All Roads Lead to Oklahoma City: The Effects of Highway Bypasses in Oklahoma Towns

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Small towns face threats to their existence on many fronts. The growing urban areas of America continue to attract migrants, especially younger generations who see more opportunities and excitement in the cities. Educational, recreational, and shopping amenities are perceived to be better in affluent suburbs, service and manufacturing jobs remain tied to larger agglomerations, and transportation linkages seek to move people and goods quickly along highway routes between urban nodes. In this framework, small towns are often impediments to efficient movement, because they require lower speed limits and often have intersections with stop lights or other traffic control devices. To avoid these interruptions to traffic flow, small towns are often targeted for highway bypasses that veer around the town. The resulting reduction of high speed through-traffic certainly has environmental and safety benefits, but these towns are often dependent on traffic-related business establishments for jobs and taxes. This study examines the effects of highway route changes on the relationship between economic activities and population in Oklahoma to evaluate the extent to which these routes alter small town economies. Key Words: highway bypasses, retail business, rural Oklahoma.

Like many other aspects of American society, transportation issues are often perceived differently in urban and rural areas. In large cities, there never seem to be enough freeways to alleviate congestion during peak hours, and new expressways or additional lanes are eagerly anticipated by everyone, or at least everyone who does not live in the path of that route. Away from the cities, however, the benefits of transportation changes are not as clear-cut. Many small towns depend on a single major highway as their connection to the outside world and to attract outside income. Though the construction of a new bypass route does not sever the physical connection, it routes the bulk of passing traffic around the town (Handy et al. 2002) and away from its business sector. This business sector, with its gas stations, restaurants, and other small retail establishments, depends on both local and non-local customers for revenues, local wages, and taxes (Davies 1998, 168). Sustaining damage to this portion of the economy can be devastating to small towns that lack a significant industrial or service sector to pick up the slack.

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The goal of this paper is to determine the strength of the relationship that exists between population and business levels across Oklahoma. Two key characteristics partition urban places in this study: presence or absence of a bypass and relative position in the urban hierarchy of the state. Within this hierarchical framework of target and control towns, this paper analyzes the effects of highway bypasses and population on business activities at the three-digit North American Industry Classification System (NAICS) level of detail for the 115 populated places included in the study. The results point to notable business differences between bypassed and non-bypassed towns that can be incorporated into future bypass planning stages, a critical step that can mitigate the real and perceived negative impacts of bypasses (Handy et al. 2001b).

To determine the extent to which small towns depend on highways, this paper uses a previously-developed data management and analysis framework and completes the reporting of an on-going research project whose goal has been to analyze the effects of highway bypasses in rural Oklahoma. This project was initially motivated by efforts of the Oklahoma Department of Transportation (ODOT) to obtain a spatial decision support system (SDSS) for planning highway construction in southeastern Oklahoma (Comer et al. 2000). Support from the Oklahoma Transportation Center (OTC) permitted the expansion of the project to cover the entire state. All aspects of the project are available at http://www.ocgi.okstate.edu/otc2003/.

A theoretical basis of this study is the belief that an inherent ordering of places exists, with larger places having larger market areas, providing more goods and services, and existing at longer distances apart than smaller places. This theoretical model, known as Central Place Theory, has strongly influenced Geography over the past five decades and has clear implications for market centers and retail functions (Berry and Parr 1988). A bypass directly influences several key characteristics of central places. Bypasses are designed to shorten travel times, which should expand market areas given consumers' limited travel budgets. Since bypasses are designed more to aid through traffic than local traffic, however, they may expand the market areas and economic activities of larger, nearby communities more than the bypassed town. This may be exacerbated when a large metropolitan area is nearby, providing area shoppers with better access to a wider range of choices for basic goods and services as well as offering items not available in smaller cities and towns (Handy et al. 2000). In all these ways, then, a bypass can have a significant effect on the economy of the bypassed town as well as neighboring places.

This paper documents business changes that may have resulted from a bypass and, by extension, assesses the effect of a bypass on a town's importance in the central place hierarchy of Oklahoma. This hierarchy is explicitly addressed through the partitioning and analysis of places by size category, permitting the identification of differential bypass effects. Given this theoretical geographic framework, the next step is the selection of an appropriate methodology from the wide field of Transportation Geography, and specifically of bypass studies.

Transportation Geography and Bypass Studies

Transportation Geography is as diverse and fragmented as Geography itself, and the literature evinces a tendency towards two types of analyses, macro- and micro-scale. A scan of two leading books in the field (Taaffe et al. 1996; Black 2003) reinforces the “big picture” focus, with major topics including: evolution of the U.S. transportation system, network analysis, gravity and spatial interaction models, air transportation, urban transportation modes, policy and planning issues, and commodity flow analyses. An internet search on the phrase “bypass studies” produces an array of town- and county-level studies across the U.S. and elsewhere, most of which are research and consulting reports interspersed with the occasional journal article. The diversity of study scales extends to the application of specific methodologies concerning bypass research as well. The literature reviewed below is largely confined to bypass studies in non-metropolitan areas as background to the research presented in this paper.

Two older studies focused on the economic development of rural areas in North Carolina resulting from the completion of Interstate 40. One study (Clay et al. 1992) evaluated the overall impacts of the highway corridor, and proposed strategies that would allow all areas of the corridor to benefit, rather than just the metropolitan terminuses of Raleigh and Wilmington. This approach inherently viewed the highway corridor as an economic boon, but one that would be unevenly spread without proper policies and planning. The other study (Hartgen et al. 1992) evaluated the growth potential at the 22 interchanges along that route and used regression to determine what types of economic activities were most likely to succeed at each interchange.

These papers offer mixed guidance for the study at hand. On the one hand, they targeted rural areas and employed regression analysis, a widely used and understood statistical method. On the other hand, both evaluated the economic benefits that would accrue from the opening of a new interstate highway link, and did so with county-level data due to the broad availability of many variables at that scale. A comparable study in Kentucky (Thompson et al. 2001) likewise evaluated bypass impacts at the county level, finding that retail sales were reduced and the business mix had changed due to a bypass. Given that most recent bypasses in rural Oklahoma have been two lane state highways, and that county-level data would completely disguise the effects in specific towns, finer geographic precision is desired.

When working at smaller geographic levels, other factors must be considered. Perera (1990) classified the economic effects of highway construction into permanent impacts, which are of concern here, and temporary impacts caused by construction-related activities. Buffington et al. (1992) identified many areas of permanent impacts, including the effects on businesses, property values, relocation and employment, and tax revenues. Even within the realm of permanent impacts, a major distinction exists between businesses that depend on pass-by traffic, businesses that are destinations for shoppers but which still feel the effects of traffic level changes, and businesses that serve the everyday needs of local residents (EDRG 2004). Yet another perspective trifurcates the study of bypass impacts into those that improve the quality of life, those that affect existing businesses in the town center, and those that create overall changes in the entire community, including both retail and industrial activities (Handy et al. 2000).

A recent flurry of activity has focused on bypass impacts in mostly rural areas, including Iowa (Otto and Anderson 1995), Kansas (Burress 1996), and Wisconsin (Yeh et al. 1998), to name a few prominent examples. Two other projects studied Texas, providing evidence from a geographically and culturally similar context to Oklahoma. Furthermore, these efforts addressed many of the same issues and employed similar methods as this paper, adding to the growing body of evidence concerning highway relief routes, as bypasses are often called in the literature.

Both Texas projects were conducted for the Center for Transportation Research at the University of Texas. The first study (Andersen et al. 1993) was performed in the early 1990s and consisted of a focused micro-scale study of bypassed Texas towns that were paired with similar, non-bypassed towns as a control group. Numerous econometric (regression) models were developed to relate retail and service receipts to socioeconomic data in the area, with a goal of determining the most important influences on economic activities in the towns and detecting the effects of bypasses. This particular study has been cited as a rarity in that pre-bypass growth rates were accounted for when attributing economic changes to bypass construction (Thompson et al. 2001), something most studies have neglected. In general, Andersen et al. (1993) found that population was the most important determinant of economic activity. While not surprising, this finding leads directly to the primary assumption of this paper that bypasses around small towns can speed up the rate of population and business decay (Baltensperger 1991).

The more recent and more comprehensive Texas study included an identification of issues (Handy et al. 2000), an econometric analysis of 23 bypassed towns and 19 control cities to estimate the impact of a bypass on retail sales and establishments (Kockelman et al. 2001; Srinivasan and Kockelman 2002), a case study analysis of 10 of the bypassed and 4 of the non-bypassed towns (Handy et al. 2001a; Handy et al. 2002), and an assessment of planning techniques for future bypasses (Handy et al. 2001b). In aggregate, this project determined that impacts were mostly negative for small cities, while results were mixed in medium cities, a similar finding to that in Oklahoma's small towns (Comer and Finchum 2001, 2003, 2004). In terms of retail sectors, negative impacts were most severe on per capita sales in gasoline stations. In particular, the more traffic that was diverted to the relief route the worse the impact, whereas the greater the overall traffic per capita in a town the less the impact. Furthermore, proximity to a larger city exacerbated the negative impacts (Srinivasan and Kockelman 2002).

The Texas studies are most applicable to the research reported in this paper due not only to physical proximity and cultural similarity, but also because the latter study took place around the same time as the initial work in Oklahoma performed both by the authors (Comer et al. 2000; Comer and Finchum 2001, 2003) as well as others at the University of Oklahoma who conducted parallel research from an economics perspective (Rogers and Marshment 2000). Thus, there is a temporal continuity between the Oklahoma and Texas studies. Furthermore, Rogers and Marshment found similar results as did the authors through different methods: bypasses in the smallest Oklahoma towns have had no significant impact on business levels. Instead, competition from national chains, retirement of older store owners who lack the desire or resources to relocate to the new route, and larger national growth in the suburbs at the expense of rural areas and inner cities seem to be the real culprits (Rogers and Marshment 2000).

The most consistent finding that emerges from the bypass literature field is the inconsistency in research methods or results. This observation has appeared as a strong critique of the field (Thompson et al. 2001), as merely an aggregate finding (NCHRP 1996), and even as an implicitly acceptable reality (Handy et al. 2000) given the diverse types of impacts a highway can cause, the multitude of variables and data sources available for study, and the time and cost constraints faced by most researchers. Perhaps not surprisingly, the findings and results of bypass studies have been as varied as the methods, ranging from largely positive (Buffington and Burke 1991), neutral (Otto and Anderson 1995; Rogers and Marshment 2000), to strongly negative (Andersen et al. 1993; Srinivasan and Kockelman 2002). In short, the broad group of studies has little in common, often rests on weak evidence, and provides little guidance on whether bypass impact mitigation measures work (NCHRP 1996).

Given this lack of agreement on methods or expected results, each project must adopt appropriate methods within existing constraints and attempt to add to the growing body of evidence on the impacts and effects of highway bypasses. Possibly no consensus on methods or results will emerge as the uniqueness of each study area means different places will have different outcomes. Confounding even this view, however, Thompson et al. (2001) noted that three different studies of generally similar places in Texas had markedly different findings (Buffington and Burke 1991; Andersen et al. 1993; Srinivasan and Kockelman 2002). With a dearth of detailed studies focusing on Oklahoma and with little agreement on how to conduct such a study, this paper provides another viewpoint on this topic with its focus on the effects of highway bypasses on small towns in Oklahoma. County-level data are at too gross a geographic scale for detailed analysis; this study works at the town and block group-level of detail. Temporary effects are important but short lived and often involve a great deal of income leakage out of the region; this study concentrates on permanent, long-term, and local effects. Retail and personal service businesses drive the economies of small towns; this study restricts itself to a range of three-digit NAICS retail and service sectors that are usually present in small towns.

Project Development

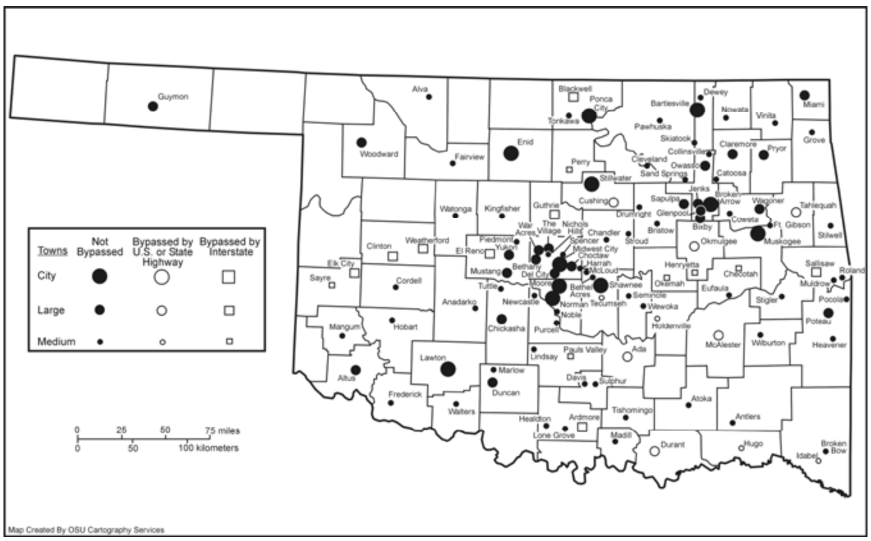
Town Size Classification and Study Area

A crucial framework in this study and a key factor in evaluating bypass effects is town size. It is commonly believed that smaller towns are more vulnerable to route changes, especially bypasses, whereas cities have more diversified business activities and also are less spatially focused on a single route through town. Such logic appeared in a seminal overview of highway improvement studies (Horwood et al. 1965) and permeates most subsequent literature. To account for this important variable, this study uses a pre-existing stratification scheme based on the urban hierarchy of the Oklahoma's populated places (Comer and Finchum 2004).

The largest stratum is termed City and includes 11 towns between 25,000 and 95,000 persons. Any larger cities, including Tulsa and Oklahoma City, are excluded due to the focus on smaller places in the state. The next stratum, Large Towns, encompasses 37 places with populations between 7,500 and 25,000 persons. The 67 Medium Towns have between 2,500 and 7,500 persons, and Small Towns, which were used in earlier research but not this paper, round out the framework with fewer than 2,500 persons. Figure 1 depicts all towns included in this paper, stratified by size, bypass status, and bypass type. The bypassed places are categorized based on information provided by ODOT and include state highways and interstates.

Because our earlier ODOT project specifically targeted eight Small Towns, on-site data collection was necessary due to non-reporting of Census data for places smaller than 2,500 persons. Fortunately, the small number of towns studied and their spatial concentration along U.S. 70 permitted field work. In order to develop a consistent, state-wide research methodology, this paper favors Census Bureau data on socioeconomic and business characteristics at the sub-county level, specifically block group-level population data and town-specific business data. This approach ousts Small Towns from the present study, but earlier research had already demonstrated the on-going demise of business activities in Small Towns in Oklahoma, bypassed or not (Rogers and Marshment 2000; Comer and Finchum 2001). Furthermore, analysis of changes in socioeconomic variables between 1990 and 2000 revealed structural issues in Small Towns in the state, including higher home vacancy rates, older populations, and lower per capita incomes (Comer and Finchum 2003). The effects of bypasses are thus rather clear in Small Towns but less obvious elsewhere. Therefore, the research interest shifts to the 115 larger places shown in Figure 1. These places represent the population of places in Oklahoma defined by the Census Bureau as "urban" (2,500 persons or more) up to a ceiling of about 100,000 persons.

Figure 1. Locations, sizes, and bypass status of study towns in Oklahoma



Cross-Sectional Business Data

Both cross-sectional and time series approaches are common in the literature, as is the use of a wide array of other variables (see Handy et al. 2000, Appendix, for examples). With this paper's goal of standardizing the input data and moving away from a case study approach, the primary business variables that are available derive from the Economic Censuses and include: number of establishments, revenues, payroll, and number of employees (U.S. Census Bureau 2001). However, revenues, payroll, and employee data are often non-disclosed in Oklahoma due to small numbers of establishments, so the number of establishments itself is selected as the primary business indicator of interest due to its universal reporting. Retail sales (Rogers and Marshment 2000) and sales tax collections (Comer and Finchum 2001) have been used in prior Oklahoma studies and have revealed no significant bypass-induced economic changes and have demonstrated limited utility in these earlier studies.

Numerous factors work against conducting a time series analysis in this paper. Attempts to reconcile information across the Standard Industrial Classification (SIC) system and NAICS conversion (1992-1997) prove less than satisfactory, preventing the development of a consistent business data set before and after the SIC-NAICS conversion. The recent Texas study stands as perhaps the most comprehensive and long-term bypass impact study conducted to date, but it used SIC-classified data from 1954 to 1992 (Srinivasan and Kockelman 2002), thus avoiding the SIC-NAICS conversion altogether. Additional impediments for the Oklahoma study include the short time period during which ODOT commissioned the initial project (1999-2000) and the dearth of state bypasses built during the 1980s and 1990s.

NAICS sectors

The NAICS sectors selected for this study are listed in Table 1, represent services and businesses that demonstrate sensitivity to highway routes and construction, and are drawn from the two-digit sectors of Wholesale Trade (42), Retail Trade (44 and 45), Real Estate (53), Accommodation and Food Services (72), and Other Services (81). Another paper (Comer and Finchum 2004) documented results at the two-digit level of aggregation; this study focuses on more detailed three-digit sectors. Three-digit sectors narrow the scope to economic activities that dominate the business districts of non-metropolitan areas and usually can be correlated to specific store types and retail chains, although this level of aggregation still leaves open the possibility of mixed-use store types. However, five- and six-digit sectors become very detailed and hence create even more data problems as most towns would have only a few such establishments. Such a narrow range of values for the numbers of establishments would greatly limit any statistical analysis. Numerous other studies have either been limited to two-digit SIC codes or only a handful of specific business types (Srinivasan and Kockelman 2002); the breadth and depth of sectors reflected in Table 1 is greater than is typical in the literature.

Methodology

The research methodology used to analyze the NAICS business data is regression analysis, a statistical technique that constructs a "best fit" trend line between two or more variables. The coefficient of determination r^2 measures the strength of the trend between the independent and dependent variables. Analyzing the r^2 value alone, however, is not sufficient. The major assumptions of homoscedasticity, linearity, independence, and normality must be evaluated and they are met by the NAICS sectors in Table 1; a few other sectors behave badly and are dropped from the analysis. To test the reliability of the regression analysis and to account for the greater reliability of relationships estimated from larger sample sizes, the significance of regression statistics are measured by the F distribution. The significance of the F value measures the likelihood that the observed trend could have occurred by chance. Higher values of F indicate less likelihood of chance playing a role and are identifiable by p-values close to zero.

Table 1. NAICS codes selected for analysis

NAICS code	Sector name
421	Wholesale trade, durable goods
422	Wholesale trade, nondurable goods
441	Motor vehicle and parts dealers
442	Furniture and home furnishings stores
443	Electronics and appliance stores
444	Building material and garden equipment and supplies dealers
445	Food and beverage stores
446	Health and personal care stores
447	Gasoline stations
448	Clothing and clothing accessories stores
451	Sporting goods, hobby, book, and music stores
452	General merchandise stores
453	Miscellaneous store retailers
454	Nonstore retailers
531	Real estate
532	Rental and leasing services
721	Accommodation
722	Food services and drinking places
811	Repair and maintenance
812	Personal and laundry services

In this project, the number of establishments in each town and NAICS sector is used as the dependent variable. After experimentation with the socioeconomic variables that are available from the Census Bureau, the total population of a town proves to be the best explanatory indicator of business activity. This result was also obtained by Andersen et al. (1993), and population is therefore chosen as the independent variable in the regression analysis. One final data issue relating to data consistency between sources requires attention. Economic Censuses are conducted on a quinquennial cycle in years ending in 2 and 7 as opposed to the decennial Census of Population. Therefore, Census Bureau population estimates for each urban place are obtained to benchmark the regression of population and numbers of establishments to the same year, 1997. Business data for 2002 for Oklahoma by place are still pending release as of July, 2005. As a result of these various data and time limitations, this study models the relationship between town size via population and business activity via the number of establishments for various NAICS sectors, for both bypassed and non-bypassed towns in each size category, for the year 1997. A comparison of the results between population and bypass strata points to the effects of bypasses, and separate analyses for each town size stratum distinguishes the differential effects of bypasses at the three levels of the urban hierarchy used in this study.

Relationships between Town Size, Bypass Status, and Business Activities

Analysis for all town sizes and all NAICS

First, an overall analysis of the relationship between population and the number of establishments is useful for determining the broad range of regression relationships. Regressions are conducted for each NAICS sector irrespective of town size or bypass status and are presented in Table 2, sorted from highest r^2 to lowest. With the numbers of observations (n) ranging from a low of 61 to a high of 108, every regression is significant with a p-value of 0.000. This indicates high confidence in the strength of these relationships as measured by r^2, that there is less than one chance per thousand that the results occurred due to chance, and that the r^2 values can be directly compared to evaluate the strength of the linear trend.

Table 2. Overall regression analysis

NAICS	r^2	p-value	n	NAICS	r^2	p-value	n
31	0.874	0.000	99	441	0.682	0.000	105
22	0.870	0.000	108	443	0.648	0.000	61
11	0.851	0.000	75	422	0.642	0.000	66
32	0.802	0.000	97	452	0.565	0.000	103
446	0.758	0.000	106	444	0.551	0.000	103
812	0.751	0.000	83	442	0.479	0.000	84
453	0.715	0.000	106	448	0.477	0.000	94
447	0.711	0.000	108	451	0.401	0.000	63
445	0.710	0.000	108	721	0.380	0.000	85
421	0.686	0.000	77	454	0.355	0.000	77

There is no clear division of the NAICS sectors into good and poor-performing categories, as r^2 values gradually decline. The largest r^2 differences between two adjacent sectors are 0.077 (NAICS 422 and 452), 0.072 (444 and 442), and 0.068 (513 and 451). These three gaps appear in the bottom third of the table. All other differences are less than 0.05, or 5% of the explainable variation in the number of establishments. The retail categories, NAICS sectors 44/45, tend to populate the lower (right) half of Table 2 with only four sectors appearing in the upper (left) half, indicating a lesser influence of town size on businesses and a greater influence of some other factor like traffic levels. However, past experience with traffic count data in the state has demonstrated serious deficiencies and the data could not be used effectively (Comer et al. 2000).

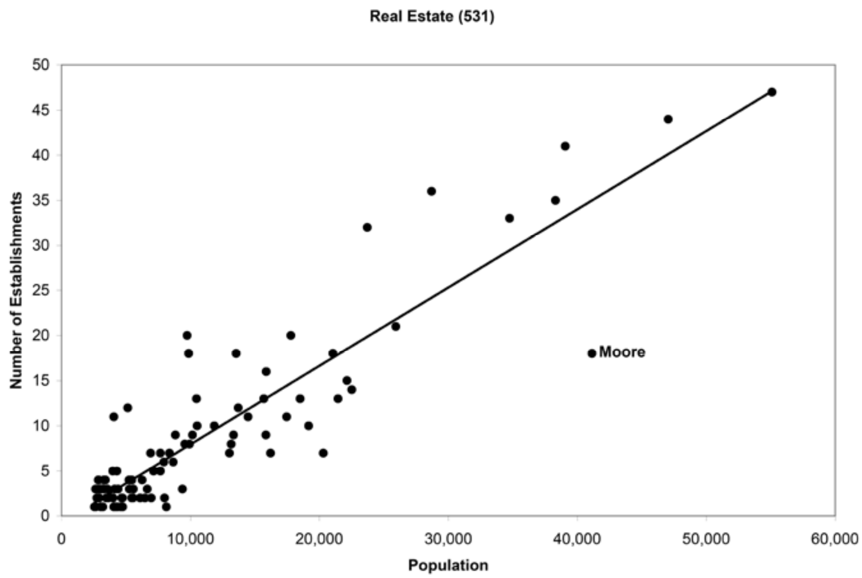


Figure 2. Relationship between population and real estate establishments, all places (n=99)

The real estate sector (531) tops the list of predictability based on population, which is easily understood and readily apparent in Figure 2. More people mean more homes, assuming a relatively stable ratio of people per household across the state, and therefore more businesses specializing in that sector, except in the Oklahoma City suburb of Moore. Restaurants and bars (722), repair shops (811), and rental and leasing services (532) also rank near the top and population explains over 80% of the variation in numbers of establishments. The retail sectors that do make the top half of the list represent the "bread and butter" of small towns: health and personal care, which includes pharmacies and drug stores, cosmetics and beauty supplies (446), miscellaneous retailers, which includes florists, office supplies, gift, novelty, souvenir, and consignment and resale shops (453), gasoline stations (447), and grocery, convenience, and other specialty food stores (445). The retail sectors that have lower r^2 values tend to be more specialized types of retailers not uniformly present in smaller towns, such as sporting goods stores (451), clothing (448), furniture (442), and building and garden retailers (444).

Of greater interest are the sectors that are poorly predicted by population. The worst relationship is for the non-store retailers sector (454), which includes infomercial broadcasting, direct mail advertising, catalogs, and other retail forms that are independent of fixed locations. It makes sense that these are not strictly related to town size, and operations of this nature can be profitably set up just about anywhere. Likewise, this type of business is not traffic or route dependent, making use of broadcasting, telephone, or parcel services.

In contrast to its two-digit (72) companion of bars and restaurants, the accommodations sector (primarily hotels and motels, sector 721) performs second-worst. Hotels require moderate population thresholds or busy interstate interchanges to stay in business, and many of the towns studied here are too small to support hotels to the extent that Oklahoma City, Tulsa, and Cities can. Only two of the Large Towns have more than ten accommodations businesses, and no Medium Town has more than seven of these establishments. Even in Cities, the numbers of establishments vary wildly, from a low of two in Moore to a high of 37 in Norman, with a great deal of variation between those bounds. Thus, other factors, such as Norman being the home of the University of Oklahoma, are better predictors of the number of establishments. Accommodations, of all sectors, likely depends the most on non-local, traffic-based patronage.

Of greater interest in this study is the varying strength of the regression analyses for three-digit NAICS sectors between town sizes, as well as between bypassed and non-bypassed towns within the same size stratum. These comparisons directly address two main influences on business activities in rural areas, population and routes changes. The comparison of bypassed and non-bypassed results within each size category assumes that other characteristics of the places are similar and the primary causative agent is the presence of a bypass.

Analysis of Cities

Adding to the overall regression results presented in Table 2, the right half of Table 3 shows the regression results for the Cities in the study, none of which have a bypass as defined by ODOT. The sectors in Table 3 are ranked from highest r^2 to lowest for the City stratum. The clearest trend is that in all but one sector (451), the strength of the trend (r^2) is weaker in the Cities than in the overall analysis of all places, usually by ten percent or more. In the most extreme cases, electronics and appliance stores (443), general merchandise stores (452), and health and personal care stores (446) lose thirty to forty percent of their explanatory power when moving from the entire state to the City stratum. The City stratum is clearly very heterogeneous, ranging from 25,000 to 95,000 persons, and includes major suburbs like Moore and Broken Arrow as well as free-standing cities like Lawton and Stillwater. As a result, the free-standing places must provide a broader range and selection of activities (Baltensperger 1991), while suburbs may be dominated by the urban core of Tulsa or Oklahoma City or other nearby suburbs.

Table 3. Regression results, Overall and City stratum

	Overall (n=115)			**City (n=11)**			**Difference in**	
NAICS	r^2	p-value	rank	r^2	p-value	rank	r^2	rank
811	0.851	0.000	3	0.839	0.000	1	-0.012	2
532	0.802	0.000	4	0.708	0.001	2	-0.094	2
722	0.870	0.000	2	0.686	0.002	3	-0.184	-1
531	0.874	0.000	1	0.680	0.002	4	-0.194	-3
445	0.710	0.000	9	0.644	0.003	5	-0.066	4
453	0.715	0.000	7	0.571	0.007	6	-0.144	1
451	0.401	0.000	18	0.571	0.007	7	0.170	11
812	0.751	0.000	6	0.512	0.013	8	-0.239	-2
447	0.711	0.000	8	0.498	0.015	9	-0.213	-1
441	0.682	0.000	11	0.467	0.020	10	-0.215	1
446	0.758	0.000	5	0.429	0.029	11	-0.329	-6
422	0.642	0.000	13	0.416	0.032	12	-0.226	1
421	0.686	0.000	10	0.405	0.035	13	-0.281	-3
442	0.479	0.000	16	0.352	0.054	14	-0.127	2
444	0.551	0.000	15	0.325	0.067	15	-0.226	0
454	0.355	0.000	20	0.300	0.081	16	-0.055	4
448	0.477	0.000	17	0.285	0.091	17	-0.192	0
452	0.565	0.000	14	0.247	0.120	18	-0.318	-4
443	0.648	0.000	12	0.241	0.125	19	-0.407	-7
721	0.380	0.000	19	0.197	0.171	20	-0.183	-1

As an example of the variability of the City stratum, Sector 452 is highlighted. This sector mostly consists of department or club/warehouse stores like Sam's Club and typifies the variation among the Cities as Figure 3 reveals a weak adherence to the statistical trend line. All of the Cities below the regression line are suburbs of Tulsa or Oklahoma City except Stillwater; two major suburbs, Midwest City and Shawnee, appear above the line; and Lawton is arguably the most remote City in the state. Thus, Cities are a diverse and inconsistent group. However, given the overall focus of this study on smaller places, this result is of moderate interest.

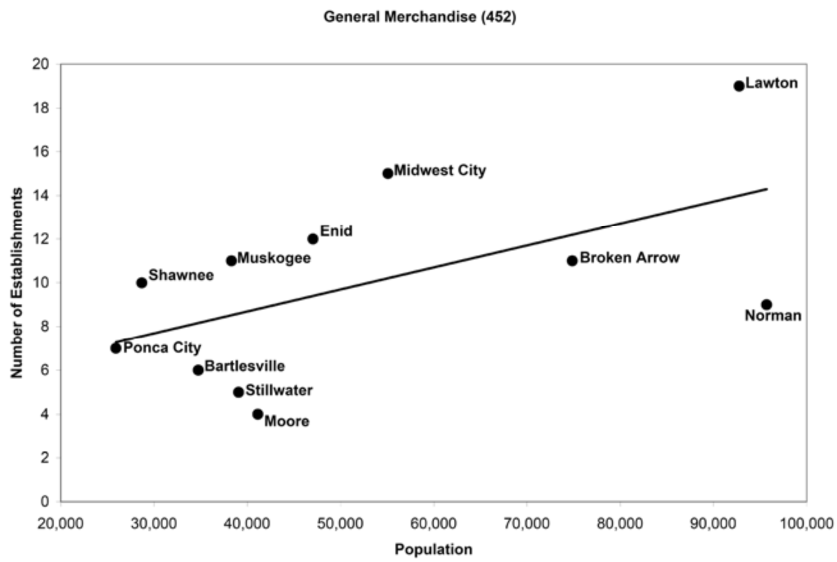


Figure 3. Relationship between population and general merchandise stores, Cities (n=11)

Despite the general decline of r^2 values for Cities as compared to the entire sample, the relative ordering of sectors is fairly consistent, even given the constraint of there only being eleven observations in the City stratum. Repair and maintenance shops (811), rental and leasing services (532), foodservices and drinking places (722), and real estate comprise the four best modeled sectors in both halves of Table 3. Alternatively, accommodations (721), clothing and accessories (448), non-store retailers (454), and building and garden stores (444) always rank in the bottom quartile. Accommodations and non-store retailers have already been evaluated in terms of their poor predictability, while clothing stores historically and Lowe's-type stores lately are strongly spatially associated with established retail shopping agglomerations. The explanation seems to hold that some Cities, especially certain suburbs, are retail hubs while others are underserved due to their proximity to other suburbs or central cities.

Analysis of Large Towns

Table 4 shows the regression results for Large Towns, sorted by the difference between the bypassed and non-bypassed r^2 values. Of interest, only two sectors (447 and 811) have a lower r^2 in bypassed towns than in non-bypassed towns. Also, while twelve of the sectors have r^2 values over 0.5 in the bypassed towns, just two non-bypassed r^2 values are above 0.5 and many linger near 0.0 and are insignificant. The broad conclusion to draw from Table 4 is

Table 4. Regression results, Large Town stratum

Status	**Not bypassed (n=23)**			**Bypassed (n=14)**			**Difference in**	
NAICS	r^2	p-value	rank	r^2	p-value	rank	r^2	rank
448	0.000	0.937	20	0.618	0.001	4	0.618	16
444	0.143	0.075	11	0.753	0.000	1	0.610	10
422	0.001	0.917	17	0.533	0.003	9	0.532	8
441	0.228	0.021	8	0.743	0.000	2	0.515	6
454	0.001	0.927	18	0.450	0.017	15	0.499	3
443	0.012	0.662	15	0.482	0.012	14	0.470	1
812	0.045	0.370	13	0.498	0.005	13	0.453	0
421	0.088	0.191	12	0.501	0.010	12	0.413	0
452	0.186	0.051	9	0.559	0.002	7	0.373	2
451	0.008	0.703	16	0.360	0.030	17	0.352	-1
531	0.295	0.007	7	0.576	0.002	6	0.281	1
442	0.001	0.907	19	0.281	0.051	18	0.280	1
532	0.145	0.073	10	0.418	0.012	16	0.273	-6
453	0.299	0.007	6	0.557	0.002	8	0.258	-2
446	0.413	0.001	4	0.612	0.001	5	0.199	-1
722	0.510	0.000	2	0.681	0.000	3	0.171	-1
721	0.023	0.524	14	0.180	0.130	20	0.157	-6
445	0.431	0.001	3	0.510	0.004	10	0.079	-7
447	0.385	0.002	5	0.209	0.100	19	-0.176	-14
811	0.683	0.000	1	0.505	0.006	11	-0.178	-10

that the level of business activity in Large Towns is much more consistently related to population when a bypass is present. Bypasses likely result in a reshuffling of retail and service activities, kill off marginal operations downtown, and force the surviving businesses to reach a minimum threshold of customers by relocating to the bypass or reorienting their sales focus to a new clientele, a phenomenon observed by Andersen et al. (1993) among others.

Business levels in bypassed Large Towns are not only better modeled than non-bypassed Large Towns in relative terms, but are also on par with the results for the City stratum in absolute terms vis-à-vis the r^2 values. The typical City r^2 value is just under 0.5, while the typical r^2 value for bypassed Large Towns is right at 0.5 and for non-bypassed Large Towns is around 0.2. This is probably not a coincidence. Bypassed Large Towns have a large enough downtown cluster, and enough activities filling that cluster, to have warranted a bypass to speed traffic around the town. In this sense, they are more like Cities than are the non-bypassed Large Towns, for which no one has seen the need, or found the funds, to build a bypass.

Table 5. Regression results, Medium Town stratum

Status	**Not bypassed (n=59)**			**Bypassed (n=8)**			**Difference in**	
NAICS	r^2	p-value	rank	r^2	p-value	rank	r^2	rank
422	0.005	0.761	18	0.723	0.068	2	0.718	16
443	0.272	0.015	4	0.821	0.278	1	0.549	3
442	0.003	0.755	19	0.431	0.077	6	0.428	13
446	0.075	0.045	12	0.441	0.072	5	0.366	7
451	0.158	0.092	5	0.491	0.506	4	0.333	1
454	0.129	0.037	8	0.416	0.240	7	0.287	1
811	0.020	0.485	16	0.238	0.405	9	0.218	7
421	0.447	0.000	1	0.656	0.097	3	0.209	-2
445	0.066	0.056	13	0.199	0.268	11	0.133	2
721	0.041	0.228	14	0.118	0.451	13	0.077	1
453	0.284	0.000	3	0.351	0.122	8	0.067	-5
448	0.000	0.987	20	0.061	0.555	15	0.061	5
452	0.011	0.465	17	0.024	0.715	17	0.013	0
444	0.031	0.215	15	0.033	0.664	16	0.002	-1
532	0.140	0.016	7	0.134	0.372	12	-0.006	-5
441	0.083	0.036	10	0.072	0.519	14	-0.011	-4
812	0.077	0.113	11	0.002	0.926	20	-0.075	-9
531	0.091	0.041	9	0.012	0.799	19	-0.079	-10
447	0.145	0.004	6	0.021	0.730	18	-0.124	-12
722	0.340	0.000	2	0.208	0.256	10	-0.132	-8

With 23 observations in each non-bypassed regression in Table 4, an r^2 value of about 0.2 is necessary to achieve the standard 0.05 significance level. However, in terms of the quality of the line fit, only sectors 811, 713, and 722 (foodservices and drinking places) perform well with r^2 values above 0.5. On the other hand, with nine fewer observations, an r^2 value of about 0.3 is needed to achieve a 0.05 significance level for bypassed towns. Despite this impediment, only sectors 721 (accommodation) and 447 (gasoline stations) perform so poorly that the r^2 values are at 0.2 or below and p-values are above 0.05.

These two poorly-performing sectors in bypassed Large Towns, accommodations and gasoline stations, are harder to predict in bypassed towns because these may be the two most traffic-dependent sectors in the study. Distance to a major city almost certainly plays a role beyond population. For example, a bypassed Large Town that is 20 miles from Tulsa will likely have a lot of traffic pass by to obtain greater variety and perhaps better fuel prices in the city, whereas a more remote town will have more accommodations to offer as it dominates its local area and provides relief to travelers in urgent need of fuel. A review of individual observations confirms this suspicion; all Large Towns that are suburbs of Tulsa or Oklahoma City have five or fewer hotels/motels, while nearly all "free-standing" Large towns have six or more such establishments. Gasoline stations also experience this effect. Places on the periphery of the major metropolitan areas are negatively affected by Tulsa and Oklahoma City, and a bypass further enhances the rate of business decay in those towns. As in other parts of the U.S., more isolated locales are better able to retain their businesses (Davies 1998, 83).

Analysis of Medium Towns

Table 5 repeats the format of Table 4 for Medium towns, again sorted by the difference between the bypassed and non-bypassed r^2 values. All but the last six sectors have a higher r^2 in bypassed towns than non-bypassed towns, though the top six sectors have the largest overall differences. Sectors 422 (wholesale trade, nondurable goods), 443 (electronics), 442 (furniture), 446 (health and personal care), 451 (sporting goods and hobbies), and 454 (non-store retailers) all exhibit low and mostly insignificant r^2 values for non-bypassed towns and big increases for the bypassed towns. Past the top six, none of the r^2 differences are especially notable.

The biggest issue in this portion of the analysis is the wide discrepancy in observations. There are 56 non-bypassed Medium towns in this study but only 8 bypassed towns; as a result, it is easy for most of the r^2 values in the left-hand side of Table 5 to attain significance and quite difficult in the right-hand side. Thus, even an r^2 of 0.656 for sector 421 is insignificant in the bypassed towns. The real issue of sample size, as ever, comes down to believability. Eight observations could much more likely line up by chance than could 59, so strong inferences are risky in the Medium Town bypassed sub-stratum.

Overall, the typical non-bypassed r^2 value is 0.12 and the typical bypassed value is 0.27, both revealing very weak relationships at best. The 59 non-bypassed observations only require r^2 to be about 0.06 to be significant to the 0.05 level, and with the highest r^2 value being slightly below 0.5 (421, durable wholesale trade), the ability of population to predict business levels is minimal in non-bypassed towns and is only slightly better, but unreliably so, in bypassed towns.

Analysis of Overall Results

As a means of assessing the regression results across town size strata and bypass status but avoiding the consistency issues of comparing r^2 values from samples of varying sizes, Table 6 analyzes the ranks that were presented in Tables 3 through 5. For each of the twenty NAICS sectors' ranks for Cities, bypassed and non-bypassed Large Towns, and bypassed and non-bypassed Medium Towns, Table 6 reports the mean rank, best rank, worst rank, and standard deviation of ranks for these five status-size strata. NAICS sectors are sorted by Average Rank, and ties are broken by the standard deviation. For all rank statistics in Table 6, lower values are more desirable because they represent good relative performance.

The consistently best-performing NAICS sectors are foodservices and drinking places (722) and miscellaneous store retailers (453), both based on average ranks and standard deviations. Restaurants and bars are very population-based and traffic-dependent, are important sectors to study in this project, and are generally easy to predict based on population, though less so in Medium Towns. Miscellaneous store retailers include florists, office supply stores, novelty and souvenir stores, used merchandise (consignment shops), pet stores, and tobacco stores; in other words, the small, boutique-type shops that are the most common form of retail in rural areas and small towns. The personal care/pharmacy sector (446) is third best overall, though its highest best rank is 4 while it drops out of the top half in both non-bypassed Medium Towns (rank 12) as well as in Cities (rank 11). The rapid recent profusion of Walgreens and CVS pharmacies in the state may have skewed the results for this sector.

Two sectors of great interest are electronics and appliance stores (443) and building and garden stores (444). Both sectors experience extreme highs and lows. Sector 443 is the best sector in bypassed Medium Towns with an r^2 value of 0.821, but also ranks next-to-last in Cities and rather poorly in Large Towns with ranks of 15th and 14th and with identical r^2 values of 0.012 for both non-bypassed and bypassed places. Sector 444 ranks 15th for Cities with an r^2 value of 0.325, 15th and 16th for the Medium Town sub-strata with r^2 values of 0.03 for both, but is the best-predicted sector in bypassed Large Towns with a very healthy r^2 value of 0.75. While these types of establishments, typified by the Best Buy and Circuit City chains for sector 443 and Lowe's and Home Depot for sector 444, historically would have been associated with metropolitan areas and suburbs, the state has seen a rapid profusion of these establishments in smaller towns and suburbs, similar to the pharmacies mentioned earlier. The central place concepts of order and hierarchy appear to be disappearing as retail chains in America, emboldened by the success of Wal-Mart, reach into ever smaller places with smaller-scale stores designed to meet the increasingly big-city consumer demands of rural Americans.

Accommodations, for reasons mentioned previously, are not easily predicted with a pair of last-place rankings and a study-worst mean rank of 13. Also, the retail sectors are scattered throughout Table 6, demonstrating the uneven predictability of this category of interest. This highlights the continuing difficulty and limitation in this type of study; first, of obtaining appropriate business data, and second, of identifying and applying appropriate analysis methods.

Table 6. Rank analysis across town size strata

NAICS	Average Rank	Best Rank	Worst Rank	Std. Dev. of Ranks
722	4.0	2	10	3.4
453	6.2	3	8	2.0
446	7.4	4	12	3.8
811	7.6	1	16	6.5
421	8.2	1	13	5.7
445	8.4	3	13	4.2
441	8.8	2	14	4.4
531	9.0	4	19	5.9
532	9.4	2	16	5.3
451	9.8	4	17	6.2
443	10.6	1	19	7.7
447	11.4	5	19	6.7
444	11.6	1	16	6.2
422	11.6	2	18	6.5
454	12.8	7	18	5.0
812	13.0	8	20	4.4
452	13.6	7	18	5.2
442	15.2	6	19	5.5
448	15.2	4	20	6.6
721	16.2	13	20	3.5

Conclusions

The overall goals of this paper have been to analyze bypass effects in non-metropolitan Oklahoma and to evaluate the predictability of business sectors most commonly found in towns and smaller cities across the state. Bypasses are widely believed to be bad for small towns as they allow non-local travelers to completely avoid the downtown business area. This loss of activity is also assumed to lead to population decline, especially as younger residents seek more options and variety in cities and suburbs (Davies 1998, 84). This population loss then further damages small town business by reducing the local component of its clientele in a downward, positive-feedback spiral that drains towns of people, businesses, and jobs. Given the connection between population and economic health, this study documents the reality of this relationship by assessing the influence of town size and bypass status on business levels.

This paper did not seek to address the absolute changes wrought by bypasses; that type of analysis has been reported elsewhere (Comer and Finchum 2001, 2003). Instead, the ability to predict business levels based on town size and bypass status was of key interest because of the variation among these three variables in the state. Armed with these results, and a qualitative assessment of why these results occurred, policy-makers and other interested parties can look to the future and make use of an Internet-based SDSS to assess future bypasses. As spurred by the original desire of ODOT, the results presented here place the assessment of the social and economic effects of bypasses on par with the traffic, environmental, displacement, and cost analyses that were already a part of the pre-construction evaluation performed by ODOT. The methodology and results described here will hopefully lead to further work and more improvement in the study of the effects and impacts of highway bypasses in small towns.

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