grid. Each geographical unit has merit as a potential basis for analysis. City or county boundaries form natural political subdivisions within a metropolitan area that would serve to reflect different combinations of public services, infrastructure and taxes. They also form the basis for land policy through zoning and the jurisdiction's comprehensive plan.

But there are many location factors that may be meaningful to an analysis of demand that are more detailed in scale than city or county boundaries. At the extreme one could examine demand at the parcel level, allowing the maximum ability to identify location characteristics, especially using the modern capacities of geographic information systems (GIS). But, while parcel-level data is attractive from the perspective of representing a functional unit of analysis of real estate demand, it will be subject to substantial data error that complicates its use (Waddell, Moore and Edwards 1998). Moreover, complications occur because a legally transferable and developable *parcel* is not always identical to an assessor's *tax lot*.

One of the other intermediate geographic units will probably be more suitable for general use in analysis of real estate demand. Traffic analysis zones are particularly useful because metropolitan planning organizations will maintain travel model systems that can produce important accessibility estimates at this level, and may monitor development at this level as well. Neighborhoods and employment centers are more natural units of analysis, since they represent functional geographies for real estate and may approximate meaningful submarkets.

All of these geographic units (including parcels) are subject to one criticism related to their use in quantitative analysis: they are arbitrary in shape and vary significantly in size. The implication is that the results of the analysis will be heavily influenced by the geographic unit of analysis, a problem that geographers have labeled the *modifiable aerial unit problem*. If one uses an arbitrary rectangular grid as a unit of analysis, some of these problems are reduced, and there are gains

Table 4 Location factors influencing demand for real estate

Residential	Commercial	Industrial
Access to employment	Highway or arterial frontage	Access to highway
Access to shopping	Access to customers	Access to airport
Socioeconomic composition	Access to labor	Access to labor
Open space	Access to related businesses	Access to related businesses
Land use mix	Land use mix	Land use mix
Taxes	Taxes	Taxes
Public services	Public services	Public services
Transit access		

in processing efficiency, but additional processing is needed to report findings for more common boundaries that the public understands.

What location factors influence real estate demand? Table 4 summarizes some principal location factors identified in the literature as influencing household or firm location.

Accessibility has long been recognized as a key determinant of demand for real estate by location (Muth 1969). Much of the character of modern urban form has been attributed to adaptation to the now-ubiquitous automobile. For households, access to employment and shopping are significant, though perhaps less so today with the degree of automobile ownership and transportation capacity (Giuliano 1989). There has been a recent surge in interest in more localized, pedestrian-scale accessibility and its potential for reducing vehicular travel (Handy 1993). There is a substantial body of research documenting the importance of socioeconomic, lifecycle and ethnic composition of neighborhoods in determining residential location choices (Downs 1981). Similarly, neighborhood crime and school quality are often cited influences on housing choice.

For business location, access to customers and labor force figure prominently. For firms producing or distributing transport-costly goods, access to a shipping node by rail, highway or air may also be significant. The agglomeration economies, or efficiency gains of locating close to other related businesses with which face-to-face contact is important, is generally credited as being the origin of the patterns of clustering that form central business districts and subcenters (DiPasquale and Wheaton 1996). With the most rapid growth of employment occurring outside recognizable centers, it is possible that these effects are dwindling over time in response to other factors (Waddell and Shukla 1993).

Demand From the Perspective of Individual Consumers

Individual Preferences and Constraints

The previous sections explain the demand for residential, commercial and industrial real estate products and land based on the behavior of consumers as *groups*. Now we shift perspectives to look at the behavior of the *individual consumers* within these groups, which allows more direct examination of product differentiation, market segmentation and locational effects.

We focus on the probability term in the preceding version of the model. The idea is to formulate a model that predicts the probability P that a representative consumer of type j will choose a particular real estate site z from the available vacant inventory:

$$P_j(z) = f(Y, \pi, H, N)$$

Where

Y = household income or firm profit
π = the price of the building

H = a set of structural characteristics of the building
N = a set of location characteristics at the site

The most common statistical technique for estimating this model is the logit model, which predicts the probability that each of a set of discrete alternatives will be chosen, as a function of the characteristics of these alternatives and the characteristics of the consumer (McFadden 1973):

$$P_j(z) = \frac{e^{\alpha(Y-\pi_z)+\beta H_z+\delta N_z}}{\sum_z e^{\alpha(Y-\pi_z)+\beta H_z+\delta N_z}}$$

Where

$P_j(z)$ = the probability of a consumer of type j choosing site z
Y = household income or firm profit
π = the price of the building
H = a set of structural characteristics at the site
N = a set of location characteristics at the site
α, β, δ = sets of estimated demand parameters

A principal challenge in operationalizing this model is choosing the unit of analysis. As noted earlier, the unit of choice could range from the parcel to the city, with clear tradeoffs along the way. Let us suppose, for now, that we are using the parcel or a relatively fine grid as the unit of analysis, thereby reducing one aspect of complexity by allowing us to make the simplifying assumption that each alternative represents a homogeneous choice. At this level of detail we could not possibly estimate the choice problem with all the alternative parcels actually enumerated as choices. Fortunately, it has been shown that we can obtain consistent estimates of the parameters using only a random sample of alternatives (Ben-Akiva and Lerman 1985).

A significant concern regarding the assessment of demand for alternative types of real estate and location emerges from consideration of new forms or configurations of real estate. The most common approach to analyzing the demand for a variety of products is to observe the purchases made by various consumers, the characteristics of the consumer and the product they purchased, and to then undertake a quantitative analysis of the consumers' "revealed preferences." Assuming there are three brands of a product available and that we observe a substantial sample of consumers choosing from these products, we could estimate a choice model such as that in the preceding section, and measure the effect of consumer income, age and other observed personal characteristics, as well as the effect of price, quality and other product characteristics, on their choice. The resulting model would encapsulate the relationships between these characteristics of the consumer and the alternative products, and provide a basis for predicting market share based on changes in the mix of consumers or in one or more of the characteristics of the products.

Now consider the introduction of a new product not currently on the market. Assume it is substantially the same as the other products, in the sense that each of its attributes falls within the range of the observed attributes of existing products, and the mix of attributes was comparable to existing products. Under these conditions, we might make reasonable predictions about shifts in market shares precipitated by the introduction of the new product, using our estimated model of revealed preferences. However, what if the new product's characteristics substantially differed from the existing products, either because one or another of its attributes were beyond the range of the existing products' attributes or its mix of attributes was substantially different or it contained a significant new attribute? It would then be inadvisable to consider applying the model based on revealed preferences. Our experience with these products would not provide much insight into how consumers would compare the new product to existing ones.

In this example, we face a problem common in urban land use and transportation planning: introduction of a new transportation mode, such as light rail; or consideration of real estate alternatives that are relatively new and untested in the marketplace, such as certain configurations of mixed-use, high-density development or neotraditional urban design in suburban settings. The problem is that we have inadequate information—from an examination of revealed preferences—to make plausible predictions about the market shares that will be commanded by these new products. This problem has surfaced in other fields, particularly in market research. The general solution is the use of stated-preference surveys that ask respondents to compare hypothetical choices constructed to efficiently measure the relative preferences of consumers to the characteristics of new alternatives as compared to existing ones. Since responses to hypothetical situations differs from actual behavior, stated preference surveys alone are perhaps somewhat suspect. But when combined with revealed preference analysis, such responses can provide a valuable means to assess new alternatives that adjust for such biases (Small and Winston 1999).

Submarkets

To a large extent, we have already discussed submarkets by discussing differences in consumers, real estate products and location. In this section, we want to combine those ideas into the single idea that such variability creates submarkets.

Consumers will consider the available real estate alternatives and may determine that some available products are relatively similar, and so are close substitutes, whereas others are so different that they are not substitutes at all. Similar substitutable alternatives—such as adjacent houses with the same floorplan in the same subdivision—form collections of real estate alternatives toward which particular consumers may be relatively indifferent. As a result, they will price-shop among available alternatives within the preferred cluster. In other words, they will be price-elastic in their demand for alternative units that are relatively substitutable. As we compare this cluster to more distinct (therefore less substitutable) alternatives, we could group these latter alternatives into relatively homogeneous clusters that represent other submarkets, the demand for which will reveal varying degrees of substitutability.

The submarket concept is useful in that it may provide a valuable means to reduce the complexity of assessing the full detail of the real estate inventory, parcel by parcel, while capturing the essential elements that affect differing demand and supply reactions and resulting effects on vacancy and prices.

If we use the differentiation of real estate products to represent different submarkets that are subject to different consumer preferences, supply functions or policy, we can treat them as linked submarkets. It is likely that submarkets, like individual parcels, will be regarded by consumers as substitutes with varying degrees of similarity. Similarly, from the supply perspective, these submarkets represent different targets for the supply of real estate, with differing rates of return. To incorporate the choice of submarket into the demand function presented above, we can introduce it as a marginal choice that conditions the choice of an individual property within a submarket. To do this, we estimate a second equation for the marginal choice of submarket, and make the choice of property conditional on this choice:[3]

[3] This formulation, known as a nested logit model, allows changes in the availability or characteristics in one submarket to influence the choices between submarkets (Ben-Akiva and Lerman 1985).

$$P_j(z)|P_j(s) = \frac{e^{\alpha(Y-\pi_z)+\beta H_z+\delta N_z}}{\sum_z e^{\alpha(Y-\pi_z)+\beta H_z+\delta N_z}}$$

and

$$P_j(s) = \frac{e^{\alpha+\beta\Phi_s}}{\sum_s e^{\alpha+\beta\Phi_s}}$$

Where $P_j(s)$ = marginal probability of choosing submarket s
Φ = inclusive value (sometimes referred to as the Logsum) from the conditional choice of property, or expected utility from choosing a property within this submarket

The full probability of choosing a particular submarket and a property within it is then the product of these marginal and conditional probabilities. This formulation allows changes in the availability or characteristics in one submarket to influence the choices between submarkets. In the marketplace, one would expect that if a particular submarket became relatively less expensive it would attract more consumers, all else being equal.

Submarkets offer a mechanism to analyze groupings of real estate products organized by structural and locational characteristics into groupings that represent relatively similar and substitutable alternatives to consumers. Within these submarkets, consumers and suppliers interact to demand and produce real estate, and government policy intervenes through various mechanisms such as infrastructure, services, regulation, taxes, fees or subsidies. They exhibit varying degrees of substitutability, based on the perception of similarity by consumers. They are also connected, so that a change in one will affect other submarkets to the degree that they are similar and substitutable (Rothenberg et al. 1991).

One risk in the proposed method of analysis is that the logit technique assumes *independence of irrelevant alternatives*, meaning that if we add a seemingly irrelevant alternative, it will draw proportionally from all other alternatives. This assumption is fine unless some alternatives are more similar substitutes for the one being added, and therefore more of the shift in probability should draw from these alternatives. Provided that the essential characteristics that describe the similarity are included in the model estimation, this does not present a problem. Nesting the model as a set of marginal and conditional choices is a general solution to observed violations of this assumption (Ben-Akiva and Lerman 1985).

The discussion to this point has led to the development of a relatively simple model of real estate demand that incorporates some of the key elements: product differentiation, market segmentation, individual preference, constraints and submarket substitutability. We now seek to frame this discussion within the broader dynamic of real estate markets, and explore the effects of interaction of demand and supply in the short and long run, and of governmental intervention.

Real estate submarkets are linked, not only within a particular type of real estate, but also between real estate types that are not close substitutes, i.e., residential, commercial and industrial, for at least three reasons. First, all real estate is competing for location within a finite inventory of land. Restrictive single-purpose zoning practices may make this competition secondary to policy constraints, but it does not obviate the basic competition for land that exists in the market. Second, properties of one type may generate externalities (like pollution) that either positively or adversely affect properties of other types in the vicinity. This, after all, is the basis for zoning. Third, there is a continual interaction between these real estate submarkets as housing follows jobs and vice versa, in a slow dance of decentralization.

Acknowledging these interactions, the analysis of real estate demand for one type cannot be thoroughly understood without consideration of the others. Nevertheless, it is quite uncommon to see these interactions systematically explored in an analysis of real estate demand.

Other Considerations in Assessing Demand

Whether one attempts to estimate land demand based on an analysis of groups or individuals, those estimates should include consideration of the durability of real estate products, the influence of public policy on the markets for real estate, and how demand and supply interact.

Durability of Real Estate Products

The built stock of real estate is highly durable, lasting over 100 years if well constructed and maintained. Given this longevity, real estate supply is predominantly offered from the existing inventory of building stock, and new construction reflects only 2–3 percent of inventory in any given year (Rothenberg et al. 1991). New housing construction is principally targeted at middle-class and affluent consumers with preferences for larger houses and lots in suburban locations. A combination of building codes, minimum-lot-size zoning and competition from the downgrading of the existing housing stock make new construction at the low- and moderate-income scale relatively less profitable (Rothenberg et al. 1991).

Viewed from the perspective of the consumer (the demand perspective) the durability of the housing stock and the tendency of new construction to be high-end housing lead to a pattern of upward mobility through the housing stock. This process, described by some as *housing filtering*, also means that much of the housing stock will move gradually toward lower-income households, with accompanying reductions in housing maintenance. Upper-income households are relatively more likely to move into new housing, creating vacancies in existing housing. Lower-income households are typically making upgrade moves within the existing housing stock, following this chain of vacancies. Ultimately the chain of vacancies accumulates in the neighborhoods viewed by households as least desirable (that is, those with the least demand) and may lead to abandonment of units that become unprofitable to maintain.

Housing mobility is also likely to vary substantially over the lifecycle of a household, with newly formed young households experiencing relatively high rates of mobility compared to elderly households. This tendency is compounded by consideration of the effect of housing tenure. Renter tenancy requires relatively low transaction costs to move, whereas the relocation costs for a homeowner involve substantial transaction and search costs, both in selling and buying a new home.

The implications of these general tendencies, for an analyst estimating the demand for residential land, are (1) that changes in the balance of demand and supply can influence the rate of housing filtering, leading to more or less demand for new housing construction on vacant land; and (2) that housing demand is influenced by patterns of mobility tied to the changing demographic composition and income distribution of the population.

Public Policy

Direct and indirect effects of government intervention cannot be ignored in assessing demand for real estate. Table 5 shows some of the potential direct and indirect effects of public policy on demand for real estate.

Table 5 Direct and Indirect Effects of Local Government Policies

Direct Effects on Demand	Indirect Effects via Supply
Zoning, affecting land use mix	Zoning, affecting density
Provision of parks and other amenities	Property taxes
Property taxes	Permitting requirements and delays
Infrastructure, especially transportation	Development impact fees
Quality of public services, especially schools and public safety	Concurrency requirements
	Urban growth boundaries

The direct effects of local government policy on demand are those that alter the attractiveness of a particular location for different types of households and businesses. Clearly, the provision of better infrastructure and public services, accompanied by lower taxes, should increase demand, while the reverse combination will depress it (all else being equal). Property taxes affect demand both directly and indirectly; they affect owner-occupants directly, and tenants of housing or nonresidential floorspace indirectly, as property taxes are passed on, at least in part through rents.

Government policies also affect demand indirectly, through their effects on the supply of real estate. Zoning, for example, may restrict the supply of land for certain types of development that are in high demand, thus driving up prices for this submarket. Effects of UGBs on real estate markets—particularly on housing prices—have been widely debated, but with little conclusive evidence as to the magnitude of the price effect (Knaap and Nelson 1993). Construction delays created by permitting and review processes make market supply less elastic with respect to fluctuations in market demand, and create greater volatility in prices in the short-run. In turn, price fluctuations affect market demand and may significantly alter location patterns for different types of consumers. For example, a delayed supply response to a surge in demand for apartments may create a tight housing market (low vacancy rates) in the short-run, which could mean rent increases that precipitate displacement of low-income renters to less expensive (less desirable) locations. The way that consumers are sorted out across the available real estate inventory, then, is a function of the relative availability, characteristics and pricing of the real estate, all of which may be directly or indirectly affected by government policy.

Analysis of demand for urban real estate may be motivated by an interest in setting public policies (e.g., UGBs or zoning), but demand is not independent of these policies. The question of where to draw a UGB to accommodate a 20-year supply of land becomes more complex once one acknowledges that the answer depends largely on the effects of government policies on demand and supply of real estate, in both the short- and long-term. In other words, attempts to assess real estate demand without considering the interactions of demand and supply and the effects of government policy, will provide biased information.

Interactions of Demand and Supply

The preceding discussion focuses on choices consumers make from the available supply of real estate. A condition of variable demand and fixed supply effectively describes the short-run situation that active consumers in the real estate market face. If demand surges within a metropolitan market over a brief period (say, one month to a few months) because of significant job growth or in-migration of households, housing choices of such new arrivals are constrained by the existing supply of real estate. New construction may be initiated in response to the surge in demand, the drop in vacancy rates and the resulting surge in prices. But it takes time for developers to acquire sites, secure permits, obtain financing and actually build the new supply. These delays

cause much of the short-term fluctuation in vacancy rates and prices, which in turn influence demand.

In analyzing demand, then, one must consider the effects of short-term supply constraints and the volatility in vacancy rates and prices that follow the changes in demand. In the longer-term—during which developers can respond to vacancy and price signals in the market and bring new construction to the market—one can consider supply elastic, or responsive to the demand-induced changes. In this longer-run scenario, new demand will translate into adjustments in the supply of real estate, both from new construction and from modification of the existing stock. If one considers the real estate market as a set of related submarkets, changes in demand that affect one submarket will end up triggering an array of responses, both within this submarket and other submarkets close to it in substitutability. New construction and conversion of real estate from other submarkets will flow into a submarket that has experienced a surge in demand and, therefore, in real estate prices and rates of return. These modified prices will induce some consumers to switch to relatively less-expensive options in the short-run, with partially offsetting moves after supply adjustments partially offset the initial changes.

Implications

These models of demand, though simple, provide some insight into what a more-detailed analysis of demand should consider:

- Differentiation of real estate product types along dimensions meaningful to real estate consumers;
- Market segmentation that recognizes important distinctions among different types of consumers;
- Location factors influencing demand;
- The effects of durability of the building stock on demand for and modifiability of existing real estate;
- Public policy. Demand for real estate is not independent of governmental action that may affect demand directly through property taxes, or indirectly through their effects on supply, such as potential housing price effects of zoning constraints, UGBs or development impact fees;
- Demand and supply interactions. Demand cannot be completely understood without considering interactions with supply; for example, the supply and demand decisions of owner-occupant households are flip sides of the same coin.

An Example of a Method for Forecasting Land Demand

We have built a case for evaluating demand within a broader context of market demand and supply interactions and government policy interventions, and pointed out the limitations of extrapolations of demand as a method for informing policies related to managing growth. But a framework needs specific methods if it is to have a practical application. In this section we discuss methods that could allow planners and policy makers to make more informed, useful estimates of (1) long-term demand for residential, commercial and industrial land and real estate by location within a metropolitan area; and (2) the potential consequences of smart growth policies.

First, a prerequisite to any intelligent analysis of the interactions of market factors and public policy is the development of a suitable system of monitoring different types of development (see Bramley, this volume). Second, suitable analytical methods should be brought to bear on these data. The complicated interactions among demand variables (and among demand variables with supply variables) lead to modeling.

Good models become complicated. The next chapter explores the Metro-Scope model used by Portland Metro, which links a land monitoring system to real estate and transportation activity. An even more detailed model of real estate demand and supply, UrbanSim, has been recently developed and applied in several metropolitan areas (Waddell 2000; 2001). UrbanSim is a simulation system that interacts with metropolitan transportation models and integrates model components that simulate real estate development subject to planning constraints, real estate demand by households and jobs and real estate prices, and the interaction of these using locations defined by 150 meter grid cells. The model system internalizes many of the considerations identified in this chapter, but is complex and requires substantial data such as parcel and employment databases to calibrate and apply. It is available as open source software at *www.urbansim.org*. An overview and case study of the application of UrbanSim in Eugene-Springfield, Oregon is available elsewhere (Waddell, forthcoming). Simpler models, however, can still be consistent with the main principles outlined earlier in this chapter.

In this section, we provide a simpler application from a regional study in the Salt Lake City metropolitan area, entitled the Greater Wasatch Area Housing Analysis. This analysis does not require specialized software or an integrated model; it works with standard data sources and spreadsheets to make conclusions about future housing demand.[4] Our purposes in describing this model are to illustrate how some of the concepts of demand described above become operationalized in a real-world setting, and to provide a starting template for regional governments that might want to do this type of forecasting. The principal differences between this methodology and those presented in the analytical models is that the latter deal with interactions between demand and supply and add considerable detail in the treatment of location.

The Greater Wasatch Area Housing Analysis was a forecast of housing demand (it did not consider nonresidential demand) completed for Envision Utah, a public-private community partnership dedicated to studying the effects of long-term growth in the Greater Wasatch area of northern Utah (ECONorthwest 1999). Envision Utah was charged with developing land use alternatives to accommodate 20 years of growth in a 10-county area around Salt Lake City. Debate about the feasibility of some of those alternatives led to a recognition that the process needed some analysis of the long-run future of regional housing markets. The purpose of this analysis was to describe, at a regional level, what kind of housing existed in 1999, and what kind of new housing would be likely to be demanded in the next 20 years, given likely changes in demographics, market forces and public policy.

The analysis took a long-run perspective on housing—it looked at long-run trends and downplayed short-run cycles. That approach was shared by the Governor's Office of Planning and Budget, which prepares the official state and county population forecasts. By using official population forecasts as the basis for the analysis of housing demand, the analysis implicitly considered many of the key demographic and economic variables that influence those forecasts.

The housing analysis was based on a conceptual framework that recognizes the relationship of demand and supply, and the exogenous effects of demographic and socioeconomic changes, physical constraints and government policy. The framework is consistent with the description of the interaction of real estate markets described earlier in this chapter. In the context of the demand framework described above, the housing analysis covered, at some level, the following categories of variables:

- *Aggregate demand*. The state's long-run demographic forecasts, by county, was the main driver of housing demand: more people in a metropolitan area (as residents) create more demand for housing, which creates a derived demand for residential land (a place to put the dwelling units).

[4] This model looks only at housing demand. McClure (this volume) looks at nonresidential demand, which is driven by forecasts of employment growth.

- *Product differentiation*. The analysis considered four categories each of single-family and multifamily housing. The differentiation was done by density (by lot size of single-family units; by persons per acre for multifamily units) to facilitate conversion to demand for land.
- *Market segmentation; individual preferences and constraints*. The analysis addressed key characteristics considered in professional literature and practice to be highly correlated with housing choice: in particular, household size, income and age-of-household-head. The analysis did not include a specific logit specification of individual preference, but did use a simple regression analysis to correlate consumer characteristics with a probability of having a certain housing type.
- *Location*. The locational disaggregation was only to counties: 10 for the Greater Wasatch area. Locational factors typically considered important in explaining housing choice (e.g., school district, travel times to activity centers) were not explicitly considered. Thus, the analysis is useful for evaluating regional implications, but not for neighborhood-level or even municipal-level analysis.
- *Individual preferences and constraints*. The analysis did not model individual choice.
- *Submarkets*. The analysis had no specific modeling of submarkets or the substitutability of one submarket for another. The implicit assumption was that the long-run population that allocated to counties was, again implicitly, considering those tradeoffs. The 10 counties were aggregated into four subareas, but these were very large and were not the type of submarket referred to earlier.
- *Durability of real estate products*. The analysis did not explicitly consider the filtering process. It implicitly allowed for households to shift to other housing types as their characteristics changed.
- *Public policy*. The analysis did not explicitly model the constraints imposed or benefits conferred by public policy. Key public policies, however, were identified and described in the report summary and their implications were considered qualitatively in the final demand allocations.
- *Demand and supply interaction*. The analysis does not model the interactions, but addresses them qualitatively by commenting on, for example, how a public policy, like restricting the supply of land for multifamily housing, could lead to a lower absorption of that type of housing than a baseline demand forecast might suggest.

The analysis simultaneously acknowledged the complexity of the housing market and the need for some type of forecast of future housing demand, as well as for some assessment of the implications of that forecast for regional households and urban form. Such forecasts are inherently uncertain. Their usefulness for public policy often derives more from the explication of their underlying assumptions about the dynamics of markets (demand and supply conditions) and policies than from the specific estimates of future demand.

The analysis then focused on long-run (to 2020) demographic change and new housing. The long-run focus allowed the analysis to ignore short-run events, such as business cycles, changes in interest rates, vacancy rates, lease rates, projects in the pipeline and so on. The assumption was that the region's official long-run population forecast was at least approximately correct. The main steps in the analysis were:

- Define the study area (10 counties centered around Salt Lake City).
- Describe current and forecasted demographic and socioeconomic characteristics that affect the amount and type of housing consumers will demand and the market will build.
- Analyze the current housing market (type of housing existing and being constructed).
- Describe how changing economic and demographic trends are expected to impact the future housing market.
- Identify public policy barriers that prevent the market from meeting current housing demand, and barriers that may prevent the market from meeting future demand.
- Simulate demand by housing types and lot size, by county, to 2020.

The analysis showed that the state's long-run forecast assumed—based on past trends and assumptions about future growth—that almost 70 percent of the population growth in the Greater Wasatch area would be from natural increase (births less deaths), with 30 percent from net migration (more in-migration than out-migration). The relatively high percentage of growth from natural increase (roughly twice the rate of other metropolitan areas on the West Coast) reduced some uncertainty about future housing types (because of relatively strong relationships between household life cycles and housing choices). The analysis also showed that, compared to the entire U.S., the Greater Wasatch area would have a smaller share of households in the retirement phase of their lifetime, and a larger share of young singles, young couples and families.

Given the propensities of these classes of households, one should expect (all else being equal) the regional market to build a larger share of multifamily rental housing, affordable housing for first-time homebuyers and single-family housing for couples with children, than national averages for similar sized regions. Other things being equal, the trend of decreasing household size should increase aggregate demand for housing units and increase demand for smaller single-family housing and for units in multifamily structures (because of lower space needs and less income per household). That is, for a given population increase, more new units will be needed when household size is decreasing, because there are more households.

The analysis examined these and other national and local data (including some rough estimates of buildable, serviceable residential land by county) to determine which key forces would be affecting future housing markets. It concluded:

- *Number of housing units*. The economic forecasts predicted substantial population growth—the Greater Wasatch area would have to provide housing for an additional 363,000 households over the next 20 years (the aggregate demand forecast).
- *Type of housing structures*. The expected growth in income did not necessarily mean households would purchase more large-lot dwellings. The expectation nationally was that the money would go into larger single-family and multifamily units with more amenities but on smaller lots.

The main demographic changes—migration of mobile young adult and elderly households to the West, smaller household size and the increasing average age of the population—all argued for a shift toward smaller units and more multifamily units.

While the large amount of potentially buildable land in the region suggested that land prices would stay relatively low and average lot size could stay relatively high, the analysis noted the possibility that public policy in this area could change for a number of reasons. These include public concerns about sprawl, congestion and natural resources, and increasing fiscal pressures of trying to serve expansive development while also providing infrastructure and maintaining environmental quality.

In response to these forces, the study predicted more planned-unit developments in the future, which could include mixed uses, a mix of housing types, smaller lot sizes for single-family units and overall increases in housing and site amenities.

Housing affordability would continue to be a problem in this region as it is elsewhere. As in the past, the public sector would be unable to supply resources to have much effect on the problem. The expectation was that consumers would be more willing to give up lot size than built space, and would make various choices regarding tradeoffs between built space and amenity. The implication is a shift toward smaller lots, multifamily units and manufactured housing.

- *Housing tenure*. Evidence clearly shows that increasing income and increasing age-of-household-head correlate with increasing home ownership, and that single-family detached homes have been the preferred form of home ownership. The big question for the Wasatch area was whether the economic forecast of increasing average real income would hold, and how that income would be distributed. For example, if real income increases are driven largely by increases in the upper 10

percent of all households, there might be little effect on tenure, as those households already own homes.

These and other conclusions led to a framework for assumptions that were incorporated into a spreadsheet model that simulated future housing demand.[5]

The simulation used the state's household forecasts as a base to calculate the number of new households by county. It then applied an overall residential vacancy assumption to derive the number of new dwelling units (new DU = households/(1 − vacancy rate)). It allocated new housing units by type and tenure. To estimate the percentage of dwelling units that would be expected to be single-family, the researchers conducted a regression analysis using the Public Use Micro-Sample (PUMS) data (U.S. Census 1990). That regression analysis estimated the percentage of housing that would be single-family, based on factors that the study argued are theoretically linked to the choice of housing type, including household size, age-of-household-head, income and number of workers in the household. The regression specification for 1990 explained about 80 percent of the variation in structure type.

The regression model required the distribution of households by size, age-of-household-head and income to predict the ratio of single-family units in 2020. Because income projections were unavailable and household size was only available as an average, the researchers analyzed the relationship between the three variables to develop an expected distribution for 2020 of household sizes and incomes, based on age-of-household-head and average household size.

The simulation illustrated how changes in demographic variables known to influence housing preference might influence housing demand. Implicitly, the simulation assumed the housing market to 2020 will be no more constrained by public policy (in terms of the type, mix and density of housing units) than it was up to 1990.

Ultimately, the study focused on two simulations. The base simulation assumed a continuation of trends observed between 1990 and 1998 in the Greater Wasatch area. The alternative simulation modifies the baseline scenario to account for projected demographic shifts in the population and assumptions about the effect of reasonable changes in public policy.

To make the base simulation, ECONorthwest built a model to forecast the percentage of housing units that would be single-family in 2020, by county, for Utah. The model predicted the share of single-family housing units as a function of the number of households in the county, the shares of households in each of four household size categories, the shares of households in each of four household income categories and the shares of households in each of four age-of-household-head categories.[6] It also differentiated between the 10 most developed counties in Utah and the remaining counties.

The model explained the shares of single-family residences quite well, with the exception of two counties that were not part of the study. The included variables explained 68 percent of the variation between counties. Additional variables probably would improve the model, but the included variables were those for which historical and consistently forecasted 2020 values were available. The model (using the same independent variables) also was estimated to predict the shares of mobile and single-family attached homes.

[5] The study emphasized the word *simulate* rather than forecast, because possible combinations of changes in variables that will affect housing were large. The study explicitly made different assumptions about key variables to illustrate a reasonable range of future demand by housing type. The key issues were whether the future housing market would produce housing in the next 20 years of types and in quantities that looked like today's housing products, or whether it would shift.

[6] Two of the variables in the model were transformed to better match the theoretical specifications of the general linear model. The share of single-family residences was converted to the log-of-the-odds (the natural log of the share, divided by one minus the share) and the number of households in each county was logged.

Developing the model meant, essentially, estimating the coefficients for the independent variables (e.g., household size, income and age-of-household-head), based on historical data (1990 PUMS data). The next step was to insert into the model forecasts of the independent variables (long-run demographic forecasts by state agencies) to obtain a prediction of the independent variable (number of households likely to be residing in single-family dwellings in the forecast year). An implicit assumption of the analysis is that other factors (the health of the national economy or the structure of the local economy) will not vary in ways that would affect housing choices.

In essence, the model just described was the study's attempt to deal with the equation in the "Market Segmentation" section of this chapter: specifically, with the probability variable P. The model is using household type, defined by several measurable variables, to estimate P, which can then be applied to estimates of aggregate households (A) to get demand (D) for product by type as a function of consumer type.

The simulations reported new housing units by housing type and tenure. Single-family housing was further broken down by lot size because land consumption by residential development is a key consideration for defining and evaluating the vision for a change in development patterns being proposed by Envision Utah. Multifamily housing was broken down into four subcategories: duplex, row house, garden apartments (also called walk-up apartments, usually with at-grade parking but having no more than three stories and no elevator), and urban apartments (with more than three stories and including high-rise apartments). Duplex refers to two units in a single structure; row house refers to three or more units in a single structure (also known as townhomes). Duplexes and row houses are distinguished from apartments because units are side-to-side rather than stacked.

Table 6 shows a sample output (for the base simulation), based on trends exhibited in the Greater Wasatch area between 1990 and 1999, primarily as evidenced in building permits for that period.[7] This simulation provided a baseline for the area assuming continuation of past trends.

A continuation of past trends was useful for providing a baseline for analysis, but many factors pointed to a shift in the type of new housing that would be built in the Greater Wasatch area between 2000 and 2020. Key factors included decreasing household size, increasing ages and increasing average real incomes. An alternative simulation used the regression analysis to predict the percentage of new units that would be single-family or mobile-manufactured housing based on expected demo-

Table 6 Base Simulation: New Housing Units by Type and Tenure, 2000–2020, Greater Wasatch Area

Housing Structure Type	Owner-Occupied	Renter-Occupied	Manufactured	Total	Percent of Total
Single-family by lot size (sq. ft.)					
< 5000	15, 659		7, 263	22, 922	6
5,000–9,999	141, 487		405	141, 892	37
10,000–19,999	94, 708		0	94, 708	25
> 20,000 (1/2 acre +)	30, 739		0	30, 739	8
Subtotal	*282,593*		*7,668*	*290,261*	*76*
Multifamily by type					
Duplex	1, 590	7, 719		9, 309	2
Row house	12, 871	10, 463		23, 334	6
Garden apartment	4, 432	42, 452		46, 884	12
Urban	818	11, 036		11, 854	3
Subtotal	*19,712*	*71,670*		*91,381*	*24*
Total	*302,305*	*71,670*	*7,668*	*381,642*	*100*

Source: ECONorthwest (1999)

[7] The forecast of growth for housing units is slightly greater than the forecast of growth for households because of vacancy rates (considered explicitly in the model) and demolition of existing units (not considered explicitly).

Table 7 Distribution of Housing by Type, Actual and Predicted, Greater Wasatch Area

	Actual			Predicted			
				Base Simulation		Alternative Simulation	
Housing Type	1999 Total (%)	Change 1990–1999 (%)	1999 Total (%)	Change 2000–2020 (%)	2020 Total (%)	Change 2000–2020 (%)	2020 Total (%)
Single family	66	73	67	74	70	59	64
Multifamily	29	25	29	24	27	40	33
Mobile/Manufactured	5	2	4	2	3	1	3

Source: U.S. Census (1990); BEBR (1990–1999); ECONorthwest (2000–2020; 2020)

graphic shifts. The model predicted declining shares of single-family dwellings in most counties (in other words, the percentage of single-family housing built in the next 20 years will be lower than the current (1999) percentage of total housing that single-family housing composes), primarily because of declining average household size and increasing average age-of-household-head. Multifamily dwellings account for nearly 40 percent of new housing built between 2000 and 2020 in the alternative simulation, a significant shift from trends experienced between 1990 and 1999.

Note that the shift in share from single-family to multifamily housing demand was driven entirely by demographics. It was not influenced by assumptions about other factors such as decreased land supply, or increased price of land or public services.

The study was explicit that the simulations were two of many possible futures for housing demand. The intent was to put some reasonable bounds on future demand.

Table 7 shows how the differences were summarized (detailed tables showed eight categories of housing type by county). The main difference between the two simulations is a shift in the composition of new housing development of about 15 percent from single-family units to multifamily units during the 2000–2020 period.

The alternative simulation was driven largely by expected demographic shifts. Other factors, however, could affect the distribution of housing by type and density:

- Public policy can play a key role in housing types and densities through land use designations, capital improvement plans and other policy tools. For example, restrictive zoning policies can reduce the number of multifamily dwellings that are built, or can designate larger overall lot sizes for single-family dwellings. Public policy can also lead to more compact growth and a different housing mix through decisions as simple as eliminating or reducing minimum lot-size constraints where market demand is encouraging developers to build more densely. Other policies are more complicated (politically, if not technically), like minimum density zoning, UGBs or incentives for public housing (e.g., extending the period during which a redevelopment agency can capture tax increments if it provides a certain percentage of housing as part of its redevelopment projects).
- Total land supply did not appear to be a constraining factor in the region for the next 20 years, since there is plenty of land that is not constrained physically (steep slopes, wetlands, floodplains). But other factors (local water supply, public service policies or pubic service costs) could lead to some reductions in the relative availability of buildable, serviceable land, which would in turn increase land prices and housing costs.
- Long-term income trends suggested an increase in real income region-wide. All other things being equal, increases in income mean more single-family dwellings, larger dwellings and higher home ownership rates. But other factors could offset the impact of increased incomes. For example, a recession or real increases in housing cost could eliminate or counter real increases in income. Moreover, expected income increases will not affect all households equally: the region will still have low-income households looking for affordable housing.

- The ability to sustain the expected rate of development over the next 20 years may be affected by air quality, congestion or other environmental constraints. These factors have negatively affected other communities in the U.S., though they did not yet appear to be critical constraints for the Greater Wasatch areas.

These factors were not accounted for in the alternative simulation. The schedule, budget and available data did not call for the development of a model that would incorporate such considerations as independent variables. Thus, the study used a more practical method to address these issues: it used the simulations as a point of departure for discussions among local housing professionals. Of the 23 developers, builders, lenders and realtors who reviewed this report, 83 percent thought the estimates in Table 7 were reasonable. Staff at the Governor's Office of Planning and Budget added some useful but minor changes. Comments from the technical advisory group for this project were included in this report—none changed the estimates in Table 7. A presentation to the steering committee for the Envision Utah project led to discussion of the implications of the findings, but suggested no direction to change the findings.

The housing market analysis played an important role in the regional planning for the Greater Wasatch area. It provided strong evidence that socioeconomic and demographic factors largely beyond the control of typical public policies would be changing the mix of housing from that being demanded and built in current markets. When that information was coupled with other information about land supply, services and likely directions for public policy, most participants in local housing concluded that a shift (not huge, but a shift nonetheless) toward multifamily housing products was likely. Thus, public policy aimed at accommodating such a shift (e.g., the preferred growth alternative being developed by Envision Utah) was reasonable.

Implications for Urban Land Monitoring

This chapter provides a framework for considering the demand for urban land and illustrates one approach that planners in metropolitan areas might apply when attempting to forecast future land consumption. We see several implications for land monitoring.

- Monitoring land supply is only a subset—albeit an important one—of monitoring land markets. Given advances in databases, land use information and GIS technology, it becomes cheaper and easier to obtain a "snap-shot" of current land supply. For example, Metro in Portland has been refining its analysis for 20 years. It now has a relatively accurate picture of where and how much vacant, buildable land exists in the urban area, and the ability to cross-reference that land to a variety of physical, market and policy attributes.

But, monitoring demand has not reached the same level of detail in public agencies, and the prediction of future demand (absorption) is more complicated yet. Monitoring building permits is a step toward demand-side monitoring, and vacancy rates and building absorption are particularly good indicators of shifts in demand. But, as emphasized, price is clearly a key variable. More work must be done to standardize measures of price change for quality-controlled real estate products. One can imagine a public development policy that would bring land into a UGB or trigger infrastructure investment in response to land price increases that exceeded some adopted threshold.

- Given the importance of both demand and supply, their interaction in urban land markets and the complexity of these market interactions, some form of analytical modeling of demand and supply may be useful to inform a monitoring program. To the extent smart growth planning involves asking questions—such as when to extend a UGB or modify growth constraints to avoid unnecessary housing price inflation and housing affordability concerns—there may be a valuable role for modeling. Models such as MetroScope and UrbanSim can potentially be useful

in providing more rigorous and unbiased answers to questions about the likely effects of a range of smart growth policies that will cause differing outcomes under different conditions. Failure to account for many aspects of the analytical framework presented here in the assessment of potential effects of many land use and transportation policies may produce inaccurate or biased results.

Ultimately, the rising public concern about urban sprawl provides a tremendous opportunity to overcome some obvious pitfalls of a politically divided debate over the role of planning and markets in enhancing quality of life in America's metropolitan areas. Those who seek to curb the consequences of urban sprawl will have to be sensitive to the difficult challenges of implementing policies that interfere with the deep-rooted principles of local control and individual property rights. Generating a consensus about how metropolitan real estate markets work, and the influence of public choices on these markets, is a step in the direction of finding more fundamental common ground for visions to collectively improve our metropolitan regions. Perhaps the bipartisan surge of concern about sprawl is indeed an opportunity for smart planning, and for smart growth.

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