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# Lot Size, Zoning, and Household Preferences

*Impediments to Smart Growth?*

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Elizabeth Kopits, Virginia McConnell, and Daniel Miles



**Lot Size, Zoning, and Household Preferences:  
Impediments to Smart Growth?**

Elizabeth Kopits  
U.S. EPA – National Center for Environmental Economics

Virginia McConnell  
Department of Economics  
University of Maryland, Baltimore County

Daniel Miles  
Department of Public Policy  
University of Maryland, Baltimore County

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## Abstract

The paper explores a number of issues related to lot size and urban density, drawing on data from urban and suburban counties in the State of Maryland. The paper has three separate parts. The first is a descriptive analysis of the trends in single-family residential lot size over the past 35 years in eight counties in Maryland. We find a good deal of variation in both lot size and trends in lot size over time. We then examine the extent to which lot size is being constrained by regulation by comparing actual subdivision density to the allowable density under zoning rules. This analysis is done for three counties with different degrees of suburbanization. We find that only in the areas with the very large lot zoning does zoning seem to be constraining actual lots size. There is a good deal of excess capacity in the density that could be built, especially in the more densely zoned areas. Finally, recognizing that households have preferences for lot size and other housing characteristics, we provide some evidence about the strength of household preferences over lot size and their willingness to trade off lot size for other characteristics.

# Lot Size, Zoning, and Household Preferences: Impediments to Smart Growth?<sup>1</sup>

## Kopits, McConnell and Miles

### I. Introduction

One of the major obstacles to smart growth, as envisioned by the State of Maryland and other groups around the country, is the trend toward low-density development. Households appear to prefer large lots, and jurisdictions often set zoning rules that result in low average densities, especially in suburban areas. Even in more urbanized areas, when densities are set at higher levels, existing residents often try to reduce the density on any new development. This paper will explore some of these issues related to lot size and urban density, drawing on evidence from the suburban Maryland region. The paper has three parts. First, we will examine the extent to which lot sizes have been increasing over time, and how those trends appear to vary by stage of development and by regulatory pressures. Next, we examine the extent to which lot size is being constrained by regulation by comparing actual lot size to the allowable density under zoning rules. Finally, we provide some evidence about the strength of household preferences over lot size.

With new methods of monitoring and measuring spatial land use features, there has been a good deal of interest in recent years on measuring patterns of urban expansion (e.g., Burchfield et al., 2006; Irwin, Bockstael, and Cho, 2006; Knaap, Song, and Nedovic-Budie 2007). Locally, the State of Maryland monitors urban land use with satellite data<sup>2</sup>, and also provides a comprehensive spatial land use at the property level through the spatial data base "Property View" (Maryland Department of Planning, 2005). These data sources are often in conflict (Irwin, Bockstael, and Cho, 2006), and for lot size data, the property level data is preferred. Knaap, Song, and Nedovic-Budie (2007) have used the property level data from Property View for one county to look at lot size trends as one of a number of indicators of urban sprawl. They find that lot sizes rose through the 1970s, but have actually fallen since that time. We use the property view data to examine trends in lot size for eight different counties in the Washington Baltimore region: Montgomery, Prince Georges, Howard, Anne Arundel, Calvert, Charles and Baltimore Counties. We focus on single family residential and townhouse properties and find that levels and trends differ considerably across the region.

For a subset of counties, we are able to compare densities of the actual developments or subdivisions that have been built and examine both how these differ from the allowed densities. Levine (2005) has argued that it is large lot zoning that is causing low density urban expansion. However, from earlier work on Calvert County,

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<sup>1</sup> The authors appreciate the data and assistance received from the planning departments of Montgomery, Calvert, and Charles Counties, CUERE at UMBC, and the helpful comments of Ted McConnell. The views expressed in this paper are those of the authors and do not necessarily represent those of the U.S. EPA. No official Agency endorsement should be inferred.

<sup>2</sup> Maryland Department of Planning; Land Use Land Cover in Maryland by Political Jurisdiction, Planning Data Services, GIS Section, Baltimore. [http://www.mdp.state.md.us/zip\\_downloads\\_accept.htm](http://www.mdp.state.md.us/zip_downloads_accept.htm).

Maryland, we found that in some areas the actual densities are often well below the maximum allowed densities, meaning that average lot sizes are larger than permitted by zoning regulations. This seems to be particularly true in areas zoned for high density development, and less true in the low density areas (McConnell, Walls, and Kopits, 2006; McConnell and Walls, 2006). We explore this issue for a set of counties.

A central concern for policy-makers who would like to promote more compact suburban development patterns is to understand how households value lot size, and how they might trade off lot size for other housing attributes (e.g., house size and age). Using detailed data on over two decades of house sales in Calvert and Montgomery County, we estimate the value of lot sizes and how households trade off lot size for housing attributes. We also investigate the degree to which the value of a larger lot has changed over time in the two counties.

## **II. Trends in density over time, by County in Maryland**

There are conflicting statements and evidence about what has been happening to lot size and density trends in urban areas in recent years. There is concern that lot sizes are large in suburban jurisdictions, and have been increasing as development pushes the limits of urban areas to more distant locations. On the other hand, there is some evidence that lot sizes have stopped increasing and have even declined in certain suburban jurisdictions (Knaap, Song, and Nedovic-Budie 2007). It is likely that both are true. Lot sizes are the result of many competing forces. They depend not only on preferences which vary across households and can change over time, but also on economic and political forces. Lower land prices in more distant locations could be expected to result in larger lots, as would higher incomes. High growth rates and the associated attempts to limit and control new development that often accompany it can lead to higher land prices, restrictions in the supply of housing, and in some cases a reduction in the lot size of new housing (Glaeser et al, 2005).

We take a simple approach in the first part of this paper, which is to look at the trends in average lot size over time – in an attempt to observe the general outcome of these complex interactions. We are also interested in what lot sizes and density look like in different parts of an urbanized area. Our study region is the Washington-Baltimore metropolitan area, which we broadly define to include eight suburban and exurban jurisdictions as corridor shown in Figure 1. Counties included in the analysis are Montgomery, Prince Georges, Howard, Anne Arundel, Calvert, Charles and Baltimore. We examine trends in single-family residential (single family detached (SFD) houses and townhouses) density and also the extent of high-density development. We use property level data for this analysis for each of the counties.<sup>3</sup> Property data is more accurate for

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<sup>3</sup> For each county, our dataset includes all residential parcels with a built structure (as indicated by the year the structure was built) and information on the size of the lot. To ensure that small structures (e.g., barns) were not considered as houses, the final sample includes only parcels with assessed improvement value over \$50,000. Parcels greater than twenty-five acres in size were also dropped from the dataset. The final dataset contained 970,012 parcels. The data were drawn from the State of Maryland's "Property View" database.

assessing density, compared to satellite data or other methods that have also been employed (Irwin, Bockstael, and Cho, 2006).

**Figure 1. Map of Maryland**

*[Insert Map of Maryland (highlighting 8 counties in the study region) here]*

Table 1 shows the extent of variation in the amount of new single family residential development across the counties in our sample, and in lot sizes of that development. Over the whole area, single family housing comprises nearly 70% of all residential dwelling units, with the other 30% including condominiums and apartments. Calvert and Charles County have over 92% in single family units on one extreme, and more suburban counties of Montgomery, Prince Georges and Baltimore County with 50-65% of units built in single family.

Median lot size of recently built houses is about a ¼ acre for all counties except Calvert, which had median lot size of nearly an acre for houses built over 1996-2005. Mean lot size is higher than the median in all countries, indicating that there are quite a few large lot outliers, especially in the more exurban counties. Average lot size ranges from over 1.2 acres in the more outlying counties of Calvert and Charles, to about a ½ acre in Montgomery and Prince Georges, the two counties bordering Washington, D.C. The others range between ½ and ¾ of an acre on average. The degree of variation is high in all counties, with coefficients of variation between 2 and 2.5 in all counties, except Howard, Charles and Calvert. With a coefficient of variation of 1.3, Calvert has perhaps the most homogeneous density of jurisdictions in the study region.

**Table 1. Density of New Single-Family Residential Development, Maryland Counties<sup>a</sup>**

County	% of all residential units built through 2005	Lot size of units built 1996-2005		
		Median	Mean	Std. Dev.
Anne Arundel	82.0%	0.18	0.50	1.18
Baltimore County	47.9%	0.18	0.67	1.46
Calvert	97.5%	0.92	1.27	1.66
Charles	92.7%	0.28	1.21	2.08
Frederick	86.7%	0.23	0.68	1.71
Howard	73.8%	0.30	0.68	1.19
Montgomery	66.9%	0.18	0.47	1.10
Prince Georges	65.2%	0.24	0.38	0.80
<b>Total</b>	<b>67.7%</b>			

<sup>a</sup>Single-family development includes single-family detached dwellings and townhouse units.

As we would expect, average lot sizes are much higher for multifamily housing units – condominiums and apartments – which are not included in Table 1. In most counties these developments have lot sizes of around 0.059 and 0.053 acres per unit, respectively, over the study region or densities close to 10 times those of the single family developments. Instead of 2 units to the acre as in the residential areas, there are closer to 20 units to the acre. However, we are not able to include multi-family development in our more detailed analysis of lot size trends below. This is because the property level data, including information on the year built and lot size, are incomplete for many counties. We have been able to perform only limited analyses using the data that is available. However, in addition to some information on average lot size, we do find that there seems to be less variation in the density of these multi-family housing types compared to the single family development.

Figure 2 shows mean and median lot size of single family units (including town houses) built in each year from the 1970s to 2005 in each county. In general, lot sizes vary a good deal across counties but there seems to be little consistent upward or downward trend over time for all of the counties. This is consistent what Hammer et al. (2004) found for the Midwest, that there is a good deal of variation in growth patterns and density trends of urban, suburban and rural areas. Here we are looking at lot size trends, and we find that they vary considerably across the counties.

There are some counties and time periods where we see that lot sizes have fallen. Some of the observed increase in density (or decrease in lot size) in the later 1970s or early 1980s may be explained by programs or regulations adopted around this time.<sup>4</sup> For example, in Montgomery County, lot size fell from 0.64 to 0.23 between 1978 and 1983. This coincides with the adoption of the transferable development rights (TDR) program. In the early years of the TDR program, transfer activity was high with developers purchasing TDRs from farmers in the western part of the county in order to increase

<sup>4</sup> Since much of this development is occurring within subdivisions, there may be a lag between when density decisions are made (at the time of subdivision recording) and density levels observed in Table 1 and Figure 2 in the year houses are built.

density in designated TDR receiving areas (see McConnell and Walls (2006) for details of the Montgomery County TDR program). The graph shows a similar decline in mean and median lot size in Calvert around 1980, and a large drop in the late 1980s following a period of increased activity in its TDR market.<sup>5</sup>

In Frederick, median lot size fell drastically from nearly one acre in the late 1970s to 0.23 by 1980, but mean lot size of new development only declined in the late 1980s, from a high of 1.4 acres in 1987 and to 0.67 by 1990. There was a change in zoning in Frederick County around 1980, requiring larger minimum lot sizes in the agricultural areas but allowing additional higher density options in the urban areas, particularly in Frederick City. The decline in mean lot size after 1988 may reflect primarily the fast rate of growth in subdivision development at residential densities in and around the city of Frederick.

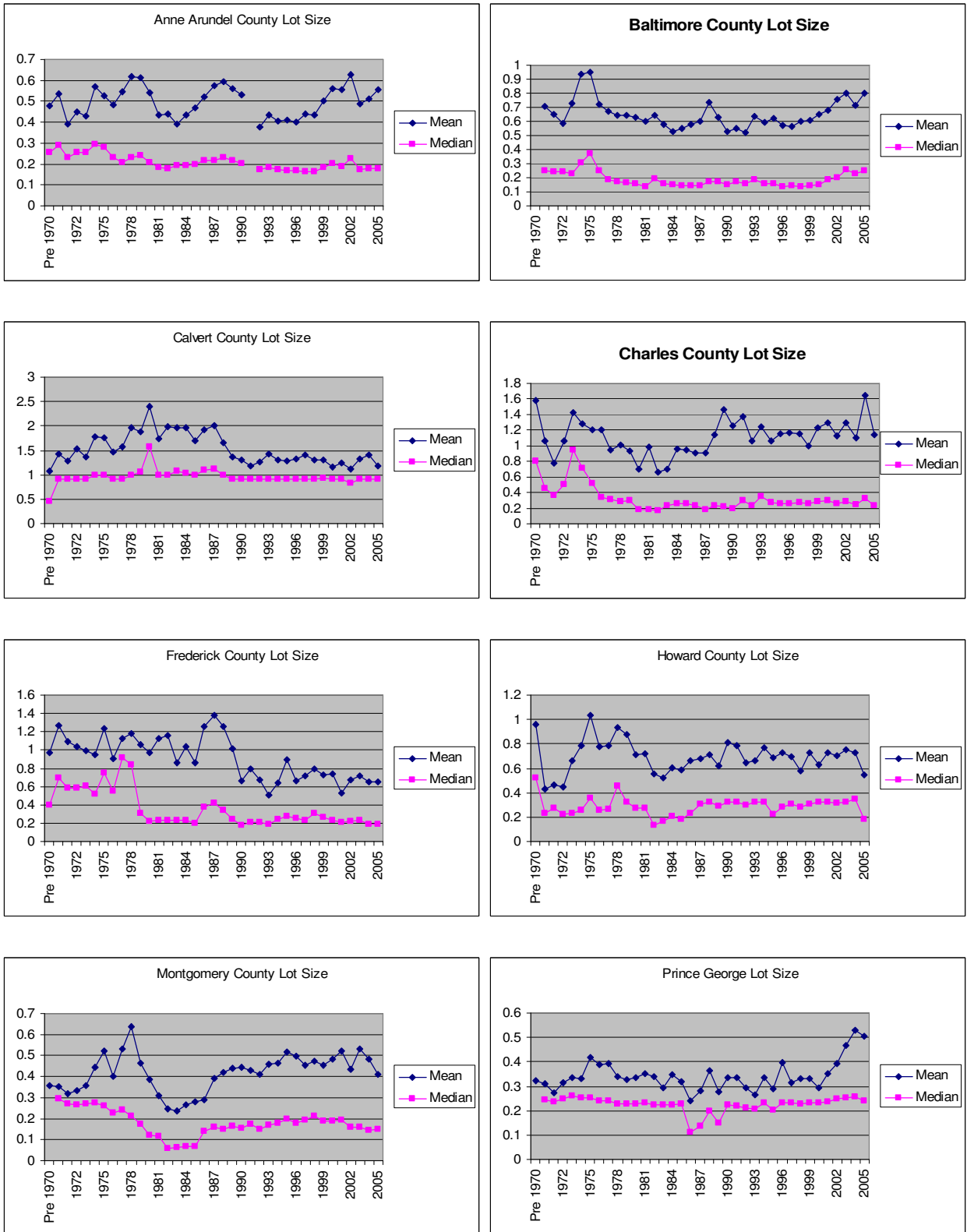
What is interesting is that mean lot sizes did not continue to fall in all of the counties in our study area. Mean lot size began increasing again in the late 1980s and into the 1990s in Charles, Baltimore, Montgomery, Anne Arundel to some extent, and in Prince Georges since 2000. Median lot size drifted up a bit too, but generally not as quickly, suggesting that it is increasing lot sizes in the lower density developments that is driving the increase in the means during this period. The counties that have experienced less of a divergence between mean and median lot size since 1990 are Calvert, Frederick, and Howard. Mean and median lot size has remained below 1.5 and 1 acres, respectively, in Calvert since 1989. This may reflect the county's active TDR market and strict clustering requirements imposed on all subdivision development since the early 1990s.

It is interesting to consider if we see evidence that these trends in the density of new units point in the direction of what has been historically observed in U.S. cities, which is the flattening of urban density gradients over time (McDonald, 1989). In other words, do we see any evidence here of trends toward more uniform density? If the ex-urban counties were seeing more dense development and the close in suburban areas were seeing constant or somewhat lower density, this might be confirmation of some flattening. We do see downward trends in lot sizes in the exurban counties, Calvert and Frederick, but not in Charles County. The suburban county densities appear to be quite constant over this period. We would, of course, need to include multi-family units in any analysis to fully address this issue.

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<sup>5</sup> Kopits, McConnell, and Walls (2008) find the number of lots created through the purchase TDRs in Calvert increased on average by 3 lots per year in subdivisions using TDRs over 1983-1987, all else equal.

**Figure 2. Mean and median lot size of new single-family residential development<sup>a</sup>, Maryland Counties**



<sup>a</sup>Single-family development includes single-family detached dwellings and townhouse units.

One other qualification to the density estimates provided in Figure 2 is that the discussion thus far has focused on actual lot size of all single-family housing. Since most suburban and ex-urban housing occurs within subdivision developments, it is also interesting to take a look at how density has changed at the subdivision level. Increasingly, many subdivisions include "clustered" development, in which houses are located on a portion of the total land area and the remainder is left as open space. In some communities, the zoning law mandates clustering; in others, clustering is recommended but not required. Proponents of clustering requirements argue that undeveloped areas (e.g., undisturbed forest, pastureland, recreation facilities, trails, etc.) convey value, not only to the residents of the subdivisions themselves, but also to the broader community, by preserving more of the aesthetic and rural character of the community and improving environmental quality through habitat protection or water pollution reduction in the region (Arendt, 1992). In communities on the urban-rural fringe, clustering residential developments may be one option in the local government's toolkit for maintaining an agricultural base and curbing sprawl.

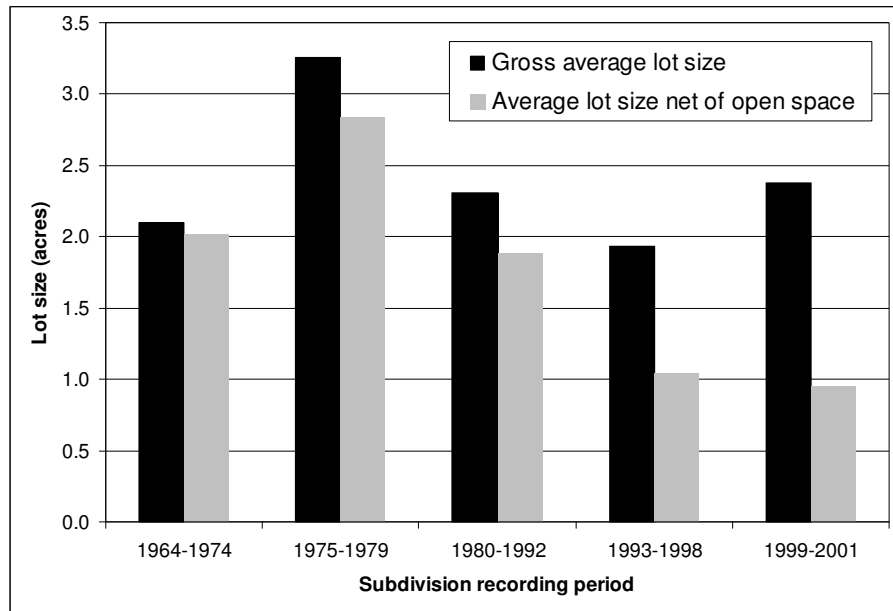
Among the eight counties examined here, the effect of clustering over time is most apparent in Calvert, where mandatory clustering for all major subdivisions has been in place since 1992. Figure 3 shows average lot sizes within Calvert County by different time periods.<sup>6</sup> Although the average gross lot size, calculated as total subdivision acreage divided by the number of houses, has remained relatively high and constant over time, the average lot size net of open space has declined. This provides some indication of the extent to which clustering has been increasing in the county in recent years. Gross lot size is trending up in the late 1990s due to a major countywide downzoning that occurred in 1999, but actual house lots continued to fall in size slightly, reflecting more open space in subdivisions.<sup>7</sup>

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<sup>6</sup> The time periods are chosen to reflect zoning and other changes in the county. Note that these periods generally do not match up with the years shown in Figure 1, since houses are often built several years after a subdivision is recorded.

<sup>7</sup> The net lot size should correspond to our mean lot size estimates from Figure 2 above, and they are roughly consistent.

**Figure 3. Gross vs. net density of new major residential subdivisions, Calvert County**



### **III. The relationship between minimum zoned lot size and actual lot size.**

It has been argued in the planning and economics literature that large lot zoning may be contributing to urban sprawl (Levine 2005, Fischel 1999). In counties such as Calvert that have downzoned regions of the county to lower density levels, in an attempt to limit growth, we expect average lot sizes to increase. Average lot size did increase in Calvert after properties were downzoned in 1975 and in 1999 (see Figure 3 above). But, to what extent do zoning limits actually determine lot size? If lot sizes tend to be right at the limit of the minimum land area allowed by zoning, that suggests that zoning would in fact be the major determinant of lot size. This would be consistent with arguments that in many communities, the role of zoning has become exclusionary, or for the purpose of excluding additional development, especially higher density development (Fischel, 2004). Outer suburbs are more likely use this type of low density zoning, so we may be more likely to see lot sizes determined by zoning in those areas.

On the other hand, more urbanized areas and inner suburbs that are already developed are more likely to employ zoning rules that attempt to maintain "like uses" or to prevent spillovers among uses. Recently, mixed use zones that include commercial and different residential densities in the same development have become more common. Are these areas also likely to build at the maximum allowable lot size? McConnell, Walls, and Kopits (2006) estimated a density equation for subdivisions in Calvert County and found that while the underlying zoning influenced density, other factors were also important. They did find, however, that rural areas were more likely to be built at the limit of the allowable density. We extend this work by looking at three counties each with different degrees of urbanization and development. The three are Calvert County, which is a primarily rural county with a few small urbanized areas, Charles County which has

several larger urban areas but has many rural areas as well, and Montgomery County, much of which is part of the suburban area of Washington D.C. All three counties have seen rapid development over the last 20 years. We examine how the ratio of actual lot size to allowed lot size varied across the range of allowable densities permitted in each county.

Since most residential development occurs within subdivisions, we used subdivision level data for our analysis. We include data on each subdivision recorded over 1967-2001 in Calvert, 1980-2004 in Montgomery, and 1992-2005 in Charles County. We obtained the following data for the three counties: the year the subdivision was approved and the existing zoning rules at the time, any exemptions to the zoning rules such as for low income dwelling units or transferable development rights, the land area of the project, and the number of units approved.

The exceptions to the zoning rules are important to this analysis. Each of the three counties examined here has a TDR program, by which housing units can be transferred from one area to another. The use of TDRs allows for additional density in some "receiving" areas; that is, it allows density to be higher than the zoning rules allow in those areas. The maximum allowable number of additional units with TDRs is always specified as part of the TDR receiving area designation. In our analysis below, we account for the allowed use of TDRs to have higher allowed density. In Montgomery County there are also exceptions to the allowed density with the use of Moderately Priced Dwelling Units (MPDUs). In fact, MPDUs are required in larger subdivisions. Finally, in all jurisdictions, there are cases where zoning limits on a particular property are grandfathered to an earlier zoning allowance. In these cases, we are likely to see some properties developed at higher densities than existing zoning regulations would allow. We now turn to the three case studies.

### *Calvert County*

Calvert County is the most rural of the three counties, but it has seen the fastest rate of growth in development. Between 1990 and 2000, the population grew by nearly 50%. In an effort to maintain productive farmlands and the rural character of the region, the County has actively pursued various land preservation programs, and has one of the most active and broadly-applied TDR programs in the country. In fact, the two aspects of Calvert County that differentiate it from the other counties examined here, is that it has attempted to use zoning to limit growth, and that it allows TDRs to be used to increase density of development in virtually all areas of the county. Developers' ability to use TDRs in Montgomery and Charles is much more limited.

The zoning regulations are complex and have changed over time in Calvert County. The full regulations are described in McConnell, Kopits, and Walls (2006), and we only summarize some important features here. TDRs can be used to add to density in all of the residential areas, and in many of the rural areas as well. The rural areas are divided into two broad categories that we will call "Rural" areas and "Rural Preservation", both requiring an average minimum lot size of 5 acres for much of the

period under study. However, TDRs can be purchased and used in any of the Rural areas, to reduce average lot size to 2 acres. TDRs cannot be used to increase density in the Rural Preservation areas.<sup>8</sup> TDRs can be used to increase density to a much greater extent in any of the residential zones and in the Town Centers. It is important to note that there have also been some changes to the allowable baseline zoning and the number of TDRs that can be purchased in Calvert. Major downzonings in 1999, and again in 2004 reduced the number of units that could be built on any property, but the pre-downzoning density levels can still be achieved through the purchase of TDRs in all areas of the county (including Rural Preservation areas).

To compare observed and allowable density, we first calculated the maximum number of housing units that could have been built in each subdivision according to the zoning and TDR regulations in place at the time the subdivision was recorded. For example, a 100-acre subdivision recorded in a Rural area in 1990 was permitted 20 houses under the baseline 5-acre zoning plus another 30 houses with the purchase of TDRs, resulting in a maximum allowable density of 50 units (i.e., a minimum of 2 acres per lot). We then compared this to the actual number of lots that were recorded in the subdivision.

Figure 4 shows the ratio of actual total lots built to the total potential number of lots allowed under zoning and TDR regulations, for 398 subdivisions recorded over 1967-2001. The horizontal axis identifies the different density limits faced by developers across the county, shown by minimum lot size. For example, the Rural Preservation areas are on the far right, with a minimum lot size of 5 acres. Rural areas allowing the use of TDRs require a minimum of 2 acres per lot as shown in the middle bar. Town Centers permit the smallest minimum lot size of 0.07 acres: that is, with TDRs they can build as many as 14 units per acre, shown to the far left in Figure 4. Each bar shows the ratio of actual lots built to the allowed number averaged across all of the subdivisions in that zoning category.

We find that subdivisions are much more likely to be close to the limit in the outlying rural suburbs. In the lowest density areas with 3 and 5 acre minimum lot sizes, the total units built are actually greater than the number allowed, most likely due to the presences of some grandfathered lots from less restrictive densities in place before.<sup>9</sup> On the other hand, the residential and Town Center areas (bars to the left) are built at densities well below density limits permitted by zoning. The TDRs allow density to go to quite high levels in the Town Center, because that is where the County wants to see higher densities, but it is clear from the figure that those areas are not getting much density above what the baseline would allow. For example, in Town Center areas, maximum allowable density is 14 units per acre (when TDRs are used), the realized density is only 2.8 units per acre. While in the rural areas where the maximum allowable density is 0.20 units per acre (one unit per five acres), the actual density is 0.28 units per acre (one unit per 3.57 acres).

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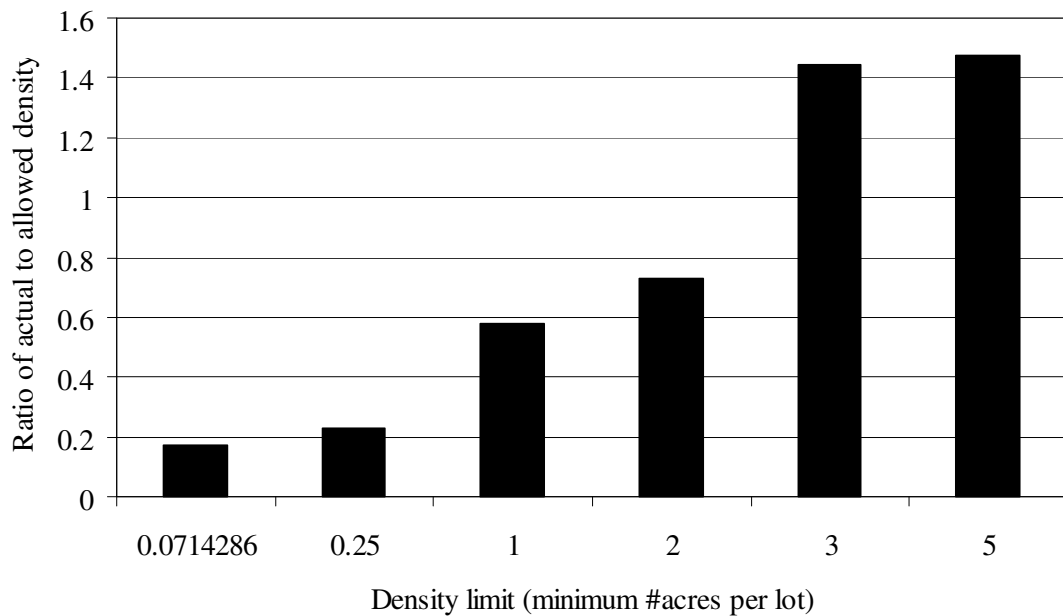
<sup>8</sup> For information on the names and zoning for each of these areas in Calvert County see McConnell, Walls, and Kopits (2006).

<sup>9</sup> The early zoning in the rural areas had been at 3 units per acre.

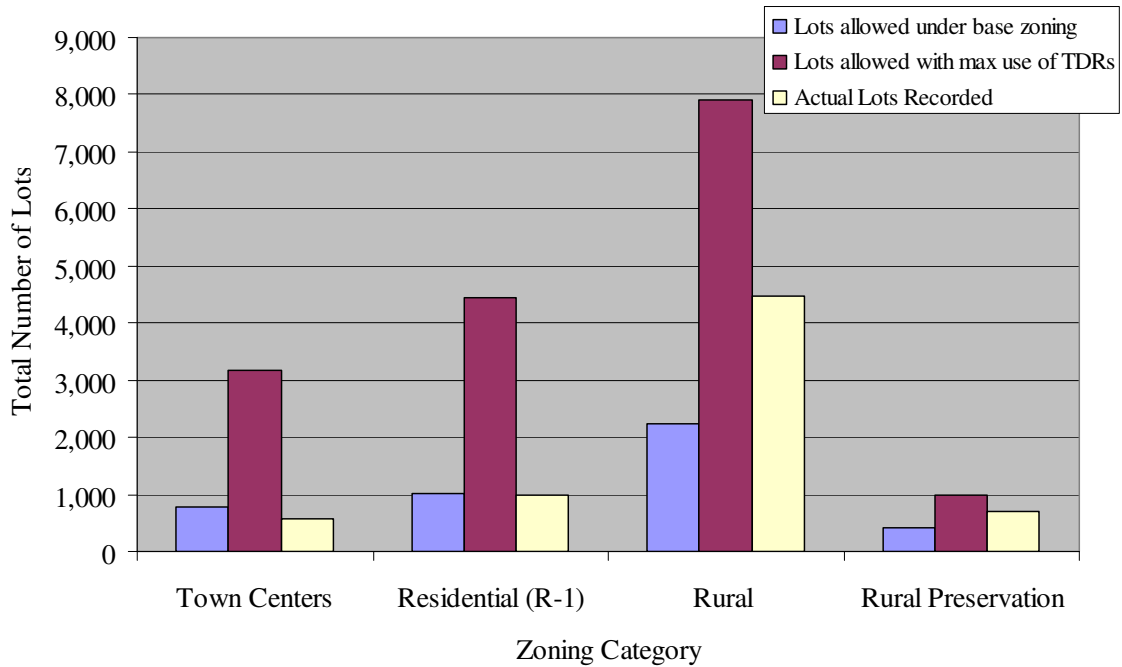
We illustrate in Figure 5 with data from all subdivisions recorded in regions permitted to use TDRs (234 subdivisions in total, over 1983-2001). For each category the first bar shows the number of lots summed across all subdivisions in that category that could be built under baseline zoning without TDRs; the second bar shows the maximum allowable lots with TDRs, and the last bar shows the actual number recorded. Note that the Rural Preservation areas were able to use TDRs only after the 1999 downzoning, to buy back to original levels. It is clear that in no areas is the development density going close what was allowed with TDRs. And, in the Town Center and residential areas, there is effectively no additional density above the baseline with the use of TDRs.

In conclusion, we find that the low density areas requiring higher minimum lot sizes do tend to be built to the zoning limit in Calvert County. The more residential areas and towns do not. The use of TDRs offers a good deal of extra density in many areas, but it does not tend to be used to the limit allowed.

**Figure 4. Ratio of Actual to Allowable Zoned Density, Subdivisions Recorded over 1967-2001, Calvert County, Maryland**



**Figure 5. Total Number of Lots Allowed under Baseline Zoning, Max TDR Use, and Actual Lots Recorded, Subdivisions Recorded in TDR Regions, 1983-2001, Calvert County, Maryland**



*Charles County*

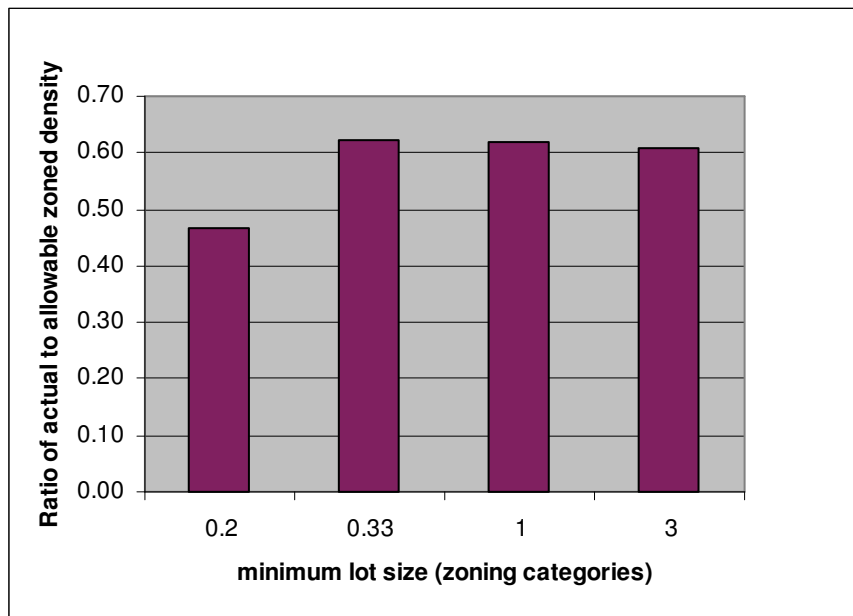
We perform a similar analysis for Charles County, drawing on data obtained from the County for subdivisions recorded since the early 1990s. Charles County includes the rapidly growing area of Waldorf, which is a larger urbanized area than any in Calvert County. The area around Waldorf is designated as a development district, and has the only residential zoning in the County, with areas zoned for low density residential (requiring a minimum of 1 acre per lot), medium density (minimum 0.33 acres/lot), and high density (minimum of 0.2 acres/lot). Most of the rest of the County is zoned as Conservation or Rural Conservation which requires a minimum lot size of at least 3 acres. There is no history of zoning changes as there has been in Calvert County. There have been several attempts to downzone parts of the county to lower density in the rural areas, but to date these have not been successful.

There is a TDR program in Charles County that allows development in certain areas to purchase TDRs and be built at higher densities than the baseline zoning. However, TDRs can only be used for additional density in the residential areas of the development district. For various reasons, the TDR program has not been nearly as active as the one in Calvert County. The program in Charles was initiated in 1993, but only 9 TDR transactions had occurred as of 2004. Because TDRs can be used anywhere in the development district, but have been used in so few developments, we treat the non-TDR developments separately in this section from the developments that did use TDRs.

Figure 6 shows the comparison of actual and allowed densities for the 306 subdivisions in the non-TDR sample.<sup>10</sup> As in the Calvert analysis above, we take the actual density in each subdivision and average those across each zoning category. The graph shows the ratio, averaged over all subdivisions facing the same density limit. The zoning categories in Charles County are very simple. Almost all rural areas require a minimum lot size of 3 acres, shown as the right bar on the graph. Subdivisions built in these areas are built at roughly 60% of the allowable density. Average actual densities are closer to 5 acre lots than 3 acre lots. Whether this is due to regulatory factors such as forest conservation requirements, or environmental constraints in certain areas, or to household preferences for larger lots is not clear.

The other 3 bars in Figure 6 show the ratios of average actual density to allowable density in the three zoning areas in the development district. The high density residential area is shown in the bar on the left and the medium and low density residential areas are shown as the middle bars. The actual to allowed density is similar in most of the residential area to the rural areas: actual density is lower than allowed (about 60% of allowable). However, the ratio of actual allowable is less than 50% in the high density residential area. Lot size there is roughly 0.43 acres when it could be as small as 0.2 acres.

**Figure 6. Ratio of Actual Average Subdivision Density to Allowable Zoned Density, Non-TDR Subdivisions Recorded Over 1992-2005, Charles County, Maryland**



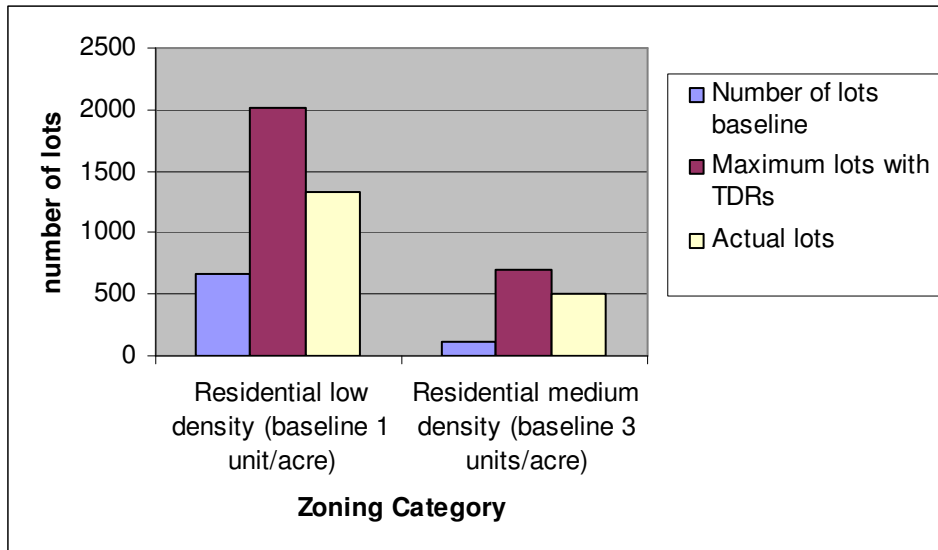
<sup>10</sup> There were 378 subdivisions in the file we received from Charles County. Some of those were discontinued or voided before getting final approval from the Planning Board, or before they were actually built. Some had missing data. And, in the analysis above, we included only those subdivisions that were larger than 3 lots.

As noted above, there were only 9 subdivisions in our sample that used TDRs, although about 120 subdivisions built in the development district could have used them. One of the 9 subdivisions is not included in our analysis because it covered a large geographic area and was built at less than the allowed density. It wasn't clear why TDRs were needed, and we were not able to discover why it was an exception. The remaining 8 subdivisions that did use TDRs were built mostly in the low density residential areas (6 of the 8), with the others built in the medium density residential areas. No TDRs were used in the high density residential areas, even though they could have been used there.

The results of the TDR subdivision analysis are shown in Figure 7. The story is similar to what we found in Calvert County. Note, however, that the Calvert analysis included all subdivisions that could have used TDRs, and this analysis just includes those that did use them. The use of TDRs in Charles County did increase density in the subdivisions where they were used, but density did not go to the allowable limit. And, as in Calvert County, of the areas where TDRs could be used, they appear to have been used more often in the lower density areas, rather than the higher density areas.

In summary, we find that the density at which subdivisions are built is well below the allowed density in all areas of the County. Lot size is certainly not being determined, at least on average, by zoning regulations.

**Figure 7. Total Number of Lots Allowed under Baseline Zoning, Max TDR Use, and Actual Lots Recorded, Subdivisions Using TDRs, 1993-2005, Charles County, Maryland**



*Montgomery County*

The last jurisdiction we examine is Montgomery County, which has areas that are part of the major suburbs of the Washington, D.C. metropolitan area, and other areas which have a farming tradition and continue to provide a rural base for the County. The County has also experienced the pressures of rapid growth in recent years, but is also

close to being entirely either built out or preserved in permanent land preservation programs. The developed areas have many more zoning categories than either Calvert or Charles counties, with density levels in theory as high as 50 units per acre. Also noteworthy is that a large agricultural area in the northwest of the County was downzoned to a minimum lot size of one unit on 25 acres in 1980.

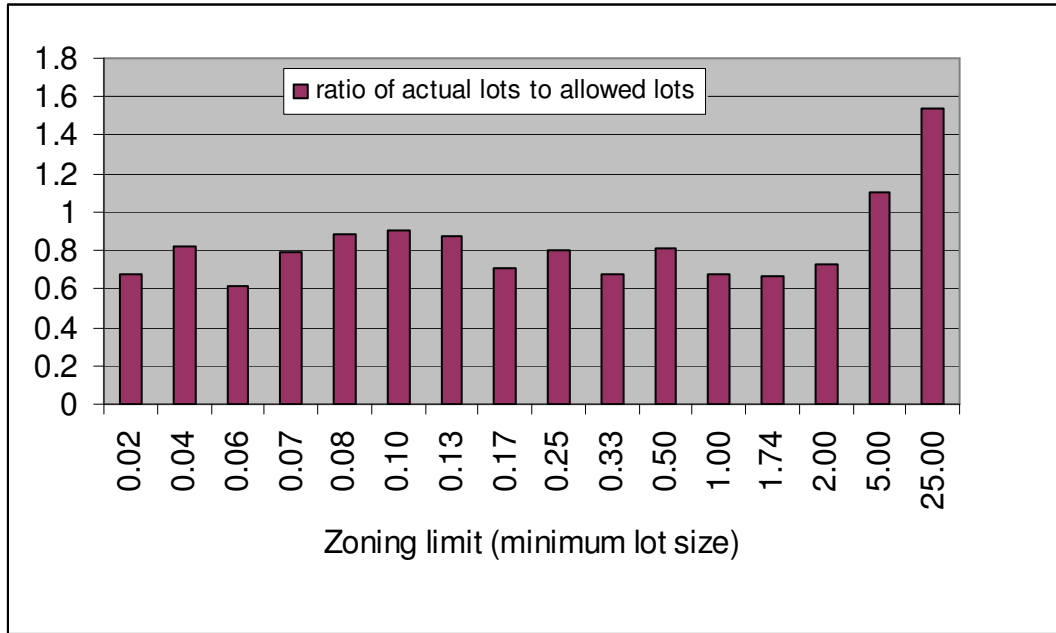
The TDR program in Montgomery County was initiated in 1980 and was originally designed to transfer development rights from the large agricultural area that was downzoned from a minimum lot size of one house on 5 acres to one house on 25 acres, to areas of the county that were suitable for higher density development. The location of receiving areas for these TDRs was left up to each of the separate Planning Areas that have responsibility for local land use Master Plans. Planning Areas have tended to designate only small areas for TDR use, and have done so in a piecemeal fashion over time. The allowable limit on the use of TDRs is effectively different in almost every receiving area. We were able to determine which areas were designated TDR receiving areas, and what their limit was for the use of TDRs.<sup>11</sup> We show the results for the actual to allowed development below separately for subdivisions that were allowed to use TDRs from those which could not use TDRs.

Figure 8 shows the results for the non-TDR subdivisions in Montgomery County. The pattern of actual lots built compared to the allowable number is not as clear as for the more rural counties above. The lowest density zones -- the preservation areas zoned at one unit on 25 acres and the rural areas zoned at one unit on 5 acres -- do have ratios that are over one. These areas may have some grandfathered properties that have been allowed higher densities. The zoning rules in these areas do seem to be determining lot size. However, the areas zoned for minimum lot size between 1 and 2 acres have densities well below what would be allowed. Developments at about 8-12 units per acre (or average lot size of 0.13 to 0.08) seem to be built at densities close to the limit. These densities are primarily town house developments. Actual densities relative to allowable fall again at very high densities. These developments are at only 50-60% of the allowable limit.

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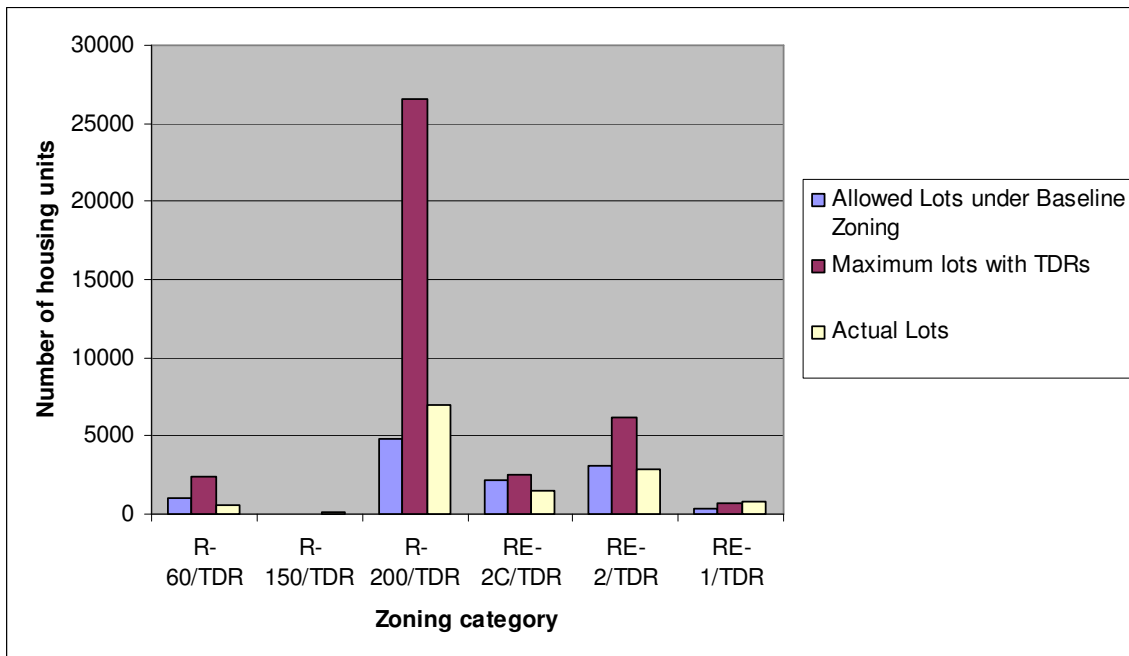
<sup>11</sup> The County has an overall limit on the TDRs that can be used in any zoning category, but the Planning Areas tend to set the limits on the individual receiving areas well below that County limit. See McConnell, Walls, and Kelly (2006).

**Figure 8. Ratio of Actual Subdivision Density to Allowable Zoned Density, Non-TDR Subdivisions Recorded 1980-2004, Montgomery County, Maryland**



The story on TDR subdivisions in Montgomery County is similar to the results for Calvert and Charles above. As shown in Figure 9, in each of the zoning categories, many more TDRs were allowed than the actual number used. Some subdivisions were built in TDR designated areas, and did not use TDRs at all.

**Figure 9. Total number of baseline lots, lots allowed with TDRs, and actual lots, Subdivisions using TDRs, 1980-2004, Montgomery County, Maryland**



Overall, we find some evidence that in the most rural areas, subdivision development densities are strongly affected by the zoning rules. We find this in Calvert and Montgomery Counties, but not in Charles County. This could be due to the fact that in Charles County, the minimum lot size is never greater than 3 acres, whereas it is 5 acres or higher in the other counties. We also find some evidence that in the residential areas, especially those that are zoned for relatively high density, developers are not building as densely as allowed. Whether this is due to household preferences for lower density, or the ability of local residents to block higher density is an interesting and still open question. In the next section, we are able to look a bit more closely at household preferences for lot size.

#### **IV. Household preferences for lot size**

Given that densities are often observed to be well below the levels allowed by zoning regulations, it is clear that an important part of what drives the building of houses on large lots is individual preferences. This section sheds light on these preferences by estimating a simple hedonic property value model for Calvert and Montgomery County. The hedonic price technique has the virtue of relying on observed behavior, rather than hypothetical surveys, to elicit values, and it has the advantage of controlling for many other factors that affect housing prices. Although there are many hedonic studies looking at the value of different amenities (including different types of open space), our analysis is unique because we are able to control for all subdivision and neighborhood level characteristics while focusing on the effect of lot and house specific characteristics.

We use the model to examine how the value of lot size has changed over time and how households trade off lot size for housing structure characteristics. By conducting the analysis for both Calvert and Montgomery Counties, we are able to determine how preferences vary across jurisdictions with different characteristics. Findings from the Calvert analysis have implications for ex-urban counties in which sprawling residential development, where lot sizes are large. Results from Montgomery County will reflect conditions and preferences that exist in more inner suburban regions that are already quite densely developed.

For this analysis, we limit the sample to subdivisions that had at least 10 house sales over the study period. In the Calvert County sample, this allows us to include 3,352 individual house sales occurring over 1981-2001 within 89 subdivisions. The Montgomery sample includes 22,575 sales within 1,148 subdivisions occurring over 1981-2005. Table 2 provides summary statistics for the house specific variables included in the model. Gross floor area and house age are similar across the two counties, with the average house being 2000-2600 square feet and 6-7 years old at the time of sale. Lot sizes are larger in Calvert, however, with mean lot size of 1.5 and 0.37 in Calvert and Montgomery, respectively. As expected, housing prices are much higher in the more urban Montgomery County, where the mean value is \$366,522, while it is \$193,233 in Calvert County.

**Table 2. Summary Statistics for Single Family House Sales, Calvert and Montgomery County, Maryland**

Variable	Calvert				Montgomery			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Sale price (nominal \$)	193233	72655	50400	765291	366522	227567	50000	5000000
Lot size (acres)	1.525	1.587	0.057	30.410	0.327	0.373	0.026	13.120
Gross floor area (sq ft)	2081.89	802.88	704	6575	2640.40	963.48	648	20891
Age (years)	5.84	10.01	0	186	6.87	8.17	0	114
Sale year	1994.39	5.07	1981	2001	1996.90	6.53	1981	2005
#Sales	3,352				22,575			
#Subdivisions	89				1,148			

We assume households choose housing characteristics, location and amenities to maximize utility. Under this assumption and a housing market in equilibrium, we can use the hedonic price model (see Rosen (1974)) to examine consumer behavior with regard to housing choices. The hedonic price function can be specified as  $P = f(I, C, S, T)$ , where  $P$  is the price of the property,  $I$  represents the lot size,  $C$  is a vector of structural characteristics (age, square footage, etc.) associated with the house, and  $S$  represents a vector of subdivision characteristics, accessibility measures and neighborhood amenities. We control for all observed and unobserved attributes in  $S$  that are common to all houses within a subdivision by including subdivision fixed effects in the model. We also control for inflation and factors affecting countywide demand for housing over time by including sale year dummy variables represented in the equation by  $T$ .

Table 3 shows the results of the hedonic equation estimation. The characteristics of the house we include in addition to lot size are house size in floor area square footage, and the age of the house. Because our primary interest is in lot size and how households might trade off lot size for other housing attributes in these two different jurisdictions, we interact lot size with the other housing characteristics. We also include an interaction term between lot size and the year in which the house sold to determine if the willingness to pay for lot size has changed over time. The top section of Table 3 shows the coefficient estimates for lot size, the other housing characteristics and the interactions. When we estimate the hedonic price equations with just lot size and the other housing characteristic variables and no interaction terms, they are all significant. Adding interaction terms can influence the coefficients and their significance for individual variables. To determine if the interaction terms are significant as a group, we perform an F-test. In both counties, we reject the hypothesis that as a group they have no effect.<sup>12</sup>

The interaction terms are all significant except for sale year in Calvert County. Larger house size is associated with a slightly lower marginal value for an additional acre of lot size. Older houses have lower prices other things the same, but a bigger lot size has an offsetting effect of that age discount. In more recent years, lot size has had less of an effect on price in Montgomery County. To fully examine the effect of lot size on price, we

<sup>12</sup> For Calvert County, the F value is 56.16, and for Montgomery County it is 119.13.

calculate the marginal willingness to pay for additional private acreage by the partial derivatives of the price function with respect to each attribute, evaluated at various values of the relevant interaction variables. These results are shown at the bottom of Table 3.

**Table 3. Hedonic Regression Results, Calvert and Montgomery County, Maryland**  
Dependent Variable is the natural log of house sale price

	<b>Calvert</b>	<b>Montgomery</b>
	<i>Coeff. (Robust Std. Err.)</i>	<i>Coeff. (Robust Std. Err.)</i>
Lotsize	0.44581 (0.74301)	9.96370 (2.99716)**
Lotsize <sup>2</sup>	- 0.00028 (0.00040)	- 0.00603 (0.00416)
Gross floor area	0.00015 (0.00001)**	0.00015 (0.00001)**
Lotsize*Gross floor area	- 0.00001 (0.00000)**	- 0.00002 (0.00001)**
Age	- 0.00266 (0.00091)**	- 0.00501 (0.00162)**
Lotsize*Age	0.00012 (0.00006)*	0.00300 (0.00134)**
Lotsize*Sale year	- 0.00020 (0.00037)	- 0.00492 (0.00150)**
Constant	11.12193 (0.03609)**	11.45378 (0.02762)**
Adjusted R <sup>2</sup> :	0.8509	0.8809
Obs; Subdiv	3352; 89	22575; 1148
<b>Marginal effect with respect to lot size:</b>		
<i>Evaluated at mean values of all vars:</i>	0.022 (0.005)**	0.112 (0.022)**
<i>Evaluated at Sale year =</i>		
1985	0.023 (0.005)**	0.170 (0.029)**
2000	0.020 (0.006)**	0.096 (0.023)**
<i>Evaluated at house size =</i>		
2000 sq. ft.	0.022 (0.005)**	0.123 (0.023)**
3000 sq. ft.	0.014 (0.006)**	0.105 (0.022)**

Coefficients on the individual subdivision dummy variables and sale year dummy variables are not shown here but are available upon request. \*\* signifies significance at the 95% level; \* at the 90% level.

Consistent with results of other hedonic studies including lot size variables (see Sirmans et al., 2006), households in both counties show a strong preference for larger lots. As shown in the elasticity estimates at the bottom of Table, evaluated at the sample mean of the relevant interaction variables, we find that a one acre increase in private lot size is associated with an approximately 2% and 11% increase in house price, all else equal, in Calvert and Montgomery, respectively. This suggests that for an average priced house in 2004 (about \$200,000 in Calvert County and \$350,000 in Montgomery County), an increase in lot size from 1 acre to 1.5 acres would increase price by about \$2,000 in Calvert and \$19,250 in Montgomery County. It is important to note that these marginal values should be interpreted not as the value of a 0.5 acre lot in these jurisdictions, but marginal value of adding another 0.5 acre to an existing developed lot. And these estimates abstract from the neighborhood or locational aspects of any particular lot; in this model those are captured separately in the fixed effects. The magnitude of these estimates of the value of lot size is robust across various specifications of the model, including one without interaction terms or with additional house characteristics in the Calvert regression.

Although the value of additional lot size is on average five times larger in Montgomery County than in Calvert County, its effect on price has fallen over the period

under study. The significant interaction term between lot size and sale year in Montgomery indicates that marginal willingness to pay for lot size has decreased over time. As shown in Table 3, the marginal value of an additional acre fell from 17% in 1985 to 9.6% in 2000. In Calvert, the marginal effect remains around 2% over the sample period. The value of larger lot sizes appears to be falling in Montgomery County, and this may be indicative a declining interest in larger lots in suburban areas.

Finally, we find that the marginal willingness to pay for larger lot size is somewhat lower for larger houses in both counties. We look at house sizes of 2,000 square feet and 3,000 square feet, sizes that are around the mean size in both counties (see Table 2). Table 3 shows the elasticity of price with respect to lot size evaluated at these house sizes. This gives an indication of the rate at which homebuyers are willing to trade off lot size for house size—e.g., for a 1000 sq. ft. increase in house size, the marginal value of an additional acre fell by 1% in Calvert and 2% in Montgomery.<sup>13</sup>

In summary, we find that households value additional acreage for their own lots, and as one might expect, these values are larger in urbanized Montgomery County where land values are higher and where most lot sizes are lower. However, we do find that the value of larger lots seems to be decreasing over time, at least in Montgomery County. Also, there is some indication of a willingness to trade off lot size for house size. In earlier work on Calvert County, we found additional evidence about household preferences with regard to lot size. We looked at whether residents of subdivisions would trade off lot size for more open space in their subdivision or for being adjacent to open space. We found evidence that of willingness to trade lot size for both of these amenities.

## V. Conclusion

Lot sizes vary across counties and trends in lot size also vary. Average lots sizes are relatively large, even in the inner suburban counties. There is no strong trend toward higher density, though things do not appear to be getting much worse in terms of lot size. But large lot sizes do mean more land used in urban areas. To the extent that smart growth policies succeed, there will need to be a move toward higher density. And it does not appear that zoning is determining lot size, except maybe in the lowest zoned ex urban areas. A big issue is that people have preferences for large lots. This remains a difficult challenge for achieving smart growth outcomes.

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<sup>13</sup> We also calculated the marginal value of house price with respect to age of the house and to house size (square footage). Evaluated at the sample means of the relevant interacted variables, in Calvert County the marginal effect of age on house price is -0.002 (0.001) in Calvert and -0.004 (0.001) in Montgomery, which means that house price would decrease 2% and 4%, respectively, for a house 10 years older. The marginal effect of house size on price is 0.00015 (0.00001) in both counties, meaning another 1,000 square feet would increase house value by 15%.

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