2017

PALM BEACH COUNTY INTERNAL TRIP CAPTURE STUDY

FOR MIXED USE DEVELOPMENTS

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LETTER FROM JOHN L. RENNE, PHD, AICP

Professor Reid Ewing and Dr. Guang Tian are international leaders in researching travel behavior in mixed-use developments. Reid is one of the most cited planning scholars, with nearly 18,000 citations to his credit according to Google Scholar. Our careers have interwoven as Reid served on my dissertation committee at Rutgers University in the early 2000s. Before that, Reid worked here in South Florida at the Center for Urban and Environmental Solutions, where his work led to leading books and articles that have guided a generation of transportation and land use planners. His first internal trip-capture study was published in 2001, based on a study in South Florida with Dr. Eric Dumbaugh, who is now also a colleague in the School of Urban and Regional Planning at Florida Atlantic University.

CUES was excited to work on this project with Reid, who lead this most recent study on internal trip capture in Palm Beach County, with a focus on Abacoa. This study shows that large, master-planned communities have a high internal capture rates. Abacoa's rate was 48%, however 90% of trips were by automobile with only 5% walking and 5% biking.

Abacoa was intended to be a model community, thus the MacArthur Foundation endowed the Abacoa Project at CUES in partnership with the nonprofit, Abacoa Partnership for community. The endowment enables research to study the community's impact over time.

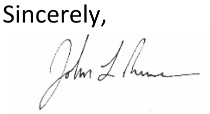
The outcomes of this study show the following:

1. Abacoa and other mixed-use developments in Palm Beach County contain a high share of internal trips. In fact, the share of internal trips, as evidenced by the data collected in this study, is significantly higher than predicted when the project was undergoing entitlements in the 1990s.
2. Data for this sort of research, which was collected from the Palm Beach County Metropolitan Planning Organization (MPO) does not provide as robust data as researchers would like at the neighborhood or even Downtown scales. The data appears to underreport walking, bicycling and transit trips, yet these are the same data that calibrate traffic impact fee models across Palm Beach County. Using limited data reinforces and possibly overstates the use of automobiles in mixed-use communities. There is a constant need for better data to address these questions on the neighborhood-scale.
3. Regardless if walking, bicycling and transit use are underreported or not, this study of mixed-use developments shows a high-level of automobile-dependence in Palm Beach County's mixed-use communities. CUES is committed to research and outreach efforts to promote plans and policies that result in a sustainable future – one that create more options for mobility and less dependence on driving.

This study has generated additional questions: What policies and plans should be implemented for existing communities, like Abacoa, downtown locations and other mixed-use communities to promote infill development that encourages more walking, bicycling and transit use? What plans and policies can local governments adopt to expand transportation infrastructure to support multimodal transportation systems?

The answers to these questions require a cultural shift in how local governments and developers embrace and prioritize the creation of sustainable and livable communities across South Florida. These aims are at the core of our work at CUES, in close partnership with the Abacoa Partnership for Community.

Sincerely,



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INTRODUCTION

Mixed-use development (MXD) is a signature feature of smart growth, New Urbanism, and other contemporary land-use movements aimed at reducing the private automobile's dominance in suburban America. By putting offices, shops, restaurants, residences, and other co-dependent activities in close proximity to each other, MXD shortens trips and thus allows what might otherwise be external car trips to become internal walk, bike, or transit trips. This in turn can reduce the vehicle miles generated by an MXD relative to what it would be if the same activities were separated in single-use developments. Less VMT not only relieves traffic congestion but also reduces greenhouse gas (GHG) emissions, air pollution, and fuel consumption. MXDs are also promoted for their supply-side benefits, such as possibilities for shared-parking and economizing on roadway and related infrastructure expenditures (since peak travel periods often differ between offices, retail, and other uses, enabling investments to be "de-scaled").

A diverse group of stakeholders has a vested interest in the traffic impacts of MXDs. The replacement of off-site car trips with on-site walking or cycling or (for larger mixed-use sites) on-site transit or driving, matters to developers who want smooth-flowing traffic conditions to help market their projects, to communities that want to hold existing residents harmless from traffic impacts, and to traffic engineers whose very profession is devoted to facilitating traffic flows but often harbor some skepticism about the traffic benefits of MXDs.

Accurately estimating the proportion of trips captured internally by MXDs is vitally important if communities are to accurately assess their traffic impacts and "reward" such projects through lower exactions and development fees or expedited project approvals. However, absent a reliable methodology for adjusting trip generation estimates, communities face a dilemma when assessing MXD proposals: do they err on the conservative side by downplaying internal capture and thereby potentially discourage worthwhile projects, or err on the liberal side and risk unmitigated traffic impacts? Often, the "do no harm" sentiment prevails, meaning when in doubt, go with conventional practices – which, with MXD proposals, typically means only a small downward adjustment in estimated trips, if any adjustment at all.

In addition to getting internal capture estimates right, accurate assessments of MXD projects also depend on estimating the share of external trips served by alternative modes (e.g., transit and walking). These too must be subtracted from nominal trip generation rates in order to estimate the net impacts of MXDs on traffic and VMT.

Community acceptance depends on whether a proposed MXD is perceived as a good neighbor. Exaggerated estimates of a project's traffic generation can heighten concerns about congestion, community image and character, and even public health and safety. A NIMBY backlash can add substantially to the time and expense of securing project approval, and can result in the project being scaled back to a level at which elected officials feel that the trip generation is more acceptable. However, the market demand for the development that is disallowed does not vanish and more often than not ends up in another location, often at a lower density and in a less mixed-use configuration. The end result can be more traffic and higher overall VMT than if the original MXD proposal had been approved.

Development fee programs rely heavily on traffic generation estimates. As the most comprehensive and widely used reference on the subject, the *Trip Generation Manual* of the Institute of Transportation Engineers (ITE) has become the principal data source for setting transportation development fee rates. Most cities, counties and regional agencies opt for uniformity rather than accuracy in this regard. In the interest of standardization of assumptions and approach, many jurisdictions rely on the numbers in the *Trip Generation Manual* to quantify traffic impacts and mitigation fee schedules. The unquestioning use of the ITE manual can unreasonably jeopardize a MXD project's approval, financial feasibility, and design quality.

The methodology of this study is based on earlier work; for details, see Ewing et al. (1991); Ewing et al. (2010); and Tian et al. (2015).

LITERATURE REVIEW

There has not been much research on internal capture of trips by MXDs. The standard way of estimating the proportion of trips that remain within the development (i.e., the internal capture rate), and hence place no strain on the external street network, is based on Chapter 7 of the ITE *Trip Generation Handbook* (2nd Edition, 2004). The procedure works as follows:

- The analyst determines the amounts of different land use types (residential, retail, and office) contained within the development.
- These amounts are multiplied by ITE's per-unit trip generation rates to obtain a preliminary estimate of the number of vehicle trips generated by the site. This preliminary estimate is what the site would be expected to generate if there were no interactions among the on-site uses.
- The generated trips are then reduced by a certain percentage to account for internal-capture of trips within MXDs. The reductions are based on look-up tables. The share of internal trips from the appropriate look-up table is multiplied by total numbers of trips generated by a given use to obtain an initial estimate of internal trips for each producing use and attracting use.
- For each pair of land uses, productions and attractions are reconciled such that the number of internal trips produced by one use just equals the number attracted by the other use. The lesser of the two estimates of internal trips constrains the number of internal trips generated by the other use.

The ITE methodology has major shortcomings:

- The two look-up tables are based on data for a "limited number of multi-use sites in Florida" (specifically three sites analyzed by the Florida Department of Transportation, Trip Generation Handbook, 2004, p. 130). The accuracy of forecasts is thus dependent on how closely the site being analyzed matches the sites used in the tables' creation. The fact that the data are drawn from the suburbs of Florida casts doubt on the applicability to other parts of the country. The handbook acknowledges this problem and instructs the analyst to find analogous sites locally and collect his own data to produce locally-valid look-up tables.
- The land use types and adjustments embodied in the look-up tables are limited to the three uses – residential, retail, and offices. The traffic impacts of other mixed uses cannot be assessed.
- The scale of development is disregarded. Clearly, a large site with many productions and attractions is more likely to produce "matches" than a small site, and the look-up tables for large sites should have higher cell percentages than the tables for small sites. Development scale was the most significant influence on internal capture rates in a study of South Florida MXDs, and more than half of all trips were found to be internalized by community-scale MXDs, far in excess of any rate obtainable with the handbook method (Ewing et al. 2001).
- The land use context of development projects is ignored. Common sense and the literature tell us that projects in remote locations are more likely to capture trips on-site than are those surrounded by competing trip attractions. For MXDs in South Florida, the second most important determinant of

internal capture rates was accessibility to the rest of the region (second after the scale of development). Conversely, projects in areas of high accessibility are more likely to generate walk trips to external destinations.

- The possibility of mode shifts for well-integrated, transit-served sites is not explicitly considered. This may not bias results for free-standing sites, but infill projects within an urban context may capture few trips internally but still have significant vehicle trip reductions relative to the ITE rates.

Due to these weaknesses, there have been recent efforts to improve on the ITE methodology. One effort, a bottom up approach, added to the paltry set of development projects that currently constitute the ITE database on MXDs, analyzed in detail this larger sample's trip making characteristics, and then derived a set of more complete adjustments to ITE trip rates. NCHRP Project 8-51, Enhancing Internal Trip Capture Estimation for Mixed Use Developments, added four sites to the three that currently form the basis for internal capture calculations in ITE's *Trip Generation Handbook*. The project has developed an estimation procedure that includes a proximity adjustment to account for project size and layout (Bochner et al. 2011).

A second approach, more top down in nature, assembled enough data on MXDs to estimate statistical models of traffic generation in terms of standard built environmental variables—the so-called "D" variables of density, diversity, design, destination accessibility, distance to transit, and development scale. Taking this approach, Ewing et al. (2001) modeled internal capture rates for 20 mixed-use communities in South Florida. For the 20 communities, internal capture rates ranged from 0 to 57 percent of all trip ends generated by the community.

To explain this variation, internal capture rates were modeled in terms of land use and accessibility measures. The variable that proved most strongly related to internal capture was neither land use mix nor density, but the size of the community itself. The two communities with the highest internal capture rates, Wellington and Weston, also are the largest – each having more than 30,000 residents and 5,000 jobs. Indeed, these two communities are large enough to have incorporated as their own small cities. The second most important variable was regional accessibility, which was inversely related to internal capture rates. Both of these communities are on the western edge of development in Southeast Florida, far from other population centers.

Due to size and inaccessibility, these communities capture a much higher percentage of trips internally than does, for example, the higher density and better-mixed Miami Lakes. However, Miami Lakes doubtless generates shorter auto trips and many more walk, bicycle, and transit trips than the other two. Its overall impact on the regional road network is almost certainly less.

The validity and reliability of Ewing et al.'s results were limited by the small sample, limited geography coverage, and small number of built environmental variables. A follow-up study improved on the earlier study by, in this order: (1) pooling travel and built environmental data for 239 MXDs in six diverse regions; (2) consistently defining travel outcomes and built environmental variables for these MXDs and regions; (3) estimating models of internal capture, external walk and transit choice, and external private vehicle trip length using hierarchical modeling methods; and (4) validating the results through comparison to traffic counts at an independent set of mixed use sites in various parts of the U.S. (Ewing et al. 2010). Standard protocols were used to identify and generate datasets for MXDs in six large and diverse metropolitan regions. Data from household travel surveys and GIS databases were pooled for these MXDs, and travel and built environmental variables were consistently defined across regions. Hierarchical modeling was used to estimate models for internal capture of trips within MXDs, walking and transit use on external trips, and trip length for external automobile trips. MXDs with diverse activities on-site were shown to capture a large share of trips internally, reducing their traffic impacts relative to conventional suburban developments. Smaller MXDs in walkable areas with good transit access were found to generate significant shares of walk and transit trips, thus also mitigating traffic impacts.

In a follow up to this study, Tian et al. (2015) more than doubled the number of regions in the database from six to 13, increased the number of MXDs from 239 to 412, and increased the number of trip records from 35,877 to 70,074. This study also updated household trip records for three regions whose earlier travel surveys dated from the 1990s—Boston (1991), Houston (1995) and Portland (1994). All data now dated from the 2000s or later. As in the earlier study, standard protocols were used to identify and generate data sets for MXDs. Data from household travel surveys and geographic information system (GIS) databases were pooled for these MXDs, and travel and built environmental variables were consistently defined across regions. Hierarchical modeling was used to estimate models for internal capture of trips within MXDs, and walking, biking and transit use on external trips. MXDs with diverse activities on-site were shown to capture a large share of trips internally, reducing their traffic impacts relative to conventional suburban developments. Smaller MXDs in walkable areas with good transit access were found to generate significant shares of walk, bike and transit trips, thus also mitigating traffic impacts.

SELECTION OF MXDS

Chapter 7 of the ITE Trip Generation Handbook covers something called a multi-use development. In the ITE text, the term multi-use development is said to exclude traditional downtowns, suburban activity centers, and developments covered by existing ITE land use classifications, specifically shopping centers, office parks with retail uses, office buildings with retail, and hotels with limited retail. Taken literally, this definition contains inconsistencies as compared to mixed-use definitions from other authoritative sources.

The Urban Land Institute (ULI) defines an MXD as having three or more significant revenue producing uses; significant functional and physical integration of the different uses; and conformance to a coherent plan. If we rephrase this as “two or more uses,” it becomes a generic definition of mixed use. Functional and physical integration are critical; this implies the availability of local interconnecting streets. Conformance to a plan may also be important. The plan may be a downtown redevelopment plan or a suburban activity center plan or a neighborhood plan. It does not have to be a development plan put forth by a single master developer. The pattern of land use and street connection is more important than the pattern of parcel ownership.

In general, our samples MXDs conform to the ITE Handbook definition of multi-use development. However, where the ITE definition is open to interpretation, we've opted to be consistent with the criteria used to select survey MXDs for the NCHRP 8-51 study, another ITE-guided study on mixed use trip generation. The ITE definition of multi-use development was modified to create a generic definition of MXD that would encompass many existing areas with interconnected, mixed land use patterns:

> “A mixed-use development or district consists of two or more land uses between which trips can be made using local streets, without having to use major streets. The uses may include residential, retail, office, and/or entertainment. There may be walk trips between the uses.”

To identify MXDs in six study regions at the dates of the most recent regional household travel surveys, Ewing et al. (2010) used a bottom-up, expert-based process in which planners for the different localities were queried about MXDs within their boundaries. Using this approach, a definition of an MXD was read to local planners over the phone, and they were asked to name, identify the boundaries, and list the uses contained within such areas. The same approach was used Guang et al. (2015) for 13 study regions.

For this study of Palm Beach County, initially we identified 51 MXDs and six single-use developments. For comparison's sake, only developments and districts with 30 or more trips in the 2009 Household Travel Survey were included in our sample. The sampling error would be too great for smaller developments with fewer than 30 trips. This left us with a sample of 15 MXDs and three single-use developments as a control group.

The focus of this study is on Abacoa. Abacoa is a 2,055-acre, master-planned, mixed-use community in Palm Beach County, Florida. It was built around the concepts and principles of traditional neighborhood development (Abacoa POA, 2016). It is an example of the new urbanism architectural movement in Florida. It was planned to be a place where people can live, work, play, and go to school. It aims to join today's modern lifestyle with the traditional, neighborly community from the past. The development is built with front porches, alley access garages, central community greens and community buildings to foster a sense of community among neighbors.

Construction began on Abacoa in 1997. There are now 17 different neighborhoods, each with its own style of architecture. There are business districts, with professional offices, restaurants, and retail stores. When fully built, Abacoa will be home to 6,073 residences and just over 3 million square feet of commercial space. The master plan, which resembles a patchwork quilt, melds homes, neighborhoods, schools, shops, offices, recreation sites, nature preserves into a cohesive richly textured whole. Each distinct aspect works to engage people more closely with their surroundings and each other.

As a mixed-use development, Abacoa is large in terms of acreage. As noted, it is over 2,000 acres, where the average acreage of MXDs in our 412 national sample is 192 acres. Even among the MXDs studied in Palm Beach County, only two are over 1,000 acres. This fact alone suggests that Abacoa will have a relatively high internal capture rate.

DATA SOURCES AND VARIABLES

The most widely used data source to study travel behavior is the household travel survey. Household travel survey data are the fundamental input for regional travel demand modeling and forecast. Many metropolitan planning organizations (MPOs) conduct their own travel surveys. In the last five years, we have been contacting MPOs and collecting household travel survey data. A main criterion for inclusion of regions in our studies has data availability. Specifically, regions had to offer regional household travel surveys with XY coordinates, so we could geocode the precise locations of trip ends. It is not easy to assemble databases that meet this criterion, as confidentiality concerns often prevent MPOs from sharing XY travel data. The regions included in our previous studies had, in addition, to supply GIS data layers for streets and transit stops, population and employment for traffic analysis zones, and travel times between zones by different modes for the same or close enough to the years that the household travel surveys were conducted. Fortunately, we have all the data for Palm Beach County. Here is the list of the data:

- 2009 household travel survey data
- Land use data at the parcel level
- Traffic analysis zone (TAZ) boundaries with socioeconomic information
- Street network shape file
- Transit stop shape file
- Travel time skims

Based on these data, seven types of D variables were measured and used to predict the travel characteristics of MXDs. Table 1 provides the definitions and descriptive statistics for all variables. For the travel outcomes, we are interested in whether a trip is internal or external to the MXD. An internal trip is a trip where both origin and destination fall within the development. An external trip is a trip where either the origin or destination is outside the development. If it is external, we would like to know it is a walk, bike or transit trip. A seventh D, demographics, is measured by household size and vehicles per capita in the household. The other six Ds – density, diversity, design, destination accessibility, distance to transit, and development scale – are as commonly measured in the literature.

Table 1. The Definition and Descriptive Statistics of Variables.

Outcome variables	Definition	Mean	S.D.
INTERNAL	Dummy variable indicating that a trip remains internal to the MXD (1 = internal, 0 = external).	0.33	0.47
EXTERNAL WALK	Dummy variable indicating that the travel mode on an external trip is walking (1 = walk, 0 = other).	0.01	0.14
EXTERNAL BIKE	Dummy variable indicating that the travel mode on an external trip is biking (1 = bike, 0 = other).	0.01	0.09
EXTERNAL TRANSIT	Dummy variable indicating that the travel mode on an external trip is public bus or rail (1 = transit, 0 = other).	0.00	0.00
Explanatory variables			
	Level 1 traveler/household level		
HHSIZE	Number of members of the household.	2.62	1.35
VEHCAP	Number of motorized vehicles per person in the household.	0.82	0.39
BUSSTOP	Dummy variable indicating that the household lives within 1/4 mile of a bus stop (1 = yes, 0 = no)	0.49	0.50
	Level 2 MXD explanatory variables		
AREA	Gross land area of the MXD in square miles.	1.14	1.11
POP	Resident population within the MXD; prorated sum of the population for the census block groups that intersect the MXD. Prorating was done by calculating density of population per residential acre (tax lots designated single-family or multifamily) for the entire census block group, then multiplying the density by the amount of residential acreage within the block group contributing to the MXD, and finally, summing over all block groups intersecting the MXD area. For Houston, data at the traffic analysis zone (TAZ) level were prorated.	5170.04	5472.93

EMP	Employment within the MXD; weighted sum of the employment within the MXD for all Standard Industrial Classification (SIC) industries. For Portland, employment estimates were based on the average number of employees in each size category, summed across employer size categories. For other regions, data at the TAZ level were prorated.	4249.13	3435.71
ACTIVITY	Resident population plus employment within the MXD.	9419.16	7545.39
ACTDEN	Activity density per square mile within the MXD. Sum of population and employment within the MXD, divided by gross land area.	10955.97	7790.96
DEVLAND	Proportion of developed land within the MXD.	.94	.07
JOBPOP[a]	Index that measures balance between employment and resident population within MXD. Index ranges from 0, where only jobs or residents are present in an MXD, not both, to 1 where the ratio of jobs to residents is optimal from the standpoint of trip generation. Values are intermediate when MXDs have both jobs and residents, but one predominates. [a]	.41	.29
LANDMIX[b]	Another diversity index that captures the variety of land uses within the MXD. This is an entropy calculation based on net acreage in land-use categories likely to exchange trips [b]. The entropy index varies in value from 0, where all developed land is in one of these categories, to 1, where developed land is evenly divided among these categories.	.69	.13
INTDEN	Number of intersections per square mile of gross land area within the MXD.	121.53	45.52
EMPMILE	Total employment outside the MXD within one mile of the boundary. Weighted average for all TAZs intersecting the MXD. Weighting was done by proportion of each TAZ within the MXD boundary relative to an entire TAZ area (i.e., “clipping” the block group with the MXD polygon).	16820.16	12193.06
EMP10A	Percentage of total regional employment accessible within 10-min travel time of the MXD using an automobile at midday.	10.45	4.72
EMP20A	Percentage of total regional employment accessible within 20-min travel time of the MXD using an automobile at midday.	38.61	10.63
EMP30A	Percentage of total regional employment accessible within 30-min travel time of the MXD using an automobile at midday.	68.87	16.60
STOPDEN	Number of transit stops within the MXD per square mile of land area. Uses 25 ft buffer to catch bus stops on periphery.	19.46	16.61

RAILSTOP	Rail station located within the MXD (1 = yes, 0 = no). Commuter, metro, and light rail systems are all considered.	.20	.41

[a]JOBPOP = 1 - [ABS(employment - 0.2 * population)/(employment + 0.2 * population)]; ABS is the absolute value of the expression in parentheses. The value 0.2, representing a balance of employment and population, was found through trial and error to maximize the explanatory power of the variable.

[b]The entropy calculation is LANDMIX = - [single-family share * LN(single-family share) + multifamily share * LN(multifamily share) + commercial share * LN(commercial share) + industrial share * LN(industrial share) + public share * LN(public share)] / LN(5), where LN is the natural logarithm.

DESCRIPTIVE ANALYSIS

Table 2 provides descriptive statistics for MXDs in our Palm Beach County sample and comparable single-use developments used as controls. The internal capture rates for the MXDs range from 0 percent to 73 percent. Abacoa has a 48 percent internal capture rate, which is the second highest in the sample. Among all the MXDs in Palm Beach County, the average internal capture rate is 30 percent, which is higher than the 19.7 percent in our national MXD dataset.

This is probably due to the size of the developments in Palm Beach County. The average development size of the 15 MXDs in Palm Beach County is 728 acres, whereas the average development size of our national MXDs is only 192 acres. Travel impedance being what it is, the larger the development, the more likely a traveler is to opt for a trip attraction within the development. Put another way, the frequency of trips drops off with distance. Travelers are likely to bypass trip attractions in a very small MXD for other trip attractions nearby. Not so for large MXDs which require long trips just to leave the MXD.

The average internal capture rate for MXDs in Palm Beach County is also higher than the average internal capture rate of three single-use developments, even though just slightly higher. But this may be explained by the fact that the average size of single-use developments is much larger than MXDs.

Among the MXDs in Palm Beach County, the average external non-auto mode share is only 3 percent, which is much lower than the 24.3 percent in our national MXD dataset. In the national dataset, there are as many external trips by non-auto modes as there are internal trips by all modes. Both types of trips take pressure off the external street network, and hence should be discounted in traffic impact studies. For the Palm Beach County dataset, the external trips are highly auto dependent for all MXDs. For external trips in Abacoa, only 5.2 percent are by walking, and none are by bike or transit. Although this external walk share is higher than other MXDs and non-MXDs in Palm Beach County, it is way below the average of national MXDs.

Another positive point about Abacoa from Table 2 is that the average vehicle-miles traveled (VMT) per trip is the fourth lowest in the 15 MXDs. It is also much lower than the average VMT per trip in the three single-use developments.

Table 2. Internal Capture and External Mode Choice of each MXD and non-MXD in Palm Beach County

	mxdname	Acre	total trips	internal trips	% internal	# of external trips by modes					% external non-auto	avg trip length	avg VMT
						Total	walk	bike	transit	auto			
3001	Abacoa	2,147	172	82	48	90	9	0	0	81	5	4.09	3.26
3003	Boca Del Mar	2,237	168	50	30	118	0	2	0	115	1	6.64	6.12
3010	Chasewood Plaza/Gateway PUD	85	32	8	25	24	2	0	0	22	6	3.06	3.04
3011	City Place	74	38	4	11	34	0	0	0	34	0	10.53	10.47
3014	Downtown Delray Beach	1,469	117	38	32	79	2	2	0	73	3	5.96	5.57
3015	Downtown Lake Worth	958	111	52	47	59	0	2	0	57	2	4.31	4.17
3016	Downtown West Palm Beach	330	70	24	34	46	2	0	0	44	3	6.5	6.36
3017	Downtown/Gardens Mall	487	86	8	9	78	0	0	0	78	0	5.24	5.24
3026	Meadows PUD & Meadows Square	343	52	16	31	36	2	2	0	32	8	3.73	3.46
3040	Southwest Neighborhood	971	122	54	44	68	6	0	0	60	5	3.49	3.09
3043	The Fountains of Boynton Beach	230	33	6	18	27	0	1	0	26	3	3.5	3.41
3046	Town of Palm Beach 1	135	30	22	73	8	0	0	0	8	0	1.3	1.08
3050	Villages of Oriole Plaza	263	54	14	26	40	1	0	0	39	2	3.56	3.53
3051	Wellington Green/The Mall at Wellington Green	614	45	8	18	37	0	0	0	33	0	7.63	7.49
3093	PGA National	2,328	108	36	33	72	3	0	0	69	3	5.95	5.88
3095	Boca Town Center/Gables	711	75	16	21	59	0	0	2	56	3	10.17	8.25
3096	Ballenisle Country Club	1,111	68	20	29	48	0	0	0	48	0	4.78	4.75

COMPARISON WITH LARGE MXDS

To better understand the travel outcomes in Abacoa and other MXDs in Palm Beach County, we limited our samples that are over 1,000 acres to compare apples to apples. There are eight out of our national 412 MXDs larger than over 1,000 acres. There are two other MXDs and two single-use developments in Palm Beach County that are over 1,000 acres. Tables 3 and 4 show the detailed comparisons of internal and external mode shares among these developments.

In Table 3, Abacoa has as high as 48 percent internal capture, which is the higher than other big MXDs and the two big single-use developments in Palm Beach County, and the eight MXDs in the national dataset. That means almost half of the trips generated by the developments in Abacoa stay inside Abacoa. However, for the mode shares of these internal trips in Abacoa, there are only 5 percent are walking trips. Relatively, 90 percent of these trips are made by auto. The walking mode share is way lower than the other two big MXDs in Palm Beach County and the eight MXDs in other regions. Surprisingly, that is even lower than two single-use developments.

Table 3. Comparison of internal capture in Abacoa and other MXDs over 1000 acres.

	acreage	trips	internal trips	internal capture (%)	internal mode share (%)			
					walk	bike	transit	auto
MXD in Palm Beach County								
Abacoa	2,147	172	82	48	5	5	0	90
Boca Del Mar	2,237	168	50	30	32	0	0	68
Downtown Delray Beach	1,469	117	38	32	26	0	0	68
Single-use in Palm Beach County								
PGA National	2,328	108	36	33	28	0	0	72
Ballenisle Country Club	1,111	68	20	29	40	0	0	60
Eight MXDs in other 13 regions								
Average	2393	683	233	34	28	2	1	67

With a high internal capture rate, Abacoa has the lowest external trip rate of the large MXDs. More surprisingly in term of mode share for external trips, Abacoa has a relatively high, 10 percent, walking mode share. It is higher than all other comparison groups. How would this happen? This might make sense after taking a look the land uses around Abacoa. There are two schools just across the northwest corner of Abacoa and there are quite a few retail uses across the northeast corner and the south of Abacoa. These are all destinations that may attract residents of Abacoa. And also, walking becomes an option of travel choice since they are so close to the development.

Table 4. Comparison of external mode shares in Abacoa and Other MXDs over 1000 acres

	acreage	trips	external trips	external capture (%)	external mode share (%)			
					walk	bike	transit	auto
MXD in Palm Beach County								
Abacoa	2,147	172	90	52	10	0	0	79
Boca Del Mar	2,237	168	118	70	0	2	0	97
Downtown Delray Beach	1,469	117	79	68	3	3	0	92
Single-use in Palm Beach County								
PGA National	2,328	108	72	67	4	0	0	96
Ballenisle Country Club	1,111	68	48	71	0	0	0	100
Eight MXDs in other 13 regions								
Average	2393	683	450	66	3	1	5	87

STATISTICAL ANALYSIS

Multilevel (two levels) logistic regression was estimated for all MXDs with 30 or more trips in Palm Beach County using the software package HLM 7. Multilevel modeling (MLM) is used because the data structure is nested. Trips are nested within MXDs. Trips that are associated with the same MXD share the built environment of that MXD. In the multilevel structure, Level 1 is trips and level 2 is MXDs. There are 15 MXDs with 1170 trips. Due to sample size, we only estimated an internal capture model and did not distinguish trip purpose as we did in the early paper (Tian et al., 2015). We also tried to estimate an external walking model, but did not get a reasonable model. There are too few external biking and transit trips to model. Table 5 shows the result of the internal capture model.

Table 5. Log Odds of Internal Capture (log-log form)

	Coefficient	*S.D.*	*t*-ratio	*p*-value
Constant	-3.277	1.131	-2.896	0.015
vehcap	-0.587	0.327	-1.792	0.073
busstop	0.480	0.293	1.640	0.101
jobpop	1.326	0.999	1.328	0.221
landmix	2.712	2.770	0.979	0.349
railstop	0.237	0.401	0.592	0.565
pseudo-R^2			0.43	

The dependent variable here is the natural log of the odds of an individual making a trip having both ends within an MXD. The model has been estimated with logarithmic (natural log) values of the independent variables. Coefficient values are elasticities of odds with respect to the independent variables. Due to the small sample size, we did not get a robust model to explain internal capture. But still, there is one demographic variable that is statistically significant at the 0.10 level. The internal capture rate is negatively associated with vehicles per capita. Also a few built environment variables have the expected signs. Only having a bus stop within a quarter mile of household comes close to statistically increasing internal capture. Having a job-balance and balanced land use mix, in this small sample analysis, do not lead to statistically higher internal capture rates. We plan to add Palm Beach County to our 13 region dataset and will doubtless find these variables are statistically significant with the larger dataset.

CONCLUSION

The internal capture rate is the percentage of all trips generated by land uses within the development that remain within the development, and hence place no demand on the external street network. The internal capture rate is a primary transportation performance measure used to judge the success of MXDs. In this study, we calculate the internal trip capture rate for Abacoa and compare it to that of other MXDs and single-use communities in Palm Beach County. We also compute mode shares for internal trips (both ends within the development) and external trips (one end outside the development). And then, we compare these measures for Abacoa to other MXDs and single-use communities in Palm Beach County and MXDs in our nationwide dataset.

The results show that the MXDs in Palm Beach County, including Abacoa, are larger than the MXDs in our nationwide dataset, in term of acreage. The internal capture of these MXDs is higher than the MXDs in our nationwide dataset. Partly that would be due to the larger development scale of MXDs in Palm Beach County. Abacoa has the highest internal capture rate among all the MXDs of the similar development scale. About half of the trips generated by the land uses within Abacoa remain within Abacoa. The high internal capture in Abacoa is also reflected by the low VMT per trip. Abacoa does not put as much traffic pressure on the external streets as do other developments. The different land uses in Abacoa are well balanced. However, the non-auto mode share of internal trips in Abacoa is the lowest among all the MXDs in the comparison groups. This may indicate that the urban design of Abacoa does not support walking, biking or even transit very well.

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