The Impact of Oil Boom and Bust Cycles on Western North Dakota: Executive Summary

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SURTC RESEARCH SUMMARY

Abstract

The objectives of this study were to determine the impact of oil boom and bust cycles on transit ridership for individuals living in the oil patch in western North Dakota as well as how variables such as income, land use, population, and local operating investments affect livability. System dynamic models were applied to analyze mode share and potential transportation investments in western North Dakota. Transit livability index measures showed large increases from 2008 to 2012 followed by overall corrections from 2013 to 2016. Further, transit fleet size has failed to increase with population growth, and pedestrian safety has become a concern. System dynamics simulations found that shifts from auto to transit would result in millions of dollars of fuel savings.

Introduction

The western half of North Dakota has experienced tremendous change in recent years due to oil exploration and drilling. Congestion and road quality problems initially affected the area during the expansion boom years. After almost a decade of North Dakota shale oil production, prices dropped from around $100 a barrel in 2014 to about $30 in early 2016 and the industry went into the bust portion of the economic cycle where oil production and affiliated employment and spending contracted. This has been followed by state and local funding cutbacks that have led to uncertainty regarding economic and social conditions. Local businesses have experienced tremendous fluctuations in sales leading to uncertainty and delayed growth plans as well.

The boom and bust cycles could have an impact on community livability. Livability is defined as suitability for human living according to the Meriam Webster dictionary. Additionally, according to Ferrell et al. (2016), livability is "people having good access to opportunities they can use in the pursuit of improvements to their quality of life." It is a metric for measuring quality of life (QoL) of a given geographical place.

This study examines the impacts of the boom and bust cycles on transit ridership and community livability in western North Dakota by calculating transit livability index measures. The study also develops a system dynamics model to show the potential impacts from increasing transit's mode share. System dynamics (SD) is a powerful tool for analyzing large-scale, complex socio-economic systems. It has been applied to a wide variety of fields, including transportation and land use.

Research Methodology

Transit livability indexes were calculated based on six core livability principles developed by the Partnership for Sustainable Communities (Table 1) (DOT et al. 2014). Table 2 shows the relationship of each livability principle to public transportation and the transit livability index measures used in the study.

Table 1. Livability Principles

Provide More Transportation Choices
Promote Equitable, Affordable Housing
Enhance Economic Competitiveness
Support Existing Communities
Coordinate Policies and Leverage Investment
Value Communities Neighborhoods

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Table 2. Livability's Relationship to Transit and Measurements

Livability Principle	Relationship to Transit	Index Measure
Provide More Transportation Choices	Transit service provides an alternative transportation choice.	Percent of workers that do not drive alone to work
Promote Equitable, Affordable Housing	Transit provides a means to connect home owners to communities and can lower overall housing and transportation expenses.	Household income after transportation and housing expenses
Enhance Economic Competitiveness	Transit provides greater accessibility to workers for commuting and access to services, improving the economic competiveness of a community.	Revenue vehicles/county population
Support Existing Communities	Transit utilizes the existing built environment to serve and support an existing community.	Ridership/developed land area
Coordinate Policies and Leverage Investment	Transit coordinates funding from federal, state, and local entities to provide quality service and operate cost-effectively.	State and local operating investment/operating expenses
Value Communities Neighborhoods	Transit adds value to local communities by serving local residents who deserve safe, affordable transportation choices while often possessing mobility disadvantages.	Ridership/county mobility needs index

Livability calculations were conducted for the nine-county region of North Dakota most heavily impacted by oil production fluctuations (Figure 1). This includes Divide, Burke, Williams, Mountrail, McKenzie, Golden Valley, Billings, Dunn, and Stark counties. Both the livability index and system dynamics models included historical data calculations as well as forecasted scenarios dependent on regional estimates.

All transit livability index measures were calculated at the county level from 2008 to 2016. Time series data illustrates the impact of oil production on transit during the defined time period. Equal weighting was assigned to all measures as individual index measures illustrate a specific livability principle. Also, after the initial calculations were completed, the index was categorized in percentiles from 1 to 10 using a normal distribution. This provided consistency for analysis and comparison among results. The system dynamics model limited the scope for this part of the study to the cities located in the nine North Dakota counties to address two dominate modes of transportation (personal vehicle vs. public bus). These cities are home to the majority of the regional population. The rest of population lives in very small towns or rural areas with little to no access to transit service.

Figure 1. Nine-County Study Region

Results

Figure 2 shows the average transit livability index results from 2008 to 2016. The county indexes were classified ranging from 1 to 10 with Mountrail County showing the highest index value for the time period while Divide County generated the lowest. Overall, index values ranged from 4.34 to 5.70 which was relatively consistent considering the differing community sizes, demographics, and locations of the counties relative to the center of the oil patch.

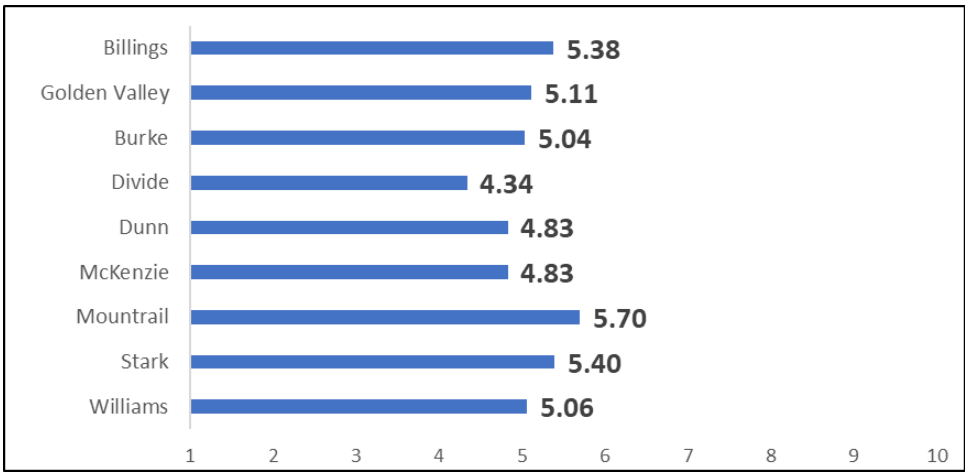

Figure 2. Transit Livability Indexes, by County, 2008-2016

Disaggregating the data to look more closely at individual measures yields some interesting findings. Figure 3, for example, shows the index values for supporting existing communities, with the counties being categorized based on county population. This measure is calculated by dividing transit ridership by the developed land area of a given county. Notice that values increased dramatically from 2008 to 2011 as ridership increased while the developed land area remained relatively constant. However, the dramatic land development, especially within the larger counties of Stark and Williams, coupled with decreased ridership, caused this measure to drop significantly from 2011 to 2016. This also raises concerns for pedestrian safety as more of the land is developed around communities and traffic begins to increase. Coupled with oil production traffic, pedestrians now have fewer options when contemplating walking for exercise along once primarily rural roads and must choose different exercise alternatives or relatively unsafe walking conditions.

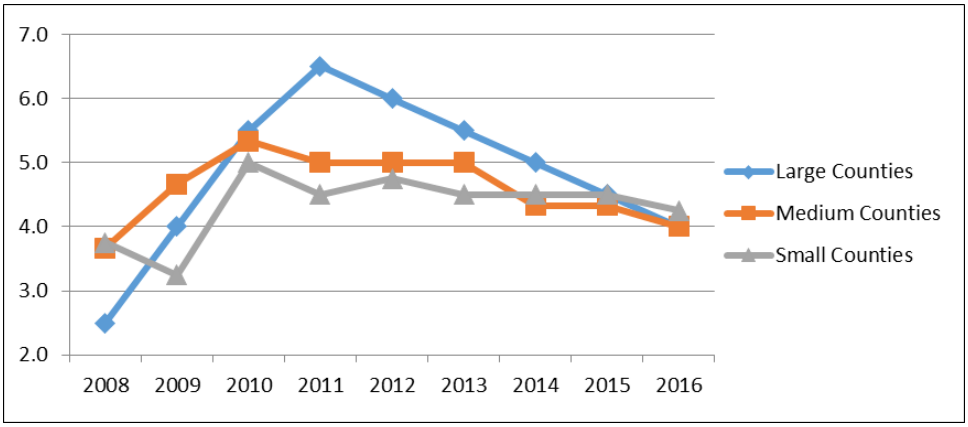

Figure 3. Support Existing Communities

System dynamics results showed that, because of several generalizations throughout the model development and because of the nature of rural transportation systems, there is sufficient vehicle capacity throughout the forecasting period from 2017 to 2027. This model is used to show the impacts of shifting private automobile trips to transit. The study examines four scenarios where 0.5%, 1%, 1.5%, and 2% of private automobile trips shift to transit. The supply-demand ratio are found to change by 0.497%, 0.998%, 1.505%, and 2.016% for 0.5%, 1%, 1.5%, and 2% changes in mode shift, showing the positive impacts of increased transit use on roadway capacity.

As shown in Figure 4, the numbers of vehicle trips saved by such a mode shift has a relative linear increase. For example, in year 2018, almost 220, 440, 660, 880 thousand trips might have been saved by 0.5%, 1%, 1.5% 2% mode shifts, respectively. Given average trip distances and vehicle fuel economy, almost 1.36 million gallons of fuel would be saved if 2% of trips shifted from private vehicle to transit.

Summary and Conclusions

Transit livability index measures showed large increases from 2008 to 2012 followed by overall decreases from 2013 to 2016. These measures have been declining as oil

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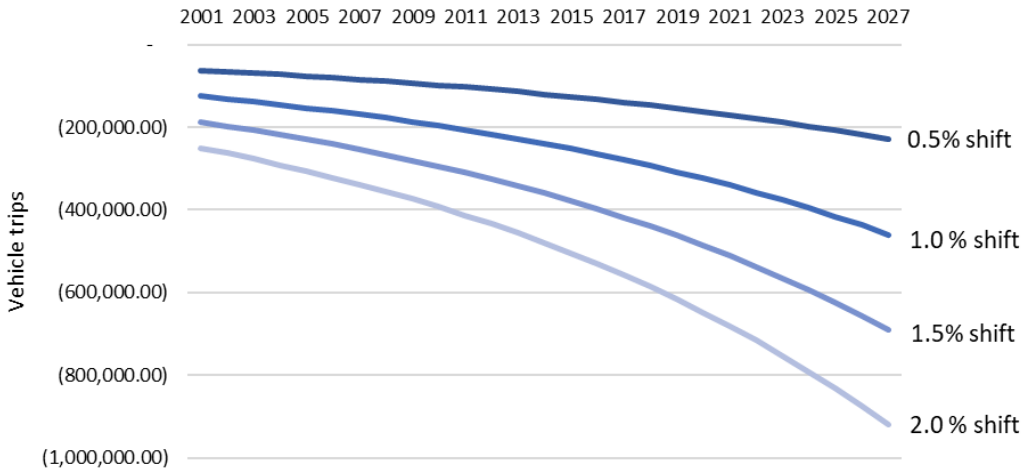

Figure 4. Vehicle Trips Saved Given Shifts in Trips to Transit

production and economic advances have diminished. Further, transit fleet size has failed to increase with population growth, and pedestrian safety has become a concern along both rural and city highways. System dynamics simulations focused on potential mode shifts from private automobile to transit, finding that shifts from auto to transit would result in millions of dollars of fuel savings in the oil patch alone.

A major finding of this research shows that although the recent oil bust has caused considerable concern in western North Dakota, the population and transit ridership are considerably larger today than they were in 2008. For example, transit ridership nearly doubled from 2008 to 2016 due largely to the expanding local economy. Various models of either fixed-route or flex-route busing should be considered by transit agencies and local policy makers for the larger communities of Williston and Dickinson, while more rural providers need to update their fleets to meet demand as well. Policy makers should also consider that the majority of local rural transit riders are elderly and need quality vehicles with updated suspensions to provide comfortable rides for their aging clientele. Due to recent cutbacks in state and local funding, agencies should also strive to better coordinate services while continuing to provide rides to county population centers that offer the goods and services many rural residents require.

References

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