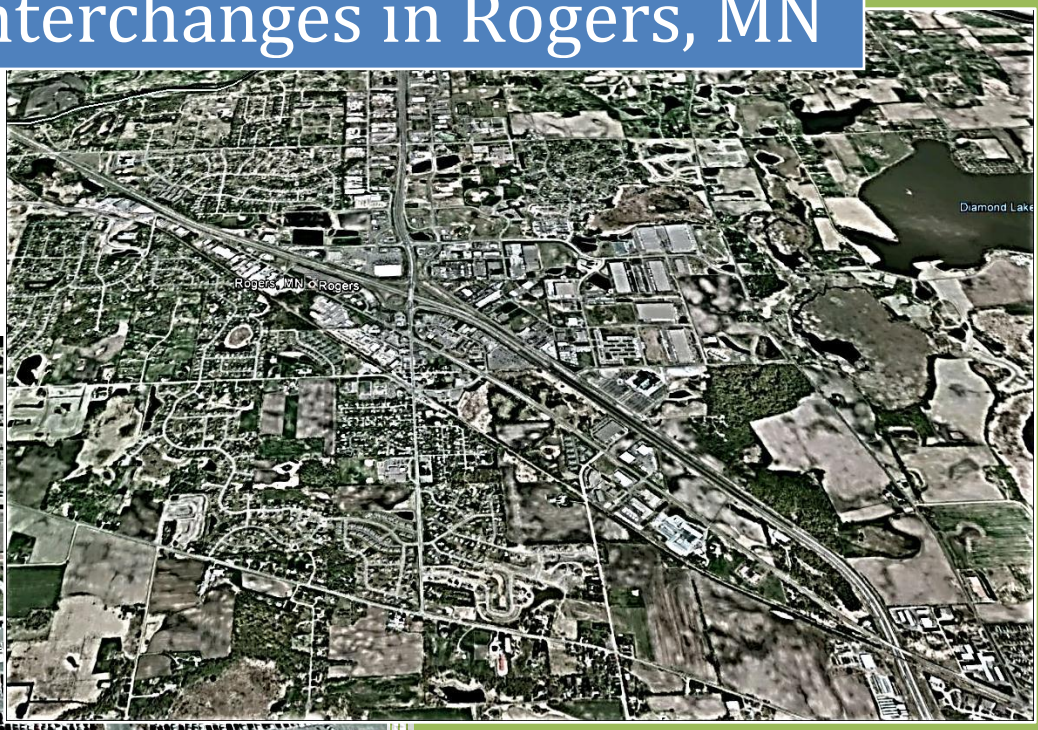
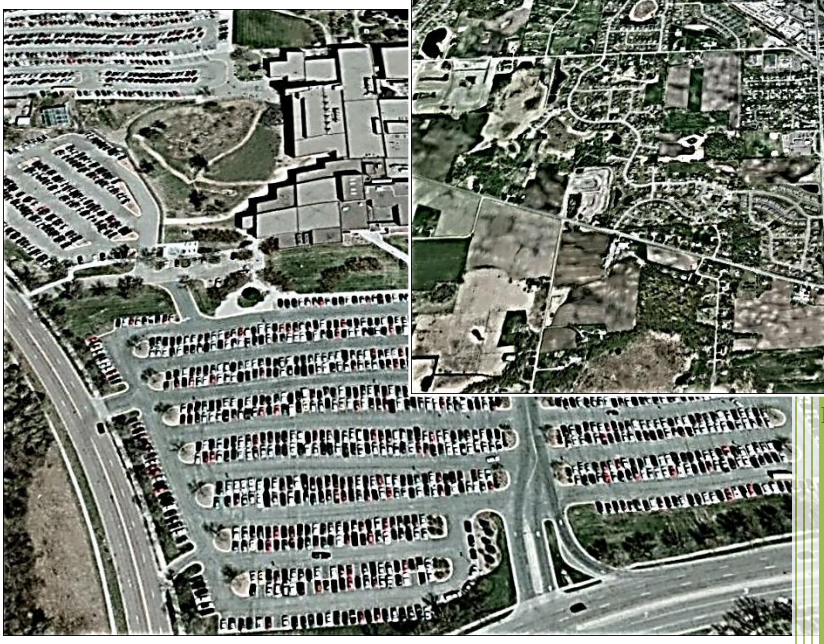
2013

The Cross-Sectional Economic Impact of Highway Interchanges in Rogers, MN



Roger, Minnesota, Interchange between I -94 and US-101



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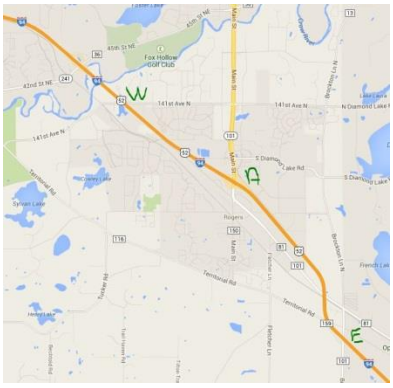
Problem formulation, research methodology, and anticipated finding.

Do four-lane highway exit-ramps or interchanges generate a spatial economic growth in areas surrounding them? If interchanges have a local economic impact, how far does it spread from the interchange? If interchanges have a local economic impact, people and companies should be likely to migrate toward the interchange to maximize income and return on equity. Professionals would want to benefit from such economic stimuli creating a higher demand for land and properties in interchange vicinity. Property market values should therefore be higher, as a result of accrued accessibility and facilitated mobility.

After extensive publication review thereafter described, the city of Rogers, Minnesota, provide a wonderful environment to determine whether an additional interchange would improve the local economic environment. Currently, the city only benefits from one interchange between Interstate 94 (I-94) and MN-101 interchange (Point A on the map below). Yet, two additional overpasses located at its eastern (E) and western sides (W) could be modified to offer greater local and regional accessibility to residents, business, and shoppers by connecting these roads to I-94. The purpose of this reseach project is therefore to determine the spatial evolution of various types of property values around eastern potential site. Using MetroGIS and Minnesota Department of Transportation data (MnDot), the project would determine he existence and strength or inexistence and weakness of causal relationship between property values and their accessibility to I-94-MN-101 interchange. The property values would be the dependent variable, and its accessibility should be one independent variable with a strong weight into the regression.



On one hand, if a strong causal relationship exists, the spatial property value-spatial variations around the potential site should be very consistent for residential and commercial properties and

follow similar patterns around the existing and proposed interchanges. In other words, the property-value-spatial variation for residential properties should be maximal in certain areas around the interchange. Similarly, property-value-spatial-variations for commercial properties should be maximal in other areas. The optimal property-value-spatial variation should be proportional or inversely proportional to their accessibility or Manhattan distance to/from the interchange. On the other hand, if no strong causal relationship exists, the property value spatial evolution should be similar across the region regardless of their accessibility from the Interchange, and the discrepancies between property-value spatial variation should be explained by sampling error only. Thus, our research should answer the question: Are the most expensive property spatial variations, the closest from the proposed interchange, or along the four-lane highway for each groups that encompass commercial, manufacturing, and residential properties.

The methodology used to determine the predictability of property value from their distance of the interchange first consists in weighting property value data provided by MetroGIS with related accessibility data provided my MnDot. MetroGIS provides descriptive information about commercial and residential properties with related geographical coordinated. MnDot provides information about traffic flows and road conditions. Dividing the distance of the most logical accessibility path between properties and the interchange with the time required to cover such a distance, should provide the "true" distance between the two points. The time adjusted true distance should consequently become a factor in predicting the value of properties. We define *the time adjusted true value* distance as the Manhattan physical distance between two points that is weighted by the number of road blocks such as stop lights and signs, speed limits, congestions, and other restrictions that impair the mobility of commuters and accessibility of sites (appendix 1).

Mapping the cross sectional and residual values should provide systematic concentrations of similar properties at specific distance from the interchange. If the null hypothesis holds, the closer the property from the proposed interchange and the greater its market values spatial evolution would be. In other words, the location of optimal property value spatial distribution should coincide with the location of the interchange. The statistical analysis should provides the definition of "close," as patterns should emerge for various type of properties. If the alternate hypothesis holds, property value spatial distribution should be uniform all over the market

without concentration around the interchange, and could be explained by sampling statistical error only.

Articles reviews and Rogers – MN- interchange selection criteria.

If transportation were instantaneous and costless, then the urban population could spread out over all usable and all land price would be reduced to their approximate value in the best alternative use. But transportation is not instantaneous and costless, and since modern life requires the concentration of people in cities, urban land takes on a special accessibility value (Brigham 1965, P 226). In other words, there is an intimate and reciprocal relationship between land accessibility and people's mobility in the determination of property values. This article reviews should therefore focus on some fundamental determinants of residential and commercial land values, on the hedonic housing and commercial market segmentation prediction accuracy, and on the interdependency of accessibility and mobility among sites in the supply and demand equilibration of market equilibrium to determine the city of Rogers, MM interchange selection criteria.

Hundreds of publications deal with the values of properties. Most of them establish static or dynamic relationships (Capozza and Helsley 1989 P 295-306) between amenities, present and future uses of lands, economic activities, historical factors affecting its utilization, accessibility, and the value of properties (Brigham 1965 P 228). None of the independent groups of variables can fully explain the resulting property values and property value evolutions alone (Dafermos and Nagurney 1989).

Without taking mobility and accessibility into their analysis, Goodman and Thibodeau (2003), in an attempt to differentiate property value evolution in cross sectional techniques, first predict property values using parsimonious and expended specifications in both empirical hedonic and hierarchical models. Parsimonious hedonic models relate the log of transaction price to dwelling size and, whereas expended specification models include additional structure characteristics such as square footage, heating system types, number of bathroom, and other amenities. Hierarchical models further refine the property value classifications by mapping them into neighborhoods such as south or north side of town, east or west of town, and so on. They conclude that *spatial disaggregation increases the prediction accuracy of hedonic house price estimates and that the*

procedure used to construct housing submarket can contribute to the efficiency of resulting market value predictions (Goodman and Thibodeau 2003).

Arnott, Lewis and Capoza(1989) confirm a positive and significant relationship between the rate of urban growth and the price of housing. Land price is proportional to lend rent, and the price of land at the boundary of an urban area equals the value of Agricultural Land. Subsequent land preparation for development includes the installation of water, electrical, and telecommunication supply, as well as the installation of sour systems and access road. Once the finished land is ready for development, land rent evolution over time is both proportional to the regional economic strength and accessibility to Central Business District (CBD) and to any other sites of interests such as commercial areas, recreational areas, etc... In urban areas where employment growth is excellent, the demand for housing and professional land is very important like in Williston North Dakota where oil fields attract millions workers (Rocco 2013). Inversely, the city of Detroit, Michigan, is experiencing the worst economic decline since the great depression as a result of the automobile industry collapse and the magnitude of related job losses. The value of once million-dollar homes sells for a few thousand dollars as people are moving away from the economically depressed regions (Rummel 2013).

Historically, there is an important interdependency between land development, mobility and accessibility, and economic development. Susan Hanson and Genevieve Giuliano (2004 P63))identify four historical periods in intraurban transport: the walking horse car Era, the Electric Street Car Era, the Recreational Auto Era, and the Freeway Era. Each era increased either the accessibility or the mobility or both by modifying the distance travelable between the residential areas and center business districts. Each era modified the geographical shape of urban area as mobility and accessibility increased creating a huge time convergence between origin and

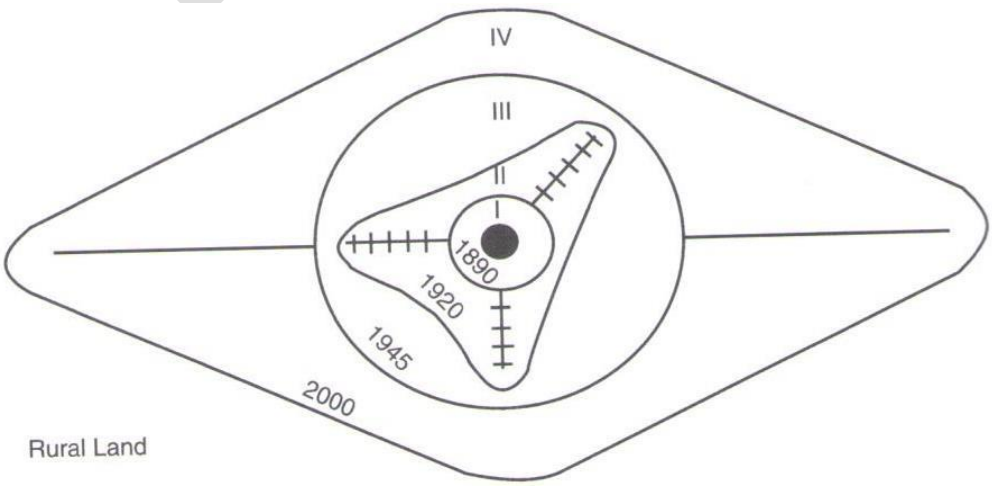


Figure 1 - Urban Development (Hanson and Giuliano 2004 P 63)

destination of any trips.(Hanson and Giuliano 2004 P330) (Adam 1979 P28). As Hanson and Giuliano describe it:

I. During the Walking-Horsecars era (1800-1890) commuters only have their feet and horsecars to move around. Everything had to be close to one another as the mobility was extremely reduced.
II. During the Electric Street Car era (1890-1920) commuters' mobility is increased by the speed of electrical street car and rail road steam engines. They can cover more distance in the same period of time, so that cities begin to spread out along street car path. Because commuters still have to walk between home and the street car stop stations, they reside along the paths of electrical street car and rail road track.
III. During the Recreational Automobile Era (1920-1945) commuters gain mobility as automobiles are not limited by the tracks of electrical street cars and rail road tracks. Commuters can complete door-to-door commutes between origins and destinations. Areas previously undeveloped are filed up with new residential construction, as the automobile increased accessibility to remote land, and mobility.
IV. During the freeway era (1945-present) commuters gain accessibility by providing high speed intraurban networks. Commuters can cover greater distance in the same amount of times. Freeways become "main streets." Urban areas expend along freeway creating urban sprawling.

In other words, modern commute is predetermined by the strength of accessibility and mobility to both central business districts and the strength of accessibility predetermine the demand for lands (Brigham 1965). Anthony Chen, Plya Chootinan, Seungkyu Ryu, and S.C. Wong, who reviewed recently developed measure for assessing the quality of origin destination estimated from traffic count, conclude that new generalized demand scale measures still have limited applications as so many parameters are unspecified. Yet, they recognize the value of traffic modelization in estimating the demand for land.

Using ArcView Network Analyst, Mohamad Abdel Aty and Yile Huang showed that the distance traveled to access or after exiting a ramp does not depend only on the spacing between ramps, but on several factors, such as trip purpose, vehicle occupancy, driver's income level, and

E-Pass use (Abdel-Aty and Huang 2004). In most cases, they demonstrated that the systems optimized route is the best route with the shortest travel time. That is, we need to dissociate the demand for land, and resulting price in accordance to the types of properties (residential, commercial, industrial) on one hand. On the other hand, each type of properties shall be divided by the type of usage (Single home, condominium, rental) and by type of income.

Finally, June Dong, Ding Zhang, and Anna Nagurney investigated supply chain network equilibrium models with and with our random demands, which support the notion of time convergence and divergence. That is, the optimal conditions predetermined by some statistical variational inequality states that *if the price that a retailer is willing to pay for the product is precisely equal to the manufacturer's marginal production and transaction cost associated with that retailer. On the other hand if the manufacturer's marginal production and transaction cost exceeds what the retailer is willing to pay for the product, then there will be zero shipment of the product between the pair* (Dong, Zhang, and Nagurney 2004 P196).

They further argue that human being can be compared to product when commuting. That is, people generally limit their commute to 45 minutes between home and work (Hanson and Giuliano 2004 P 210), That is, the distance covered in 45 minutes is proportional to the average speed and inversely proportional to road blocks and energy cost. In other words, the faster vehicles can circulate; the less congestion, street lights, right angle turn; and the lowest the cost of gas, the greater the commuted distance. Inversely, if any of the conditions above are changed, the smaller the commuted distance. Effective and efficient transportation network induces commutes who may result in greater economic growth. Thus, in the past, once farm lands were transformed or more precisely prepared for development, the urban limits moved further away as wealthier people had more opportunities to find residential area away from crowed urban city (Capozza and Helshley 1989 P 302).

Today, medium and lower income residents also seek to reside at the limits of rural and urban area as the cost of housing is often cheaper than in major urban concentration. Workers are utility and revenue maximizing economic agents. That is they want the best they can have within the limits of their revenues. Thus, people will allocate monies and time budgets for everything from work to leisure, and find the superior allocation for each budget. So, if the cost

of housing is too expensive in an area of town, people might seek alternate housing in cheaper area, though commute costs in time and monies might be greater. Similarly, in the early 2000, when the cost of gas was around US$0.80 a gallon, people used to purchase SUVs and powerful pickup trucks. As soon as cost of gas raised in 2004, and especially after 2005 hurricane Catherina, Gas Guzzling SUVs and pickup trucks piled up on every driveways between Minneapolis and Detroit Lakes with signs "for sale" on them: a clear indication that people were trying to keep their standard of living by reducing the energy cost of transportation.

As we introduce it earlier, the city of Rogers, Minnesota, provides a unique environment to assess the validity of economic impact of four-lane-highway exit ramps or interchange. Forty years ago, Rogers was a rural environment. Over the years, the interchange between I-94- MN-101 was developed, and the rural land rapidly transformed into an urban area. As of 2013, Rogers has the following characteristics:

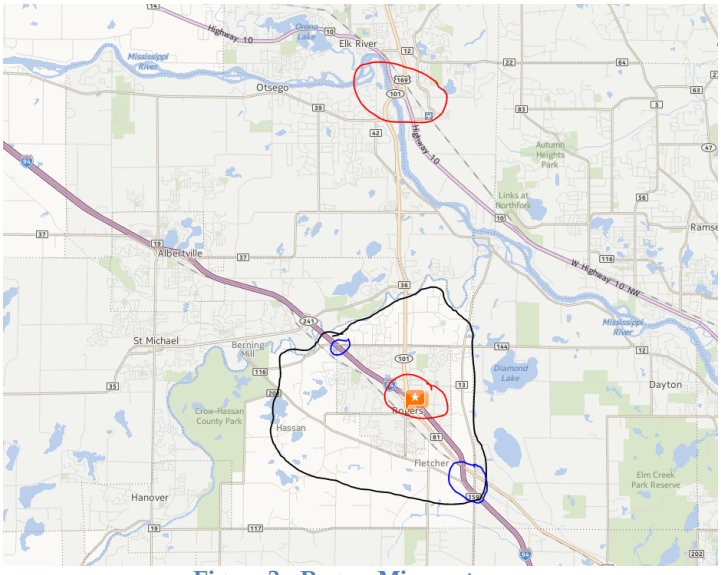


Figure 2 - Rogers Minnesota – Black: Area Of interest – Red: Access Points – Blue: Potential Access

- Market segmentation shows that the area south of I-94 is not as evenly developed than the north (Goodman and Thibodeau 2003). On the north side of I-94, MN-101 is a fast four lane freeway, whereas on the south side of I-94, MN-101 is a narrow one lane street crossing through the old Rogers downtown.
- Rogers is also surrounded by natural barriers such as the Crow and Mississippi Rivers, so that commuters only have two major exits from their neighborhood to access either I-94 or US-10 in the north making it easier to estimate commuters' path.
- Yahoo and Google maps itinerary makers demonstrate that any sites from Saint Cloud to the south Eastern side of the Twin City Metro (Inver Grove Height) is within 45 Minutes from Rogers using any of the freeways.

- On I-94, there are two bridges with no access ramps. These bridges would be our control sites, as we expect land around to be very expensive as it would take minimum work and money to upgrade the network. Hence providing rapid expansion of commercial lands around the two bridges, and residential construction in lands south of Rogers downtown as a road could rapidly be transformed into a four lane freeway to facilitate access and mobility.
- Recently, BusinessWeek cited Rogers as the best city to raise children in the nation.

We are hoping to determine that the property values distribution around I-94 coincides with the locations of interchanges for each of the categories. We should find different of areas for residential and commercial properties. For residential single dwelling, we expect expensive properties to be in "quieter" areas, and apartment building closer to the freeway.

Similarly, for commercial and industrial properties, we are expecting them to be located around fast access ramps to maximize transportation speed, and reduce production costs. Overlapping both some hotspot maps, spatial and network analysis should help identify such areas.

Appendix 1 – Data Source and Processing

Three Minnesota agencies provide 30 years data sets to complete the research project: MetroGis, the Minnesota Department of Transportation (MnDot), and the Minnesota Department of Natural Resource. MetroGIS provides geocoded databases with information about every property of the seven county metro areas of Minnesota. The Minnesota Department of Transportation (MnDot) provides geocoded databases with road condition, traffic signals and average speed. The DNR provides aerial orthonormal photography to complete the evolution of development over thirty years. Consequently,

- MetroGis data provide the geo locations of 22 types of properties from rural farm land to industrial land. Records include polygons, lines, points, property values, tax values, ownerships, and many amenities regarding each type of properties.
- MnDot data provide geo locations of roads and street from simple road to highway. Record includes daily traffic flow on the fifteen minutes basis, average speed of segments at different time of the day, road blocks, traffic congestions, and traffic counts.
- The DNR data provide photography for fifty years. Photography shows the evolution of land over the years.

So, MetroGis provides the dependent variables or property value evolution over times, whereas MnDot provide causal data that enable to adjust the Manhattan distance with all traffic flow descriptive parameters.

The city of Rogers might in addition provide information regarding urban planning strategic plan. Yet, prior to consulting them, it is important to evaluate the data on our own, then match our findings with the city of Rogers records. That will help assess if our findings are consistent with any urban strategic development plan, and if geography can detect such plan alone.

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