

TRANSPORT FINDINGS

Measuring Induced Travel Elasticities associated with Local Roads from Trip Generation

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Findings

Induced travel elasticities associated with new road capacity are typically estimated for roads of higher functional classifications, such as interstate freeways and principal arterials. These are estimated as “own” elasticities, that is an increase in lane kilometers of a given type of road leads to increased vehicle-km of travel (VKT) on that same road type. What are the elasticities associated with local roads, specifically those associated with roads for a new residential development? This question is addressed by calculating the trips generated from a development assuming different levels of trips generated from each residence. In this example, the development includes 4.32 new lane-kms of local roads. Total VKT to exit the development is calculated and the calculated VKT and amount of new lane-kms are used to estimate an implied elasticity using county-level local road lane-km and VKT data from both the States of New Jersey and Maryland. Findings suggest an induced travel elasticity for local roads generally less than for higher functional road categories but also highly dependent on the household trip generation rate.

1. QUESTIONS

Induced travel occurs when new road capacity is built, and this is usually assumed to be more likely when capacity is added to a congested highway. The new capacity, e.g. a new lane, will lead to reductions in travel time which will lead to increases in travel, especially over time as individuals adjust their schedules, route, choice of mode, trip destinations, trip frequency, and where they live and work. In the long run, a new equilibrium will occur between the amount of travel demanded and the supply of highways (Noland and Hanson 2013).

Research over decades has shown relationships between increases in lane-kms and increases in vehicle-km of travel (VKT). This includes causal studies based on instrumental variable estimation (Duranton and Turner 2011; Hymel 2019) with one study using a detailed propensity matching technique (Graham, McCoy, and Stephens 2014), among others. Volker and Handy (2022) provide the most up to date review of induced travel studies. All of these studies estimate elasticities for higher functional road classes, usually for interstates, motorways, and principal arterials. To the best of my knowledge, no research on induced travel associated with local roads has been published.

The question to be answered here is: Can trip generation associated with a new development provide a measure of induced travel elasticities for local roads?

2. METHODS

Data for this analysis is drawn from the New Jersey Department of Transportation (2024) and the Maryland Department of Transportation (2024). This data includes daily vehicle-miles of travel (VMT) and lane-miles for a variety of road classifications. The New Jersey data includes center-line mileage, while Maryland provides lane-mile data. For New Jersey, the center-line mileage is multiplied by two, as almost all local roads have one lane in each direction. Only data on local roads is used; this data includes both rural and urban roads. “Urban roads” are defined by the Federal Highway Administration as those roads in urbanized areas (based on Census definitions) with a population of 5,000 or more. The daily VMT data is annualized (times 365 days) and all data is converted to metric units and reported as such here. A limitation is that data reported by states on local roads may be of lower quality than what is reported for higher functional classifications, especially estimates of VMT.

The approach used to estimate induced travel elasticities is based on a simple calculation of trips generated from households in a theoretical new residential development with a small network of local roads. Assume a new development with an area of about 17.5 hectares. This can hold 80 lots of about 0.22 hectares each (about a typical $\frac{1}{2}$ acre lot in Imperial units), a somewhat typical exurban development pattern. This estimate does not include space dedicated to roads. If we imagine a small network as shown in [Figure 1](#), with each lot having about a 30 m frontage and 60 m in depth, this leads to eight houses along a 120 m stretch of road and we can assume six roads at 120 m intervals. In my estimate of road length, I have not counted space for the road, such as intersection size. This network now has 2.16 km of center-line road length and 4.32 lane-kms. Most exurban developments have curvilinear roads, a simple network, however, allows for simpler calculations.

Household trip generation rates are the initial input. Based on the US National Household Travel Survey (NHTS) (Bricka et al. 2024) for 2017, there were 1865 vehicle trips/year per household ([Table 3-6](#) in Bricka et al.). This comes to 5.1 trips per household per day. Similarly there were 1231 trips/year per person, or 3.37 trips per person per day ([Table 4-3](#) in Bricka et al.). This would come to 8.43 trips per household per day assuming 2.5 people per household. These estimates likely include only trips generated from the home so may be an underestimate, as they do not account for trips to the home. Results from the 2022 NHTS are lower, but this could have been reduced due to the pandemic. An older study conducted



Figure 1. Schematic of road network (source for icon: Microsoft CoPilot)

in Virginia found rates of 9.2-10.8 trips per house and included commercial trips associated with each house, something likely to have increased substantially since their study was done (Ulmer et al. 2003).

Given this range of trip generation estimates, I calculate VKT estimates within the development for 2, 5, and 10 trips per household per day. Referring to [Figure 1](#), the distance for each lot from the Main St., which leads

to the development exit is 30, 60, 90, and 120 m. In total this would be 300 m of driving distance, or 600 m for the entire road counting the lots on both sides of Main St. Assume 120 m to exit the development plus 120 m for each subsequent block along Main St. up to 720 m for the last road (6th St.). The amount of travel for all houses on each street segment to exit the development is shown in [Table 1](#) and the total VKT for the development based on one trip per household is 39.6 km. Assume that each trip includes a return and 2 trips per house per day this comes to 158.4 km. The annual total VKT generated by the development is then 57,816 km. [Table 2](#) shows estimates for different trip generation rates that are used for the induced travel elasticity calculations.

Table 1. Distance to exit development (in meters).

Streets in development, 8 houses on each side of the street (except 1 st and 6 th street)	Total travel to access Main St. (meters)	Total travel to exit development along Main St. (meters)	Total travel for to exit development (meters)
1st street	600	960	1560
2nd street	1200	3840	5040
3rd street	1200	5760	6960
4th street	1200	7680	8880
5th street	1200	9600	10800
6th street	600	5760	6360
Total	6000	33600	39600

Table 2. Total VKT per year for different trip generation rates

Trip generation rate per household	Total annual VKT for the development
2 trips/day	57,816
5 trips/day	144,540
10 trips/day	289,080

3. FINDINGS

Thus, for 4.32 lane-kms of new local road, between 57,816 and 289,080 km/year are generated, depending on the number of daily trips from each household. This calculation assumes that those living in the houses built on the new roads are newly relocated to the region. Durantón and Turner (2012) and García-López, Gómez-Hernández, and Sanchis-Guarner (2024) provide evidence for how new roads can lead to population growth, so this assumption seems reasonable, although both studies focused on major roads. García-López, Gómez-Hernández, and Sanchis-Guarner 2024 estimated an elasticity of population with respect to lane-kms of 0.723 and for employment of 0.698 in Great Britain, while Durantón and Turner (2012), using US data, estimated a much smaller elasticity of 0.13. Some of the residents may have relocated within the region, but newcomers would have moved to where they previously resided especially given that in most areas, housing is in high demand, so the net impact could be an increase in newly

generated trips and VKT. I also assume that these developments are not walkable, that is, there is no easy and safe way to walk to a final destination outside the development.

The key question is what is the elasticity of travel associated with newly built local roads? To determine the elasticities associated with the new roads I use both New Jersey and Maryland county-level data and calculate the “implied elasticity”, that is, what is the elasticity implied by the increase in VKT from the associated increase in lane-km (allowing for assumptions on how many trips are generated)? The formula for this is as follows:

$$\bar{\varepsilon} = \frac{VKT_{new}}{VKT} \cdot \frac{LKm}{NewLKm}$$

Where: $\bar{\varepsilon}$ = implied elasticity of VKT with respect to lane-km for a given road type

VKT_{new} = new VKT on the corresponding road type

VKT = the current vehicle-km of travel in the county on the corresponding road type

$NewLKm$ = the newly added lane km for the county on the corresponding road type

LKm = the current lane-km in the county on the corresponding road type

Implied elasticity estimates for all local roads are shown in [Table 3](#) by county for New Jersey and in [Table 4](#) for Maryland assuming 2, 5 and 10 trips generated per household per day. Additional results for both rural and urban roads separately are shown in the supplemental material. Implied elasticity calculations for the combination of rural and urban roads fall in between those for each separately. All these results show substantial variation in elasticity estimates, likely due to variation in initial VKT levels and the extent of the local road network. Most studies do not consider this variance, one recent exception being Chang, Indra, and Maiti (2023) using the same data as Duranton and Turner (2011) to estimate the heterogeneity of elasticities between different MSAs (ranging from about 0.8 to 1.46).

Induced travel elasticities are generally estimated for specific road types, for example a lane-km elasticity associated with an arterial road is based on regressions linking VKT on an arterial to the lane-kms of the arterial. Similar relationships apply for other road types, e.g. Noland (2001) has estimates for multiple functional classifications, but not local roads. To my knowledge all induced travel estimates are based on VKT and lane-kms for specific road types for a designated area (e.g. a county, metro area, or state), with no cross-elasticities between different road types. My implied elasticity calculations

Table 3. New Jersey all local roads: VKT, lane miles and implied elasticity assuming 2, 5, and 10 trips generated per household, 2023 data, by county (new lane-km = 4.32 km).

County	Lane-kms	Annual VKT (1000)	Implied elasticity (2 trips/day, new VKT=57,816)	Implied elasticity (5 trips/day, new VKT=144,540)	Implied elasticity (10 trips/day, new VKT=289,080)
Atlantic	2,160	592,952	0.049	0.122	0.244
Bergen	3,446	1,850,746	0.025	0.062	0.125
Burlington	3,125	1,068,519	0.039	0.098	0.196
Camden	2,348	849,769	0.037	0.092	0.185
Cape May	1,199	394,199	0.041	0.102	0.204
Cumberland	1,415	414,780	0.046	0.114	0.228
Essex	1,854	997,793	0.025	0.062	0.124
Gloucester	1,897	680,753	0.037	0.093	0.187
Hudson	636	342,790	0.025	0.062	0.124
Hunterdon	1,704	516,412	0.044	0.110	0.221
Mercer	1,600	490,344	0.044	0.109	0.218
Middlesex	2,906	1,555,660	0.025	0.063	0.125
Monmouth	4,102	2,120,477	0.026	0.065	0.129
Morris	3,000	1,565,484	0.026	0.064	0.128
Ocean	3,776	1,981,018	0.026	0.064	0.128
Passaic	1,482	798,235	0.025	0.062	0.124
Salem	962	265,713	0.048	0.121	0.242
Somerset	2,126	1,106,220	0.026	0.064	0.129
Sussex	1,601	511,421	0.042	0.105	0.210
Union	1,675	901,233	0.025	0.062	0.124
Warren	1,289	298,503	0.058	0.144	0.289

VKT and lane-km 2022 data. Source: (New Jersey 2024).

make this same assumption, as the VKT is only that generated from the houses on the new roads, but the implied elasticity is calculated from all the local roads in each county.

Depending on the specific context, there may be additional travel on local roads to access final destinations away from home (such as work, shopping, and recreational destinations); this travel is not included in the calculations and if considered would increase the value of the elasticities.

In any case, how do these calculations of induced VKT elasticities compare to estimates done for higher functional road classifications? Induced travel estimates in the most recent research have been found to be 1.0 or slightly higher, implying that any increase in capacity is quickly filled to the average level of traffic as before the expansion (Duranton and Turner 2011; Hymel 2019). The calculations for local roads are smaller. Taking the average and standard deviation across all the counties for both states for each level of trips generated by the development shows there is substantial variation in the local road induced travel elasticities. These are shown in [Table 5](#), by trip generation rate with the average ranging from 0.095 to 0.611 with fairly large standard deviations. When rural and urban roads are combined, the average elasticities are between the values for each separately and standard deviations are similar.

Table 4. Maryland all local roads: VKT, lane miles and implied elasticity assuming 2, 5, and 10 trips generated per household, 2023 data, by county (new lane-km = 4.32 km).

County	Lane-kms	Annual VKT (1000)	Implied elasticity (2 trips/day, new VKT=57,816)	Implied elasticity (5 trips/day, new VKT=144,540)	Implied elasticity (10 trips/day, new VKT=289,080)
Allegany	2036	144,841	0.188	0.470	0.940
Anne Arundel	5312	741,908	0.096	0.240	0.479
Baltimore City	2764	370,149	0.100	0.250	0.500
Baltimore County	6733	1,062,167	0.085	0.212	0.424
Calvert	1716	96,561	0.238	0.595	1.189
Caroline	1462	107,826	0.182	0.454	0.908
Carroll	3153	214,043	0.197	0.493	0.986
Cecil	1938	231,746	0.112	0.280	0.560
Charles	2431	199,559	0.163	0.408	0.815
Dorchester	1670	83,686	0.267	0.668	1.335
Frederick	4427	531,084	0.112	0.279	0.558
Garrett	1914	143,232	0.179	0.447	0.894
Harford	3256	362,102	0.120	0.301	0.602
Howard	2933	579,364	0.068	0.169	0.339
Kent	998	48,280	0.277	0.692	1.383
Montgomery	7314	883,530	0.111	0.277	0.554
Prince George's	6849	1,042,855	0.088	0.220	0.439
Queen Anne's	1708	217,261	0.105	0.263	0.526
Somerset	1023	61,155	0.224	0.560	1.119
St. Mary's	1984	196,340	0.135	0.338	0.676
Talbot	1355	146,450	0.124	0.310	0.619
Washington	2865	381,415	0.101	0.251	0.503
Wicomico	2352	159,325	0.198	0.494	0.988
Worcester	2064	177,028	0.156	0.390	0.780

VKT and lane-km 2023 data. Source: (Maryland 2024).

Table 5. Average and standard deviation of induced travel elasticities, urban and rural local roads, plus combined, by trip generation rate (combining data from both states).

	2 trips/day		5 trips/day		10 trips/day	
	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.
Urban local roads	0.095	0.075	0.237	0.187	0.473	0.374
Rural local roads	0.122	0.096	0.306	0.240	0.611	0.480
All local roads	0.097	0.073	0.242	0.183	0.484	0.365

Another way to evaluate the implied elasticities is to base them off the total of all local roads within each state. [Table 6](#) displays calculations for all local roads in both states plus combining across both states. The magnitude of the elasticity is lower, as would be expected when extending the impact over a larger area.

Table 6. State-based induced travel elasticities, combining data for all counties.

	2 trips/day	5 trips/day	10 trips/day
All local roads in New Jersey	0.031	0.077	0.154
All local roads in Maryland	0.115	0.287	0.575
All local roads for both states	0.056	0.139	0.279

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SUPPLEMENTARY MATERIALS

Supplemental material

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