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The limits to growth management: development regulation in Montgomery County, Maryland

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Abstract. In this paper the growth management system in Montgomery County, Maryland, is reviewed and critiqued with the intent of finding generalizable lessons. An overview of the twenty-year-old system is followed by an analysis of its consequences and implications. The system fails to provide effective price signals, relying instead on proactive command and control policies from the county government. Moreover the system fails to raise sufficient revenue for new infrastructure. It is suggested that an alternative reactive approach, which links the threads of infrastructure financing and adequate public facilities by replacing quotas with a market-based approach of cost-based prices, would be more equitable, efficient, and effective in implementing county goals.

Introduction

An unacceptable quality of public facilities in fast-growing communities led many to adopt a variety of growth management strategies, with varying degrees of success and numerous problems (Altshuler and Gomez-Ibanez, 1993; Baldassare, 1980; Chinitz, 1990; Dalton, 1989; Downs, 1992; Feitelson, 1993; Godschalk, 1992; Landis, 1992; Nelson and Duncan, 1995; Pollakowski and Wachter, 1990; Popper, 1988). Communities with growth regulation schemes hope that by constricting the inflow of people they can afford timely expenditures on new capital facilities such as roads, schools, water, sewers, and parks. For homeowners, the rationing of new development may make existing investments more valuable. Katz and Rosen (1987) and Pollakowski and Wachter (1990) have found price premiums in areas with growth controls. Schwartz et al (1981) and Dowall (1984) have found development spillovers into neighboring, less regulated, areas. These effects are in concordance with theory, which suggests that, as a commodity is made scarce, its price rises and substitutes are sought (Elliot, 1981; Lillydahl and Singell, 1987; Sheppard, 1988; Thrall, 1987; White, 1975). The exact amount and nature each takes depends upon the choices available to developers and consumers (Chinitz, 1990; Fischel, 1990). Growth management is a political and a pragmatic response to circumstances but whether it is economically efficient locally and/or regionally depends on the nature of the program.

Financially constrained communities will probably continue attempting to control growth, but how they will do so is an open question. In this paper the annual growth policy of Montgomery County, Maryland is reviewed and critiqued with the intent of finding general lessons which can be transferred to other communities. The annual growth policy coordinates the timing of development in accord with the provision of adequate transportation and other public facilities. It should be noted that Montgomery has other policies which also influence the location of development and infrastructure. The general plan "On wedges and corridors" (MCPD, 1963) and area plans direct development to certain areas of the county (corridors) while preserving rural areas (wedges) through zoning and transferable development rights (Bozung, 1983; Nelson and Duncan, 1995; Rose, 1984). Furthermore, functional plans direct the physical placement of public facilities whereas the capital improvement program directs their timing. Considering such a broad sweep of policies is beyond the scope of a single paper.

Although the goals of planning, zoning, and land-use regulation are quite broad, including maintaining quality of life, agricultural preservation, open space conservation, and ensuring affordable housing and economic growth, the foremost operational objective of the annual growth policy is to ensure adequate public facilities, especially transportation.

As a pioneer, Montgomery County has spent considerable resources attempting to perfect its growth management systems under the premise of rational planning. The thesis underlying this paper is that, by examination of the current state of Montgomery County's 'growth management laboratory' and by analysis of key policies within decision frameworks, a divergence from overriding efficiency, effectiveness, and equity goals becomes apparent. Understanding the causes and 'logic' of these decisions may provide insight to a reader who can apply them to more familiar circumstances.

This paper is drawn from my experience working for the Montgomery County Planning Department managing growth from 1989–94, documents produced by various agencies and agents, public hearings, and discussions with present and former staff members, citizens, and members of the development community. Although I have attempted to provide a third-person 'objective' perspective on events and issues, the county's growth management system is exceedingly complex and can be viewed from many angles, enabling alternative conclusions.

I will first discuss some decision frameworks which influence the implementation of a regulatory system, in particular, growth management, and which can be used for descriptive evaluation. This is followed by an overview of the American context of growth management systems, and Montgomery's place within it. The history of Montgomery's growth management rules and policies is summarized. Following this is a brief description of developer-funded infrastructure options that have been proposed and implemented in the county. Next is an analysis of the impacts of the system, including intended and unintended consequences, looking first at the model for setting growth limits and then at a model of the interaction of transportation and land use in the county. Some lessons from Montgomery's experience are extracted and generalized. An alternative approach to the problem is suggested, linking measures of transportation adequacy directly with financing, which would serve better the equity and efficiency goals than current policies.

Decision frameworks

Before proceeding to describe the growth management policies in Montgomery County, I will suggest some of the decision frameworks which underlie the policies. These dichotomies have been identified inductively and by no means constitute a complete list of strata on which to classify the entire decision process. However, the spectrum of dichotomies discussed below is crucial to understanding the 'logic' of Montgomery County's growth management system.

Proactive versus reactive

The first dichotomy reflects approaches to situations. In the abstract, one can proactively attempt to identify potential outcomes, and then steer decisions toward a set of specific results, or one can react to issues as they are presented in real time and decide each one in turn. Neither process is right for every circumstance, a mixture of them is used in varying degrees. Proactive approaches have higher planning costs and may still miss the mark of reality, whereas reactive approaches may require catching up with unanticipated circumstances. Within the growth management context, permitting or prohibiting development in advance of market demand leans heavily toward the proactive model, whereas a policy such as impact fees, which charges developments as they come, based on their anticipated usage of public facilities, is a more reactive model.

Categories versus continuum

Second, we can examine how a regulatory parameter is defined and implemented. A series of classes can be created, relevant examples include whether development in a particular geographical area is permitted or prohibited. Alternatively, a continuous approach can be chosen, wherein a development is permitted to proceed upon the payment of a fee which depends upon its impact: the more that is paid, the more development permitted. In economic terms, with continuous demand, categories create deadweight loss: a supplier would be willing to supply and a consumer to purchase at a price beneficial to both but the transaction is prohibited because of an artificial category boundary. As the categories within a dimension proliferate, they inevitably approach a continuum. The proliferation of categories can be seen as 'complexification', resulting in an increase in administrative costs. But the use of a continuum should not be viewed necessarily as an infinity of categories, rather it may simply be based on an elegant mathematical relationship between variables, potentially simpler than any classification with more than two categories. Again, at times both need to be used, for instance, there is a qualitative difference between housing and commercial development.

Single dimensional versus multidimensional

A third distinction falls within the nature of regulation and how rules are established. A rule can be single-dimensional; for instance, there can be a rule requiring all highways to operate at level of service 'C'. Alternatively, a rule may be multidimensional, allowing trade-offs between criteria; for example, transportation must operate at level of service 'C', which can be accomplished through some combination of highways and transit. Any system which allows either the construction of a facility or the contribution of money is at least two-dimensional. There is nothing constraining regulations to be limited to only two dimensions of trade-off except administrative energies.

Incremental versus comprehensive

Fourth, decisions may be made incrementally, varying only one or two dimensions of a regulatory system at a time, or they may be taken comprehensively, with many dimensions in flux simultaneously. Again, combinations of both are used all of the time; larger or smaller chunks can be cut off depending on circumstances. The act of creation of Montgomery County's growth management system was by necessity fairly comprehensive, though it built on the existing land regulation system. Its evolution has been far more incremental. On occasion, there may be a time for what Schumpeter (1942) termed 'creative destruction', where an existing system is discarded and replaced in its entirety.

Coordinated versus fragmented

Fifth, idea generation and decisionmaking can be more or less centralized. Montgomery County's Planning Department is in the legislative not in the executive branch of government. Although decisions may be highly coordinated within either, they are rarely coordinated between the branches. The dangers of fragmentation are a lack of responsibility as well as missing of ideas which fall in the cracks between the organizations, but overcentralization may stifle new ideas if they are not supported within the monopoly organization.

Context of growth management

Growth management, and more generally development regulation, is widespread in various forms throughout the United States. There are many approaches to growth management, ranging from simple development prohibitions through urban growth boundaries to exactions.

Kelly (1993) found 19 US jurisdictions with growth management systems and adequate public facilities ordinances similar to those used in Montgomery, though Montgomery County's growth phasing methods were the most sophisticated and complex. This suggests that, if the future is growth management, an examination of Montgomery County shows one possible scenario. Is there reason to expect other areas to follow Montgomery's lead? Though the county began its program principally as a response to congestion, recent years have seen a thrust of regulatory expansion in the environmental arena. Although enforcement of environmental quality standards will become tighter or looser in any given year with the political winds, the long-term trend is toward more regulation. Transportation control measures are a key tool advocated to reduce emissions, and growth management is one potential measure.

Growth management by development exaction and impact fees is widespread. Bauman and Ethier (1987) surveyed American communities and found a majority of communities with on-site exactions, a smaller number with off-site exactions, and a similar number with impact fees. Moreover, growth management is not confined to the local level; states have been the center of much recent expansion in managed growth policies (Bollens, 1992; Gale, 1992; Innes, 1991). The methods they choose, though necessarily structured differently, will be based on one regulatory model or another.

The growth management literature describes the county's program as a leader (Hamblin, 1991; Savage, 1993). In theory the program deals with all public facilities, but in practice transportation service standards drive it (Wickstrom and Winick, 1986; Winick, 1985; 1986). Winick (1989) enumerates features needed for implementing a growth management system for transportation purposes: a political mandate, a planning and regulatory framework, a measurement approach, standards of tolerable congestion, criteria for which transportation improvements to consider, procedures to monitor and forecast growth, and an open and public process.

One key feature missing from this list is an infrastructure-financing mechanism. Inadequacy is caused by too much demand or not enough supply given an adequacy standard. If there is agreement that the benefits of infrastructure expansion outweigh the costs, then this lack of supply can be remedied with money. As described below in the section on infrastructure financing, in Montgomery County there have been fits and starts toward obtaining financing for new transportation facilities, principally but not entirely limited to roadways, from new development, but no comprehensive program.

Historical overview

Growth management in Montgomery County began in 1974 (MCPD, 1974a; 1974b) with a report recommending the presence of adequate public facilities for new development, enactment of development district legislation, and a staging policy in each local area master plan. Through the mid-1970s, the theory of growth management was presented to the public, though no regulatory system was implemented (MCPD, 1973; 1974a; 1974b; 1975; 1976; 1977; 1979a; 1979b). Briefly, the theory was built upon the idea that an area has a carrying capacity (for instance, only so much traffic can be tolerated; Schneider et al, 1978), which depends upon the level of infrastructure (such as roadway capacity, see figure 1). As only a limited amount of infrastructure was actually deployed at any given time, only a limited amount of development could be permitted while maintaining adequacy. The system was to be implemented with computerized models tracking development, demographics, traffic, and environmental impacts.

The method to regulate development established 'staging ceilings' in each policy area in the county; figure 2 shows the current policy areas. The growth policy defines staging ceilings as the number of jobs or housing units permitted in that area.

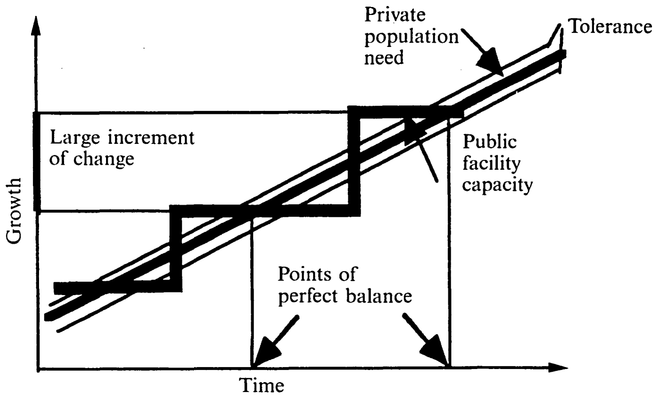

Figure 1. The timing of public facilities and private development.

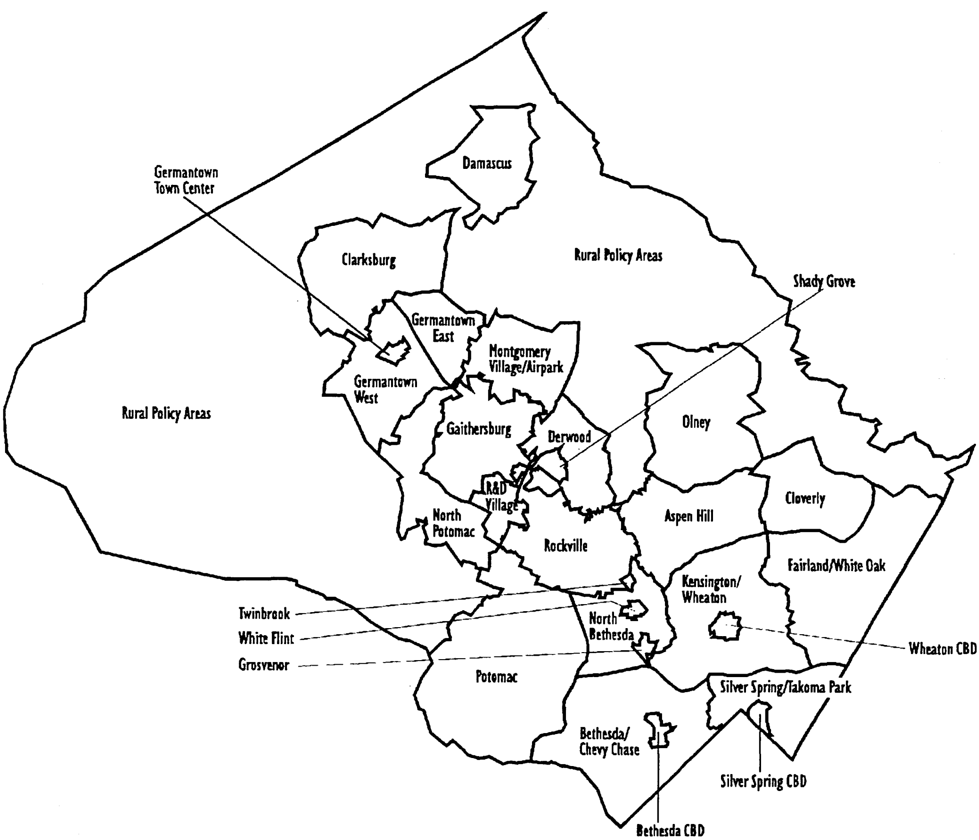

Figure 2. Policy areas in Montgomery County, Maryland

These staging ceilings are set to ensure the satisfaction of transportation level of service standards. Areas with too much traffic were placed in moratoria for new jobs, housing, or both; areas with less congestion than their standard would be allowed more development. Transportation, though nominally one of several public facilities considered for growth management, clearly became the critical constraint. How congestion was measured and against what standards this measurement was applied were critical issues to face the system over the next decade.

In the terminology of the day, this approach relied on 'police' powers to control private development rather than 'purse' powers to provide public facilities. Apparently, and somewhat surprisingly, no written consideration was given to the use of taxing powers to raise revenue from private development to fund public facilities directly. Though the planning board did not have taxing powers, it did have regulatory powers.

In January 1980 a "Comprehensive staging plan", amending the general plan, was proposed by the planning board (MCPD, 1980) but was not adopted by the county council. This was followed by the similarly titled "Comprehensive planning policies" (MCPD, 1981; 1983; 1984a; 1984b), an annual regulatory report recommending staging ceilings in each area. The ceilings were adopted and enforced as 'guidelines' by the planning board, not the county council, and thus had less legal force than a plan. By 1986 the use of staging ceilings was seen as a major power base. The "Interim growth policy" (MCPD, 1986) and then the "Annual growth policy" (MCPD, 1987; 1986–92; 1987–93) gave a greater role to the county executive and the county council in managing growth and provided a stronger legal structure to defend the system from lawsuits.

In 1993 a recession led to a shortfall in tax revenues and cutbacks in infrastructure financing for the county and state capital improvement programs. Because the amount of development permitted depends on the number of roads laid (or anticipated to be laid), staging ceilings were reduced. This reduction increased the costs of development (in many cases prohibiting it altogether) and a vicious circle was created. To exit this pattern, it was argued that the growth policy should stimulate (or at least facilitate) growth in a downturn as well as restrict it during an expansion. After the expected political wrangling, a narrow amendment to the Annual growth policy was passed by which a limited amount of new residential approvals would be permitted in each policy area, regardless of moratorium status, conditioned on a voluntary 'development approval payment', to be used for new infrastructure.

Infrastructure financing

Primarily, the county's transportation infrastructure is financed through general revenue or by higher levels of government using gas taxes and other revenue sources. But in addition to the development approval payment there are several mechanisms for privately funded transportation: infrastructure proffers, trip mitigation, impact taxes, and development districts.

Developer-funded roads

The first private system is essentially a proffers system: developers may voluntarily provide infrastructure to meet the transportation level of service requirements when their area is in moratorium. This has resulted in the formation of 'road clubs', a contract signed by a group of developers and the county, to finance and build transportation infrastructure (roads) collectively, as well as privately funded roadway and intersection improvements (Nelson and Duncan, 1995). However, this option is open only to developers, or a coalition of developers, of sufficient size to be able to afford major infrastructure.

Trip mitigation

Alternatively, as described by Ferguson (1990), a developer may enter into a trip mitigation program in order to attain approval. These programs include ride matching, shuttle services, constructing park-and-ride lots, transit subsidies, and other measures which supposedly get vehicles off roads. Their estimated cost (MCPD, personal communications)[1] is $500 per trip per year (somewhat less than $5000 for a ten-year program). By mitigating peak period, peak direction, trips, ideally the developer will eliminate the bulk of the traffic impact of the development. These programs last ten years, after which it is hoped that the county will assume operation of successful traffic mitigation programs. The earliest programs are now expiring but it is unclear whether the county will assume their operation.

Impact fees or taxes

Next, development impact fees (now taxes) are required in two areas of the county (Heath et al, 1988). The program is limited to two of the areas in subdivision moratorium at the time of designation by the county council (Germantown and Fairland/White Oak). Although the test for adequate public facilities is at subdivision, the impact fees are assessed at building permit. The fees are determined based on a top–down allocation of the total cost of unbuilt infrastructure divided by the number of unbuilt development units (considering trip generation and trip length characteristics). The share of the impact fee of the cost of unbuilt infrastructure is capped at 50%.

Initially the developments which paid the impact fee were approved either before the moratorium was imposed or because they had participated in a road club. Later, with infrastructure funded by the impact fee, the moratorium would be lifted (as happened in Germantown) and development could be approved under normal means. But this development would also pay the impact fee, in order to finance further road construction. Though roads were supposed to be programmed based on anticipated impact fee revenue, the funding of many roads slipped with the recession, so whereas Germantown has received new transportation infrastructure, Fairland/White Oak has not, and is still in moratorium. The fees are about $1500 per single family unit, far less than the cost of a traffic mitigation program ($5000).

Development districts

Last, legislation has been passed which will permit the formation of development districts. These would enable development in a designated area to proceed after paying into a fund which is supposed to cover the construction of master-planned infrastructure. This has yet to be implemented in any area of Montgomery County.

A model for setting growth limits

A brief discussion of how staging ceilings are established is in order. The current process is illustrated in the flowchart in figure 3 (see over; MCPD, 1994a), with underlying equations given in the appendix. Much of the description may seem to be technical jargon, but the techniques used and the philosophy behind them have profound policy implications.

The objective is to obtain a land-use pattern which results in traffic congestion and transit accessibility as close to the transportation level of service standard as possible. Being too congested or too uncongested (or too inaccessible or too accessible) are equally bad in this framework, as one implies excess delay (travel costs) and the other implies excess investment in infrastructure (construction and operation costs) for the amount of development permitted. These development capacities are estimated by transportation modelers working for the planning department, recommended to the planning board, which adjusts and forwards them to the county council. The process is reminiscent of the 'rational planning' model.

Step 1 involves positing a land-use pattern, namely the number of jobs and housing units in each geographic policy area, given a fixed transportation network (that which

[1] Internal memo of the transportation planning division on the cost of trip mitigation measures.

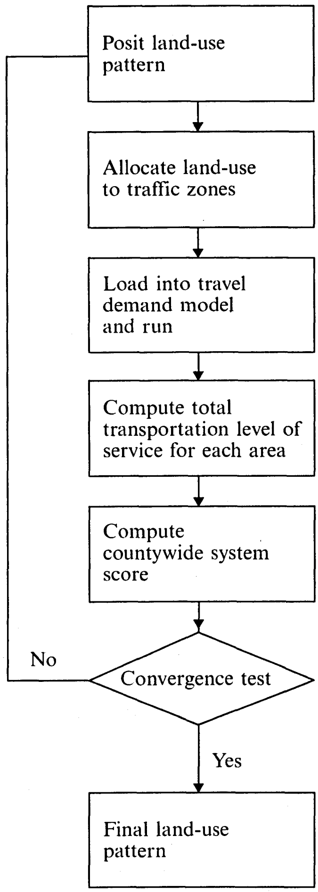

Figure 3. Process for determining staging ceilings.

is fully funded within the first four years of the county's capital improvement program or Maryland's consolidated transportation program) and an areawide average level of service standard.

Each area's total is allocated to traffic zones in step 2. These zonal land uses are put into a travel demand model in step 3 (Levinson and Kumar, 1994c; 1994d; 1995). The ability to forecast is imperfect, but in this system it is imperative.

In step 4 the total transportation level of service for each policy area is calculated. The total transportation level of service is analogous to the grade point average computed on a report card, with the level of service being a grade (A to E) and the mode share being a weight (such as credit hours) from 0 to 1. But here the goal is not maximization of grades, but rather achieving a median grade (numerically a 0.585—a number selected to minimize changes from an earlier regulatary process). To extend the analogy, getting grades which are too high implies that you studied too hard, to the detriment of other activities; high grades have a high opportunity cost.

Step 5 takes the total transportation level of service calculated for each area and compares it with a standard. The difference between the modeled level of service and the standard for each area is calculated and weighted by travel in that area. The 'optimal' land use from this transportation perspective is one which results in no difference between the modeled level of service and the standard.

The last step is the convergence test. Unless land use is optimal from a transportation perspective, another iteration should be performed. In practice, the convergence test is that staff run out of time to perform more runs of the transportation model, or other constraints prevent improvement in the total system score. The term 'optimal' implies a lot; it takes as given exogenous standards and infrastructure investment, assumes that all of the land use permitted is constructed, and assumes that the model is a correct representation of human decisionmaking.

Other constraints include the decision rule that staging ceilings in a policy area should change only if there is a transportation improvement in that area (or in an immediately adjacent area). Thus changes in level of service due to 'through-trips' (trips where neither end is generated in the policy area) are not immediately considered in this process, but rather through a process dubbed 'catch-up'. Also zoning ceilings cannot be exceeded by staging ceilings.

Staging ceilings are adjusted upward if the modeled level of service in an area is better than the standard, and downward if the modeled level of service is worse than the standard. However, the solution space of possible staging ceilings is large. There are 26 policy areas; in each area, the staging ceiling consists of jobs (the employment capacity of buildings) and housing units. In a typical area the zoning holding capacity equals 15 000 jobs and 10 000 houses. The number of possible job and housing combinations in that area is $15\,000 \times 10\,000 = 150\,000\,000$. For the county, the number of possible staging ceilings is the number in each area multiplied by that in each other area, and is $\sim 150\,000\,000^{26}$. To illustrate the size of the problem, if the computer could test each scenario in one second (and model runs are currently measured in hours), testing every scenario would take many orders of magnitude longer than the age of the universe.

Although there are more efficient approaches than strict enumeration, so long as the interactions between policy areas are considered, it is not possible to solve the problem in an optimal fashion because of computational intractability; in linear programming terminology it is NP-hard (Gass, 1985). What is left is a heuristic sub-optimal approach which results in staging ceilings that deny approval to some developments and enable others to proceed, even if the reverse would result in a better transportation level of service.

These potentially counterintuitive results are entirely due to proactive planning, attempting to determine the best solution in advance. It therefore raises the question of whether, as there is no guarantee of better performance, the proactive approach subjecting development to quotas and queues should be preferred to a reactive approach, such as impact fees, where each development is charged based on its economic consequences.

A model of transportation and land use

Figure 4 (see over) shows the feedback relationship between the transportation and land-use variables within the Montgomery County growth management system. The arrows between the boxes show a relationship; a plus (+) or a minus (−) sign indicates whether they are believed to be positively or negatively associated. Though this figure has 10 boxes and 22 lines, and is thus a simplification of the real-world system, I believe it is instructive to examine these relationships. By reviewing the system in this manner, it is possible to discover its strengths and weaknesses. Issues which should be kept in mind: (1) Are the relationships continuous or discontinuous—and which is more appropriate? (2) Are the signs on the relationships correct? and (3) Are there other relationships which are not considered?

The growth management system regulates the amount of development, which can be either housing units or jobs (the employment capacity of buildings). The amount

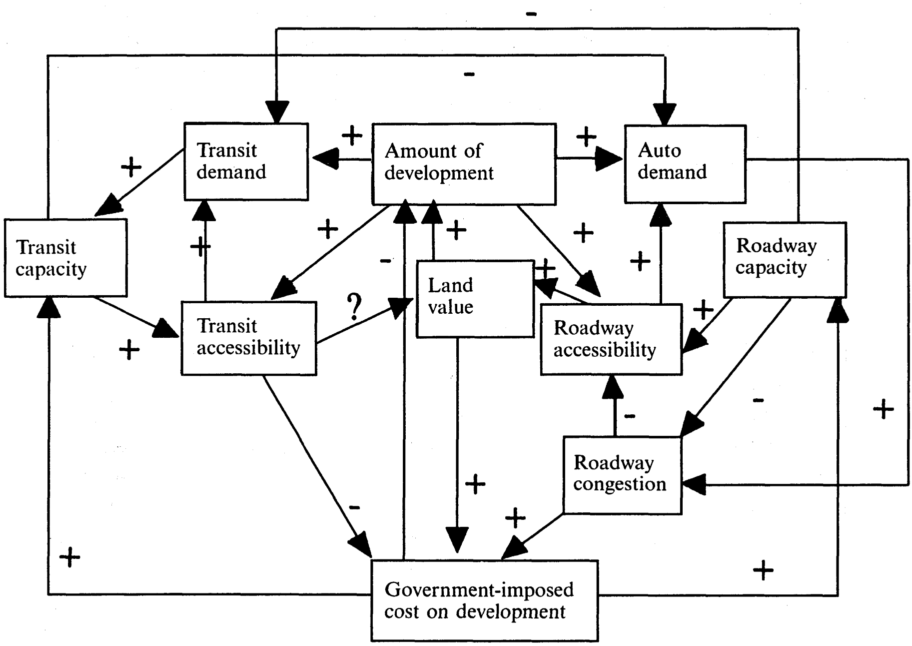

Figure 4. Transportation and the Montgomery County growth management system.

of development is positively impacted by the land value, or the anticipated market value of the developed land, and negatively affected by the government-imposed cost on development. An increase in the amount of development increases in absolute terms the demand for auto and transit, although the amount depends on a variety of factors. An increase in the amount of development also increases the accessibility provided by the transportation network (auto and transit).

Presumably the government-imposed cost of development (particularly if it exacts a tax, a piece of infrastructure, or even a transportation demand management program) increases the amount of transportation capacity available (roadway or transit). Although if it is just making development wait in a queue, there is no gain, only a deadweight loss—a key weakness of the present system. It should be noted that public planning may have other purposes than accommodating development, so the deadweight loss needs to be traded off against other gains. In the case of lumpy infrastructure investment, smoothing overbuilding and 'crashes' of the development cycle, just as in macroeconomics, may have long-term advantages.

Nevertheless, so long as road pricing remains unimplemented on arterial class roads, those roads are a public responsibility. And as new development is a major factor in new travel demand, the equity and efficiency issues here are not whether there should be some charge on new development, but rather how that charge is levied, and what share of new infrastructure costs should be borne by new development as opposed to the existing population.

Auto demand (for instance, in vehicle kilometers traveled) is positively influenced both by highway accessibility and by the amount of development and negatively affected by the amount of transit capacity provided (although probably only to a small degree). However, increased auto demand will result in increased roadway congestion. A similar structure exists for transit. Transit demand is positively affected by the amount of development and transit accessibility but generally reduced with increases in roadway capacity.

The use of transit accessibility raises an interesting question about the appropriateness of using congestion as the measure of roadway level of service. The benefit of a transportation system can be measured by means of accessibility (rather than mobility, or its converse, congestion) which is capitalized in land values: accessibility being the amount of opportunities that can be reached in a given unit of time, and congestion being the delay (or some surrogate measure) on a given link or set of links. However, accessibility and congestion (slowness) are typically positively correlated (Levinson, 1996; Levinson and Kumar, 1997). Thus the areas with the highest roadway accessibility, where a resident can reach the most jobs in the least time, are also the areas with the highest congestion—the decrease in trip distance outweighs the decrease in speed.

The congestion measure was designed based on the idea of carrying capacity (shown in figure 1), in this case applied to transportation. For a specific link or intersection, capacity is the flow of traffic beyond which queues form (delay becomes excessive) but capacity can be exceeded only for a limited period of time, otherwise queues would grow without end. Though there may be an economically efficient level of congestion, where the costs of delay to travelers are balanced by the costs of added capacity, the efficient level of congestion depends on so many factors (for instance, the value of time for each individual, the cost of land, the cost of construction, the benefit of increased accessibility, and interest rates) one should not expect that they result in exactly the same trade-off point (level of service) system-wide. However, on a facility-specific basis there is more hope; the cost of facility expansion can be priced, as can the costs of delay on that facility. Application of a system-wide standard to each facility in the network will result in spending more money to remedy expensive problems, those links where the optimal trade-off point of expansion versus acceptance of delay is at a more congested point. Similarly, this will result in not spending enough on inexpensive expansions, where the efficient standard should be less congested. Assuming a generic capacity or level of service standard for all links is thus inefficient. However, the use of congestion (level of service) as a red flag to begin a benefit–cost analysis of a local improvement may be worthwhile.

In an analogous situation to developers awaiting approval, commuters sitting in traffic queues have an associated deadweight loss (some have money and would pay for less delay, others would not travel if they were charged for traveling or compensated for not traveling—but no mechanism exists for enabling these transactions). As congestion becomes intolerable, travelers switch time-of-day, mode, destination, activity sequence, and route, and in the longer term they relocate. An important feedback in the urban system is human rationality in travel and location decisions.

Thus (temporarily ignoring transit) the county government is imposing the highest costs on new housing and employment development in places with the highest congestion, precisely the locations where government should encourage development to take advantage of the correlated access to jobs and housing. Montgomery County attempts to encourage this development through the role of transit in the equation and the positive association between roadway and transit accessibility. In the growth management system, higher transit accessibility raises the effective amount of roadway congestion that is acceptable. Nevertheless it is still problematic to consider congestion, and particularly volume–capacity ratios, as the measure of roadway level of service. Perhaps a more economically oriented measure such as change in consumer surplus, expected travel cost, or accessibility would make more sense for optimizing land use given a network, optimizing the network given a land-use pattern, or optimizing both together.

Let us now review the initial issues. First, are the relationships continuous or discontinuous—and which is more appropriate? The relationships are generally continuous now, except for the government-imposed cost on development, which is discontinuous and not always predictable in value, causing a deadweight loss as developers wait in queues. Second, are the signs on the relationships correct? They seem to be, except perhaps congestion raising the cost of development. Third, are there other relationships which are not considered? A direct relationship between roadway accessibility and the government-imposed cost of development, along the lines of a value capture or benefit assessment approach (Stopher 1993), which taxes change in property values due to changes in accessibility could be considered.

Lessons

After delving into the depths of Montgomery County's regulatory system, looking at its history and the models it utilizes for setting growth ceilings and for understanding and directing how those ceilings interact with the transportation and land-use systems, can we emerge with some generalizable lessons, transferable to other communities? Though Montgomery County is certainly not typical of most communities today, it is larger, richer, and more pro-government; it has also implemented many planning ideas far earlier than other areas. This lead time provides an opportunity for evaluation before emulation. Though some of the mistakes may appear obvious in retrospect, they were not at the time or they would not have been made.

Dividing responsibility

The political structure of an independent planning commission and department, which shaped the historical path on which Montgomery County embarked, evolved from the good government movement of the 1920s. But putting taxing powers in the hands of the county council and executive, and regulatory powers over development in an independent planning commission resulted in growth policy decisions which did not even consider the taxation alternative. As a consequence, there are a hodgepodge of infrastructure financing systems being implemented by the executive without a planning outlook, and plans being created without financing mechanisms.

Categorizing the continuous

Initially, Montgomery County's growth management system was constructed by creating various classes of things such as policy areas and transit level of service groups. The boundaries of these classes are artificial but their implications are quite real. Identical developments across the street from each other may proceed or must wait in a queue for years based on these boundaries. Although progress has been made in moving toward continuous measures, such as replacing transit level of service groups with a total transportation level of service equation, the inherent structure of most planning systems, including growth management and zoning, encompasses artificial classes and boundaries.

Setting single-dimensional standards

It is inefficient from a broader systems perspective to have a single level of service standard on roads, ignoring the differing costs of expansion of unique facilities. Decisions have costs and benefits; both must be weighed to reach an efficient and equitable result. A priori standards which do not consider all trade-offs along multiple dimensions (for example, between highways and transit, between costs of delay and construction, or between transportation and nontransportation investments) should be suspect. Some progress has been made in recognizing the trade-offs between highways and transit, but the costs and benefits of new construction and intersectoral comparison are dealt with only in a cursory and ad hoc manner.

Choosing measures of effectiveness

Montgomery County, like many other areas, chose roadway congestion rather than accessibility as its measure of effectiveness. But which is better: a trip at level of service 'F' for its entire 15 minutes, or one of 45 minutes at level of service 'C'? The growth regulations and congestion standards were imposed from the top; little research has been undertaken into what level of service is actually acceptable to the county's population. Surprisingly, table 1, derived from a 1991 travel survey conducted in Montgomery County, shows that 84.3% of survey respondents rate their commute as good or acceptable; this while between one third and two thirds of the county is in development moratorium in any given year because traffic is deemed unacceptable. Being in moratorium implies that too much development has been permitted, in other words, there is already too much traffic. If there really were too much traffic, one would expect fewer respondents rating their commute so highly.

Table 1. Results from the Montgomery County travel survey.

Traffic conditions	Responses	Percent
Good	155	35.6
Acceptable	212	48.7
Inadequate	51	11.7
Intolerable	17	3.9
Total	435	100.0

Planning 'rationally'

Montgomery County has relied heavily on the 'rational planning' model. It was noted earlier in this paper that the ability to forecast is imperfect but imperative. The solution to this paradox may not be better behavioral transportation and land-use models or more data, but eliminating the overarching dependence on those complex models. This reliance on models and analysis methods to manage growth, and determine its optimal levels, recalls Hayek's (1989) 'fatal conceit', the belief that given enough information an optimal allocation of anything is possible. In the abstract this may be true, but "At the same time, there are few today who will defend the performance of the Soviet planning system, whose targets and allocations have broken upon the shoals of economies too complex for the most supercharged computers" (Sayer and Walker, 1992, page 2). Most decisionmakers in the county do not view the system as analogous to the central planning historically associated with the eastern bloc, yet conceptually that is what a strict interpretation of the growth policy law requires—excepting some ad hoc provisions. The future is not predictable in sufficient detail for these computer models to guide long-term investment decisions competently.

Bringing distant dangers near

We come finally to the proactive versus reactive planning issue. Montgomery County has been firmly in the camp of proactive planning, attempting to direct comprehensively both the timing and the placement of development. But such direction creates inefficiencies and inequities: a development trapped in a moratorium creates a deadweight loss, whereas a development in a nonmoratorium area does not recover infrastructure costs. The result is an infrastructure funding shortfall. Because the transportation system, including traveler's short-term and long-term responses, is so elastic and the idea of rigid capacities so flawed, it casts doubt on the need to allocate land-use ceilings in advance. Table 2 (see over) shows duration of moratoria by policy area. The 'temporary' nature of moratoria has lasted a considerable time in some areas, with no

Table 2. Years of moratoria by policy area (source: MCPD, 1994b, pages 22–23).

Policy area	Number of years in housing moratoria 1982–94	Number of years in jobs moratoria 1982–94
Bethesda/Chevy Chase	0	0
Bethesda CBD (Metro)	0	1
Cloverly	13	6
Damascus	9	2
Fairland/White Oak	12	9
Derwood/Shady Grove (Metro)	0	7
Gaithersburg City [a]	1	7
Montgomery Village Airpark	3	7
North Potomac	4	4
R & D Village	2	4
Germantown East	7	5
Germantown West	9	8
Aspen Hill	5	0
Kensington/Wheaton	0	0
Wheaton CBD (Metro)	0	0
North Bethesda	3	8
Grosvenor (Metro)	3	8
Twinbrook (Metro)	3	8
White Flint (Metro)	3	8
Olney	2	2
Potomac [c]	0	1
Rockville City [a]	0	5
Silver Spring/Takoma Park	0	1
Silver Spring CBD (Metro) [b]	0	0

Notes: Boundaries for many areas have changed over the years, in particular, larger areas have been divided into smaller areas, and moratoria are counted based on the amount of time that most of the area constituting a current policy area has been in moratorium, even if the boundaries have been carved somewhat differently. Some areas which technically were not in moratorium had ceilings that were so low that developments were prevented from proceeding, for example, if 100 units of jobs capacity are remaining, an office building housing 200 jobs is blocked unless it participates in developer-financed infrastructure.

[a] Gaithersburg City and Rockville City are not within the jurisdiction of the Montgomery County Planning Department, but hypothetical ceilings are estimated for these areas to provide information

[b] Silver Spring CBD is under special rules in the annual growth policy

[c] Potomac has staging ceilings fixed at zoned holding capacities and is governed by tighter local area review standards

solution coming. The present system 'brings distant dangers near', planning for too many contingencies by constraining current opportunities.

'Just-in-time' has become a watchword in manufacturing; the idea underlying it should be considered in planning as well. Clearly, infrastructure planning, engineering, and construction occur on the order of years rather than the hours and days of manufacturing. To apply 'just-in-time' does not mean collapsing the infrastructure cycle to something on the order of manufacturing, but in addition to shrinking that time, building in response to a demand which pays its full cost rather than (1) subsidizing transportation in advance of a speculated demand, or (2) building infrastructure long after congestion has become intolerable (and economically inefficient) and new development has been placed in a multiyear moratorium.

Conclusion

Our initial evaluation test was whether the system managed growth or ensured adequate facilities. Surely it has managed growth, though if it is for the better is open to debate. It has increased the price of housing in Montgomery County (Pollakowski and Wachter, 1990). Has the system kept congestion in check or matched the provision of public facilities with private demand? The evidence indicates not: traffic volumes have grown, vehicle kilometers traveled have increased, and the number of trips has grown faster than the supply of new infrastructure, owing both to behavioral changes and to additional development (Levinson and Kumar, 1994a; 1994b). However, in parts of metropolitan Washington both with and without growth management, despite rising congestion and lengthening trips, travel times of the journey to work have not increased for thirty years and average speeds have risen over that time, outcomes associated with the suburbanization of employment, indicating that perhaps growth did not need to be so centrally controlled after all. The extent to which growth moratoria have actually prevented (or exacerbated) the rise in congestion is unknown. Neighboring counties do not have such stringent growth controls, and hence residential development in the outer suburbs, provoked by Montgomery's growth controls may make congestion in Montgomery County worse than would have happened if that development had occurred within the county. Some use this as an argument for more regional coordination (read regulation) but I suggest that it supports better the case for less local regulation, a reactive rather than proactive approach.

In this paper I have made several arguments for change. First, the county should reassess how transportation adequacy is defined, changing from a measure based on capacity or congestion focused on mobility to an accessibility measure which considers how well the transportation system serves desired destinations, the opportunities associated with development. Second, countywide level of service standards which ignore costs create economic inefficiencies which can be avoided by looking at the costs and benefits of individual projects, both within and outside the transportation network. Third, many of the problems of proactive growth management, in particular its deadweight losses and the need for reliance on a model and modelers to establish (suboptimal) quotas for new development, can be obviated if the current allocation system is replaced by a comprehensive impact tax system. The theory and practice of impact fees has been discussed at length elsewhere (Nelson, 1989), so only its relative advantages will be described here. By setting a price for development and then reacting to development by building infrastructure, government will be spending the resources of the public and private sectors more efficiently than by proactively building transportation 'on spec', or constantly playing catch-up with an artificial single-dimensional transportation level of service standard. Adequate infrastructure, as now, would depend on proper capital budgeting. But a new signal to government is introduced, the sum of tax revenue raised or anticipated to be raised in an area. Proper signals are also provided to developers, in that development is encouraged in some areas through lower taxes, where little new infrastructure is needed, or discouraged via higher payments. This reactive impact tax approach still achieves the operational objective of the growth management system, ensuring transportation adequacy (however defined), and enabling development to proceed when it pays for the economic costs it imposes on local government.

What are the prospects for change? Change will not come immediately, as the forces for the status quo are strong: citizens opposing any development, the planning bureaucracies, the lawyers who negotiate agreements, developers who already have approvals (hoping to deny competition), and landowners whose land price has risen because of moratoria in other areas. Those opposing growth management as it is currently manifested, generally the losers in the current system, may or may not see a direct infrastructure financing system as better. Although uncertainty will be eliminated, a new charge will be imposed. Probably the most likely path of change will come from a court challenge. Though the annual growth policy has been sustained in earlier challenges, moratoria on new subdivision approvals for longer than a decade suggest a taking.

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APPENDIX

There are a number of equations underlying the growth management system, which are given below. The total transportation level of service is calculated by using the following equation applied to the results of the model:

$$S_a^{\mathrm{tt}} = \sum_{i=1}^{I} S_{ai} M_{ai}^{\mathrm{m}}, \tag{A1}$$

where

S_a^{tt} is the total transportation level of service in area a;

S_{ai} is the level of service in area a by mode i [$i = 1$ (highway), 2 (transit)]; $A = 0.00 - 0.22$, $B = 0.22 - 0.44$, $C = 0.44 - 0.67$, $D = 0.67 - 0.89$, $E = 0.89 - 1.11$, $F > 1.11$;

M_{ai} is the mode share in area a by mode i (in mode set I).

Mode shares are subject to equation (A2), requiring they sum to unity:

$$\sum_{i=1}^{I} M_{ai} = 1. \tag{A2}$$

Level of service for highways is defined by means of an average congestion index, equation (A3), which is a VMT-weighted volume to capacity:

$$S_{a1} = \sum_{l=1}^{L} \frac{F_l}{K_l} \left(V_l \Big/ \sum_{l=1}^{L} V_l \right), \tag{A3}$$

where

S_{a1} is the level of service by automobile in area a of area set A, measured by means of the average congestion index;

F_l is the flow (volume) on link l of set of links L (vehicles per hour);

K_l is the capacity on link l (vehicles per hour);

V_a is the vehicle miles traveled (VMT) in area a.

The level of service for transit is calculated by using a regional transit accessibility index, which computes accessibility by transit to regional destinations, as compared with the policy area in Montgomery County with the highest accessibility, Silver Spring (SSP). It is subtracted from 1 to give an index, with 0 being the highest and 1 being the worst, comparable with the highway level of service measure.

$$S_{a2} = 1 - \sum_{b=1}^{B} D_b \mathrm{f}(C_{ab}) \Big/ \sum_{b=1}^{B} D_b \mathrm{f}(C_b^{\mathrm{SSP}}), \tag{A4}$$

where

S_{a2} is the level of service by transit mode in area a of area set A, that is, regional transit accessibility;

D_b are destinations (opportunities) available in area b (this is computed as a weighted average of housing units and jobs) of area set B;

$\mathrm{f}(C_{ab})$ is a function of cost or time from a to b by means of transit, with a higher value for near zones and lower for faraway zones (for details, see Levinson and Kumar, 1995).

The objective function is given with the following equation:

$$\text{minimize}\, Z = \sum_{a=1}^{A} \left| \left(S_a^{\mathrm{tt,mod}} - S_a^{\mathrm{tt,stan}} \right) P_a \right|, \tag{A5}$$

where

$S_a^{\mathrm{tt.mod}}$ is the total transportation level of service modeled in area a of area set A;

$S_a^{\mathrm{tt.stan}}$ is the total transportation level of service standard in area a of area set A;

P_a is the person miles traveled in area a of area set A.