Working Paper No. 14-08

Transportation Networks and the Geographic Concentration of Industry

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October 2014

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October 21, 2014

Abstract

This paper examines the e ect of expanding transportation networks on changes in industry location within the United States. I use the construction of the Interstate Highway System, from 1962 to 1996, to measure how improvements in transportation infrastructure and market access alter industry concentration. To address the endogenous placement of highways, the paper instruments for eventual highway location using a military map of high priority routes designed after the First World War. To address the endogeneity surrounding the timing of highway construction, I use a network theory algorithm to predict when each segment of the highway network should have been constructed. The algorithm ranks predicted highway segments based on their importance for network connectivity and uses a simple social planners problem to determine the order of predicted segment construction. Results indicate that counties that received interstate highways experience more overall employment growth than non-highway counties and the magnitude of this growth varies by industry. Employment in highway counties is also much more concentrated and this concentration is being captured in both more establishments and

1 Introduction

Transportation costs are an integral component of the spatial arrangement of economic activity. Expanding transportation infrastructure impacts trade flows and alters the organization of cities by changing the cost of moving goods and commuting. New transportation infrastructure motivates firms and individuals to alter their location choices. The construction of the Interstate Highway System (IHS) in the United States introduced over 40,000 miles of new highways, which lowered the costs of moving goods and people. For example, from 1975 to 1985 shipping rates by truck fell by nearly 20 percent (Rose 1988). The IHS also led to changes in driving behavior. From 1966 to 1995 the percentage of total vehicles miles traveled along interstate highways increased from 10 percent to nearly 25 percent (FHWA 1997). These changes in costs and usage suggest that interstate highways could have altered the location choices of both firms and individuals. This paper uses the construction of the Interstate Highway System to understand the relationship between transportation infrastructure and industry concentration.

schedule.

I use a county-level panel dataset spanning from 1962 to 1996 to examine industry growth and concentration using several different measures. First, I compare differences in employment growth between highway and non-highway counties and find there were significant positive differences starting in the early-1980s. This growth was more pronounced in agriculture, retail sales, and the transportation and public utilities sector. I find very little evidence of growth in manufacturing employment. Next, I use two measures of industry concentration to determine whether the employment growth was concentrated in a fewer sectors. Results indicate there was substantial increases in employment concentration in highway counties relative to non-highway counties. To measure changes in the scale of firms by industry, I compare changes in the share of large firms in highway counties compared to non-highway counties as larger firm size is typically associated with increased concentration (Holmes and Stevens 2004). These results indicate that highways led to moderately larger manufacturing firms in highway counties relative to non-highway counties. Finally, I measure the full dynamic response of receiving an interstate highway, these results indicate that it takes between 15 and 20 years before highways significantly differ from non-highway counties. These results taken together suggest that the Interstate Highway System significantly contributed to industry concentration in highway counties.

My analysis is most directly related to the growing literature on relationship between transportation infrastructure and the organization of economic activity.[1] The majority of papers in this literature study the effect of highways in cities. Several papers document population and industry decentralization, and the growth of the suburbs (Baum Snow 2007, 2014; Baum-Snow et al. 2014; Rothenberg 2013). Duranton and Turner (2012) find employment increases in cities for several years after expansions in highway mileage. Duranton, Morrow, and Turner (2013) examine trade relationships between several major cities and find that cities with more highway mileage specialize in the production of heavier goods, but there was no difference in product value.

[1]For a comprehensive survey of this literature see Redding and Turner (2014).

Michaels (2008) finds that interstate highways increase earnings in retail sales and trucking, both trade related activities, in rural counties within the US. He also finds an increase in the demand for skilled labor, however he cannot identify an effect of highways on the industrial composition of employment. Chandra and Thompson (2000) examine the effect of interstate highways on earnings by industry using a distributed lag model for a subset of rural counties. They find that earnings increased for several industries and that counties adjacent to highways experience a decline in and documents the pattern of industry growth and concentration that occurred between 1962 and 1996. Section 4 discusses the empirical strategy and the endogeneity issues associated with estimating the causal effects of transportation infrastructure on industry growth and concentration. Section 5 examines the role that highways played in employment and establishment growth in highway and non-highway counties. Section 6 discusses patterns of employment and establishment concentration induced by the IHS. Section 7 measures the dynamic effects of interstate highways. Section 8 provides two falsification exercises for robustness and Section 9 concludes.

2 History of the Interstate Highway System

2.1 Federal Aid Highway Act of 1956

In the early 1950s several Congressional Committees developed plans for funding and designing a new system of limited access interstate highways. President Eisenhower was influential in helping support some of these committees and invited Governors and heads of interest groups to participate in the planning process (Rose 1990). Industry representatives from oil, trucking, and manufacturing were particularly influential in these discussions (Kaszynski 2000).

In 1956, after several different plans, construction guidelines, and financing methods were introduced, the House and Senate ultimately agreed on an interstate highway plan. The plan was approximately 90 percent Federally funded and was paid for with taxes revenue from a variety of sources (Kaszynski 2000). Eisenhower signed the Federal-Aid Highway Act of 1956 into law on of interstate highways and the pace of construction have important consequences for empirically estimating the e ects of interstate highways.

2.2 The Pershing Map and the National Interregional Highway Committee

My empirical design requires that the interstate highway system was exogenously assigned to counties. Early proposals of interstate highway locations date back to the early 1920s, which may provide predictions of eventual IHS locations for my empirical strategy. Following the First World War the U.S. government began discussing the merits of a national highway system, similar to what it saw in Europe. This led Congress and the Bureau of Public Roads, to seek input from the War Department regarding a national system of interstate highways (Karnes 2009). The War Department commissioned General John J. Pershing to provide a network map of high priority military routes. The army did not value a \transcontinental road which merely crosses the continent", but rather they wanted \roads connecting all our important depots, mobilization and industrial centers" (Swift, 76, 2011). The resulting map contained nearly 78,000 miles of highway that the War Department deemed as strategically important. The map emphasized \coastal and border defense and links to major munitions plants" (Swift, 76, 2011). These routes were never built as superhighways but this map in uenced future highway location decisions.

National interstate highway programs were reintroduced during the Great Depression as part of New Deal legislation. President Roosevelt formed the National Interregional Highway Committee and defense establishments" (US DOT, 274, 1977). Interest groups on behalf of the farming and trucking industry \lobbied for their own plans to foster particular and local needs" (Rose, 16, 1990). The nal plan, published in 1947, was the most comprehensive national network map that had been produced and served as the major guide of highway location decisions for the next decade.

Highway construction plans were halted during the war and funding was restricted to high priority maintenance of current roads. Without adequate funding for repairs the quality of highway infrastructure deteriorated rapidly. Prior to World War II total road spending was about 1.4 percent of GNP and after the war this amount fell to about 0.2 percent (Karnes 2009). As the quality of roads decreased the demand for high quality roads increased rapidly. From 1945 to 1950 vehicle registrations increased nearly 60 percent (Swift 2011). The Bureau of Public Roads determined that between the mid-1920s and early 1950s tra c had increased by 250 percent and highway demand had increased by a factor of eight (Rose 1990). This put tremendous strain on the existing infrastructure that was ill equipped to deal with new faster cars and heavier trucks. Travel times increased dramatically due to elevated levels of congestion and the increased probability of an accident (Kaszynski 2000).

3 Data and Preliminary Evidence

My empirical analysis uses a county-level panel dataset that spans from 1962 to 1996 for the contiguous United States. The primary outcomes of interest rely on annual employment and establishment data collected by the Census Bureau and published in the County Business Patterns. This data is combined with contemporary and historical transportation network information, which allows me to examine the relationship between transportation networks and the several measures of industry growth and concentration.

3.1 County Business Patterns

In 1962 the United States Census Bureau began publishing information regarding employment and the number of establishments for counties in the United States.[2] This paper uses the employment and establishment data for the primary Standard Industrial Classi cation (SIC) economic divisions: Agriculture, Construction, Finance, Manufacturing, Mining, Retail Sales, Services, transportation and public utilities, Wholesale Trade, and Unclassi ed Occupations.[3]

For each broad industry division, I observe the total number of establishments and the total number of establishments in eight employment size groups.[4] One limitation of the County Business Patterns data is that it does not include establishments with zero employees.[5] For con dentiality purposes the Census Bureau censored the county-level employment data for some smaller industries. Similar to Duranton, Morrow, and Turner (2013), I impute employment values using the establishment count data.[6] The result is a county-level panel dataset spanning from 1962-1996 with employment quantities, establishment counts, and establishments counts by eight employment size groups for each of the ten SIC economic divisions. I also aggregate the ten SIC economic divisions to make a total category containing the employment, number of establishments, and establishment group counts for all sectors in the county.

3.2 Calculating Concentration Measures

To understand the relationship between highways and employment and establishment concentration I construct two measures of concentration. I use the following Her ndahl Index for employment

2

concentration.

$$H_{ct} = \sum_i s_{cit}^2 \qquad (1)$$

For each county c in year t, equation 1 sums the squared share of each division's employment in industry i. If employment is fully concentrated in a sector, then H_{ct} = 10000, and the index decreases as employment becomes more diverse. I construct the same measure using the number of establishments.

The Gini Specialization Index is an alternative concentration measure, used by Duranton and Puga (2004). This measure corrects for di erences in local sectoral employment by comparing it to the national share i Spt37tring it alters market power within an industry and whether it promotes entrepreneurship.

3.3 Interstate Highway System Maps

I use two data sources to construct an annual county-level panel dataset with Interstate Highway System information spanning from 1962 to 1996. The rst is current highway location information from NationalAtlas.gov (2014). I combine this le with highway construction information from the PR-511 collection at the National Archives. This series contains maps produced quarterly that show the progress of interstate highway construction. I digitized these maps and traced the annual construction progress of interstate highways in GIS.[8] I intersected this progress with a map of county locations in 1980, which allows me to know the year a county was connected to the Interstate Highway System.[9] Figure 1 shows the current interstate highway locations overlaid on a map of county locations.

For each county, I determine whether an interstate highway intersects that county and the year that segment of highway was completed. I can use this data to determine two key measures for my empirical strategy, in each year I know whether a county had received an interstate highway and how many years ago that particular segment of highway was constructed.

3.4 Supplemental Data

In order to account for factors that are correlated with the economic growth, concentration, and location and funding of interstate highways, I supplement the economic and highway information with data covering population, historical economic data, and alternative methods of transportation.[10] I use county-level population data from the U.S. Census for every decade from 1910-1950. I

[8] I denoted a segment of interstate highway completed once construction of that segment was nished and it was

combined this with information on the percent of population living in cities larger than 25,000 people, the number of manufacturing establishments, and the number of farmers from the 1910-1940 censuses. I also collected information on the number of establishments and employees in manufacturing, wholesale trade, retail trade, and farming from the 1930 and 1940 census. This historical population and industry information is useful for supporting the exogeneity requirements of my instrumental variables. Lastly, I collected high school attainment information to help approximate the skill endowment of each county in 1950 (ICPSR 2005). This measure will allow me to look for evidence of heterogeneous e ects of the interstate highway system based on the skill endowment of counties prior to highway construction.

I collected additional geographic information for alternative methods of transportation from NationalAtlas.gov (2014). I use GIS to construct an indicator that is equal to one if a county has a railroad.[11] For each county I calculate the Euclidian distance to the nearest coastal port and the nearest airport.

3.5 Summary Statistics

My completed county-level panel dataset contains employment and establishment information, highway location and construction information, historical population and economic data, and geographic measures of alternative methods of transportation infrastructure. Table 1 presents summary statistics for two groups: counties that eventually received an interstate highway and counties that never received an interstate highway. The table presents the number of observations, the mean, and the standard deviation for both groups for the full sample of years from 1962 to 1996. The last two columns calculate the di erence between highway and non-highway counties. The most ports. They were also have much larger populations in 1950 and their population grew much faster from 1940 to 1950.

To preview the empirical strategy, table 2 compares the differences between highway and non-highway counties in 1965 and 1996. The outcomes reported in the table are for the County Business Patterns employment and establishment count data, along with the concentration measures and the firm size measures. The differences between highway and non-highway counties are reported in the last two columns. Highway counties are significantly different from non-highway counties in both periods. Highway counties in 1965 have more employment and establishments, and are less concentrated. In 1996 the difference between highway and non-highway counties has grown for both employment and the number of establishments. The Herfindahl Index values for both employment and the number of establishments changes sign and now indicates that highway counties are more concentrated than non-highway counties. Comparing the difference in the means across the two time periods indicates that both employment and the number of establishments grew over the period. This growth was accompanied by increases in employment concentration, which suggests that a large portion of the job growth was concentrated in a few industries.

4 Empirical Strategy

4.1 Static Identification

To investigate the effect of the Interstate Highway System on employment growth and industry concentration, I exploit variation in the location of interstate highways at different points in time. I use a county-level panel dataset to estimate the following specification:

$$Y_{cit} = \sum_{d} \beta_d (hwy_{ct} \times YearBin_d) + \alpha_{rt} + \gamma_c + X'_{ct}\delta + \epsilon_{cit} \qquad (3)$$

where Y_{cit} is the outcome of interest in county c, in industry i at time t. The variable hwy_{ct} is an indicator variable that is equal to one if an interstate highway intersects county c at time t.

is the error term. I include controls for alternative methods of transportation infrastructure, 1950 population, and 1940 to 1950 population growth, and distance to closest Metropolitan Statistical Area (MSA) because these are likely correlated with whether a county receives a highway and when they start building that highway. I two-way cluster the standard error by county and state/year to account for serial correlation and spatial correlation in the error term. I estimate equation (4) using Two-Stage Least Squares (TSLS).[15]

4.3 Addressing Highway Endogeneity

Measuring the di erences between highway and non-highway counties will likely result in biased estimates because counties selected to receive a highway and when they receive the highway are likely to di er along unobservable dimensions that are correlated with economic growth. The history of highway construction indicates that the placement and funding of highways was an intensely political process. Politicians, lobbyists, and heads of industry all contributed to the current locations of interstate highways and state politicians were in charge of allocating resources for construction. If these outside contributors viewed highway construction and development as a place-based economic development policy, they may have been more likely to add segments of highway or reroute planned segments to reach less developed counties or start construction earlier the proposed military routes. Figure 2 depicts the highly prioritized routes drawn in the Pershing Map.[16] The Pershing Map is relatively new in the literature and has only been used by Michaels et al. (2013).

The second is the proposed map from the National Interregional Highway Committee published in a 1947 report. I similarly digitize the 1947 Plan and identify the set of counties that received proposed highways. Figure 3 shows the 1947 Interregional Highway Committee plan. This map is visually very similar to the map of eventual highway locations. Table 1 con rms this result, 81 percent of highway counties were designated to receive a highway by the 1947 Plan compared to only 32 percent for the Pershing Map. The 1947 Plan is the most commonly used location instrument in the literature (Baum-Snow 2007, 2010, 2014; Michaels 2008; Duranton and Turner 2012; Duranton, Morrow, and Turner 2013). I include this instrument in order to position my results in the context of the prior literature.

I address the endogenous timing of highway construction using an application from network theory to predict the optimal timing of highway construction. I borrow from the Newman-Girvan Algorithm (Girvan and Newman 2002, 2004; Newman 2001, 2004) to prioritize each segment of the proposed highway networks. This algorithm was originally used to identify important connections in biological and social networks. To my knowledge this is the rst application of this algorithm in the economics literature. In order to apply the algorithm to the each of the historical highway network plans, I decompose each planned road system into a mathematical network of nodes and edges, where each node occurs at the intersection of two edges or at the end of an edge. I then weight each edge by it's length. The Newman-Girvan Algorithm calculates the edge-betweenness for each edge by determining the shortest path from each node to every other node in the system and then counting the number of shortest paths that move along that edge. Edges with the largest betweenness value are more important for connecting nodes in the network, therefore these edges

[16] The full Pershing Map contains three priority levels, the depicted map shows routes in the two highest priority levels. Priority three routes are shorter in length and appear to be designed to reach specialized locations, like military installations.

of the networks should have been built earlier.

My algorithm sequentially builds the network edges with the highest betweenness value subject to an annual construction budget. I derive this constraint from the construction costs of the entire network. I calculate total construction costs by aggregating the construction cost of each edge. Construction costs are based on weighted average costs of the urban and rural mileage. I use construction cost estimates for urban and rural cost per mile from a 1955 Congressional highway proposal. Urban mileage had an estimated cost of $2,431,818 per mile, while rural costs are signi cantly lower at $378,787 per mile.[17] Contemporary cost estimates of adding new rural and urban highway mileage are consistent with this urban to rural cost ratio.[18] I use historical cost estimates instead of current cost estimates because it better approximates the decision a social planner would have made at the time of construction.

I calculate the total cost of construction for each entire network using the computed cost of each segment of the proposed network. I then calculate the annual construction constraint by dividing the total network construction cost over a twenty ve year construction period, which roughly approximates the timeframe of actual highway construction. Once I have an annual construction constraint I rank the proposed networks edges with the highest betweenness scores rst and build them in that order until the total amount spent on construction equals the annual construction constraint. Unbuilt edges are carried over to the next year and the process repeats. The algorithm allows me to assign a construction year for each edge, which results in a highway instrument that predicts both the location of an interstate highway and the year of construction.

4.4 Instrument Validity

4.4.1 Static Model Inclusion Restriction

To test whether each proposed network with predicted construction timing su ciently predicts whether a county will have an interstate highway at time t I estimate the following rst-stage

[17] These construction cost estimates include the actual cost of construction as well as the cost of acquiring land.
[18] The ratio of construction costs is more important to the model than the actual costs.

regression using a Linear Probability Model.

$$hwy_{ct} = \quad Plan_{ct} + \quad {}_{rt} + \quad {}_{c} + V^{0}{}_{ct} + \quad {}_{cit} \qquad (5)$$

The variable $Plan_{ct}$ is an indicator for whether a county c is predicted to have a highway from the proposed network in year t. I also include the covariates from the second-stage, ${}_{rt}$ are the census region year xed-e ects, are the county xed-e ects, $V^{0}{}_{ct}$ are the infrastructure, population, and geographic controls, and ${}_{cit}$ is the error term.

Figures 3 and 4 present the rst-stage regression results by year along with the corresponding F-statistics. The F-statistics in these gures only approximate the true F-Statistics used in the paper because the regressions estimate the treatment e ects for the 5 year bins. Clustering the error terms by county and state/year alters the i.i.d. assumption associated with the standard rst-stage F-statistic calculation. To test the inclusion restriction I use Kleibergen-Paap F-statistics that adjusts for clustering the error term (Stock and Yogo 2005). The Kleibergen-Paap F-statstic in the static model ranges between 20 and 170 using the Pershing Map and 140 and 1700 using the 1947

borders. Another advantage is that the Pershing system was connected with straight lines. These straight line connects remove the possibility of manipulating the route in order to pass through a speci c county.

If the military designed the network around the potential growth of industrial centers, this might result in biased estimates. To test for this, I regress the Pershing system on changes in population and employment in both agriculture and manufacturing between 1910 and 1940, with the same set of xed-e ects and controls as equation (3) and I do not nd any evidence that the military was choosing areas with high growth rates in either industry or in population. Section 8 elaborates further on these results.

5 Employment and Establishment Growth

5.1 Total Employment and Establishment Growth

To measure whether the Interstate Highway System changed industry concentration, I start by determining if there is a di erence in the size of employment and the number of establishments for highway counties compared to non-highway counties and whether or not the di erence is changing over time. Table 3 shows growth patterns for both employment and establishments using the OLS and TSLS speci cations. The coe cient estimates, $_d$, compare highway to non-highway counties measured in ve year intervals. The coe cients can be interpreted as the di erence in highway and non-highway counties in period d.

By the early 1990s employment was 7.04 percent higher in highway counties compared to non-highway counties. TSLS results for both instruments indicate positive employment growth occurred at a similar time but was substantially larger than the OLS results suggest. After the mid-1980s, the TSLS highway interaction terms are all substantially larger than the OLS. Considering the same period in the early 1990s, employment was 10-18 percent higher in highway counties relative to non-highway counties. Duranton and Turner (2012) nd that within US cities, a 10 percent

location endogeneity induces a negative bias on the estimates, which is consistent with planners and government o cials assigning interstate highways to lower quality locations. This result is consistent with the interstate highway literature and the literature on other place based development interventions (Duranton and Turner 2012).

The di erence between the OLS and both TSLS estimates in the early years indicates that the estimates are positively biased. The di erence in the direction of the bias comes from di erences in the predicted timing of highway construction. Figures 6 presents a map for actual interstate highway construction progress in 1965. Figures 7 and 8 present the maps for predicted construction progress using the Pershing Map and 1947 Plan respectively. The biggest di erences between the maps is the disjoint nature of the IHS construction compared to the predicted construction plans. The predicted construction plans build the highway networks progressively. The number of small segments in the map of actual highway construction suggests that areas were targeted. This targeting was done speci cally based on the quality of location. A comparison of the raw data supports this hypothesis, areas targeted earlier for highway construction had higher levels of employment and more establishments than areas targeted later. This bias is not present in the IV.

Putting the two forms of endogeneity together, interstate highways were assigned to lower performing locations but within this group of locations they were constructed in the highest performing places rst. The combination of these two forms of bias results in a positive bias in the early OLS estimates and an negative bias in the later estimates. The early results also indicate the importance of the positive timing bias, which is substantially larger than the negative location bias.

5.2 Employment Growth by Industry

Next I determine if the employment growth observed in the previous section varies across sectors. Table 4 shows employment growth results for 4 of the 10 industry classi cations.[20] These four industries generally follow the patterns found in total employment growth the the previous section.

[20] Regression results for all 10 industry classi cations are available in the online appendix. Employment growth across the ten industries is mostly consistent with earnings growth found by Chandra and Thompson (2000).

The results indicate employment grew the most in the agricultural sector and the transportation and public utilities sector. By the mid-1990s, employment in both sectors was between 17 and 27 percent higher in highway counties compared to non-highway counties. The large gains in employment in agriculture are consistent with the results found in Frye (2014).

Growth in manufacturing employment follows a similar monotonically increasing pattern but

6 Employment and Establishment Concentration

6.1 Concentration Across-Industries

Results from the previous section established that highways led to significant employment and establishment growth differences between highway and non-highway counties. The findings also indicate this growth was not equally distributed across industries. Unequal growth both across space and across industries suggests that highways may induce changes in regional specialization. In this section I measure the degree to which interstate highways led to differential specialization in employment and the number of establishments. To empirically measure specialization I will use the Herfindahl Index and the Gini Specialization Index described in equation (1) and (2). Larger values for both of these measures indicate a higher degree of concentration where a larger share of employment is in fewer sectors. Table 5 presents OLS and TSLS results for the different concentration measures. The dependent variable in Panel A is the Herfindahl Index and the dependent variable in Panel B is the Gini Specialization Index.

The concentration results using the Herfindahl Index indicate employment was more concentrated in highway counties in the early years of highway construction, then became more diverse, before finally becoming more concentrated again. The explanation for this pattern may be similar to the explanation for employment. If employment shifts in non-highway counties grow, particularly in very few sectors, then the herfindahl index would likely rise initially. The results from the TSLS specification with the Pershing Map indicates this shift is only temporary and by the early 1970s employment in highway counties is less concentrated than in non-highway counties. By the 1990s, highway counties are substantially more concentrated. The TSLS estimates using the Pershing Map indicate employment in highway counties was 18 percent more concentrated at the mean than non-highway counties.[21] The concentration results using the Herfindahl Index for the number of establishments shows fewer statistically significant results. The results using the 1947 Plan as an IV suggest there may have been limited establishment concentration by the mid-1990s. The results

The percentage of tiny firms in retail sales, services, and transportation and public utilities all fell considerably after the expansion of interstate highways. Considering highways only affect three of the ten industries, these results indicate that small businesses with no employees are not likely to substantially change the results. These results also suggest interstate highways are not useful for decreasing market power or promoting entrepreneurship in small businesses.

7 Dynamic Effects of Interstate Highways

The prior two sections measure the differences between highway and non-highway counties at different points in time. Now I focus on a more dynamic model for measuring the effects of the Interstate Highway System using equations 4 and 6, which map out the full dynamic response of the outcomes of interest to receiving an interstate highway.

7.1 Employment and Establishment Growth

Table 7 presents the regression results for the full dynamic response of employment and the number of establishments to receiving an interstate highway. These results are consistent with the prior findings of the effects of interstate highways on employment. Both TSLS results indicate substantial employment and establishment growth takes between 15 and 20 years to be realized. This explains why many of the positive benefits of interstate highways are not evident in the static model until the late 1970s. In 1996, the average highway was about 30 years old, which indicates the average highway community experienced between 15 and 18 percent more employment than non-highway counties.

7.2 Employment and Establishment Concentration

The dynamic response of industry concentration as measured by the Herfindahl Index and the Gini Specialization Index are presented in table 8. The two measures of concentration give slightly competing results. The Herfindahl Index results for employment suggest that the longer highways are in a county the more likely that county is to diversify. This is contrasted with the results from the Gini Specialization Index, which shows that the longer a highway is in an area the more like it

The outcomes of interest from the regression are two general measures, population and urbanization, and two measures of industry similar to the metrics used in the paper, establishments and employment. Panel A presents the results for the 1947 Plan. There is some evidence that the 1947 plan may have been influenced by the growth potential in 1930, however these effects appear to diminish by 1940. Panel B presents the results for the Military Plan. These results look better in the years immediately around the proposed plan. The only statistically significant difference is are the set of $_{d}$'s, which measures the e ect of the unbuilt segment during thed di erent periods. The interaction term in 1962-1966 is the excluded year. I include the same set of controls and xed-e ects as in the prior models. I also two-way cluster my standard errors by county and state/year. I restrict the sample to counties that never received an interstate highway, so the comparison is between non-highway counties and non-highway counties that contain any unbuilt portions of the Pershing Plan. The results are presented in table 10 and suggest that the unbuilt segments of the Pershing Map have no impact on employment and the number of establishments. This result supports the exogeneity requirements for the Pershing Map.

9 Conclusions

This paper examines the causal e ect of interstate highways on the geographic concentration of industry. The paper addresses two major forms of endogeneity regarding the placement and timing of highway construction by using historic government proposed national highway network plans and network theory. The bias induced by timing endogeneity is salient to the literature on other government infrastructure projects that are rolled out over time and show the need to account for the temporal variation in the allocation of fundings.

Results indicate the expansion of transportation infrastructure led to substantial employmenemplooa7(t)i1(f

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10 Figures

Figure 1: National System of Interstate and Defense Highways

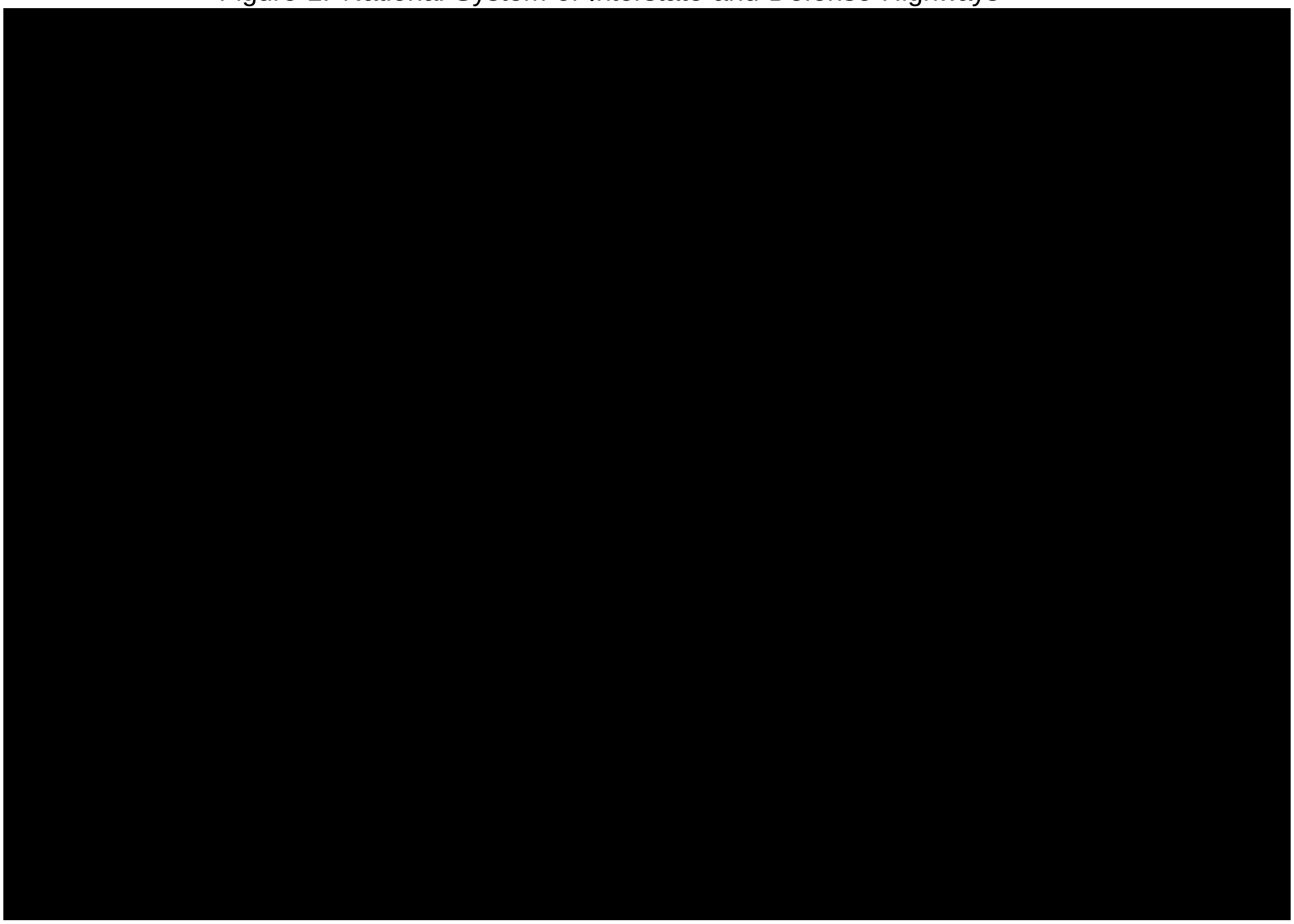

Figure 2: Pershing Military Plan

Figure 3: 1947 Plan from the Interregional Highway Committee

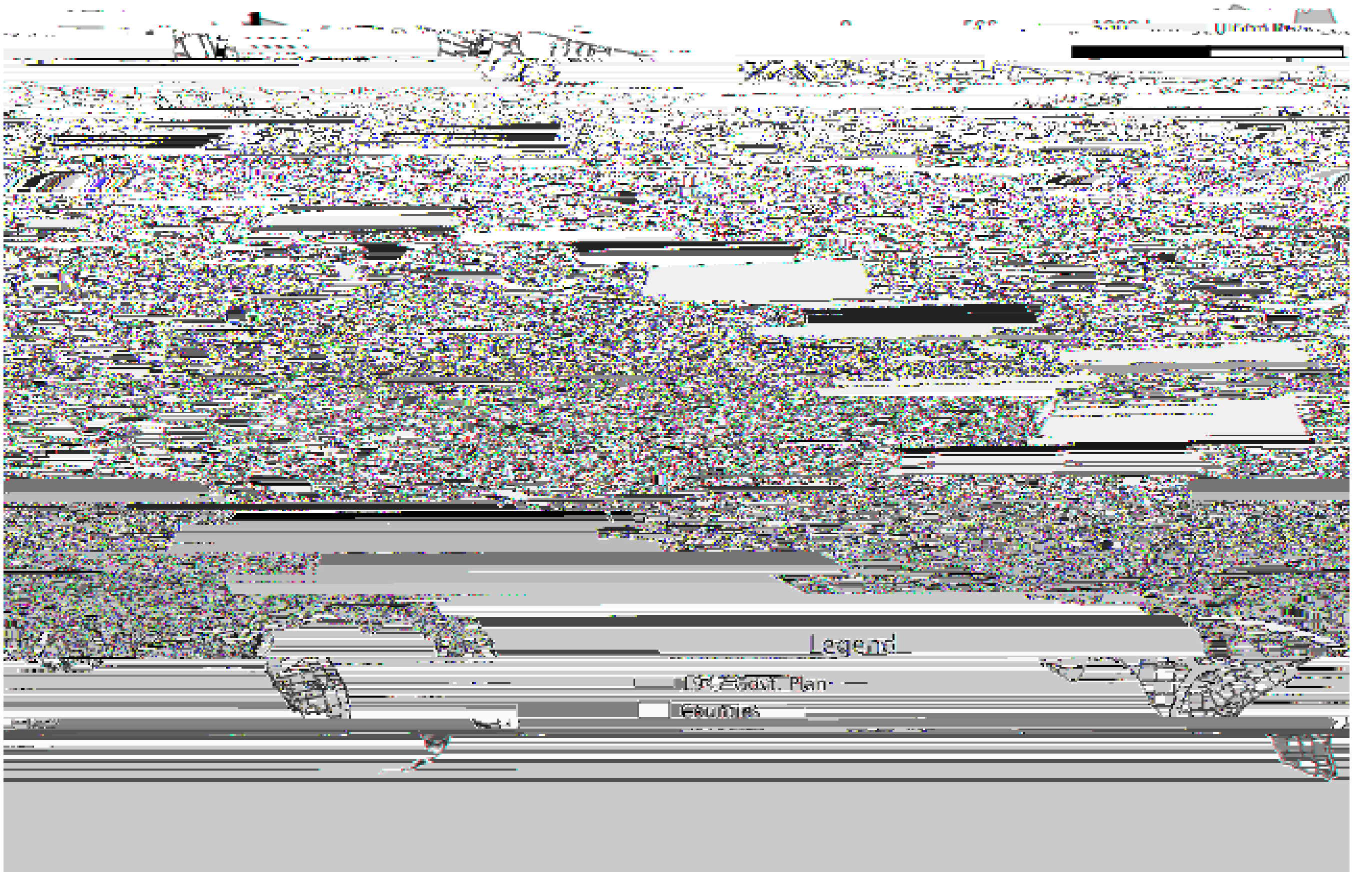

Figure 4: First-Stage Coe cients and F-Statistics by Year for the 1947 Plan

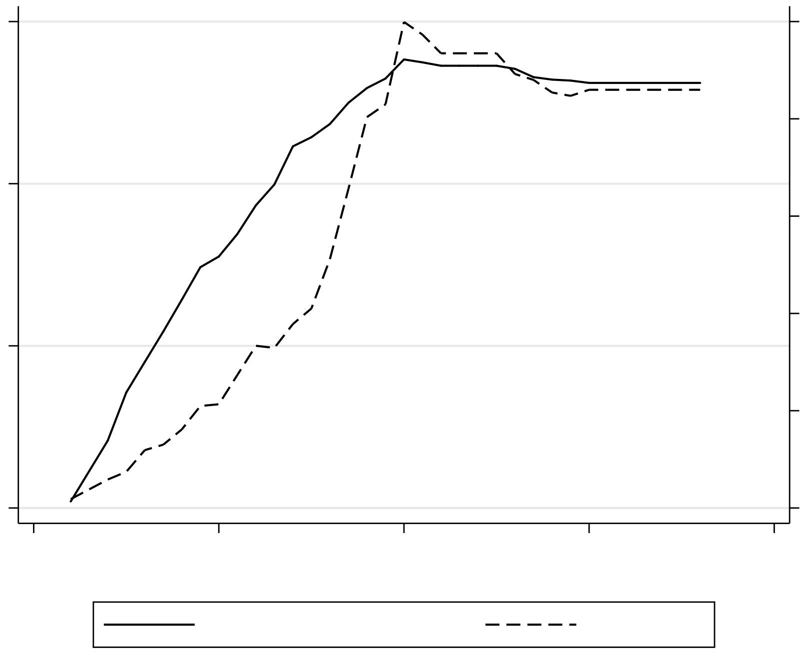

Figure 5: First-Stage Coe cients and F-Statistics by Year for the Military Plan

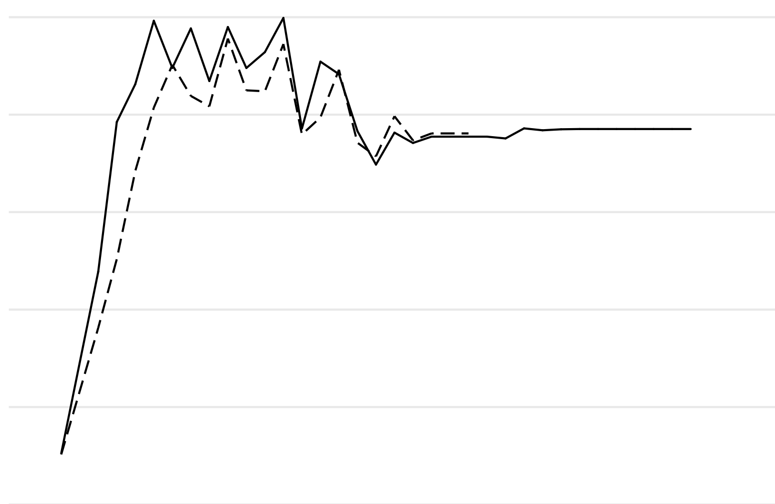

Figure 6: Interstate Highways Constructed in 1965

Figure 7: Proposed Military Plan Construction in 1965

Figure 8: Proposed 1947 Plan Construction in 1965

11 Tables

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