The Influence of Residential Development Patterns on Local Government Costs and Revenues

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INTRODUCTION

Many areas of the Commonwealth are both blessed and challenged with rapid population growth. Accompanying this rapid growth is often a concern that the locality is losing its rural character, farms, or open space. Part of the ambivalence toward population growth arises from the spatial form of that growth. Frequently new urban growth is called "urban sprawl." While not always well defined, sprawl is often a shorthand and pejorative phrase to describe land-extensive residential development that features large lot developments outside city centers. Such land-extensive development, in turn, is sometimes criticized for causing environmental degradation by accelerating the loss of open space, increasing habitat fragmentation, degrading air quality (more miles traveled and hence more emissions), and degrading water quality (increasing impervious surfaces--like roads, driveways, and rooftops--and thus increasing the quantity and decreasing the quality of runoff).

Local governments are the primary party responsible for making land use policy decisions that influence the spatial form of new housing developments. While local governments are concerned about the local environmental conditions, they also care about the costs of providing government services and changes in their tax base (primarily the real property tax base). Different land settlement patterns may influence both the cost of providing government services as well the local tax base (local government revenues). The fiscal consequences of alternative settlement patterns will, in turn, affect the willingness of local governments to encourage more compact settlement forms.

This paper investigates whether and to what extent the promotion of more land-intensive housing patterns is compatible with the fiscal incentives of local governments. To explore this relationship, the different types of spatial attributes of development are defined. The relationship between the spatial attributes of development and local government service costs and tax revenues are then discussed. The existing literature is reviewed and analyzed to isolate the influence of spatial form of development from other factors that impact local government costs and revenues.

DIFFERENT SPATIAL ATTRIBUTES OF DEVELOPMENT

To isolate the influence of spatial form of development on local government finances, a more precise definition of "spatial form" is necessary. When thinking about spatial form, a distinction between *population growth* and the *spatial form* of growth must be made. For instance, 1,000 new residents will undeniably increase local government service costs. The new population will bring more children to educate and place new demands on infrastructure (roads, water, sewer). However, these same 1,000 new people can be located on small lots adjacent to an existing town or on larger lots scattered across a rural landscape. Does the one type of settlement create different costs for the local government than another? What spatial attributes--for example lot size or distance to town--influence the cost of local government services?

To answer these questions, three different spatial attributes are identified: 1) density, 2) distance, and 3) dispersion. The unit of analysis used to isolate these three attributes is a residential *development tract.* A development tract is a grouping of parcels by a developer under a planned design. A development tract could be a small subdivision or large planned unit development. Spatial form can be more precisely defined by arrangement of parcels within a development tract (tract form) and the arrangement of development tracts on a larger landscape (tract pattern).

Development Tract Form

Two general spatial measures describe the arrangement of parcels *within* a development tract: gross tract density and net tract density. Gross density is the total number of dwelling units per acre in the development tract. It is calculated by dividing the size of the tract by the number of dwelling units in the tract. Gross tract density is the total land area of the tract including all private lots, open space, streets, and rights of way. Net tract density is a measure of average private lot size. It is calculated by dividing the amount of privately developed land by the number of dwelling units. Net tract density may be higher than gross tract density because net tract density does not include roads, open space, recreational areas, and other public areas (CBP 1993, p. 2-20).

Figure 1 shows three hypothetical development tracts. Each tract contains 12 detached dwelling units (represented by the black rectangles). In each of the three tracts, a solid line identifies the tract area while a dashed line denotes individual lots *within* the tract. Tract 1 could be described as a large-lot residential development and would be characterized by low gross and net densities. Tract 2 is characterized by low gross density and high net density (sometimes called a cluster development). Compared to Tract 1, Tract 2 has smaller lots and a significant amount of open space, which could be forestland, agricultural land, or structured open space (parks, golf courses, etc.). Furthermore, the open space in Tract 2 is legally associated with the development tract and is protected through some legal arrangement like a conservation easement. As represented in Figure 1, Tracts 1 and 2 use the same total amount of land. Both high gross and net densities, by contrast, characterize Tract 3. Because the individual lot sizes are small in area (similar to Tract 2) and the tract itself does not include any common open space, the development tract (area inside solid black line) is smaller than Tracts 1 and 2. The gray shading of Tract 3 indicates how much smaller Tract 3 is compared to Tracts 1 and 2. Obviously, Tract 3 requires far less land to accommodate these 12 dwelling units than Tracts 1 and 2.

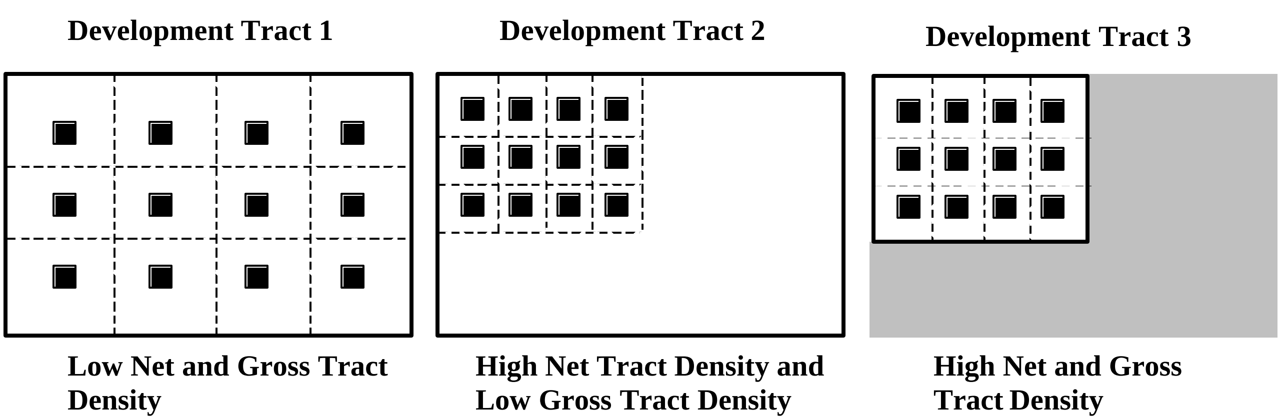

Figure 1. Gross and Net Densities for Different Development Tract Patterns

Development Tract Patterns

The layout of development tracts can be described by at least two spatial characteristics: distance and tract dispersion. Distance is defined as the distance between a development tract and some central point such as a major city, employment center, commercial center, or centralized public service provider. Tract dispersion indicates the separation between development tracts.

The arrangements of development tracts may reflect a variety of combinations of distance and dispersion. Figure 2 represents three such combinations or tract patterns. For each pattern, the squares represent development tracts (regardless of specific tract form) and are shown relative to an existing service center. Tract Patterns 1 and 2 are characterized by low tract dispersion, but differ by the average distance to an existing service center. Pattern 3 represents a distant, dispersed spatial arrangement. Patterns 1 and 3 represent similar average distances to the existing center but extremes in tract dispersion.

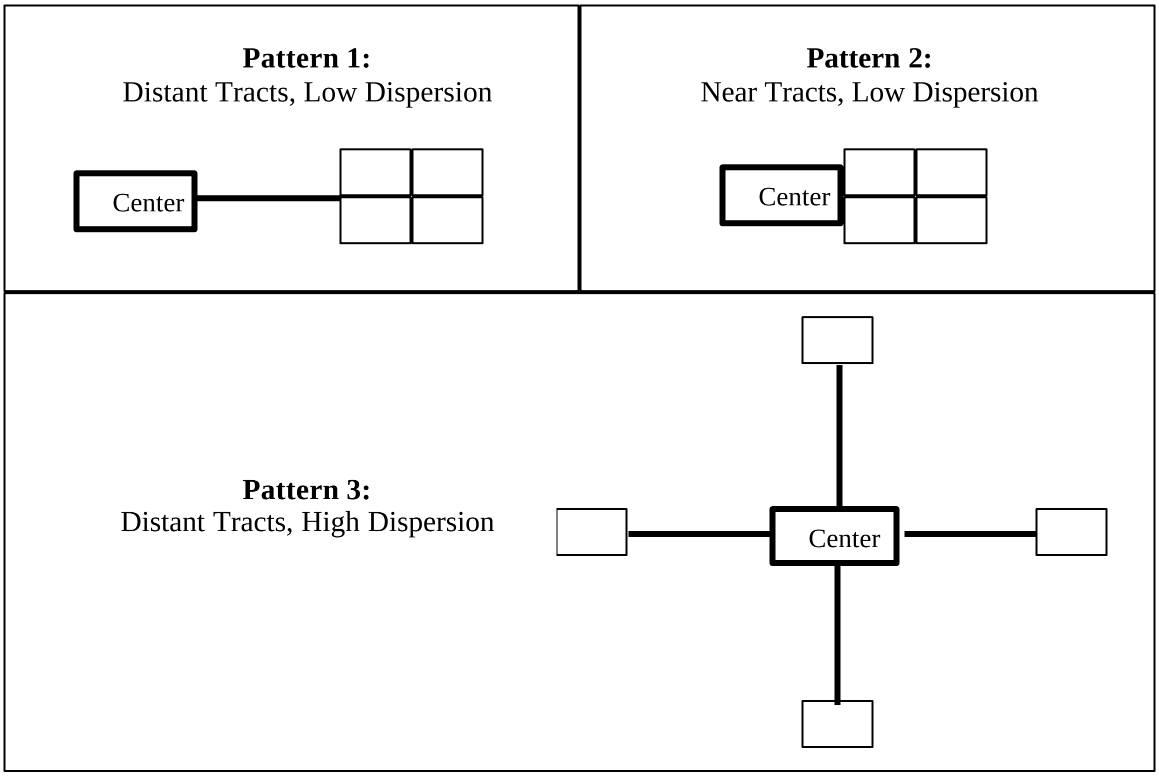

Figure 2. Tract Distance and Dispersion

COSTS AND RESIDENTIAL SETTLEMENT PATTERNS

Local governments commonly provide a variety of services including education, police protection, emergency services (fire and rescue), water and sewer, parks and recreation, and roads/transportation networks. Figure 3 shows how a number factors can influence the local government service costs. The bottom half of Figure 3 shows that total local government costs can be calculated by multiplying population served by the per capita costs to serve that population. The per capita cost of providing services can then be affected by the spatial attributes of development (as defined above), demographics, and service standards.

The analytical challenge is to isolate the influence of spatial attributes on costs from the other factors that influence total government costs: population, demographics, and service standards. The total cost of providing a local government service is obviously related to total population served. The demographic composition also can affect local government costs. For example, the more children a locality needs to educate, the more a local government will need to spend on education. Or a community with a larger percentage of retirees may spend less on public education than a similar community with more young

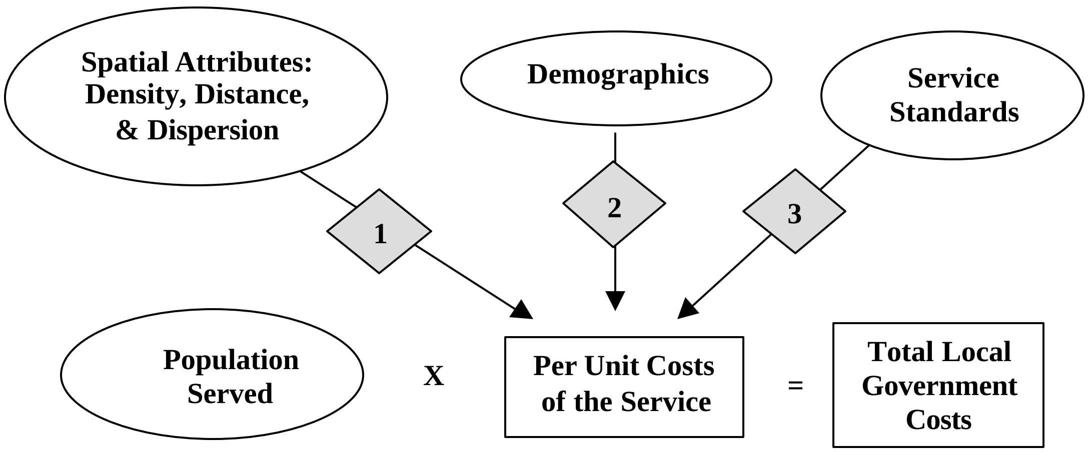

Figure 3. Direct Relationships between Local Government Costs and Spatial Arrangement of Development

families (all other factors held constant between the two communities). Finally, service standards refer to the quality of educational or police services provided by the local government. Service standards may influence the cost of providing services even if population, demographics, and the spatial form are the same. Local government may elect to spend more resources than a similar community to attract better-qualified teachers, achieve lower student-teacher ratios, and offer better educational facilities. Service standards can also be dependent on technological advances, as well as federal, state, and local regulations.

Education

Educational expenses are typically the largest part of a local government's budget. In general, significant portions of school expenditures have been found to be insensitive to the spatial attributes of development. For example, teacher salaries, administration, and capital construction projects are relatively unaffected by tract dispersion, distance, and density (Burchell 1992; Burchell et al. 1998; Duncan 1989; Frank 1989).

Busing costs are most sensitive to the spatial arrangement of development. Downing and Gusteley (1977) estimated school busing costs based on the distance of development tracts from schools. While they do not compare the costs of alternative development forms or patterns other than distance, their results indicate that distance between development tract and school affects educational expenditures through busing costs. Esseks, Schmidt, and Sullivan (1999) also estimated busing costs of three school districts. Each district has an area that is part of an incorporated municipality, presumably developed in a compact manner, and an unincorporated area settled in a low-density, dispersed fashion. In each of the three districts, busing was more expensive in the land-extensive area by a large proportion. The local government's share of annual busing costs was $297 per student for the land-extensive site compared with $53 in the incorporated area.

Taken as whole, the above literature suggests that the influence of spatial arrangement of development to taxpayers for the financial cost of education is relatively small. With the exception of busing costs, little empirical evidence supports educational costs being significantly influenced by the spatial arrangement of development. While busing costs are extremely sensitive to the spatial form of development, in the aggregate transportation tends to be a small component of total educational costs, typically constituting less than 5 percent of all education expenditures.

Roads

More land-extensive development will require greater lengths of roadway to connect individual dwelling units and development tracts. More extensive road networks imply the need for greater capital investments as well as higher maintenance expenditures (Burchell 1992; Frank 1989). Burchell et al (1998) used a road model from Rutgers University's Center for Urban Policy Research (CUPR) to project state and local road infrastructure needs and construction costs in New Jersey. This study found that construction cost of local roads (excluding maintenance costs) under compact growth is 30 percent lower than the road network needed to serve a more land-extensive development pattern.

The general finding that road costs increase significantly with land-extensive development is subject to two caveats. First, only a portion of road costs is actually paid by the local government. The local government share of total local road costs differs from state-to-state. In Virginia, for instance, the vast majority of all capital costs are paid for by state and federal sources. The category of road costs that are typically paid for by local governments is operating costs (snow removal for example). Similar to construction costs, dispersed forms of development can cause significantly higher road maintenance costs than more compact forms (Burchell 1992; Esseks, Schmidt, and Sullivan, 1999).

The second caveat is that the effects of different service standards should be considered. While more compact development may reduce the number of miles of roads needed to serve a population, these roads typically require higher service standards in the form of wider roads, more durable construction, and more frequent snow removal (Frank 1989; Esseks, Schmidt, and Sullivan 1999). Esseks, Schmidt, and Sullivan, in particular, recognize that differing service standards may have a substantial impact on costs, and they are, therefore, reluctant to draw conclusions on the effect of spatial form on road costs.

Water and Sewer Services

Studies have consistently found that the cost of providing centralized water and sewer services is particularly sensitive to the spatial form of development (Burchell et al. 1998; Frank 1989; Downing and Gusteley 1977; and Wheaton and Schussheim 1955). Water and sewer service costs include delivery infrastructure costs (pipes and pump stations), operating costs (maintenance and energy costs), water storage, and water and wastewater treatment. Delivery infrastructure costs are most sensitive to spatial development form. Lower densities generally mean longer lengths of water and sewer pipe. Less tract dispersion and distance to service centers, conversely, will lower costs as well by lowering the length of transmission mains.

Speir and Stephenson (2001) isolated the influences of density, distance, and dispersion on water and sewer costs. They found that the majority of spatially sensitive costs are tract density related costs. In other words, the infrastructure costs of connecting individual dwelling units *within* a development tract are more expensive relative to connecting distant and dispersed development tracts to the service center. These findings suggest that local governments shift significant portions of the spatially sensitive costs of providing water and sewer service to private entities by requiring developers to install water and sewer connecting mains when the houses are being constructed.

All studies reviewed conclude that lower densities increase public sector costs *under an assumption that the lower densities are served by centralized water and sewer service*. This assumption may not always apply. Spatial arrangement can influence the level of centralized service that is required. Higher density areas require centralized water and sewer distribution, collection, and treatment systems while lower density areas may be able to substitute privately constructed wells and septic fields for centralized service. Thus, public service costs can be reduced to the extent that very low-density forms can support private wells and septic systems. The cost risk of the private wells/septic occurs when continued land-extensive development can no longer support private wells and septic fields because of over-pumping or contamination of groundwater systems. If this degradation were to occur, water and sewer costs would increase sharply in order to connect existing low-density housing patterns to the public system (Wheaton and Schussheim 1955).

Emergency Services

The relationship between the cost of providing fire and police protection services and spatial arrangement has been more difficult to isolate than other government services. Logic suggests that more distant and dispersed settlement forms may increase local government costs by requiring more capital facilities or increasing personnel and operating costs. Land-extensive development, for example, may require construction of new fire and ambulance stations to maintain acceptable levels of service, suggesting that per capita costs will increase (Esseks, Schmidt, and Sullivan 1999). Similarly, land-extensive development removed from existing service centers may require either additional police stations or additional police officers and patrol cars to adequately patrol the larger areas and longer lengths of road. One study suggests that operating costs for police protection in denser neighborhoods with multifamily housing are only about two-thirds of that in areas with single-family houses on one-acre lots due to fewer patrol cars and shorter patrol routes. Fire protection may be less sensitive to distance than police service because fire fighters respond only to alarms while police officers patrol continuously (Downing and Gusteley 1977).

Addressing levels of service standards, however, complicates the relationship between emergency service cost and the spatial form of development. Many cost studies are based on the implicit assumption that service standards for emergency services (response time, for instance) are held constant. Others, however, note that emergency service response times fall with more dispersed and distant forms of development (Esseks, Schmidt, and Sullivan 1999). A similar case could be made for police patrol frequency and response times. If this relationship between frequency and response time is the case, possibly by allowing increases in emergency and police response times, local government can limit increases in police and emergency service costs. In essence, the increase in response times shifts costs away from local governments onto citizens living in more dispersed and distant settlements.

To complicate matters further, some researchers argue that land-extensive forms of development actually lower the need for, and thus the cost of, emergency services. For instance, Ladd (1992) argues that higher density developments generate higher levels of crime and conflict. If the relationship between crime and population density is true, higher per capita expenditures on police protection could occur with more compact forms of development. If lower density results in lower crime rates, this reduction in costs could offset the increases in patrol times. The same logic may also apply to fire protection if higher densities do, in fact, increase the risk of loss associated with fire to any particular dwelling unit. If crime and fire risks are related to the spatial attributes of development, then it is unclear how spatial form will influence the cost of providing emergency services and police protection.

SUMMARY OF COST LITERATURE

The spatial arrangement of development directly affects costs of only a subset of local government services. Water and sewer service is the best example of a local government service that matches the causal relationship (Arrow 1) exhibited in Figure 3. Water and sewer costs increase as development becomes more dispersed, distant, and less dense. Costs of providing roads are also influenced directly by spatial arrangement of developments, but local governments may only bear a small percentage of the construction costs. The costs of other type of services--such as education, police and emergency services--do not appear to be clearly and significantly influenced by the spatial attributes of development as represented by Arrow 1. Other influences such as demographics, service standards, and most importantly, population may be the dominant determinants of costs for these services.

With this said, the spatial attributes of development on local government costs may influence costs in more subtle ways than depicted in Figure 3. Figure 4 provides more complex ways in which spatial attributes of development may influence local government costs. Specifically, Figure 4 shows that spatial arrangements may influence local government service costs *indirectly* by influencing total population (Arrow 4), demographics (Arrow 5), and service standards (Arrow 6).

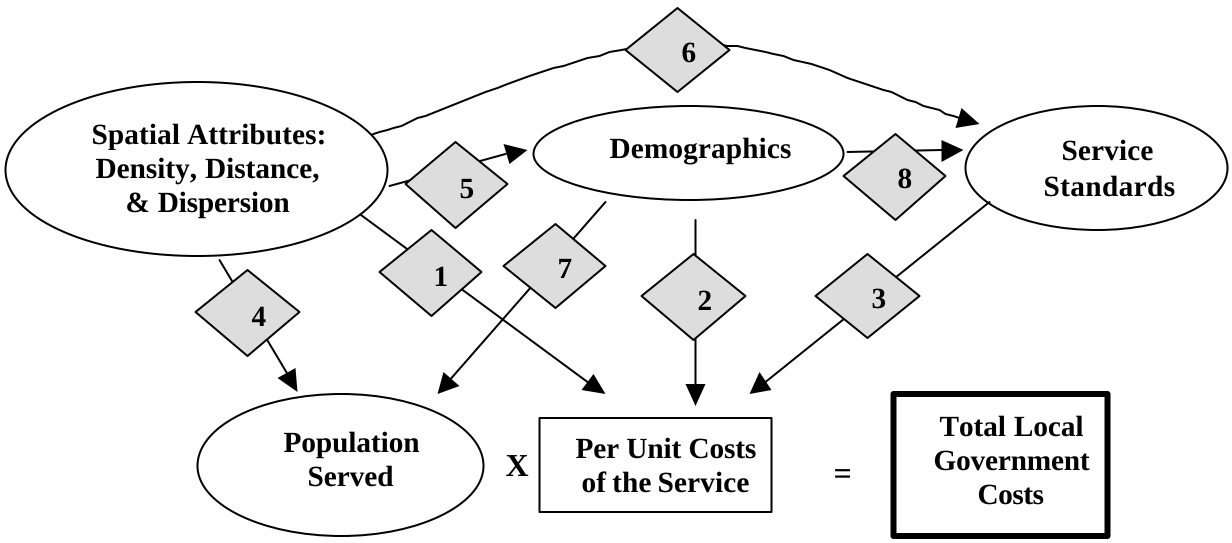

Figure 4. Potential Indirect Relationships Between Local Government Costs and Spatial Arrangement of Development

The spatial arrangement of development can influence how many people move into a jurisdiction (Arrow 4, Figure 4). For example, low gross density developments (large lots or cluster developments--tracts 1 and 2, Figure 1) limit population growth by limiting the potential number of residential dwelling units per acre, thus possibly driving up housing costs. Such development may also push development into neighboring jurisdictions. If population growth is reduced, the educational expenditures may be also. And as research has consistently shown, student numbers drive educational costs. Similarly, public water and sewer service costs can be controlled by reducing the need for public water and sewer service (more new development served by private wells and septic systems). Thus, large lot or land-extensive development patterns represent a possible mechanism to control population growth (Windsor 1979; Frank 1989). Through the relationships represented by Arrow 4, Figure 4, land-extensive development could conceptually *lower* total local government costs.

In Virginia and Maryland, local governments have explicitly promoted land-extensive development to control costs. In the past several years, county commissioners in Charles County, Maryland approved a series of rules that would increase the cost of constructing townhouses (Shields and Layton 1998; Shields 1999). The commissioners also banned construction of single-family homes smaller than 1,650 square feet (Lengel 2000). Local officials openly acknowledged that slowing population growth through lower densities was their primary objective (Shields and Layton 1998). Similarly, Prince William County, Virginia and Calvert County, Maryland have used limits on sewer service to limit population growth (Layton 1999). Sewer bans require new development to locate on large lots capable of supporting individual septic systems. The behavior of these localities provides possible evidence that the cost-reducing potential of more dispersed spatial arrangements (through limiting population growth) exceeds the direct cost-reducing potential of compact, dense settlement patterns on per unit service costs.

Different spatial forms may indirectly influence costs by changing the demographic mix of people (Arrow 5) which in turn affects the population served (Arrow 7) and per unit costs (Arrow 2). In many cost studies, the relationship between demographic characteristics and the spatial arrangement is often ambiguous. Many studies implicitly assume demographics remain constant as spatial attributes are varied. Yet the demographic profile of a population can indirectly influence costs by changing the demand and need for local government services (Arrow 7). For example, it is sometimes asserted that low-density suburban development separated from urban centers draws more households with children than higher density developments adjacent to urban centers. Conversely, high density detached developments may attract a higher proportion of childless households (Fina and Shabman 1999). Thus, local government costs can be increased because one form of development brings in more school age children per dwelling unit than another form. These observations, however, have been based on individual case studies. While the relationship between spatial arrangement and demographics could have large indirect influence on local government costs, very little research on these relationships has been conducted.

Spatial forms may also indirectly influence local government costs by influencing service standards (Arrow 6, Figure 4). As previously discussed, service standards for police and emergency services may be influenced by the spatial arrangement of development (Ladd 1992). Social science research, in general, finds positive correlations between crime rates and population densities (Kposowa, Breault, and Harrison 1995). If these results hold, increased spending on police protection in more compact developments would be necessary to maintain a given level of public safety.

REVENUES AND RESIDENTIAL DEVELOPMENT PATTERNS

In addition to costs, the revenue generated by local governments may also be sensitive to the spatial attributes of development. Excluding transfer payments from the state and federal government, local governments generate revenues from a variety of sources including real and personal property, charges/fees, permits/licenses, and local sales and use taxes.

The discussion of how spatial attributes of development influence local government revenues focuses on real property tax receipts because in most cases real property generates the largest percentage of all local government revenue. Real property taxes depend on assessed real property values, which in turn depend on market prices. Market prices for residential properties reflect buyers' and sellers' assessments of the value of the property. Buyers' willingness to pay for property is based on a combination of characteristics associated with a particular property. These characteristics can be grouped into three general categories: dimensions of the dwelling unit (age, number of rooms, square footage, etc.), spatial arrangement (tract form and pattern), and neighborhood characteristics and environmental amenities (crime rates, school quality, air quality, etc.). Statistical analysis has been used to isolate the contribution of individual characteristics to the total price of the residential property. Conceptually, such analysis isolates how property prices vary as one characteristic varies (such as lot size), holding all other attributes constant.

This section specifically describes what is known about the effect of different spatially related attributes of houses, development tracts, and patterns on property prices.[1] These findings are then used to illustrate how a local government property tax base may change with different spatial forms of development.

Tract Form

The arrangement of individual residential properties within a development tract can take an almost infinite array of forms. In Figure 1, three stylized tract forms were described. As Figure 1 suggests, development tracts can be distinguished by individual lot characteristics (lot size) and open space amenities.

A consistent finding in the real estate and economics literature is that people are willing to pay more for larger lots (Grether and Mieszkowski 1974; Nelson 1978; Knapp 1985; Dubin 1988; 1998; Eppli and Tu 1999; Leggett and Bockstael 2000; Kaltsas and Bosch 2000). While the price people are willing to pay for increases in lot size is positive, research also generally finds that people are usually willing to pay less for each additional increment in lot size. Similarly, prices for detached homes are also generally higher than prices for attached homes, given dwelling units of similar sizes and characteristics (floor space, number of bedrooms, etc.) (Mills and Simenauer 1996).

Proximity to open space also tends to increase property values. Development Tract 2 in Figure 1 reserves open space for common uses as part of the development. This open space could take a variety of forms including parks, nature preserves, or farmland. One study found that property values increase as much as 3 percent in the presence of a tract-managed and shared recreational facility (Palmquist 1980).

While not represented in Figure 1, development tract forms can also differ in terms of road network layout and construction characteristics. Traffic patterns within a development tract can significantly influence property values. Property prices vary inversely with the volume of street traffic (MacDonald and Veeman 1996; Hughes and Sirmans 1992; Asabere 1990). This relationship is best illustrated by the large positive influence cul-de-sac development patterns can have on property values. Asabere (1990) found that the cul-de-sac layouts increase property values by more than 20 percent over a standard grid pattern (Asabere 1990).

Tract Dispersion and Distance

Property values tend to fall as distance from employment centers (central business district) increases (Kain and Quigley 1970; Nelson 1978; Cobb 1984; Leggett and Bockstael 2000). These findings may not hold if the employment centers contain heavy-industry production facilities (Li and Brown 1980). The influence of tract dispersion on property values is more difficult to isolate because defining dispersion quantitatively is

[1] While the general relationships between some property characteristics and market prices might be well established, the specific values of property attributes tend to be location and time specific. Property market transactions reflect the relative scarcity and abundance of the housing stock attributes existing in the real estate market when the transaction was made as well as the local preferences and economic conditions of the buyers and sellers. Thus, the price for a small lot in a cluster development may be quite different in the area with many similar style developments compared to an area where such developments are unique. Similarly, tastes and preferences for small lot developments may be different in different localities. These observations lead to two general conclusions. First, since property prices tend to be location and time dependent, estimating how property values change across different settlement patterns is difficult unless location-specific statistical analysis is undertaken. Second, significant changes in the content and structure of the housing stock will change the prices people are willing to pay for property attributes. For example, changes in zoning rules that result in widespread construction of cluster developments could alter the relative scarcity of large and small lot developments in a housing market. In such a case, the per acre property values of the cluster development would begin to decline relative to the per acre property values of larger lot developments.

challenging. Several studies have attempted to identify how scenic views, neighborhood population density, and presence of open space influence surrounding property values. Leggett and Bockstael (2000) report that the percentage of surrounding land in open space or forest within three quarters of a mile exerts a positive influence on property values. Similar approaches have been used to measure both population density around a dwelling unit (Grehter and Mieszkowski 1978) and open space (Cheshire and Sheppard 1995). Other studies have found that a pleasant view from a house increases property values (Rodriguez and Sirmans 1995; Li and Brown 1980). In some cases, studies have shown a positive relationship between the price of a house and the proximity to farmland (Ready, Berger, and Blomquist 1997). If the quality of the view is related to quantity of open space surrounding the dwelling unit or development tract, then the quality of view indicates a general preference for disperse tract patterns.

AN ILLUSTRATION

This section examines how property values could change under a number of hypothetical development scenarios based on study results. Each scenario begins when 12 acres of agricultural land are converted into 12 single-family detached dwelling units. These 12 dwelling units are assumed to be identical in terms of individual house attributes (number of rooms, square footage, etc.). Thus the value of the physical dwelling unit itself is held constant (at $120,000 per unit). The number of people per dwelling unit and the demographic composition of the residents occupying the dwelling units are also assumed constant across the different development scenarios. For each scenario, the total property value of the 12-acre parcel will be calculated. **The values presented in this section should not be interpreted as definitive but rather illustrative of the potential property tax consequences of different spatial arrangements of development.**

In each scenario the site and the land surrounding the potential development tract are assumed to currently be in agricultural use. In agricultural use, the county assesses the land at $250 per acre under use value taxation. Next, five different development scenarios (Figure 5) are considered: 1) low gross density, 2) medium gross density, 3) cluster-medium net density, 4) high density, and 5) cluster-high net density. The low density, large lot development would place each of the 12 dwelling units on one-acre parcels with net and gross density of one dwelling unit per acre. Two cluster scenarios are considered: cluster developments with low gross densities (same as large lot development) but higher net densities (four and two dwelling units per acre). The total area developed is either three acres or six acres respectively, with the remaining portion dedicated to open space. The last two development scenarios are labeled high and medium-density developments and are similar to the cluster developments (same net densities) because dwelling units are placed on quarter-acre (high density) and half-acre (medium density) lots. However, the high and medium density scenarios are unlike the cluster development in that no land is reserved within the tract for open space. Thus, the total size of the high and medium-density development tracts are three and six acres, respectively. The remaining acres (shaded areas in Figure 5) are initially assumed to remain in agricultural use but could be developed at some future date.

Gross Density is calculated by dividing the total acreage in the tract by the number of dwelling units.
Net Density is calculated by dividing total acreage *minus* open space, streets, rights of way, etc. by the number of dwelling units.

To assess the possible consequences of net and gross density on property values, the value of quarter acre lots is initially set at $25,000. This value is comparable to tax assessment values in urban fringe areas of Virginia. Given that each dwelling unit is valued at $120,000, the total value of each quarter acre lot in the high density and cluster-high net density developments is $145,000 ($120,000 + $25,000). The total value of the 12 individual parcels for the high net density development is then $1,740,000 (12 *

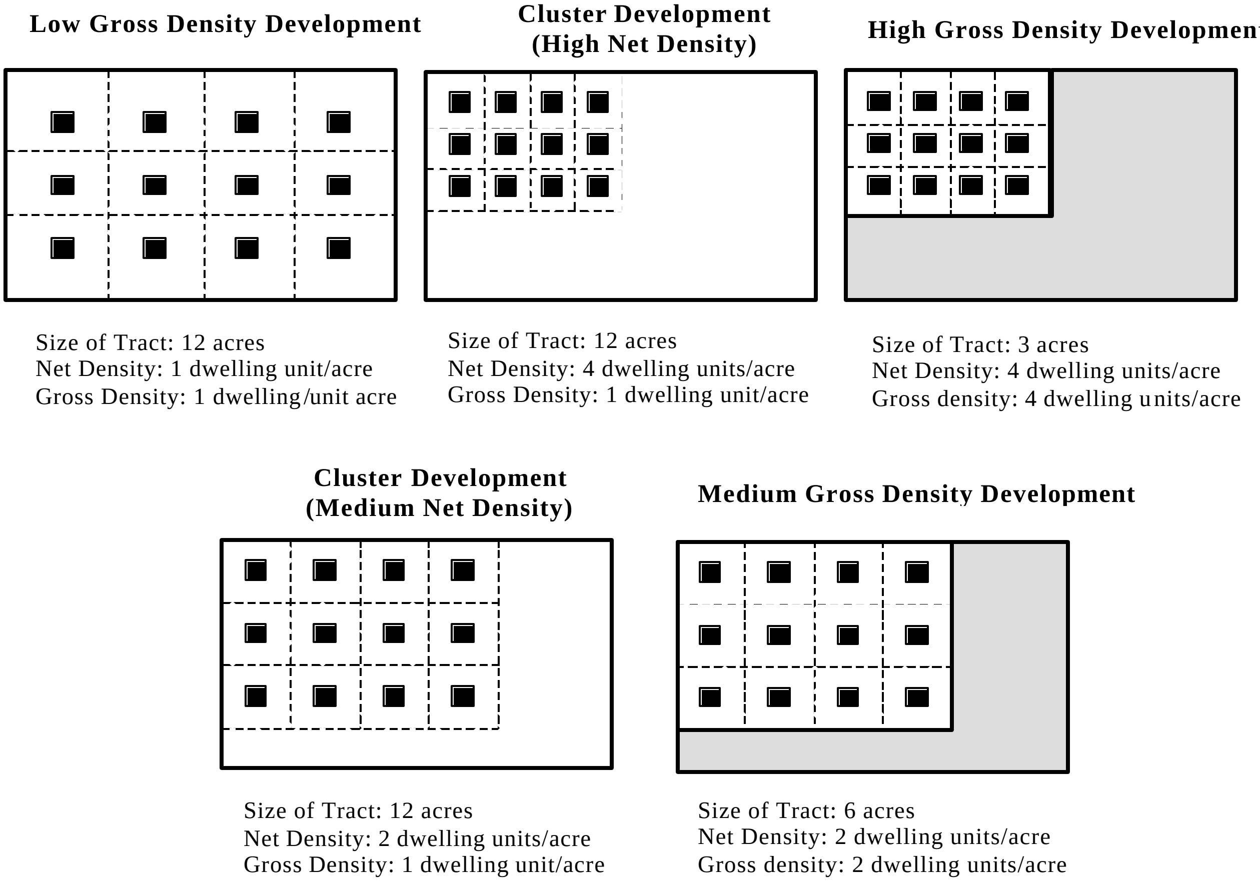

Figure 5. Development Tract Scenarios

$145,000).

An increase in lot size from a quarter to a half-acre has been found to increase the individual property values within a range of 1 to 16 percent (Leggett and Bockstael 2000; Kaltsas and Bosch 2000; Eppli and Tu 1999; Dubin 1998; Li and Brown 1980). Property values increase 4 to 20 percent when lot sizes are increased from a quarter acre to one acre in these same studies. According to these statistical relationships, lot size values increase from $26,450 to $48,200 for half-acre lots and $30,800 to $54,000 for one-acre lots.

These figures, however, do not necessarily represent the total property value of the original 12-acre tracts since significant portions of tract may remain undeveloped or developed as open space. The cluster developments (high and medium net density) reserve significant portions of the development tract as open space. This reserved open space is typically assessed at a much lower value than agricultural use values. In this example, open space is assumed to be reserved in perpetuity for recreational purposes and assessed at $50 per acre. The high and medium-density development tracts, on the other hand, require less land than either the cluster or low-density developments. The high density and medium-density development tracts are three acres and six acres respectively. The remaining acres are undeveloped, are assumed to remain in their original agricultural use, and are assessed at $250 per acre.

The total value of the original 12-acre tract under each of the five development scenarios is reported in Table 1. Generally, the lower density development scenarios generate higher property values (and thus

Table 1. Development Tract Values: Sensitivity of Property Values to Lot Size

Development Tract	Value of the lot	Value of lot plus building	% change in parcel value	Total value of individual parcels	Assessed value of remaining open space	Total value of 12 acre parcel (private parcels plus open space)
	-----------$----------		%	-------------------------$----------------------		
High Density	25,000	145,000	-	1,740,000	2,250[*]	1,742,250
Cluster (High Net Density)	25,000	145,000	-	1,740,000	450[**]	1,740,450
Medium Density***						
Low sensitivity	26,450	146,450	1	1,757,400	1,500[*]	1,758,900
High sensitivity	48,200	168,200	16	2,018,400	1,500[*]	2,019,900
Cluster (Medium Net Density)***						
Low sensitivity	26,450	146,450	1	1,757,400	300[**]	1,757,700
High sensitivity	48,200	168,200	16	2,018,400	300[**]	2,018,700
Low Density***						
Low sensitivity	30,800	150,800	4	1,809,600	0	1,809,600
High sensitivity	54,000	174,000	20	2,088,000	0	2,088,000

[*] Calculated as $250 (assessed value of agricultural land) times the number of acres remaining in agricultural land.

[**] Calculated as $50 (assessed value of recreational open space) times number of acres in open space.

[***] Sensitivity refers to the response of land prices to increases in lot size from a high density situation. Mid-range estimates were derived from Kaltsas and Bosch (2000).

property tax receipts) than higher density developments. This conclusion should hold even with gross densities higher than four dwelling units per acre. In essence, residential development is displacing lower valued uses (agriculture in this case), and the more displacement that occurs, the higher the overall property values. This conclusion is based on the assumption that agricultural land is being taxed at use value rather than market value. If land were taxed at market rates, this net effect on property values from residential developments would be less clear.

The above analysis assumes each development tract is similar in every respect except for lot size. Some of the studies reviewed have found that other development tract characteristics can influence prices people would be willing to pay for individual properties. Tract traffic patterns, cul-de-sacs, and visual appeal of the development tract may all influence property values. Many of these characteristics are not necessarily unique to development scenarios outlined in Figure 5. For instance, the high-density scenarios do not necessarily increase road traffic if the overall population in the surrounding area remains the same. The existence of a tract-level recreational area or open space, however, does vary across the five development scenarios. In the two cluster scenarios, significant portions of the development tract are reserved for recreational use. Palmquist (1980) found that the value of this amenity can get capitalized into the values of surrounding properties. Like lot size, the influence of recreational amenities and open space can vary widely across areas. Where ample open space and recreational areas are widely available, the influence of tract-level open space may be quite small. The influence on property values from such amenities could, however, increase substantially in densely settled areas.

The property values of the cluster developments are recalculated under different assumptions about the possible influence of open space amenities on property values. Using estimates from Palmquist (1980) as a midpoint, individual property values are assumed to increase 1, 3, and 6 percent in cluster developments due to the presence of reserved open space. The increase in property values is assumed to be reflected in the market transaction of individual properties and not in the assessed value of the open space.

The possible property value consequences of recreational amenities are reported in Table 2. The presence of recreational opportunities in cluster developments could increase the property value of cluster developments to levels comparable to large lot developments. Assuming property values increase 3 percent due to recreational open space, the total property value of the medium and high net density cluster developments is $1.81 and $1.88 million, respectively. These values fall within the range of property values associated with the large lot (low density) development. While cluster developments reduce lot size, it should be point out that cluster developments (low gross density development) require similar amounts of total land area to large lots developments. Thus, low gross tract densities, in general, appear to generate higher per capita property tax revenues.

Table 2. Development Tract Values: The Influence of Recreational Open Space

Development Tract	Value of lot plus building	Total value of individual parcels	Assessed value of remaining open space	Total value of 12 acre parcel
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Cluster (High Net Density)				
No change in property values	145,000	1,740,000	450**	1,740,450
1% increase in property values	146,450	1,757,400	450**	1,757,850
3% increase in property values	150,844	1,810,122	450**	1,810,572
6% increase in property values	159,894	1,918,729	450**	1,919,179
Cluster (Medium Net Density)				
No change in property values	150,500*	1,806,000	300 **	1,806,300
1% increase in property values	152,005	1,824,060	300**	1,824,360
3% increase in property values	156,565	1,878,782	300**	1,879,082
6% increase in property values	165,959	1,991,509	300**	1,991,809

* Initial lot values calculated from Kaltsas and Bosch (2000).

** Calculated as $50 (assessed value of recreational open space) times number of acres in open space.

CONCLUSIONS AND IMPLICATIONS

Many areas situated on the fringes of metropolitan areas are experiencing rapid population growth. Local governments often struggle to pay for the public services needed by the new residents. A frequently heard complaint is that "sprawl" drives up local governments costs and strains local budgets. The use of the word "sprawl" implies a particular form of growth--dispersed population, large lots, removed from existing economic centers. Yet based on existing research, to what extent the *spatial form of growth* influences the net fiscal position of local governments is unclear. The cost of providing local government services appears only moderately related to the spatial attributes of development. Local government revenues may actually be enhanced by low-density development. Indeed, it is plausible that land-extensive development forms (low gross density, high tract dispersion, and distance) can have modest positive net fiscal (more revenues, less costs) consequences to local governments for two reasons. First, lower gross density developments tend to generate more property tax revenue per dwelling unit than more dense patterns. If costs are, in fact, relatively insensitive to spatial form, the low gross density development can increase net fiscal outcomes. Second, because larger lot developments use more land and increase housing prices, such developments could dampen the demand for new houses and thus slow the rate of population growth. Thus, larger lot developments can lead to higher per capita property tax receipts and limit costs by limiting population growth.

Population growth and not "sprawl" per se appears to present the greatest budgetary challenge to local governments. Local governments struggle to pay for services, at least initially, because of large up front, infrastructure expenditures (new schools, fire stations, water mains, etc.). The struggle to pay for these services seems to occur regardless of the development pattern.

This analysis does not address the extent to which land-extensive growth causes adverse environmental or social consequences. Many suggest that such forms of residential growth do indeed carry environmental and social costs. But if land-extensive forms of development (low gross density, dispersed, and distant developments) do adversely impact environmental quality, the entity best positioned to influence land use policy--local government--does not have clear financial incentives to discourage such settlement patterns.

What do these findings mean for Virginia's ability to promote more environmentally sensitive development? In the long-term, changes in the way local governments spend and raise money could provide more incentives for compact development. For instance, having local governments pay a greater share of road construction costs, would create financial incentives for more compact development. Increasing the ability of local governments to charge impact fees for new development could, if properly structured, provide incentives for more compact development and provide an alternative way to raise revenues. Finally, reduced reliance on the property tax as a way to generate revenues could also reduce the financial disincentives that discourage higher density developments.

In the short term, local government might be more willing and able to promote more environmentally sensitive development patterns by finding better ways to accommodate the preference for land-extensive development forms. For example, cluster development may reduce the impact on water quality by limiting the total amount of impervious surface (roads, driveways) created by development.[2] While not reducing total land consumption, cluster development would have negligible to positive consequences on local government costs (lower infrastructure costs for example). The property tax consequences are less clear, but under certain conditions, the presence of reserved open space in cluster developments may at least partially offset the disadvanges of smaller lot sizes compared to large lot developments. Similarly, street width and set back requirements may be reduced without influencing the spatial attributes of a development or local government finances. Such modest changes in new development construction requirements could also reduce impervious surface cover.

These suggestions should be considered tentative. The relationship between spatial form and net fiscal impact on local government is complex and warrants further research. Relatively little work has been done to isolate the indirect effects of spatial arrangements on fiscal outcomes. For instance, the demographic characteristics of new residents (particularly the number of school age children) can have a profound impact local government budgets. Yet little is known about the relationship between spatial form of development and the demographic composition of different development forms. Similarly, little work has been done on how residential settlement patterns change the mix of commercial and residential properties. Commercial properties tend to generate significant net revenues for local governments and may be more likely to develop in areas of higher population densities. Whether the spatial arrangement of residential properties will influence the character and number of commercial establishments carries large potential implications for local government finances.

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[2] Increases in impervious cover increase the quantity of runoff. Higher volumes of runoff eventually destabilize stream banks, widen stream channels, and degrade aquatic habitat. Impervious cover also increases concentrations of urban-based effluents entering streams and rivers.

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