Perhaps the Sky's the Limit?

Airports and Employment in Local Economies*

Marquise J. McGraw†

December 18, 2015

Abstract

This paper considers the effects of small and mid-size commercial airports on their local economies over the post World War II period, specifically 1950-2010. To estimate these effects, I use a detailed, novel dataset of Census Based Statistical Area (CBSA) level employment outcomes, geographic, transportation, and city characteristics, along with previously unexploited historical aviation data. Using an instrumental variables approach with three instruments – the locations of collection points on the Air Mail system of 1938, a network of Federally constructed emergency air fields in the early years of aviation, and a 1922 plan of airways for national defense, as well as two alternative estimators – one-to-one Mahalanobis distance matching with caliper and pooled synthetic controls – I show that airports have had substantial effects on CBSA population and employment over time. Specifically, I find that relative to non-airport cities, the presence of an airport in a CBSA has caused population growth ranging between 14.6 percent and 29 percent, total employment growth of between 17.4 percent and 36.6 percent, tradable industry employment growth of between 26.6 percent and 42.6 percent, and non-tradable industry employment growth of between a non-statistically significant 2.7 percent and 16.1 percent. These effects vary by region, city size, and traffic levels. Most of these growth effects occurred over two periods: first, at the beginning of the post-war period, 1950-1960, and then, during the formative years of the jet age, 1970-1980, after which the effects of aviation remained constant. The larger effect on tradable industry employment implies that the overall employment and population effects may result from direct effects on tradable sector industry productivity, perhaps by facilitating information flows. Effects vary by initial city size and region, and are generally robust to the choice of instruments and/or estimator.

*I would like to thank Enrico Moretti, David Card, and Victor Couture for their expert guidance and advice on this project to date. I also thank Bob Helsley, Pat Kline, Dan Chatman, Mark Hansen, Severin Borenstein, Charles Becker, and Janet Kohlhase, as well as seminar participants at the University of Mannheim MAYBE Workshop, the Federal Reserve Bank of Chicago, the 2014 meeting of the Western Regional Science Association, the 2013 AEA Mentoring Program Conference, and the 2013 All-California Labor Economic Conference Poster Session for helpful comments. I am indebted to numerous undergraduate students for excellent research assistance, particularly Alice Wang, Kathleen Hui, and Xiaoxi (Cathy) Liu, who made insightful and substantial contributions to this paper. This project was conducted while I was a NSF Graduate Research Fellow at UC Berkeley, and I gratefully acknowledge their financial support. I also thank the UC Berkeley Graduate Division and the NSF/AEA Mentoring Program for additional financial support. All errors are my own.

†Assistant Professor, Department of Economics, Middlebury College. mmcgraw@middlebury.edu

1 Introduction

To the casual observer, airports and aviation in general appear to be beneficial for cities. In fact, many cities consider their airports a vital part of their local economies. Consistent with this belief, the Federal government subsidizes air travel through the provision of funds to necessary infrastructure such as the air traffic control system, and also to very small airports through programs such as the Essential Air Service. These expenditures are not trivial; as of October 2012, 120 communities in the contiguous United States received a total of nearly $225 million dollars yearly in such subsidies (Wittman and Swelbar, 2013). Local municipalities themselves also subsidize aviation by offering incentives to air carriers for service to their cities with the goal of increasing economic activity within their borders. For example, in 2010, Huntsville International Airport, a 12-gate airport in Madison County, Alabama, spent $1.5 million in local taxpayer money to attract service from AirTran Airways. In 2013, it set aside $5 million in hopes of luring more service.[1] Local leaders fear that the loss of service would hurt Huntsville's ability to attract new jobs and to compete for new conventions and tourists.

Would Huntsville, and similar places, be different had it not been for their airports? If so, how might those differences come about? How is it that airports might play such an important role, and through what mechanism? Answers to these questions are unclear from the current literature. In an era where many airlines are pulling out of smaller airports, this is a critical question. In fact, Wittman and Swelbar (2013) note that between 2007 and 2012, 24 airports lost all their commercial service at some point. Understanding how aviation might affect cities, particularly smaller cities, is critical to understanding whether there is a proper policy response. This is also important for understanding how transportation infrastructure, more generally, might affect cities, and how those effects may have developed over time. The primary goal of this paper is to examine the question of how airports have affected their local economies over the post World War II period, 1950-2010, in the hope of providing new evidence of the role of airports in these cities, particularly in medium-sized and smaller communities.

In identifying the causal effect of airports on population and employment, econometrically, the major concern is endogeneity. Airports, similar to other pieces of infrastructure such as roads, are not randomly assigned to cities, which could lead to biased estimates. In the case of airports, this is even more of a concern, given the law in the United States specifically stipulates that the construction and operation of airports is a local responsibility. This gives rise to questions which may complicate estimation of these effects. Were airports

[1] Carey, Susan. "Why Small Airports are in Big Trouble". Wall Street Journal. http://online.wsj.com/news/articles/SB10001424052702304688104579465711898215996

strategically constructed in cities that expected to thrive anyway, so that effects casually attributed to the airport could potentially result from other unexplained factors? Or, alternatively, were airports built in places with relatively dim prospects in the hope of stimulating growth in those local economies, with the true effect of aviation actually larger than initially thought?

A key innovation of this paper is a research design that examines the entire recent history of aviation in the United States during the period 1900-2010, while employing previously unexploited historical aviation data to address endogeneity concerns. I use three alternative estimation strategies to identify the causal effects of airports on local economic outcomes over the post World War II period, with a focus on population and employment (total, tradable industries, non-tradable industries, and the transportation sector) as outcomes of interest.[2] The first is an instrumental variables (IV) strategy with three instruments – the locations of mail collection points on the Air Mail system of 1938, the locations of a network of Federally constructed emergency air fields from the early years of aviation, and primary cities on a 1922 plan of airways for national defense – to estimate these effects. I argue that these factors are directly related to the eventual placement of airports in the pre World War II period, but conditional on pre-period controls, are exogenous to the outcomes of interest in later periods, enabling causal identification of the effect of interest. The second, "Caliper Matching", is a variant of one-to-one matching, which combines a caliper (to remove outliers and inliers) with a Mahalanobis distance estimator to estimate causal treatment effects under the assumption of conditional independence. Finally, the third, "Pooled Synthetic Controls", combines and averages individual case estimates generated by the synthetic control estimator Abadie and Gardeazabal (2003) to measure the average treatment effect. It accomplishes this by generating a counterfactual outcome for each Census Based Statistical Area (CBSA), which is then differenced from the actual observed outcomes to estimate effects for an individual case.

I find that relative to non-airport cities, the presence of an airport in a CBSA has caused population growth ranging between 14.6 percent and 29 percent, total employment growth of between 17.4 percent and 36.6 percent, tradable industry employment growth of between 26.6 percent and 42.6 percent, and non-tradable industry employment growth of between a non-statistically significant 2.7 percent and 16.1 percent. These effects vary by region, city size, and traffic levels. I show that airports boosted local economies over two periods: at the beginning of the post-war period, 1950-1960, and during the formative years of the jet age, 1970-1980, after which the effects of aviation remained constant. Given that the airports appear to have a somewhat larger effect on tradable industry employment, it appears that the overall employment and

[2]Tradable goods are produced in the agriculture, mining, manufacturing, and wholesale trade sectors. Non-tradable goods are produced in the construction, retail trade, finance, insurance and real estate, public administration, and services sector. (The transportation, communications, and utilities sector is considered separately.)

population effects result from direct effects on tradable sector industry productivity, perhaps by facilitating information flows, which through multiplier effects leads to higher employment in non-tradable sectors as well. To put these effects in context, the observed growth effects in the 1970s translates into $83.8 million in added payroll and 3,300 jobs for a local economy, of which roughly 950 are in tradable industries. Effects vary by initial city size and region, and are generally robust to the choice of instruments and/or estimator.

This paper proceeds as follows. In Section 2, I present a brief review of the relevant literature. Section 3 presents a simple framework for thinking about how airports may affect employment in local economies. Section 4.1 discusses sample selection and data sources and characteristics. Results are presented in Section 5, and Section 6 concludes.

2 Literature Review

The literature on the specific topic of airports and regional economic development, while growing, is still relatively small. However, this paper is also related to the broader literature on the effects of public infrastucture, as well as the literature on roads and economic development. For instance, Aschauer (1989) . was one of the first to provide evidence that public capital, specifically "core" infrastructure, plays a significant role in economic growth.[3] Munnell (1990) showed that states that have invested more in infrastructure tend to have greater output, more private investment, and more economic growth. She notes, but cannot conclusively prove, that causation seems to run from investment to increased productivity.

Closely related to the topic of airports and urban development is the literature on roads. Baum-Snow (2007) estimated the effect of highways on suburbanization using the 1947 national highway plan as an instrument for the highway system that was eventually constructed. He found if the interstate highway system had not been built, aggregate central city population in each metropolitan statistical area (MSA) would have increased by 8 percent between 1950 and 1990; however, it actually decreased by 17 percent over the period. Michaels (2008) found that the opening of the interstate highway system increased trade-related activities in rural counties. In so doing, the highways raised the demand for skilled workers in skill-abundant counties and reduced it elsewhere. Duranton et al. (2013), using the 1947 national highway plan as an instrument, showed that highways play an important role in determining the specialization of urban sectors in terms of production and trade in heavy goods. Duranton and Turner (2012) examine causality between road transportation and

[3] Aschauer includes streets, highways, airports, electrical and gas facilities, mass transit, water systems and sewers in this group.

city growth, finding significant effects of road miles on employment and population growth. For the period between 1983 and 2003, they find that a 10 percent increase in a city's initial stock of highways leads to a 1.5 percent increase in employment over the 20-year period.

In aviation, Brueckner (1982) was among the first study to explicitly consider the question of whether and how the quality of airline service received by a city impacts its business climate. Focusing on smaller cities, he was unable to obtain conclusive evidence of a relationship. He did note, however, that traffic was higher when a military base was nearby and was also increasing in the share of professional ("white-collar") jobs. Brueckner (2003) found that a 10 percent increase in passenger enplanements in a metro area leads approximately to a one percent increase in employment in service-related industries, with no effect on manufacturing or other types of employment, based on 1979 data. Green (2007) uses time-series data and finds that a 10 percent increase in boardings per capita leads to a 3.9 percent increase in population growth and a 2.8 percent higher employment growth for the ten-year period of 1990 to 2000. Taken together, these papers indicate a likely relationship between air service and local economic outcomes. However, these findings could be dominated by the effects of airports on larger metropolitan areas, such as New York and San Francisco.

Blonigen and Cristea (2012) exploit the market changes induced by the 1978 Airline Deregulation Act to examine the relationship between air traffic and local economic growth. Using time-series variation in local growth rates over a 20-year period centered around deregulation (1969-1991), they find that air service has a positive and significant effect on regional growth, with the size of these effects differing by the size of the MSA and its industrial mix. Sheard (2014) uses the Civil Aeronautics Administration's 1944 National Airport Plan as an instrument for the current distribution of airports (by size, as measured by air traffic) in the U.S. His dependent variable of interest is employment shares. He estimates that airport size has a positive effect on local employment in tradable services, with an elasticity of approximately 0.1, and a negative effect on manufacturing. He finds no measurable effect on non-tradable services. Note that his instrument is relevant to his question (of employment shares), but endogenous if one is interested in understanding aggregate population or employment outcomes, since, by 1944, planners were basing their assessments on outcomes observed well after the aviation system had become established, and were thus assigning airports to places that planners believed would need them in the future.

This paper contributes to the literature in two ways. First, unlike other papers that consider the effects of aviation only over limited periods, I consider the entire period of aviation in the United States (1900-2010), allowing for a better understanding of how the role of airports may have shifted over time. Second, by explicitly focusing on mid-sized and smaller airports, and using new data from the formative period of aviation to better identify counterfactual cities, I am able to examine these effects in a context that more closely resembles a natural experiment, improving the likelihood of identifying the effects of interest.[4] Third, by focusing on airports in CBSAs as the unit of observation, rather than air traffic, I reduce the likelihood that the observed effects of aviation are unfairly weighted toward the largest cities, which allows for a better understanding of how airports impact smaller metropolitan areas. Finally, the use of three alternative estimation strategies, each operating under different sets of identifying assumptions, allows for a fuller characterization of the role of airports on employment in local economies.

3 Local Labor Markets and Airports

Public infrastructure, such as airports, may affect the economic activity of a metropolitan area by: (1) acting as an unpaid factor of production in a firm's production function, (2) working to making other inputs more productive, (3) helping to attract other inputs from elsewhere, and/or (4) stimulating demand for more infrastructure (e.g. roads) and related services (Eberts and McMillen, 1999). In this paper, I focus on the first channel, but note the other three channels could potentially be of importance as well.

The effect of the airport shock on a representative local labor market is shown in the highly stylized model given in Figure 1. In this city, labor demand is assumed to be downward sloping, while labor supply slopes upward. In the short run (panel a), the opening of the airport acts as a shock to labor demand, which, being a productive amenity increases as the airport makes (some) existing firms more productive and also attracts new firms to the city. Hence, demand shifts from D_1 to D_2. Wages increase as well, from w_1 to w_2. In the long run (panel b), workers in non-airport cities see the higher wages in the airport city and move there, increasing the supply of labor and shifting labor supply from S_1 to S_2. This shift depresses the short-run wage gains. However, long run employment rests at L_3, which represents a larger gain $(L_3 - L_1)$ relative to the original employment boost $(L_2 - L_1)$. As a result, the airport is expected to increase employment, but not necessarily wages, in long-run equilibrium.[5]

The magnitude of the employment effect $(L_3 - L_1)$ could potentially vary by industry. This would be true if an airport affected certain industries more than others. Assume that firms in all cities produce goods of two

[4] While understanding the effects of airports on the New York City or San Francisco-Oakland Metropolitan Area is a daunting challenge, it is relatively straightforward, by comparison, to assess how an airport has affected a smaller, more isolated economy, such as the one in Elmira, NY.

[5] An alternative examination of the city's response to the airport, based on the local labor markets model derived in Moretti (2011), can be found in the Appendix.

types - tradable and non-tradable. Tradable goods - goods that are destined for consumption outside the city where they were produced - are found in the agriculture, mining, manufacturing, and wholesale trade sectors. Non-tradable goods consist of output in the construction, retail trade, finance, insurance and real estate, public administration, and services sector.[6] Let$X$ represent the set of goods produced in the economy. This is then composed of two subsets, tradable x_t and non-tradable x_m firms. There are J tradable industries producing goods x_{t1} through x_{tj}, and K non-tradable industries producing goods x_{m1} through z_{mk}.

Suppose the airport serves as a shock primarily to the tradable industry x_1 in city c. The direct effect of this is an increase in employment for industry x_1. The indirect effect is composed of changes in employment in both sectors. With the positive shock to x_1, aggregate income increases because there are more jobs and, if the labor supply curve slopes upward, local wages are higher, at least in the short-run. This, in turn, stimulates local demand for non-tradable goods. The size of this effect will depend on consumer preferences, the types of jobs in the tradable sector (skilled versus unskilled), and the elasticities of land and labor. The shock to x_1 may also stimulate additional demand for tradable goods in other tradable industries. However, this need not be a positive effect: the citywide increase in production costs reduces the competitiveness of the other tradable firms. As the price of tradables is fixed on the national market, if the local metropolitan area's cost of production becomes too high, it may become beneficial for some of these firms to shift production to other, less costly areas.

If airports are shown to affect employment in the tradable sector, then potentially gains in the non-tradable sector could be observed as well. However, the reverse would not be true if any employment growth is entirely due to increasing levels of non-tradable employment. I posit that if air travel has an effect on employment, it is likely due to the fact that it allows facilitation of information flows (Bel and Fageda (2008); Giroud (2013); Hovhannisyan and Keller (2011)), enhancing local level productivity. This could occur in either tradable industries, non-tradable industries, or both. It could also be the case that, just as the role of cities has changed over time from hubs of agricultural trade to information-based knowledge economies (see, for example, Boustan et al. (2013)), the role of airports may have shifted over time as well.

[6]The transportation, communications, and utilities sector is considered separately, but is included in all estimates of total employment.

4 Research Design and Estimation Strategies

4.1 Research Design

In the absence of any endogeneity concerns, and under the strong assumption of identical cities with identical populations and sectoral employment structures, if airports were randomly assigned to cities, estimating the treatment effect of airports would be trivially given by the difference in outcomes between airport and non-airport cities. However, even after controlling for differences in city size and employment, there are numerous reasons to believe that airports were not randomly assigned to cities. The Air Commerce Act of 1926 stipulates that the construction of airports is a local responsibility. The demand for airports at a local level can be expected to be heterogeneous - for example, places with larger populations or that expect to grow faster could be more likely to establish airports. The opposite might be true as well - places that foresaw a loss in population or in key industries may have turned to airports as a way to rescue their troubled cities. Furthermore, places where policymakers believed in the "winged gospel" of aviation may have been more likely to put substantial local resources behind airport construction and maintenance (Bednarek, 2001). Finally, as I discuss below in more detail, efforts of the U.S. Army Air Service and the U.S. Post Office Department in the 1920s and 1930s played a key role in the determination of the post-1950 location of airports.

The timing of airport openings is also a concern. Although comprehensive data on opening dates is unavailable, information is available on service activation dates.[7] In order for commercial aviation to affect the economy, not only did airports have to be built, but other pieces of infrastructure such as airways, beacons, and crucially, aircraft, had to be in place and capable of carrying significant numbers of passengers. Such technology did not exist until the post World War II period. Smaller, expensive-to-operate DC-3 propeller aircraft were used by most major airlines in the late 1940s and 1950s. With the advent and proliferation of jet aircraft through the 1960s, air travel quickly became the de facto mode of choice for long distance travel. Consistent with these factors, I follow Bednarek (2001) and consider the beginning of the post-war period as the key structural break. Since my data is decadal in nature, I consider 1950 as the base year for estimating treatment effects.[8] Hence, the treatment effect of interest in this study is the effect of a CBSA having an

[7] Activation dates indicate when the Federal government added the airport to the National Airport System. Given that these records were not maintained until 1926, airports opening earlier than 1926 are shown as being activated in 1926.

[8] One might argue that I could normalize each airport to its opening date, and look at its evolution after that. However, this would only complicate the analysis, and could even confound it. This is due to a variety of reasons: a) actual "opening dates" are really difficult to track down and are unavailable in many cases (though I have access to an "activation date", but this need not be the opening date; b) since air service essentially started in earnest in the 1945-1950 period in many places, without the technology and conditions for the rest of the aviation network in place, such an analysis would fail to pick up the desired effect of the post-WW II effects of aviaiton on the economy; and c) the effects of government efforts in fighting the second World

airport activated anytime before 1950, under the assumption that 1950 is the year during which the effects of aviation may first be measured. I also examine effects by decade.

In this study, cities of interest are those containing one (and only one) airport that is fully capable of handling commercial flight activity. To identify this set of airports and corresponding cities, airports are included in the study based upon certain criteria. First, the airport's FAA activation date must be 1950 or prior[9]. Secondly, an airport, by 1950, must be publicly owned and fully available for public use. As a proxy for capability of handling commercial operations, the airport must have an air traffic control tower. Moreover, because the process of receiving an airport in larger cities is determined by factors not common to other cities, an airport must not have been classified by the Federal Aviation Administration (FAA) as a "large hub" airport in 1964.[10] Data from FAA Form 5010 (Airport Master Record), as well as the *FAA Statistical Handbook*, was used to derive the initial sample.[11] Since I am interested in metropolitan area level outcomes, I use Core Based Statistical Areas (CBSAs) as the unit of observation. Next, in order to reduce confounding, any CBSAs with multiple airports are dropped fom the sample, along with CBSAs whose airports are less than 40 miles away from the nearest airport are dropped.[12] Airports that moved were also removed from the sample, giving the main sample of 131 airports. Figure 2 shows their locations. I also identify 14 "general aviation" (GA) airports that meet all the conditions above except for (3) to be used as a placebo sample.

To identify a suitable set of control CBSAs, I restrict the sample to the set of control CBSAs that (1) had, at a minimum, limited experience with aviation in the 1920s or (2) were slated to receive a first commercial-level airport under the Civil Aeronautics Administration's National Airport Plan of 1944.[13] For the former, I used the 1926 locations of emergency air fields, hand-entered from the Army Air Service's *Landing Fields in the United States*, as a proxy for a set of places that could support an airport, based on land availability, engineering considerations, and local-level knowledge required to construct an airport. In many (though certainly not all cases), it would have been rather easy to upgrade these facilities during the pre-period to full airport status if desired. After accounting for CBSAs dropped due to inconsistent geography, 379 CBSAs

War would be picked up in such a normalization (airport closures to civilian traffic, repurposing of some airfields as temporary military bases, etc).

[9]17 commercial airports were opened after 1950; these were excluded from the sample

[10]Given all the economic processes at work in these larger cities, including such airports could lead to bias in the estimated effects. For example, one might be concerned about confounding arising from multiple issues in this initial sample. Cities such as, say, New York and San Francisco, were destined to get airports with high-frequency service, and to continue to grow independent of any single piece of infrastructure. Moreover, in these extremely large locales, air traffic is often constrained by capacity. Given these complications, and the lack of credible counterfactual CBSAs for such places, identifying the effect of one single piece of infrastructure on population or employment growth could be a task fraught with peril, particularly within the constraints of this project's research design. Therefore, I drop any airport that was classified as a "large hub city" airport in 1964. 1964 was the first year in which a Federal agency classified airports by their size and relevance to the national aviation system.

[11]FAA Form 5010 Data: http://www.faa.gov/airports/airport_safety/airportdata_5010/

[12]ArcGIS software was used for these calculations.

[13]More precisely, locations proposed to receive airports of Class 3 or greater in the National Airport Plan.

serve as controls. Of these, 110 CBSAs share a boundary with treated CBSAs. Figure 3 shows the treated, control, adjacent, and GA airport CBSAs.

4.2 Estimation Strategies

In order to consistently estimate airport treatment effects, I implement three alternative estimators, each considered below in turn: (1) Instrumental Variables (IV), (2) One-to-One Caliper Distance Matching (Matching), and (3) Pooled Synthetic Controls (Synth). Additionally, I present baseline OLS estimates.[14]

4.2.1 Instrumental Variables

To address the endogeneity concerns noted above, I propose three instruments for airport location. These are: (1) the locations of collection points on the Air Mail system of 1938, (2) primary cities located on a 1922 plan of airways for national defense, and (3) the locations of a network of Federally constructed emergency air fields from the early years of aviation.

Air Mail Network. As early as 1918, the U.S. Post Office Department was interested in developing a network of air routes to speed mail delivery and increase its revenues for its growing Air Mail service.[15] The Postmaster General originally drew routes with specific objectives (e.g. San Francisco to New York), with the placement of intermediate stops along these trunk lines in large part due to the constraints of early aircraft. Local municipalities, through lobbying efforts, were encouraged to build airports with the promise of profits that would later flow. The Post Office contracted out the actual work of carrying the mail to enterprising airlines, which would later add passenger service as well. In fact, by the mid-1930s, four of the major airlines that would go on to dominate domestic commercial travel for most of the twentieth century began operations as contractors for the Post Office: United, American, Eastern, and Transcontinental and Western Air (TWA). The result is that by 1938, a substantial number of airports had been established and their locations would generally remain fixed. Hence, Air Mail is a relevant instrument because of the pivotal role it played in the establishment of the national aviation network. Additionally, Air Mail should have little to do (directly) with productivity or population growth of today. One may argue, of course, that the places that received Air Mail were more populous and experiencing faster growth than others. Although this is true, this is not a major concern because I control for past growth. Validity of the IV approach requires only

[14] In the appendix, I also provide estimates from a difference-in-difference estimation strategy, but due to the lack of balanced pre-trends between treated and control units, do not use that method as a primary estimation strategy.

[15] See VanDerLinden (2002) for a comprehensive survey of the history of this program.

orthogonality between post-period outcomes and the instruments conditional on the controls, not unconditional orthogonality (Duranton and Turner, 2012). Moreover, the fact that the development of the Air Mail system occurred well before 1950 also enhances the case for the validity of Air Mail as an instrument. See Figure 4 for a map. Data on Air Mail was hand-entered from the First Edition of the *American Air Mail Catalogue*, published in 1940. The Catalogue provides an index of all Air Mail routes and cities, including their start dates.

Army Air Service Plan. In 1923, the Army Air Service published the first comprehensive plan of airways and air routes deemed necessary for military navigation in *Airways and Landing Facilities,* a circular providing a template for cities to build their own airports. According to the original document, those airways would "promote commercial aviation, be an important transportation factor in the progress of civilization, and be available for national defense". The Plan stipulated that airways would have main stations 200 miles apart, substations 100 miles apart with landing fields and some level of basic services, and intermediate airfields 25 miles apart for emergency use. Hence, the location of places chosen as main stations on this plan was stipulated by the requirements above. These airfields were envisioned as places where Army pilots, the National Guard and Reserve units could train. The network was also envisioned to connect parts of the Air Service located in disparate places. For example, one of the first lines was a route between New York City, Washington DC, and Rantoul, Illinois via Dayton, Ohio, where the Air Service's engineering division was located. This plan is relevant as places located along this network likely were lobbied to construct airfields, as the Army Air Service did not have the budget to carry this out on their own. In some cases, there may have been overlap with the efforts of the Post Office as well. The validity of this plan as an instrument hinges on what was meant by "promote commercial aviation". While the document says little about this, it appears that the Army Air Service envisioned a network of airways that would primarily serve their own purposes, but yet be open to other users such as the Post Office Department and private citizens. It appears reasonable to assume that these locations were chosen mainly according to the rules set out above, without much concern for the effects of the plan on any particular set of municipalities; hence, any effects that this plan might have on employment could reasonably be expected to happen only through any effect the plan had on airport location. Main cities on the Army Air Service Plan were hand-entered directly from the map.

CAA Intermediate Airfields. These airfields were created by the Civil Aeronautics Administration as a network of emergency landing fields throughout the 1930s and 40s solely for safety reasons. Many paralleled the Air Mail system, and the locations were determined by the Federal government. Given their creation as the result of a policy directive, as well as their proximity to airports that did eventually get constructed, I use their locations as an instrument in the analysis. Their locations are related to where airports might later be permanently located, given that they are essentially mini-airports, but are assumed to be unrelated to any effect on employment or population given their small size.

Estimation. The model is estimated in two stages. The first stage fits a reduced-form equation using the instruments to predict airport location in the post-war period.[16] The second stage takes these predictions and estimates their effect on the outcomes of interest.

I estimate the following system of equations for level effects:

$$A_m = \alpha_1 + \gamma S_m + \pi Z_m + \epsilon_{1,m} \tag{1}$$

$$Y^i_{m,t} = \alpha^i_{2,t} + \beta^i_1 A_m + \beta_2 Z_m + \epsilon^i_{2,m,t} \tag{2}$$

and the following for long-differences:

$$A_m = \alpha_1 + \gamma S_m + \pi Z_m + \epsilon_{1,m} \tag{3}$$

$$\Delta Y^i_m = \alpha^i_2 + \beta^i_1 A_m + \beta_2 Z_m + \epsilon^i_{2,m} \tag{4}$$

where Y represents an outcome of interest, S is the vector of instruments , $i \epsilon I$ is a set of sectors in the economy, A is a dummy variable for having an airport in CBSA m, $\boldsymbol{Z}$ is a vector of exogenous controls for pre-period outcomes in the sector of interest (with both level and growth effects included), geography, climate, and access to other transportation networks; α_1 and α^i_2 are intercepts, and β^i_1 is the parameter of interest.β^i_1 is the contribution of having an airport to a CBSA's local economic outcome at time$t > 0$, after controlling for pre-period characteristics, relative to time $t = 0$, where 1950 is normalized to $t = 0$. $\epsilon_{1,m}$ and $\epsilon^i_{2,m}$ represent error terms. In general, $\Delta Y^i_m = ln(Y^i_{m,2010}) - ln(Y^i_{m,1950})$, but the base and end years change to encompass only one decade in some specifications. Where the outcome is presented as an employment share, $ln(Y^i_m) = ln(\frac{Ei}{E_t} \times 100)$, where E_i is employment in the sector of interest, and E_t is total employment.

It is important to keep in mind that non-randomized studies, such as this, require methods that fully adjust for the imbalance in baseline covariates between treatment and control groups. Regression can be

[16] As a robustness check, I introduce two alternative instruments - stops on Charles Lindbergh's Guggenheim Tour in 1927, and the locations of commercial/municipal airports in 1926.

problematic in this case - it can be sensitive to parametric assumptions (e.g. normality), especially when the baseline covariates are highly imbalanced. In this case, the estimates will depend heavily on correct model specification. Moreover, while there is overlap between airport and non-airport counties in the sample, it is a relatively limited amount; regression will tend to extrapolate outside of the region of common support, potentially biasing the results. To check whether this is a concern, I repeat the analysis using two other matching-based methods as described below.

4.2.2 Caliper Distance Matching

In addition to the instrumental variables method, the research design lends itself to non-regression-based methods of analysis, such as matching. As a thought experiment, consider a set of cities, some which received airports, some which did not but with otherwise similar population or employment growth characteristics up to and including 1950. Under the assumption of conditional independence, the matching estimator would give the treatment effect of airports. Given the fact that this analysis considers airports of different sizes, with varied geographic endowments and patterns of service, it is necessary to adjust for inliers and outliers, which is done by imposing a caliper.

Let Y, the outcome variable, represent an outcome of interest as in Section 4.2.1. The group of treated counties ($A = 1$) are the participants. The interest here is in comparing the mean value of Y in the group of airport counties with the mean value of the non-airport counties ($A = 0$), which are free of any mean differences in outcomes that result from differences in the observed covariates X across the groups. One crucial distinction here from the IV model of Section 4.2.1: the X matrix includes all of the variables placed in the Z matrix of the IV, and also includes the instruments themselves. Additionally, I include decade-by-decade interactions for pre-period population and/or employment growth. I make the key identifying assumption that after including this matrix of covariates, the conditional independence assumption is satisfied.

To estimate the effect of interest, the average treatment effect on the treated (ATET), I follow Rosenbaum and Rubin (1985), who suggest a matching strategy that improves on naïve propensity score matching, which is to use a distance metric that not only includes the propensity score, but in addition those covariates that are particularly good predictors of the outcome (in addition to the treatment). Since this distance metric has many components, usually a Mahalanobis distance (MD) is used to compute the distance between the treated and the controls (see Rosenbaum and Rubin (1985)). This is even more important than usual in this case because of the limited overlap on propensity scores between the treated and control groups, and misspecification of the propensity score $\rho(X)$ may lead to biased estimates. The MD between the X covariates for two units i and j is

$$MD(X_i, X_j) = \sqrt{(X_i - X_j)^T \hat{C}^{-1} (X_i - X_j)}$$

where $\hat{C}$ is the sample covariance matrix of X and $X^T$is its transpose. In this project, I include the vector of covariates X, as well as the propensity score, in the match function.

Given the need for enforcing an optimal pre-treatment balance of treated and control units, a caliper is applied as well. A caliper is the distance which is acceptable for any match. Observations which are outside of the caliper are dropped. A caliper value should be provided for each covariate in X. The caliper is interpreted to be in standardized units. The caliper is set to a standard of 0.3 standard deviations for population/employment levels in the pre-treatment period. However, for values in 1940 and 1950, the caliper is enforced at 0.2 standard deviations. Note that caliper= .3 means that all matches not equal to or within 0.3 standard deviations of each covariate in X are dropped. While it is true that dropping observations generally changes the quantity being estimated, this is entirely consistent with the research design as given in Section 4.1. In the absence of the caliper, it is impossible to achieve useful pre-treatment covariate balance, given the fact that some airport cities are outliers relative to other CBSAs.

The caliper matching routine was implemented using Jaskeet Sekhon's `Matching` package for `R` (Sekhon, 2011).

4.2.3 Pooled Synthetic Control Analysis

Additionally, I consider a reweighting/matching strategy based on synthetic controls. The use of synthetic controls was first proposed by Abadie and Gardeazabal (2003) and Abadie et al. (2010). It allows for the extension of the traditional differences-in-differences framework by allowing treatment effects to vary over time. In my case, the synthetic control is constructed as the weighted average of CBSAs in the "donor pool" - that is, the set of control counties described in Section 4.1.

Suppose there is a sample of $C + 1$ CBSAs, indexed by c, among which unit $c = 1$ is the treated CBSA and $c = 2$ to $c = C + 1$ are potential controls. We also assume a balanced panel with a positive number of pre-intervention periods, T_0, as well as a positive number of post-intervention periods, T_1, with $T_0 + T_1 = T$. Let Y_{ct} represent the outcome of unit c at time t. For a given t (with $t \geq T_0$), the synthetic control estimator of airport's effect is given by the difference between the treatment and synthetic control at that period:

$$Y_{1t} - \sum_{c=2}^{C+1} w_c^* Y_{ct}$$

where: $\mathbf{W} = (w_2, ..., w_{C+1})^T$ is a $(C \times 1)$ vector of positive weights that sum to 1; $\mathbf{X}_1$ is a $(k \times 1)$ vector containing a set of pre-intervention characteristic values; and $\mathbf{X}$ is a $(k \times C)$ matrix collecting the values of the same variables for the CBSAs in the set of airport potential CBSAs.

The synthetic control algorithm chooses optimal weights $\mathbf{W}^*$ that minimizes the mean square prediction error (MSPE) given by

$$\text{MSPE} = \|X_1 - X_0 W\|_V = \sqrt{(X_1 - X_0 W)^T V (X_1 - X_0 W)},$$

where an optimal choice of variable weights $\mathbf{V}$ assigns weights to linear combinations of the variables in X_0 and X_1.

In practice, I implement this estimation strategy using Abadie et al. (2011)'s `R` package `Synth`.

Next, I pool treatment and control units to create a set of matched cases. Importantly, to ensure optimal pre-period covariate balance, I discard units with poor fits before fitting the event-time specification to them. In this case, I discard units with MSPE < 0.05. I follow Severnini (2012) and pool treatment and control units to create a set of matched cases. For each outcome of interest Y, for each t in the analysis, estimate the following specifications:

Growth effects:

$$\Delta Y_m^i = \beta^y(\mathbf{1}(treat)) + \alpha_m + \epsilon \tag{5}$$

Level effects: For each $t \, \epsilon$ [1950, 1960, 1970, 1980, 1990, 2000, 2010],

$$Y_{m,t}^i = \beta_t^y(\mathbf{1}(treat)) + \alpha_m + \epsilon = \tag{6}$$

where α_m is a CBSA fixed effect. Standard errors are clustered at the case (CBSA) level.[17]

[17] As an alternative, standard errors may be bootstrapped at the CBSA level. Standard errors given by this method are close to, but generally slightly smaller than, bootstrapped standard errors. The standard errors considered here consider the uncertainty in the estimated effects, but not the corresponding uncertainty in the selection of CBSAs in the donor pool.

4.3 Data

A novel data set consisting of a balanced panel of CBSA-level outcomes for 1900-2010, inclusive, was constructed to estimate the effects of interest. It includes data on population, land areas, employment levels by sector, geography and climate characteristics, and previously unexploited historical information related to the development and creation of the aviation system. Most of the data was obtained at the county level and then aggregated into 2010 CBSAs.[18]

Employment data were obtained for the following sectors, in addition to total employment: Agriculture and Mining, Construction, Manufacturing; Transportation, Communications and Utilities; Wholesale Trade; Retail Trade; and Services. In general, data from 1900-1940 were obtained from the IPUMS database (Ruggles et al., 2010) by aggregating the microdata to the county level; 1950-1970 data were obtained from aggregate county-level data found in the City and County Data Book; and the remainder was downloaded from National Historical Geographic Information System (NHGIS) at the county level. Population data was obtained from the NHGIS U.S. Census database as well. I use payroll values from the County Business Patterns (CBP). For 1950, data were hand-entered from the 1951 CBP where available, and imputed for the rest based on 1964 values and state level effects, with additional values from NHGIS. Earnings data was also obtained from the Bureau of Economic Analysis. For rents, I use median contract rents from the City and County Data Book for 1930 and 1940, as well as rents from the NHGIS Census database for 1980-2010 (the rest are missing). More details on the construction of the population and employment data can be found in Appendix A.

Additionally, data were collected on a variety of geographic, transportation, and climate characteristics as controls. Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Other controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, having a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Please see Appendix A for more details on the source and construction of each of these variables.

Appendix Table A.1 gives characteristics of CBSAs with and without airports. Airport CBSAs are more likely to contain political capital cities and to have a land grant college. They are also more likely to have larger amounts of other transportation infrastructure such as roads, ports, or river access, and to be larger

[18]CBSAs consist of the county or counties or equivalent entities associated with at least one core (urbanized area or urban cluster) of at least 10,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties with the counties associated with the core. "CBSAs" refers collectively to metropolitan statistical areas and micropolitan statistical areas. CBSAs were selected as the unit of observation for the analysis since the service areas of airports are generally diffuse. The Data Appendix gives more information on how the data were aggregated and adjusted, where necessary, to ensure consistent geography throughout.

in overall land area as well. However, climate does not vary substantially between CBSAs with airports and those without. Additionally, the distribution of airports and non-airport CBSAs across regions are similar. Other findings are also consistent with the discussion given in Section 4. Airport CBSAs were more likely to have been located on the 1938 Air Mail network, and to have been home to a city listed in the 1922 Army Air Service Proposed System of Air Routes. Moreover, airport CBSAs are more likely to have been home to CAA intermediate airfields, political capital cities, and to have a land grant college. They are more likely to have larger amounts of other transportation infrastructure such as roads, ports, or river access, and to be larger in land area as well. In general, climate does not vary substantially between CBSAs with airports and those without. Finally, the distribution of airports and non-airport CBSAs across regions, access to a coast, and right-to-work state status are roughly similar. In what follows, controls for many of these characteristics will be included.

5 Results

5.1 Long Differences, 1950-2010

Ordinary Least Squares. Table 2 gives the main OLS results for the various outcomes considered - long-differences estimating the growth in the working age population (comprised of individuals between ages 15 and 64), total employment, and employment in tradable, non-tradable, and transportation resulting from the presence of an airport in a CBSA.[19] Panel A, controlling only for levels of pre-period population through 1950 and CBSA land area, gives an estimate of 0.364 (43.9 percent). Thus, it appears that in that initial specification, population grew 44 percent more in airport CBSAs than in non-airport CBSAs over the 1950-2010 study period. Controlling for regional effects via indicator variables for the nine Census divisions reduces the estimate to 0.246 (27.9 percent). Adding other controls in specification (3) – controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river – gives a very similar estimate of 0.252 (28.7 percent). In Panel B, estimates in the first three specifications ranges from 0.430 (52 percent) with only prior population controls included, to 0.292 (33.9 percent) with all controls, except for pre-period population, included. Specifications (4) through (6) replicate specifications (1) through (3), the

[19]Tradable goods are produced in the agriculture, mining, manufacturing, and wholesale trade sectors. Non-tradable goods are produced in the construction, retail trade, finance, insurance and real estate, public administration, and services sector. (The transportation, communications, and utilities sector is considered separately.)

only difference being the inclusion of controls for past population levels. The estimates change little, as the final estimate given in specification (6) of Panel B is 0.273 (31.4 percent).

Panel C shows the effects on tradable employment. Here, adding population controls has an interesting effect, reducing the magnitude of the estimated coefficients dramatically. This is puzzling. Economically, there is no reason to believe that tradable employment levels should respond much to city population. This is especially true since tradable employment, by definition, includes the production of goods and services that are sold on a national or international market, for consumption (in general) outside the borders of any single metropolitan area. Moreover, in Panel D, estimates of non-tradable employment remain stable across all six specifications, with a coefficient of 0.164 (17.8 percent) in specification (3), and 0.157 (17 percent) in specification (6). If, indeed something is happening here that is economically significant, we would expect the estimates for specifications (4) - (6) in Panel B to be substantially smaller and closer to their counterparts in Panel D, which is clearly not the case.

One plausible explanation is that the estimates for the tradable sector exhibits classical measurement error that worsens in the presence of multicollinearity (see, for example, Carroll, Raymond et al. (2006)). While the processes generating the data for tradable employment and total population differ, it is likely that any error in measurement is common to both. Moreover, the correlation coefficient between the two variables is 0.87 in 1950 and 0.86 in 2010, so multicollinearity could very well be a concern. The components that comprise tradable sector employment - agriculture and mining, manufacturing, and wholesale trade - exhibit higher levels of variability relative to the other study variables. The noise increases the bias in the tradable sector estimates. This, coupled with collinearity that accentuates attenuation of the coefficient on having an airport, leads to estimates that are subject to a significant amount of attenuation bias.[20]

In Panel E, specification (3) gives an estimate of transportation/communications/utilities (hereafter transportation) sector employment of 0.248 (28.1 percent), while specification (6) gives an estimate of 0.124 (13.2 percent). Given the discussion above, it appears likely that the transportation sector estimates also suffer from attenuation bias. Additionally, it follows that specifications (4) - (6) for the IV estimates that follow may also be biased for tradable sector employment and transportation employment.

[20] Following Carroll, Raymond et al. (2006), consider the general linear model $Y = \beta_0 + \beta_z^t Z + \beta_x^t X + \epsilon$. In the presence of classical measurement error, when $Z = 0$, it can be shown that regressing Y on X yields $\hat{\beta_x^t} = \beta_x^t \cdot \frac{\sigma_x^2}{\sigma_x^2 + \sigma_u^2}$. Adding the set of covariates Z, in this case, log population, changes the attenuation factor. It becomes $\hat{\beta_x^t} = \beta_x^t \cdot \frac{\sigma_{x|z}^2}{\sigma_{x|z}^2 + \sigma_u^2}$, where $\sigma_{x|z}^2$ is defined as the residual variance in the regression of X on the added covariates Z. In the presence of Z, $\sigma_{x|z}^2 < \sigma_x^2$, implying that collinearity accentuates attenuation. Given the amount of noise in the tradable sector (and transportation sector) data, it is likely that measurement error has induced bias in the affected estimates.

Instrumental Variables. Table 3 gives the first stage of the IV estimation, which predicts whether or not a CBSA will have an airport in 1950 or after, relying on all instruments as described in 4.2.1. Across all six specifications, the instruments remain positive and in most cases significant. Of the three instruments, the location of 1938 air mail terminals consistently provides the largest contribution to the first stage. P-values from Hansen's J test are large, especially in specifications (3) and (6), indicating that the excluded instruments are appropriate and are independent of the error process. The smallest F-statistic of the six specifications is 28.30 and the R^2 statistics are between 0.45 and 0.50, indicating the instruments have reasonable explanatory power. In what follows, the first stage always uses all three instruments. Table A.6 in the Appendix shows that estimates on total employment are reasonably robust to the combination of instruments used.

Table 4 presents the IV counterparts to the estimates provided in Table 2. IV estimates on population growth in Panel A, specifications (3) and (6) are slightly larger than their OLS counterparts. In Panel B, total employment is estimated to increase by 0.312 (36.6 percent) before controls for population are included, or 0.235 (26.5 percent) once they are added. In Panel C, tradable sector employment experiences the most dramatic change between specifications once prior population is added in specifications (4) through (6), with the estimated effect going from 0.335 (40 percent) in specification (3) to 0.038 (3.9 percent) in specification (6). In contrast, estimates of non-tradable employment in Panel D actually increase somewhat and more likely to remain significant after controlling for population. Finally, Panel E shows that transportation sector estimates decrease from 0.433 (54.2 percent) in specification (3) to a non-significant 0.185 (20.3 percent) once population controls are applied.

As in the OLS case above, the dramatic influence of population controls on both tradable and transportation employment effects is puzzling. It is likely that the instrumental variables estimator was unable to correct for the attenuation bias in the original OLS estimates; hence the IV estimates in specifications (4) through (6) may not be valid. To determine whether these estimates are economically significant, or due to multicollinearity or perhaps noise in the data interacting with the past population levels, I next present results from two related, but different methods based on entirely separate sets of assumptions: one-to-one matching with caliper, and pooled synthetic controls. As these are not regression-based methods, they do not suffer from the possibility of attenuation bias. Hence, if in the matching and synthetic control estimates, specifications (4) - (6) are close to their respective counterparts in specification (1) - (3), it is extremely likely that attenuation bias is at play. Moreover, using these two alternative methods enables a general check on the soundness on the magnitudes and signs of the IV estimates presented in Table 4.

Caliper Matching. Caliper matching, along with the pooled synthetic control method, requires balance between treated and control units in the pre-period. Panel 3 of Figures 6 through 10 show the matching method was able to successfully balance the primary covariates of past population and employment across the pre-period. Turning to the results presented in Table 5, note that across all employment and population groups considered in panels A through E, there is very little difference in the estimates across specifications (1) - (3). Additionally, the inclusion of population controls makes little difference in the magnitude of the estimates, as expected. Taking specification (6) as the final specification for this method, we see that airports are responsible for growth in population of 0.194 (21.4 percent), overall employment growth of 0.275 (31.7 percent), and growth in transportation sector employment of 0.567 (76.3 percent). Importantly, in Panel C, it is clear that the estimate of growth in the tradable sector, 0.355 (42.6 percent), is much closer to the estimated growth in the tradable sector given by specification (3) of the IV Table 4, 0.335 (39.8 percent) than specification (6), 0.038 (3.9 percent). Moreover, the growth in the non-tradable sector of 0.149 (16.1 percent) estimated by caliper matching is closer to the IV specification (3) estimate of 0.178 (19.5 percent) than it is to the specification (6) estimate of 0.251 (28.5 percent). Effects on the transportation sector remain large and significant throughout all specifications, with estimated employment growth of 0.567 (76.3 percent) given by the final specification (6).

Pooled Synthetic Controls. Panel 4 of Figures 6 through 10 show the pooled synthetic control method was also able to successfully balance the primary covariates of past population and employment. Generally, the coefficients estimated by the synthetic control method are smaller than those obtained by matching. This is expected, as each synthetic case study is essentially providing a custom reweighted control estimate for each treated unit. In contrast, caliper matching only ensures balance on average, but not within individual matched pairs. In general, after all covariates are added to the model in specification (6), growth in population resulting from the airport is estimated to be 0.136 (14.6 percent). The change in total employment is estimated to be 0.160 (17.4 percent). Notably, even with the reduced magnitudes of those estimates, the change in tradable sector employment remains large at 0.255 (29 percent), again more in line with IV Table 4 specification (3) than specification (6). In contrast to the other methods, small and insignificant effects for non-tradable employment are obtained. Also, just as in the case with matching and IV specification (3), effects on the transportation sector remain large and significant throughout all specifications, with a value of 0.333 (39.5 percent) obtained in the final specification (6).

Overall, it appears that with the inclusion of past population histories, matching and synthetic control estimates respond little to the additional information. The response of sectoral employment, particularly tradable and transportation, to the inclusion of past population values in the OLS and IV specifications is likely due to attenuation bias. This may result from measurement error, noise, and/or multicollinearity, and is not reflective of any critical structural trends in local economy employment not already captured by past employment level controls. As a result, I take model (3) as my final specification in the OLS and IV cases, and use the values from specification (6) when discussing the matching and synthetic control cases, since they appear to respond as expected – that is, not substantially – to the inclusion of population as a control. The top panel of Appendix Table A.2 summarizes these findings by method for each method's preferred specification. [21]

Considering the evidence presented thus far, I find that over the 1950-2010 period, the presence of airports in a CBSA has caused population growth ranging between 0.136 (14.6 percent) and 0.255 (29 percent), total employment growth of between 0.160 (17.4 percent) and 0.312 (36.6 percent), tradable sector employment growth of between 0.236 (26.6 percent) and 0.355 (42.6 percent), and non-tradable employment growth of between a non-statistically significant 0.027 (2.7 percent) and 0.149 (16.1 percent).

It is instructive to interpret the results in light of CBSA employment shares to understand these estimated responses in the broader context of other local economic trends. In 1950, the share of tradable sector employment in airport CBSAs was 40.5 percent, while the share in non-airport counties was 47.8 percent. By 2010, these shares had decreased to 16 and 20.5 percent, respectively. Even with the increase in tradable employment levels, relative to their 1950 levels, airports caused a decrease in tradable employment shares of between 0.142 (15.3 percent) and 0.234 (26.4 percent) while leading to their increase in the non-tradable sector by 0.038 (3.9 percent) to 0.083 (8.7 percent). Taken together, the job "growth" estimated for tradable sector jobs is essentially one of retaining existing tradable sector jobs, which through multiplier effects led to the creation of more non-tradable sector jobs. As the entire U.S. economy shifted from a manufacturing-based economy to a service-based one, airports played a key role in the transition.

Finally, in all the estimates, note the effect on population is less than that on employment in virtually all the specifications. Not only did airports contribute to increasing levels of employment among the existing labor force, but they appear to have intensified labor force participation as well, providing the jobs that would enable, for example, women to join the ranks of the employed in significant numbers. Figure A.3 shows how airports shifted the employment to population (EPOP) ratio on average as well, with much of the divergence occurring in the 1970s.

Estimates of treatment effects for specific sector outcomes can be found in Appendix Table A.2. Additionally, more details on employment shares can be found in Appendix Table A.3.

[21] Appendix Table A.2 provides difference-in-difference estimates for reference as well, many of which are close to methods estimated by the other methods.

5.2 Decade-By-Decade and Dynamic Effects

Table 7 gives IV estimates of the decade-by-decade effects of airports on employment since 1950.[22] In each specification, note that pre-period employment controls are included up to the base year. Significant growth in population and total employment occurred in two periods: 1950-1960 and 1970-1980. Estimated growth in population and employment, respectively, were 0.083 (8.7 percent) and 0.124 (13.2 percent) in the 1950s, and 0.081 (8.4 percent) and 0.0982 (10.3 percent) in the 1970s. Panel C shows that, as previously noted, the EPOP ratio diverged most dramatically in the 1970s, with roughly 3 percent higher labor force participation in airport CBSAs. Tradable employment grew in the 1950s, 1970s and 1980s, with the largest gain of 0.146 (15.7 percent) taking place in the 1950s. Non-tradable employment grew by 0.083 (8.7 percent) in the 1950s and 0.135 (14.5 percent) in the 1970s. Transportation sector employment, as expected, grew mostly in the early periods of airports, and would continue to grow through 1980, after which transportation sector employment levels would remain essentially constant.

Table 8 gives effects of airports, for each decade, on selected earnings and housing outcomes.[23] Panel A shows that airports had mostly insignificant effects on total CBSA payroll in each decade, with the exception of the 1970s. Panel B shows that per-worker payroll increased by roughly 4 percent in the 1960s; however, this was the only decade for which this would be true. Panel C, using earnings data from the Bureau of Economic Analysis, shows that earnings increased 13.9 percent between 1970 and 1980, with smaller increases thereafter. However, Panel D indicates that workers did not benefit from this; the additional payroll generated is almost entirely due to the additional jobs that the airports created. Finally, Panel E indicates that rents were unaffected by the airports.[24]

Figures 6 - 9 provide another perspective on the dynamic effects of airports over time. Each figure plots the evolution of the treatment effect for each year between 1950 and 2010. Note that the figures are normalized to 1940, so that effects on impact can be more easily seen. In general, the dynamic trends are similar to those already described above, and are similar across the various estimation methods. The estimated IV effects in the 1940s and 1950s are quite large, especially for tradable sector employment and transportation sector employment. Since the mean airport in the sample was open by 1940, it is not surprising that firms and individuals began to position themselves in locations with airports as the potential utility of aviation became clear to firms and individuals.

[22]See Appendix Table A.9 for OLS estimates.
[23]See Appendix Table A.10 for OLS estimates.
[24]Rents are unavailable for 1960 and 1970; however they are available for 1950. Running a regression of change in rent between 1950 and 2010 on having an airport in the CBSA yielded a zero effect.

Effects for individual sectors are shown in Figures 10 and 11. Tradable sector employment appears to be driven by growth in agriculture and mining. Wholesale trade increased the largest anticipatory effect before 1950, but afterward the impact remained constant. Hence, aviation led to an early growth spurt, but no additional growth since. This is evidence that while air cargo may be driving some of the observed effects, it is not necessarily the sole source of these effects. Nontradable sector employment has increased in construction, finance and real estate and services, but not in retail. Additional construction, increased financial sector activity and increased professional services as a result of the airport could rise solely on their own, or could be new demand resulting from the increase in tradable sector jobs.

5.3 Extensions

I now consider whether the average effects reported above, differ by city size, region, or service levels. Table 9 provides estimates of the main effects of interest by population quartile.[25] In the first quartile, that is, for airport cities with 1950 populations between 15,000 and 60,000 people, it appears that the airport had comparatively small and insignificant effects on all outcomes considered. In the second quartile, comprised of cities with populations between 60,000 and 120,000 people, the airports had large and significant effects on population and employment. This is true of cities in the third quartile (with populations between 120,000 and 250,000) and fourth quartiles as well (with populations between 250,000 and 1.24 million). Although the low F statistics shown in columns (1) - (3) may be of concern, it appears that the bottom 25 percent of cities, by population, may have had different outcomes from the remaining 75 percent.

Airports also appear to have affected different regions in slightly different ways. This can be seen in Table 10.[26] The Midwest has benefited dramatically from aviation, with a roughly 75 percent increase in population and total employment attributable to the airport. It also appears that the airports benefited the South by shifting EPOP ratios. Hence, it is possible that airports helped the South transition to a more modern service based economy during the 1970s and beyond. Finally, it appears that the West benefited from strong growth in its tradable sectors. Given the fact that the economies of the West are much younger than their counterparts in the rest of the U.S., airports seem to have played a role in allowing Western local economies to quickly catch up to those of the rest of the country.

Another way of examining the heterogeneity of the treatment effects is to examine the outcomes given by the synthetically created cases with the strongest fits.[27] Figures A.4 and A.5 shows that the Midwest benefited

[25]See Appendix Table A.11 for OLS estimates.
[26]See Appendix Table A.12 for OLS estimates.
[27]MSPE < 0.05 for the scatter plot (Figure A.6) and table; MSPE < 0.01 for the bar charts (Figures A.4 and A.5)

from its airports in a substantial way in terms of population and overall employment. Many of the airports at the top of the list are associated with universities (Bloomington-Normal Regional, Columbia Regional) or strong manufacturing and tourism industries (Springfield-Branson). A drawback of the synthetic control estimator is that it predicts negative growth in places with weak fundamentals. Manufacturing economies that experienced rapid population decline such as Syracuse and Elmira, New York, fall into this category. On balance, however, the synthetic control results confirm that the Midwestern and Southern regions of the U.S. benefitted substantially from the rise of aviation. However, rust belt cities such as Dayton, OH and Erie, PA would experience population declines despite having airports. In general, though, more cities experienced tradable employment gains then tradable employment losses. The scatterplot in Figure A.6 shows that there is, generally, no relationship between initial level of population in 1950 and the airport treatment effect.[28] From this, it appears that the contribution of an airport, while on average positive, is (1) highly variable, (2) is heavily dependent on local level fundamentals such as having a university, good tourist attractions, and/or a solid local employment base independent of the airport, and (3) does not vary much, relative to the size of a community. Thus, policy makers should be careful to cite transportation investments in cities with strong fundamentals in order to yield the highest return. It is also instructive to consider the interaction of region and initial city size on employment effects. Table A.13 examines this, again using the synthetic control estimator.[29] This exercise confirms and summarizes the existence of heterogeneity in individual city outcomes as described above. Interestingly, airports in the South and West were most effective for the largest cities, while those in the Midwest were most effective for the smallest cities.

I next consider how traffic flows may affect sectoral employment outcomes. Figure A.1 shows the air traffic levels for the various sample groups of airports over time. “Enplanements” measures the number of people who have boarded an aircraft at a particular airport, while “operations” refers to the number of departing and arriving flights.[30] It is immediately evident that enplanements have increased over time, with flight operations increasing at an even faster rate (this is due to air carriers’ desire to capture market share in the 1990s and part of 2000s). For the airports in this study, enplanements as a share of total commercial traffic enplanements have remained relatively constant over time. Enplanements per capita have increased sharply over the period for primary airports (i.e. airports for which traffic data is available from 1964 on), from 0.5 enplanements per capita in 1964 to almost two enplanements per capita in 2000 (but then falling to

[28]However, Austin, TX and Colorado Springs, CO are notable outliers in this regard.

[29]The IV estimates become inconsistent with so few airports in each case.

[30]Technically, “enplanements” refers to the number of passengers boarding a flight at a given airport that was classified by the Federal Aviation Administration as an air carrier, air taxi, or commuter flight. “Operations” refers to the number of flights taking off from a given airport that were classified as itinerant air carrier or itinerant air taxi operations. While many of the airports in the sample also have significant activity classified as general aviation, I do not count these flights, as many of these are operations by private pilots or for flight instruction.

1.5 enplanements per capita in 2010). A similar pattern emerges for the non-primary airports (which have traffic data from 1980 on). These airports collectively have a much smaller share of air traffic, and, also have, on a per capita basis, between 0.5 and 0.75 enplanements per capita since 1980. Taken together, this means that air traffic has (1) been increasing over time, which could potentially explain, for example, why there has not been a decrease in any of the observed employment effects; (2) the sample airports' role in the aviation network has remained relatively constant over time, as measured by the share of passengers serviced by them; and (3) enplanements per capita has been increasing, meaning that the intensity with which the airports have been used has increased, at least through 2000.

The question then becomes whether there might be any evidence that this change in traffic may have affected one industry moreso than another. To address this question, I use industry-specific fixed effects regressions to see how the intensification of air traffic might affect these economies. The specification, for each industry j and CBSA i, is:

$$y_{ijt} = \alpha_i + \beta_1 Log(T)_{ijt} + \gamma_t + \mu_{it} + \epsilon_{ijt} \tag{7}$$

where y_{ijt} is log employment in the industry of interest, $log(T)$ refers to log per capita traffic as measured by log enplanements, γ_t is a year fixed effect, μ_{it} is a CBSA fixed effect, and ϵ_{ijt} is an error term. The regression includes traffic data from 1980 through 2010.

Generally, it appears that non-tradable employment responds more to increasing air traffic, with an elasticity of per capita traffic to CBSA employment 0.067, versus a non-significant elasticity of 0.035 for tradable employment. Within the nontraded industries, the strongest impacts are on the construction and financial, insurance, and real estate services industry, with elasticities of 0.121 and 0.102, respectively. The effect on construction is likely a response to the increased economic vitality that airports bring to many of the regions where they are situated, while the effects on the finance and service industries could be indicative of the role that face-to-face contact plays in ensuring success in information-based industries such as finance and certain types of services, such as consulting. Thus, it appears that just as airports provided key links allowing for a thriving tradable sector in their early years, the importance of aviation has now increased for the non-tradable sector as well. As the service sector is where the vast majority of modern jobs are located, there may be some justification for cities to advocate for high levels of air service. See Table A.5 in the Appendix for more details.

5.3.1 Airports and Job Creation

Using the estimates of job growth presented for the 1970-80 period in Tables 7 and 8, I recover the amount of additional earnings and payroll, as well as the number of jobs created by the average airport in the sample, during that period. In the treated airport communities, payroll growth of 0.125 (13.3 percent) and earnings growth of 0.130 (13.9 percent) translates into added payroll generated of $83.8 million ($74.0 million if measured in earnings rather than payroll) in 2010 dollars. After accounting for multiplier effects, the average airport is estimated to generate over 3,350 jobs, of which roughly 950 are in the tradable sector.[31]

As a reference case, consider Branson Airport, the first all-new major commercial airport to open in the United States in 2009. The airport cost $155 million to build in 2010 dollars.[32] Estimates on the expected payroll and number of jobs to be generated by the airport are extremely close to the figures given above.[33] It appears that Branson Airport can pay for itself in little over three years, the costs of environmental externalities and federally provided services such as air traffic control notwithstanding. It must be stressed that these are averages, and that a particular airport may generate little if any economic boost for its local economy, if, as in the Elmira case study (Section **??**), macroeconomic forces and/or local level fundamentals are such that the airport fails to have a stimulative effect.

5.4 Additional Robustness Checks

Robustness to alternative methods. It has already been shown that the main estimates presented here are generally robust to estimation with alternative estimators. Additionally, as a check on the instruments used, I carry out regressions of airports on the change in total employment, but with various combinations of instruments. Table A.6 shows that IV estimates are generally consistent, providing evidence that estimates are robust to various combinations of the potential instruments given in Section 4.2.1, as long as the Air Mail instrument is included in the set of instruments. The two remaining instruments are too weak to be useful on their own.

Non-towered GA airports. Table A.7 shows the estimated effect of the small general aviation airports on the economy. The sample size is small ($n = 14$). These are small airports that are not equipped for commercial service, but otherwise meet conditions for inclusion in the sample. The IV estimator finds no significant

[31] Recovering the number of transportation sector and other sector jobs is complicated by the fact that the coefficient on 1970-1980 transportation sector employment is small and not statistically insignificant.

[32] Branson Airport Fact Sheet, http://flybranson.com/docs/BransonAirportFactSheet.pdf

[33] Branson airport is estimated to generate $77.5 million in payroll and 3,299 jobs for the Branson Lakes Regional Economy.

effects. However, the matching estimator picks up a negative effect on population and transportation sector employment. Given the small sample size and fact that the matching coefficient on total employment is 0.014, it is unlikely that those are much more than statistical noise.

Neighboring CBSAs. Table A.8 considers the effect of neighboring CBSAs on airports. While the IV estimates remain noisy, the other methods indicate employment effects close to zero. This indicates that spillovers of airports on neighboring CBSAs is not an issue in the analysis. Moreover, removing neighboring CBSAs from the analysis does not affect the IV estimates substantially.

6 Conclusion and Policy Implications

This paper has considered the effects of small and mid-size commercial airports opened before 1950 on their local economies over the post World War II period, specifically over the period 1950-2010. I used a rich, detailed dataset of CBSA-level employment outcomes, geographical, transportation, and city background characteristics, as well as previously unexploited historical aviation events to estimate these effects. Using an instrumental variables approach, as well as caliper matching and pooled synthetic control methods, I showed that airports have had substantial effects on population and employment. Specifically, I found that relative to non-airport CBSAs, the presence of an airport in a CBSA has caused population growth ranging between 14.6 percent and 29 percent, total employment growth of between 17.4 percent and 36.6 percent, tradable sector employment growth of between 26.6 percent and 42.6 percent, and non-tradable employment growth of between a non-statistically significant 2.7 percent and 16.1 percent. These effects vary by region, city size, and traffic levels. The growth in the effects happen over two periods: from 1950-1960 and 1970-1980, after which the effect of aviation remains relatively constant on local economies. Evidence indicates that airports stimulate this employment and population increase via a direct effect on employment in tradable sectors, which through multiplier effects leads to higher employment in nontradables. The estimated effects for the 1970-1980 period translate into $83.8 million in added payroll and 3,300 jobs for a local economy generated by an airport, of which roughly 950 are in the tradable sector. It is important to note that the contribution of an airport, while on average positive, appears to be heterogeneous in the following respects: (1) it is highly variable, (2) it is heavily dependent on local level fundamentals such as having a university, good tourist attractions, and/or a solid local employment base independent of the airport, and (3) it does not vary much relative to the size of a community.

Taken together, I have shown that, on balance, infrastructure investment stimulates growth in the economy.

Cities that were able to find a place for themselves in the network early on have, on average, benefited from their positioning. The lesson here is not that cities should rush to open new airports. Rather, it is crucial for cities to maintain their competitive edge by sometimes being willing to take intelligent risks in nascent technologies, and that if successful, cities benefit. Moreover, it appears that the effects are highly dependent upon local level fundamentals and are quite heterogenous, but, with the exception of all but the smallest of cities, are independent of city size. Hence, some small airports have contributed to positive outcomes; others have not. At a minimum, service should be maintained to existing airports, at least at current levels. Whether an increase in service might intensify these observed effects overall is unclear, but there is some evidence that higher utilization of airports is associated with higher service sector employment, so perhaps increased air service could stimulate further growth in local economies. Investment and implementation of next-generation air traffic control capability, which would allow aircraft to fly more closely together and to operate more efficiently has the opportunity to positively affect airport communities. Finally, it appears worthwhile to continue to invest in airports, to ensure that firms and individuals who can benefit from the aviation system can do so, at least until the next innovation in long-distance transporation infrastructure comes along.

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Table 1: **Sample Means - Airport Characteristics**

	All Airports ($n = 131$)	
Variable	Mean	SD
Activation Year	1940.66	(2.91)
Distance to nearest CBD (miles)	4.79	(2.53)
Land Area of Airport (acres)	2185.52	(1667.94)
Current length of longest runway (feet)	8894.42	(1730.72)
Distance to nearest comm. airport (miles)	87.60	(39.46)
Boardings/Enplanements [thousands] (1960)	103.22	(165.25)
Boardings/Enplanements [thousands] (1980)	369.78	(570.63)
Boardings/Enplanements [thousands] (2010)	869.20	(2091.69)
Flights/Operations [thousands] (1960)	6.04	(7.39)
Flights/Operations [thousands] (1990)	35.13	(56.23)
Flights/Operations [thousands] (2010)	35.98	(61.77)
Per Capita Boardings (1960)	0.29	(0.39)
Per Capita Boardings (1980)	0.95	(0.94)
Per Capita Boardings (2010)	1.13	(1.19)

Notes: Standard Deviations (SD) in parentheses. Boardings/enplanements and flights include air carrier, air taxi (on-demand) and commuter flights.

Table 2: **OLS Results: Effect of Airports on CBSA Outcomes, Long Differences 1950-2010**

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Change in Population (All Persons, Ages 15 - 64), 1950-2010						
Airport	0.349***	0.223***	0.235***	0.349***	0.223***	0.235***
	(0.064)	(0.060)	(0.053)	(0.064)	(0.060)	(0.053)
R^2	*.335*	*.481*	*.549*	*.335*	*.481*	*.549*
n	508	508	506	508	508	506
Panel B: Change in Total Employment, 1950-2010						
Airport	0.430***	0.298***	0.292***	0.400***	0.262***	0.273***
	(0.067)	(0.064)	(0.056)	(0.064)	(0.062)	(0.057)
R^2	*.291*	*.439*	*.512*	*.358*	*.503*	*.548*
n	508	508	506	508	508	506
Panel C: Change in Tradable Sector Employment, 1950-2010						
Airport	0.479***	0.358***	0.311***	0.222***	0.160**	0.190***
	(0.069)	(0.072)	(0.065)	(0.067)	(0.070)	(0.067)
R^2	*.279*	*.374*	*.448*	*.416*	*.462*	*.491*
n	506	506	504	506	506	504
Panel D: Change in Non-Tradable Sector Employment, 1950-2010						
Airport	0.182***	0.144***	0.164***	0.164***	0.126***	0.157***
	(0.053)	(0.049)	(0.047)	(0.053)	(0.049)	(0.047)
R^2	*.435*	*.518*	*.549*	*.449*	*.533*	*.56*
n	496	496	494	496	496	494
Panel E: Change in Transportation Sector Employment, 1950-2010						
Airport	0.396***	0.287***	0.248***	0.238***	0.125**	0.124**
	(0.076)	(0.076)	(0.068)	(0.066)	(0.062)	(0.060)
R^2	*.215*	*.368*	*.475*	*.477*	*.571*	*.612*
n	420	420	419	420	420	419
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Pre-period Population	N	N	N	Y	Y	Y
Region	N	Y	Y	N	Y	Y
Geography/Transport	N	N	Y	N	N	Y

Notes: Table reports results of ordinary least squares (OLS) regressions of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 -1950 in ten year increments. (Log population is substituted for log employment in Panel A.) Population controls include controls for pre-period 15-64 population, in log levels, for 1900-1950 in ten year increments. Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: **IV Regressions - First Stage Statistics**

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			Dependent Variable: Have Airport			
On 1922 Army Air Service Plan	0.234***	0.180***	0.156**	0.229***	0.163**	0.142**
	(0.0606)	(0.0628)	(0.0666)	(0.0611)	(0.0635)	(0.0668)
On 1938 Air Mail Route	0.443***	0.405***	0.391***	0.437***	0.389***	0.375***
	(0.0570)	(0.0591)	(0.0624)	(0.0582)	(0.0607)	(0.0636)
CAA Intermediate Airfield	0.0452	0.0567*	0.0717**	0.0424	0.0556*	0.0698**
	(0.0309)	(0.0312)	(0.0342)	(0.0311)	(0.0309)	(0.0338)
Constant	-0.925***	-1.438***	-1.332***	-0.785***	-1.302***	-1.187***
	(0.176)	(0.234)	(0.277)	(0.247)	(0.287)	(0.336)
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Pre-period Population	N	N	N	Y	Y	Y
Region	N	Y	Y	N	Y	Y
Geography/Transport	N	N	Y	N	N	Y
Observations	508	508	506	508	508	506
R-squared	0.451	0.480	0.486	0.459	0.492	0.497
F statistic	62.78	39.78	31.61	45.81	34.84	28.30
Overid (Hansen's J) P-Value	0.0839	0.726	0.906	0.0216	0.660	0.649

Note: Table reports the first stage regressions of CBSA airport status on whether the CBSA was on the 1922 Army Air Service Proposed Airways Systems of the United States (see Figure 5), the 1938 Air Mail network (see Figure 4), or on a CAA intermediate airfield (see Figure **??**). Cluster-robust standard errors given in parentheses, clustered on the CBSA level.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: **IV Results: Effect of Airports on CBSA Outcomes, Long Differences 1950-2010**

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Change in Population (All Persons, Ages 15 - 64), 1950-2010						
Airport	0.571***	0.254*	0.255*	0.571***	0.254*	0.255*
	(0.127)	(0.139)	(0.134)	(0.127)	(0.139)	(0.134)
First Stage F	*69.245*	*43.176*	*33.617*	*69.245*	*43.176*	*33.617*
n	508	508	506	508	508	506
Panel B: Change in Total Employment, 1950-2010						
Airport	0.681***	0.339**	0.312**	0.653***	0.231	0.235*
	(0.130)	(0.139)	(0.130)	(0.126)	(0.144)	(0.138)
First Stage F	*62.777*	*39.775*	*31.612*	*45.806*	*34.844*	*28.295*
n	508	508	506	508	508	506
Panel C: Change in Tradable Sector Employment, 1950-2010						
Airport	0.719***	0.466***	0.335**	0.273**	0.032	0.038
	(0.119)	(0.128)	(0.137)	(0.131)	(0.154)	(0.164)
First Stage F	*52.589*	*32.095*	*28.475*	*48.698*	*34.804*	*30.582*
n	506	506	504	506	506	504
Panel D: Change in Non-Tradable Sector Employment, 1950-2010						
Airport	0.300***	0.157	0.178	0.301***	0.181	0.251*
	(0.111)	(0.124)	(0.123)	(0.114)	(0.127)	(0.130)
First Stage F	*76.203*	*46.382*	*35.998*	*51.121*	*38.247*	*31.745*
n	496	496	494	496	496	494
Panel E: Change in Transportation Sector Employment, 1950-2010						
Airport	0.773****	0.549****	0.433***	0.509****	0.235*	0.185
	(0.153)	(0.163)	(0.152)	(0.124)	(0.135)	(0.139)
First Stage F	*69.487*	*45.751*	*34.34*	*52.465*	*43.248*	*34.832*
n	420	420	419	420	420	419
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Pre-period Population	N	N	N	Y	Y	Y
Region	N	Y	Y	N	Y	Y
Geography/Transport	N	N	Y	N	N	Y

Notes: Table reports results of instrumental variables (IV) regressions of log population/employment outcome on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 -1950 in ten year increments. (Log population is substituted for log employment in Panel A.) Population controls include controls for pre-period 15-64 population, in log levels, for 1900-1950 in ten year increments. Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* p < 0.1, ** p < 0.05, *** p < 0.01

Table 5: **Caliper Matching Results: Effect of Airports on CBSA Outcomes, Long Differences 1950-2010**

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Change in Population (All Persons, Ages 15 - 64), 1950-2010						
Airport	0.184***	0.176***	0.194***	0.166**	0.179***	0.194***
	(0.066)	(0.067)	(0.068)	(0.066)	(0.068)	(0.068)
Matched Cases n	76	76	76	76	76	76
Panel B: Change in Total Employment, 1950-2010						
Airport	0.272***	0.273***	0.265***	0.287***	0.256***	0.275***
	(0.050)	(0.053)	(0.053)	(0.050)	(0.054)	(0.053)
Matched Cases n	74	74	74	74	74	74
Panel C: Change in Tradable Sector Employment, 1950-2010						
Airport	0.362***	0.385***	0.355***	0.380***	0.388***	0.355***
	(0.060)	(0.058)	(0.055)	(0.059)	(0.058)	(0.056)
Matched Cases n	71	71	71	71	71	71
Panel D: Change in Non-Tradable Sector Employment, 1950-2010						
Airport	0.154***	0.163***	0.145***	0.122***	0.148***	0.149***
	(0.040)	(0.038)	(0.038)	(0.040)	(0.040)	(0.038)
Matched Cases n	54	54	54	54	54	54
Panel E: Change in Transportation Sector Employment, 1950-2010						
Airport	0.490***	0.538***	0.586***	0.422***	0.443***	0.567***
	(0.052)	(0.054)	(0.056)	(0.047)	(0.048)	(0.055)
Matched Cases n	28	28	28	28	28	28
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Pre-period Population	N	N	N	Y	Y	Y
Region	N	Y	Y	N	Y	Y
Geography/Transport	N	N	Y	N	N	Y

Notes: Table reports results of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated, after employing one-to-one matching with caliper. The caliper is set such that observations outside of 0.3 standard deviations of 1900 - 1940 employment, and 0.2 standard deviations of 1950 employment, are dropped prior to employing standard one-to-one matching. Robust Abadie-Imbens standard errors are given in parentheses. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 -1950 in ten year increments. (Log population is substituted for log employment in Panel A.) Population controls include controls for pre-period 15-64 population, in log levels, for 1900-1950 in ten year increments. Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: **Synthetic Control Results: Effect of Airports on CBSA Outcomes, Long Differences 1950-2010**

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Change in Population (All Persons, Ages 15 - 64), 1950-2010						
Airport	0.091	0.171**	0.136**	0.091	0.171**	0.136***
	(0.075)	(0.067)	(0.067)	(0.075)	(0.067)	(0.067)
Matched Cases n	68	76	94	68	76	94
Panel B: Change in Total Employment, 1950-2010						
Airport	0.153*	0.238***	0.211**	0.146*	0.231***	0.160***
	(0.088)	(0.074)	(0.084)	(0.080)	(0.078)	(0.073)
Matched Cases n	63	75	81	70	70	84
Panel C: Change in Tradable Sector Employment, 1950-2010						
Airport	0.251***	0.282***	0.301***	0.196**	0.295***	0.255***
	(0.082)	(0.085)	(0.095)	(0.081)	(0.092)	(0.062)
Matched Cases n	56	65	76	63	65	78
Panel D: Change in Non-Tradable Sector Employment, 1950-2010						
Airport	0.018	0.114**	0.059	-0.021	0.085	0.027
	(0.069)	(0.074)	(0.071)	(0.071)	(0.071)	(0.067)
Matched Cases n	50	59	82	58	65	82
Panel E: Change in Transportation Sector Employment, 1950-2010						
Airport	0.761***	0.664***	0.318***	0.410***	0.493***	0.333***
	(0.142)	(0.151)	(0.114)	(0.100)	(0.114)	(0.106)
Matched Cases n	38	41	55	41	42	57
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Pre-period Population	N	N	N	Y	Y	Y
Region	N	Y	Y	N	Y	Y
Geography/Transport	N	N	Y	N	N	Y

Notes: Table reports results of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. First, a synthetic control unit was estimated for each of the above outcomes for each CBSA with an airport. Then, the treated/synthetic control units were pooled, and poorly fitting cases, defined here as cases where the mean squared prediction error (MSPE) of the synthetic unit was above 0.05, were removed. Next, a fully flexible difference-in-difference event-time model was employed, normalized such that the baseline year is 1950. The coefficients reported above are the 2010 outcomes from that model, representing the long difference outcome. Cluster-robust standard errors, clustered at the CBSA level, are given in parentheses. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 -1950 in ten year increments. (Log population is substituted for log employment in Panel A.) Population controls include controls for pre-period 15-64 population, in log levels, for 1900-1950 in ten year increments. Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: **IV Results: Decade-by-Decade Effect of Airports on CBSA Outcomes, Long Differences (Population and Employment Measures)**

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome by Decade	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10
Panel A: Change in Population (All Persons, Ages 15 - 64)						
Airport	0.0833*	-0.0106	0.0811**	0.00327	0.0114	-0.00530
($n = 506$)	(0.0471)	(0.0401)	(0.0364)	(0.0251)	(0.0199)	(0.0146)
First Stage F	33.62	33.17	32.46	31.42	30.54	29.61
Panel B: Change in Total Employment						
Airport	0.124**	-0.0142	0.0982***	0.00799	-0.0163	-0.00357
($n = 506$)	(0.0511)	(0.0357)	(0.0373)	(0.0297)	(0.0215)	(0.0226)
First Stage F	31.61	31.86	31.02	30.62	30.24	29.26
Panel C: Change in Total Employment to Population Ratio						
Airport	0.00985	-0.00429	0.0320***	0.00834	-0.00838	0.0117
($n = 506$)	(0.0143)	(0.0113)	(0.0108)	(0.00918)	(0.00844)	(0.00932)
First Stage F	27.59	26.53	25.76	24.91	24.76	24.01
Panel D: Change in Tradable Sector Employment						
Airport	0.146**	-0.0200	0.0853*	0.0667	-0.0443	0.0288
($n = 504$)	(0.0609)	(0.0537)	(0.0443)	(0.0429)	(0.0369)	(0.0423)
First Stage F	28.48	29.10	27.83	27.99	27.25	26.42
Panel E: Change in Non-Tradable Sector Employment						
Airport	0.0832**	-0.0494*	0.135***	-0.00896	-0.0416*	0.0171
($n = 494$)	(0.0351)	(0.0293)	(0.0416)	(0.0300)	(0.0248)	(0.0256)
First Stage F	36.00	35.38	34.11	33.00	31.85	30.67
Panel F: Change in Transportation Sector Employment						
Airport	0.225***	0.0579	0.0486	-0.0231	-0.00305	0.0313
($n = 419$)	(0.0535)	(0.0526)	(0.0525)	(0.0537)	(0.0613)	(0.0575)
First Stage F	34.34	33.84	33.96	33.75	33.44	33.57
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y	Y	Y

Notes: Table reports results of instrumental variables (IV) regressions of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Each specification represents one decade. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 up to the base year, in ten year increments. For example, specification (3) includes log employment controls, by decade, through 1970 in ten year increments. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: **IV Results: Decade-by-Decade Effect of Airports on CBSA Outcomes, Long Differences 1950-2010 (Income and Housing Measures)**

	(1)	(2)	(3)	(4)	(5)	(6)
	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10
Panel A: Total Payroll (County Business Patterns Measure)						
Airport	-0.0188	0.0568	0.125*	0.0478	-0.0169	0.00768
	(0.138)	(0.0475)	(0.0652)	(0.0659)	(0.0454)	(0.0547)
First Stage F	33.62	33.17	32.46	31.42	30.54	29.61
Panel B: Per-Worker Payroll (County Business Patterns)						
Airport	0.00504	0.0395*	0.00515	0.0142	0.00589	-0.0106
	(0.0592)	(0.0202)	(0.0245)	(0.0256)	(0.0245)	(0.0312)
First Stage F	33.62	33.17	32.46	31.42	30.54	29.61
Panel C: Total Earnings (Bureau of Economic Analysis)						
Airport	-	-	0.130**	0.0464	-0.00153	-0.0261
			(0.0556)	(0.0468)	(0.0348)	(0.0421)
First Stage F			32.46	31.42	30.54	29.61
Panel D: Earnings Per Worker (Bureau of Economic Analysis)						
Airport	-	-	0.0239	0.00619	0.0188	-0.0190
			(0.0232)	(0.0266)	(0.0206)	(0.0268)
First Stage F			32.46	31.42	30.54	29.61
Panel E: Median Rent (Census)						
Airport	-	-	-	0.0166	-0.00559	0.00989
				(0.0418)	(0.0241)	(0.0220)
First Stage F				31.42	30.54	29.61
Observations	506	506	506	506	506	506
Pre-period Population	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y	Y	Y

Notes: Table reports results of instrumental variables (IV) regressions of logged outcomes above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Each specification represents one decade. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include population (15-64) controls specific to the sector being analyzed, in log levels, for 1900 up to the base year, in ten year increments. For example, specification (3) includes log employment controls, by decade, through 1970 in ten year increments. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: **Results: IV Estimates of Airport Long Difference Effects By 1950 Population Quartile**

	(1)	(2)	(3)	(4)
1950 Population Quartile	First	Second	Third	Fourth
Panel A: Population (All Persons, Age 15 - 64)				
Airport	0.0699	0.499*	0.348*	0.551*
	(0.374)	(0.299)	(0.204)	(0.305)
First Stage F	2.034	2.096	5.731	23.24
n	408	408	408	407
Panel B: Total Employment				
Airport	0.199	0.496*	0.381**	0.547*
	(0.346)	(0.294)	(0.192)	(0.310)
First Stage F	2.006	2.070	5.662	23.59
n	408	408	408	407
Panel C: Employment to Population Ratio				
Airport	0.0269	0.0155	0.0212	0.0160
	(0.0502)	(0.0507)	(0.0331)	(0.0482)
First Stage F	2.085	2.068	5.297	18.94
n	408	408	408	407
Panel D: Tradable Sector Employment				
Airport	0.113	0.407	0.377*	0.431
	(0.384)	(0.331)	(0.227)	(0.348)
First Stage F	1.974	2.117	5.289	22.44
n	406	406	406	405
Panel E: Non-Tradable Sector Employment				
Airport	0.181	0.379	0.197	0.284
	(0.294)	(0.267)	(0.182)	(0.297)
First Stage F	1.979	2.074	5.693	23.32
n	396	398	398	397
Panel F: Transportation Sector Employment				
Airport	0.461	0.483	0.439**	0.682**
	(0.334)	(0.358)	(0.219)	(0.313)
First Stage F	2.679	2.169	6.483	20.51
n	323	330	331	329
Controls:				
Pre-period Employment	Y	Y	Y	Y
Region	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y

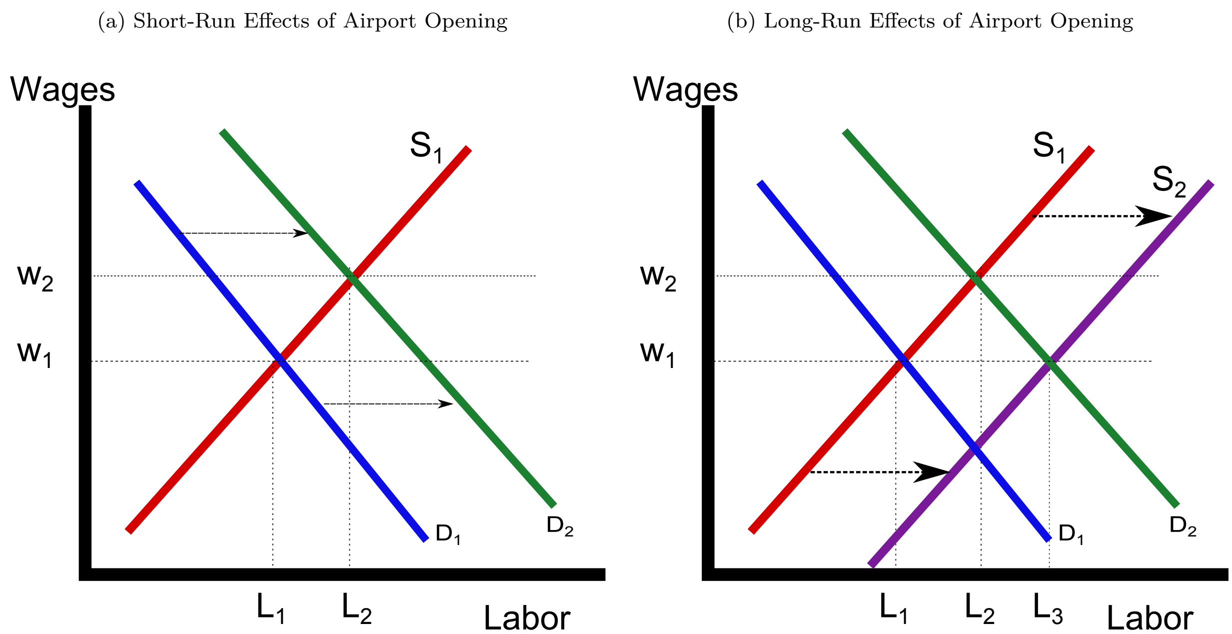
Notes: Table reports results of instrumental variables (IV) regressions of log population/employment outcome on an indicator variable for whether a CBSA has an airport, with various controls as indicated, by quartile of 1950 population. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 to 1950. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: **Results: IV Estimates of Airport Long Difference Effects By Census Region**

	(1)	(2)	(3)	(4)
Census Region	Northeast	Midwest	South	West
Panel A: Population (All Persons, Age 15 - 64)				
Airport	0.427	0.565**	0.262	0.163
	(0.377)	(0.238)	(0.357)	(0.294)
First Stage F	2.371	11.48	13.16	7.369
n	391	417	425	398
Panel B: Total Employment				
Airport	0.419	0.557**	0.363	0.234
	(0.369)	(0.221)	(0.347)	(0.298)
First Stage F	2.334	11.58	12.91	7.384
n	391	417	425	398
Panel C: Employment to Population Ratio				
Airport	-0.00951	0.00274	0.0481	0.0193
	(0.0736)	(0.0393)	(0.0546)	(0.0450)
First Stage F	2.267	10.92	10.39	5.539
n	391	417	425	398
Panel D: Tradable Sector Employment				
Airport	0.0734	0.447	0.288	0.427*
	(0.472)	(0.275)	(0.401)	(0.255)
First Stage F	2.267	11.09	11.77	6.913
n	389	415	423	396
Panel E: Non-Tradable Sector Employment				
Airport	0.278	0.440**	0.295	-0.0565
	(0.325)	(0.218)	(0.291)	(0.293)
First Stage F	2.353	11.79	13.78	7.498
n	381	407	414	387
Panel F: Transportation Sector Employment				
Airport	0.340	0.661***	0.454	0.460
	(0.404)	(0.245)	(0.416)	(0.290)
First Stage F	2.653	12.05	12.09	10.05
n	314	338	343	318
Controls:				
Pre-period Employment	Y	Y	Y	Y
Region	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y

Notes: Table reports results of instrumental variables (IV) regressions of log population/employment outcome on an indicator variable for whether a CBSA has an airport, with various controls as indicated, by region as given by the U.S. Census Bureau. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 to 1950. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: **Stylized Model of Airports and Local Labor Markets**



In this highly stylized model, labor demand is assumed to be downward sloping, while labor supply slopes upward. In the short run (panel a), the opening of the airport acts as a shock to labor demand, which increases as the airport makes (some) existing firms more productive and also attracts new firms to the city. Hence, demand shifts from D_1 to D_2. Wages increase as well, from w_1 to w_2. In the long run (panel b), workers in non-airport cities see the higher wages in the airport city and move there, increasing the supply of labor and shifting labor supply from S_1 to S_2. This shift depresses the short-run wage gains. However, long run employment rests at L_3, which represents a larger gain $(L_3 - L_1)$ relative to the original employment boost $(L_3 - L_2)$. As a result, the airport is expected to increase employment, but not necessarily wages, in long-run equilibrium.

Figure 2: **Map of Sample Airports**

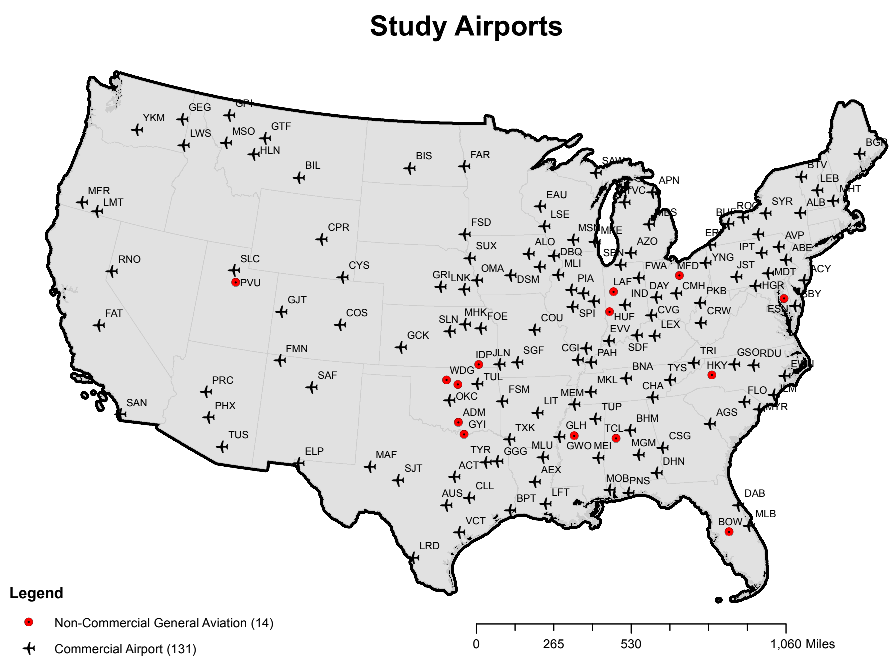


Figure 3: **Map of Sample CBSAs**

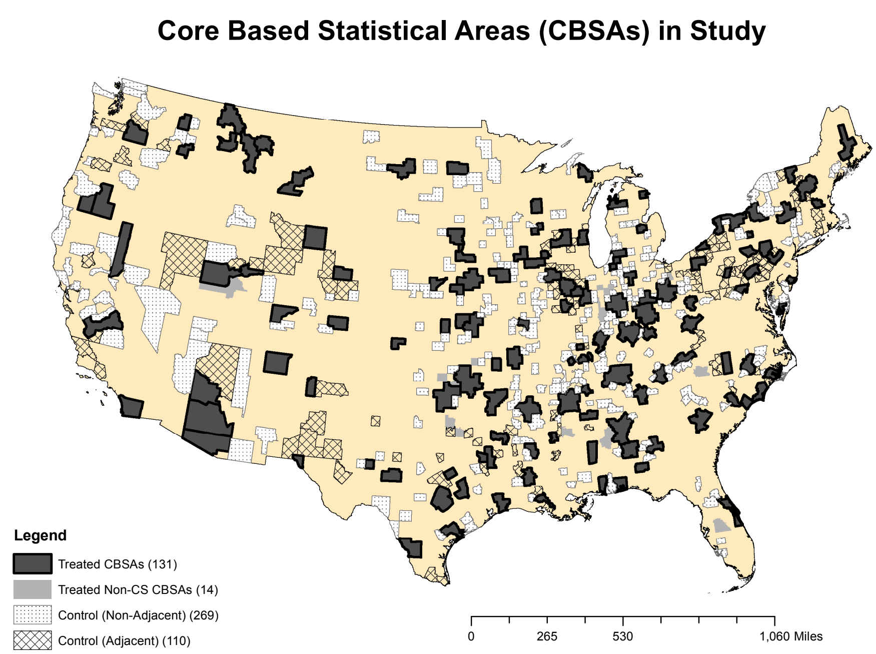


Figure 4: **Air Mail Network, 1938**

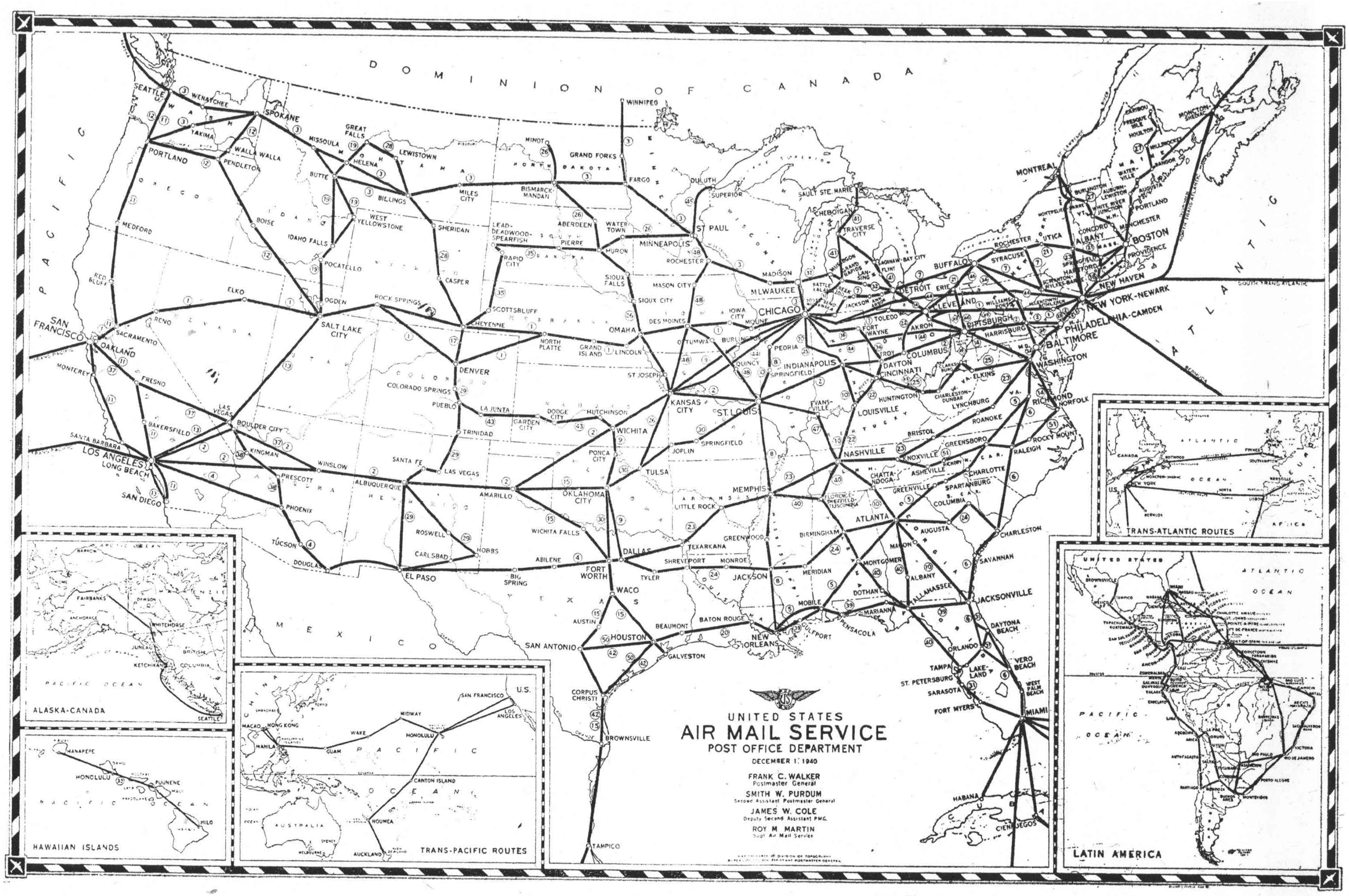


Figure 5: **Army Air Service 1922 Proposed Airways Systems of the United States**

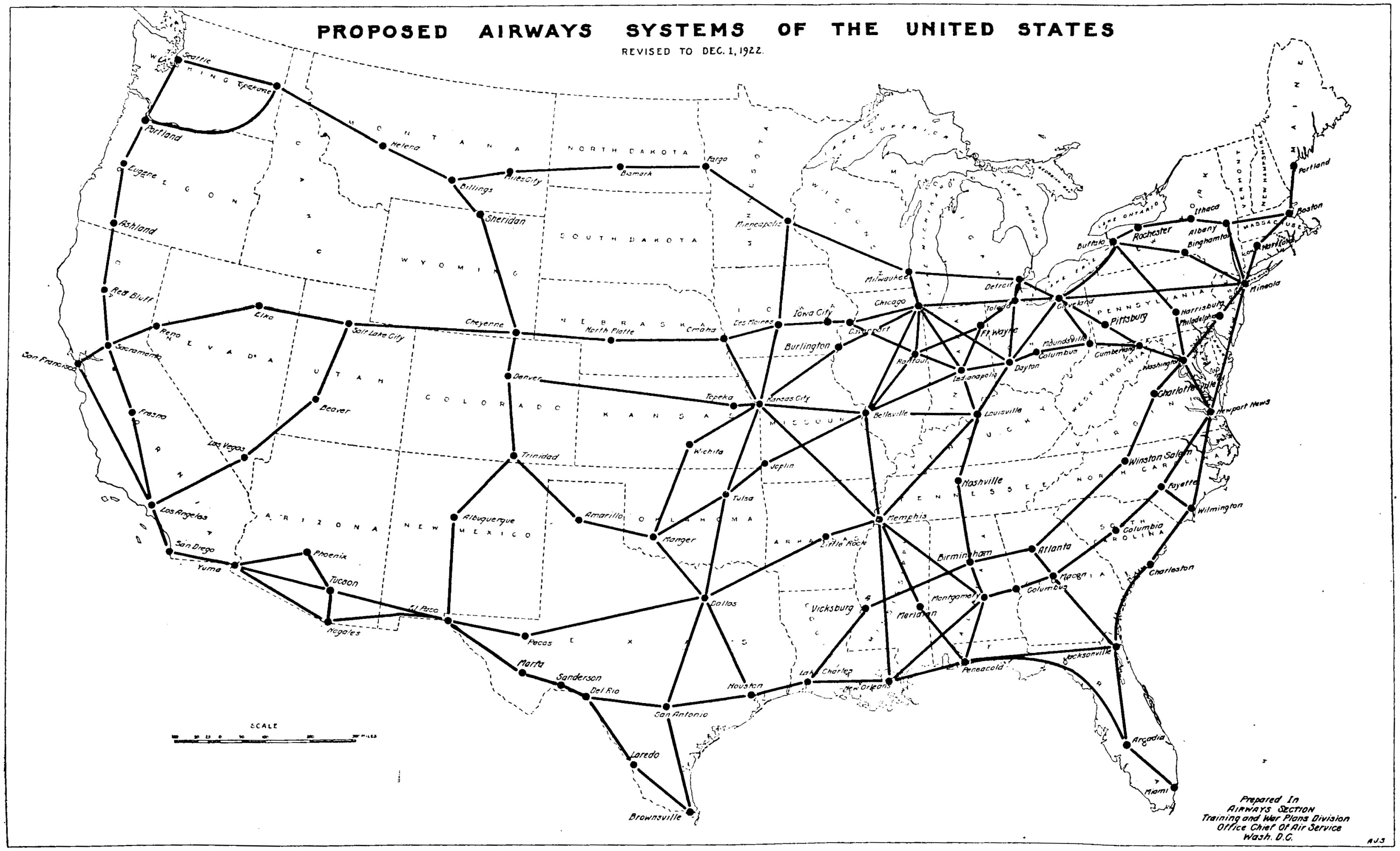
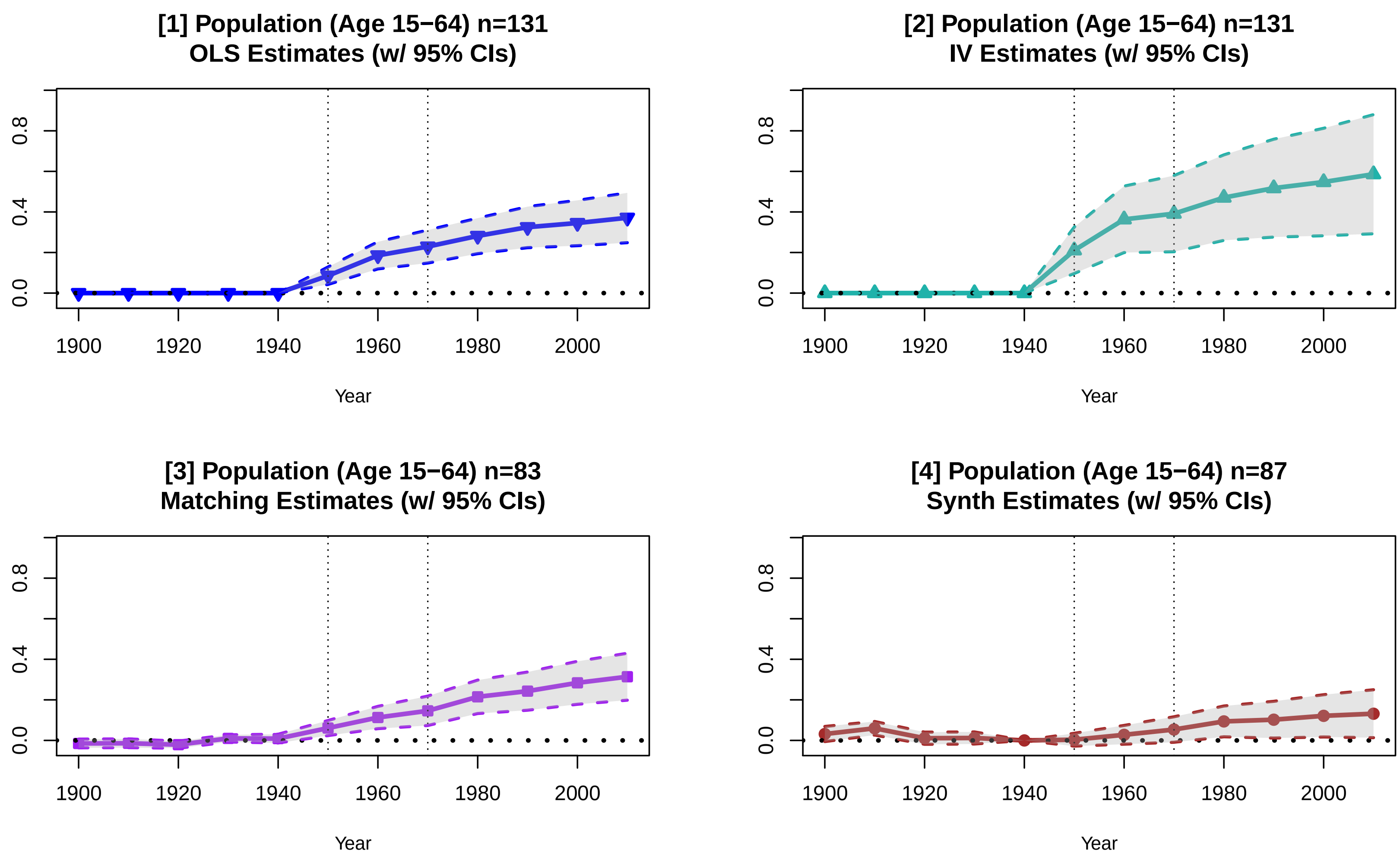
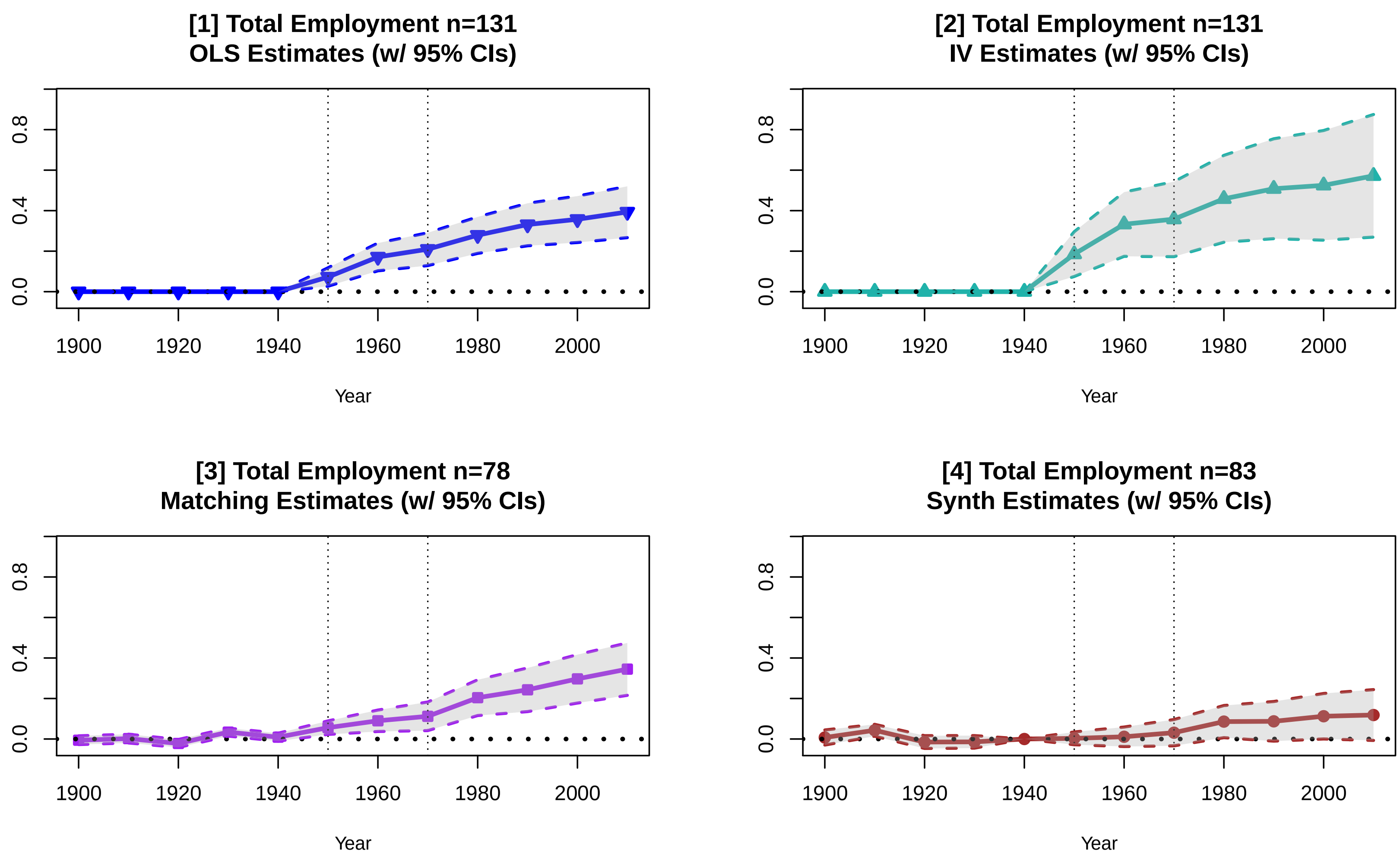


Figure 6: **Evolution of Treatment Effect: Log Population**



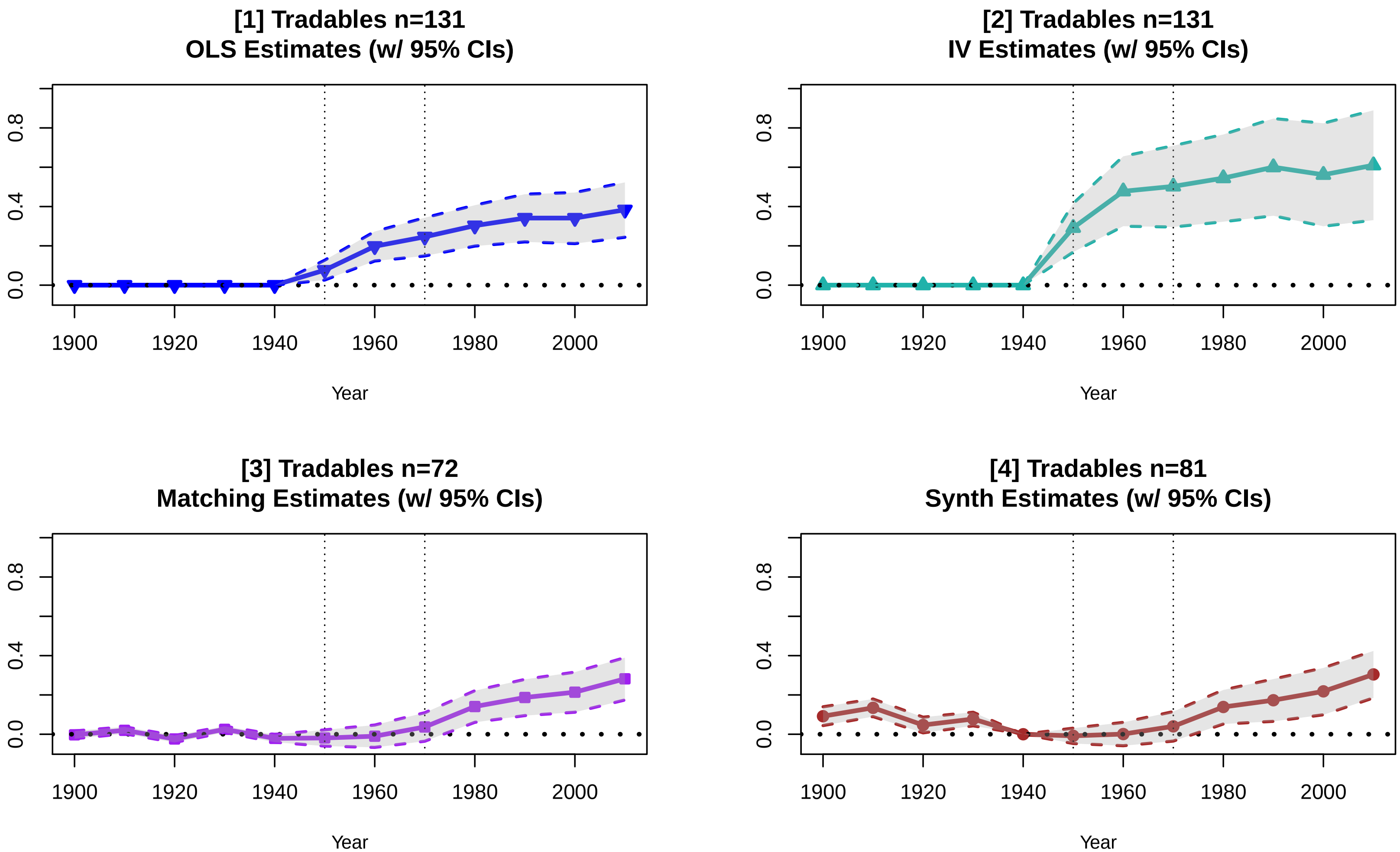
Notes: Figure shows the evolution of the airports' effects over time, relative to a normalization such that the 1940 outcome is normalized to zero. In each case, 95 percent confidence intervals are given by the dotted lines and shaded regions. Panel 1 gives OLS outcomes. Panel 2 gives the preferred instrumental variables (IV) outcome. Panel 3 gives the matched estimates from caliper matching, and Panel 4 gives the pooled synthetic control estimates. In panels 1, 2, and 4, standard errors are clustered at the CBSA level. In Panel 3, robust Abadie-Imbens standard errors are given. Please see section 4.2 for more details of the estimation and construction of each series.

Figure 7: **Evolution of Treatment Effect: Log Total Employment**



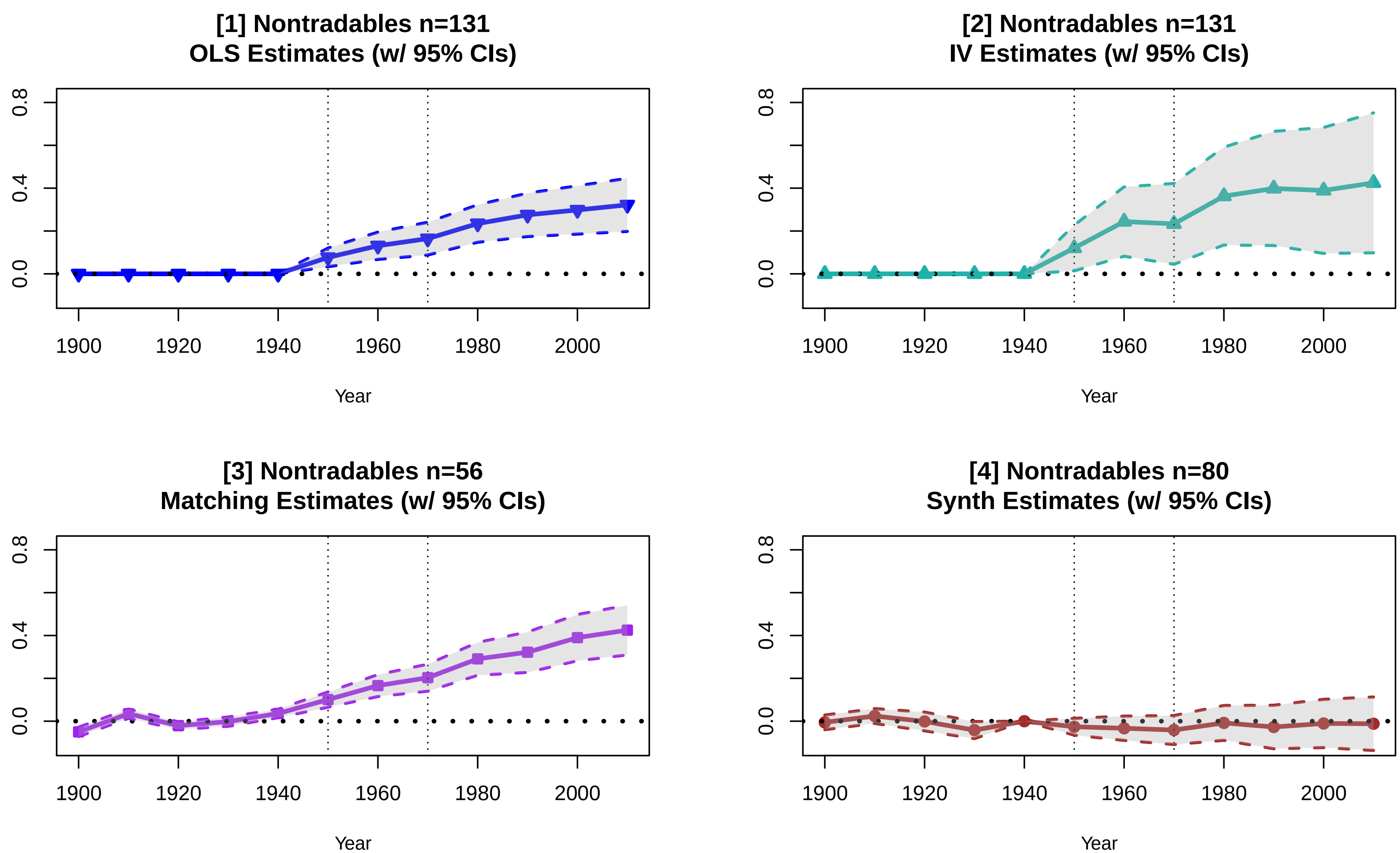
Notes: Figure shows the evolution of the airports' effects over time, relative to a normalization such that the 1940 outcome is normalized to zero. In each case, 95 percent confidence intervals are given by the dotted lines and shaded regions. Panel 1 gives OLS outcomes. Panel 2 gives the preferred instrumental variables (IV) outcome. Panel 3 gives the matched estimates from caliper matching, and Panel 4 gives the pooled synthetic control estimates. In panels 1, 2, and 4, standard errors are clustered at the CBSA level. In Panel 3, robust Abadie-Imbens standard errors are given. Please see section 4.2 for more details of the estimation and construction of each series.

Figure 8: **Evolution of Treatment Effect: Tradable Sectors**



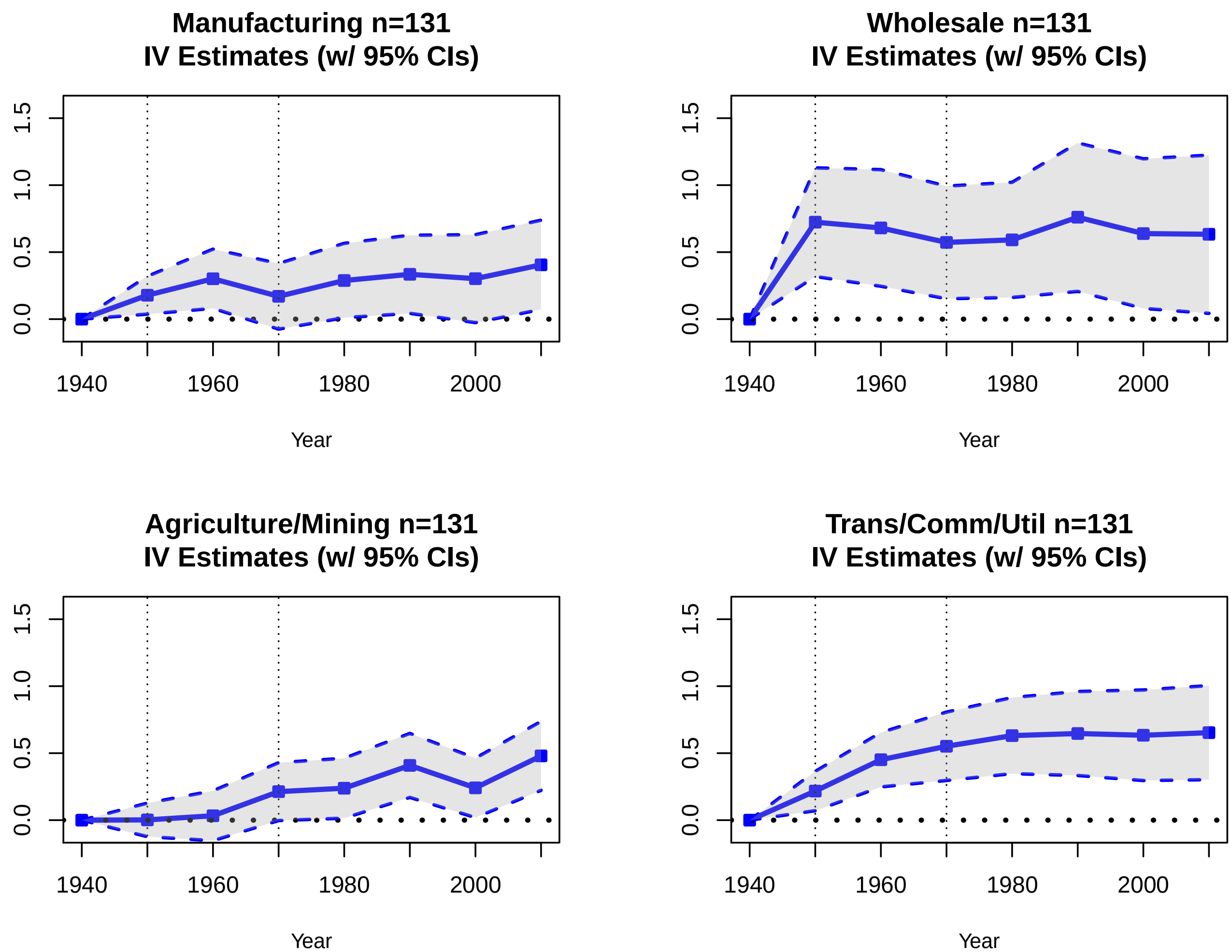
Notes: Figure shows the evolution of the airports' effects over time, relative to a normalization such that the 1940 outcome is normalized to zero. In each case, 95 percent confidence intervals are given by the dotted lines and shaded regions. Panel 1 gives OLS outcomes. Panel 2 gives the preferred instrumental variables (IV) outcome. Panel 3 gives the matched estimates from caliper matching, and Panel 4 gives the pooled synthetic control estimates. In panels 1, 2, and 4, standard errors are clustered at the CBSA level. In Panel 3, robust Abadie-Imbens standard errors are given. Please see section 4.2 for more details of the estimation and construction of each series.

Figure 9: **Evolution of Treatment Effect: Non-tradable Sectors**



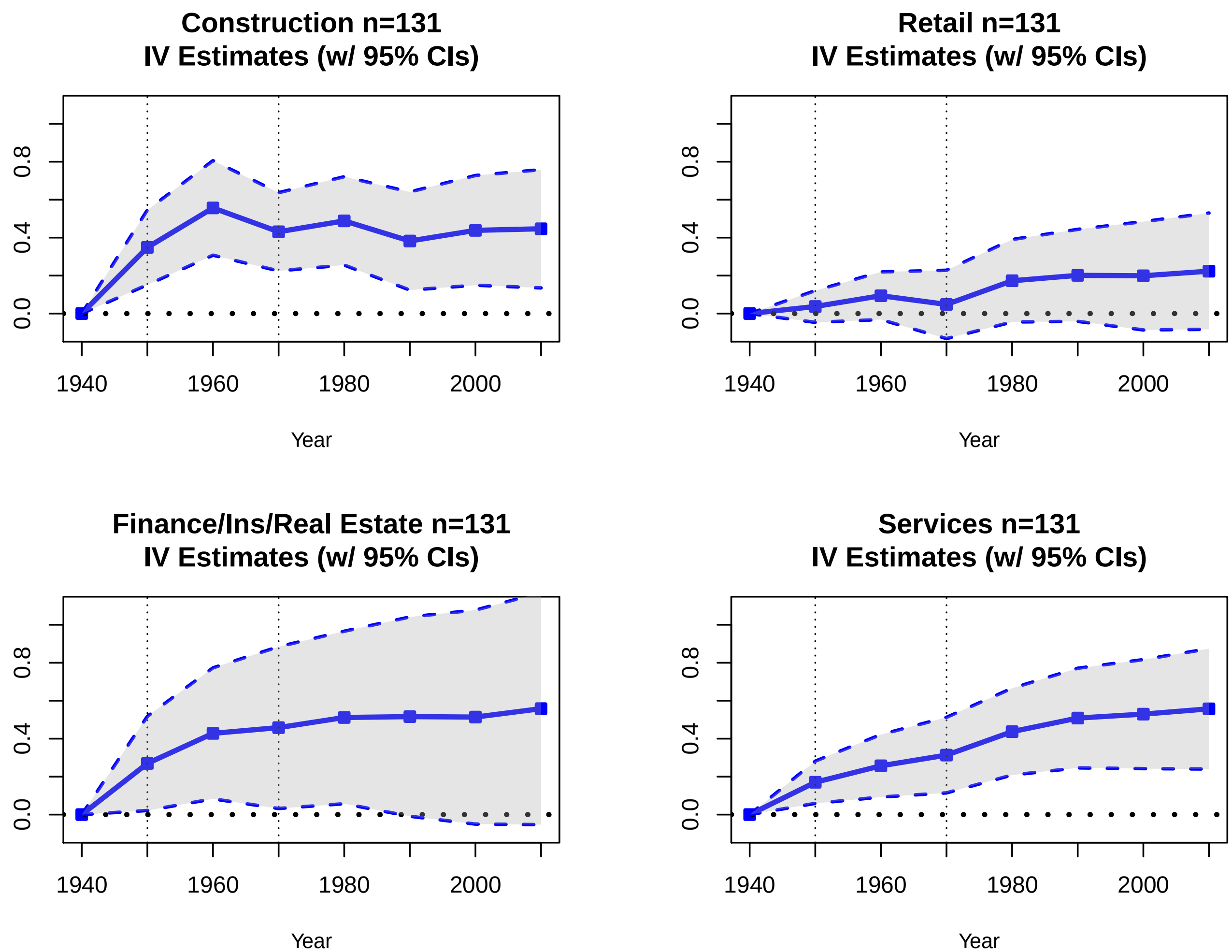
Notes: Figure shows the evolution of the airports' effects over time, relative to a normalization such that the 1940 outcome is normalized to zero. In each case, 95 percent confidence intervals are given by the dotted lines and shaded regions. Panel 1 gives OLS outcomes. Panel 2 gives the preferred instrumental variables (IV) outcome. Panel 3 gives the matched estimates from caliper matching, and Panel 4 gives the pooled synthetic control estimates. In panels 1, 2, and 4, standard errors are clustered at the CBSA level. In Panel 3, robust Abadie-Imbens standard errors are given. Please see section 4.2 for more details of the estimation and construction of each series.

Figure 10: **Evolution of Treatment Effect: IV - Non-Tradable**



Notes: Figure shows the evolution of the airports' effects over time, relative to a normalization such that the 1940 outcome is normalized to zero. In each case, 95 percent confidence intervals are given by the dotted lines and shaded regions. Standard errors are clustered at the CBSA level.

Figure 11: **Evolution of Treatment Effect: IV - Non-Tradable**



Notes: Figure shows the evolution of the airports' effects over time, relative to a normalization such that the 1940 outcome is normalized to zero. In each case, 95 percent confidence intervals are given by the dotted lines and shaded regions. Standard errors are clustered at the CBSA level.

A Data Appendix

A.1 Census Population and Employment Data

Population data were obtained from the National Historical Geographic Information System (NHGIS) for 1900-2010. These include total population, nonwhite population and urban population. The key limitation of the County Business Patterns data is that it begins in 1946 (and my series begins in 1951), right around the time at which I claim airports are opening and aviation is coming into its own. Moreover, there appears to be some concern that the CBP datasets are not as comparable over time as one would like, likely due to changes in the way firms were selected for inclusion in this, especially early on. As a result, the primary employment data used in this analysis is derived from the Industry data of the U.S. Census, allowing for consistent series of census-derived industrial data from 1900 to 2010. Sources for each employment data point:

- Agriculture and Mining: 1900 - 1940 from IPUMS 1% Sample, 1950-1960 from CCDB (note: mining imputed from 1950 and 1970 values since missing), 1970-2010 from NHGIS
- Construction: 1900 - 1940 from IPUMS 1% Sample, 1950-1960 from CCDB, 1970-2010 from NHGIS
- Manufacturing: 1900, 1920, 1930, 1940 from NHGIS; 1910 from IPUMS (derived from 1% microdata); 1950 from City and County Data Book (CCDB) using 1949 manufacturing employee count; 1960 from CCDB using 1958 manufacturing employee count; 1970-2010 from NHGIS
- Transportation, Communication and Utilities: 1900-1930 from IPUMS 1% microdata, 1940-1960 from CCDB entries, 1970-2010 from NHGIS
- Wholesale Trade: 1900-1940 from IPUMS 1% microdata, 1950 from CCDB 1948 wholesale employment count; 1960 from CCDB 1958 wholesale employment count; 1970-2010 from NHGIS
- Retail Trade: 1900 – 1930 from IPUMS 1% microdata; 1940 from CCDB 1939 retail employment count; 1950 from CCDB 1948 retail employment count; 1960 from CCDB 1958 retail employment count; 1970-2010 from NHGIS
- Finance, Insurance, and Real Estate (FIRE): 1900 – 1940 from IPUMS 1% microdata; 1950 and 1960 from CCDB 1950/1960 FIRE employment count; 1970-2010 from NHGIS
- Services: 1900 – 1940 from IPUMS 1%, 1950-1960 linearly imputed from 1940 and 1970 values, 1970-2010 from NHGIS

- Public Administration: 1900 - 1940 from IPUMS 1%, 1950-1960 from CCDB, 1970-2010 from NHGIS
- All employment: 1900-1940 from IPUMS 1%, 1950 – 1960 from CCDB; 1970-2010 from IPUMS From these, employment shares were defined as the share of employment in the industry of interest divided by total employment (by year). Missing data was imputed by taking the geometric mean of neighboring data points (this affected 121 out of roughly 250,000 cells). Finally, cells that still were missing were imputed with values from the next ten years (this affected 10 out of roughly 250,000 cells). Finally, cells missing 1900 population or employment data were flagged, as in many cases, these counties were not officially part of the United States until 1912 or after.
- Note: "Trade" = Wholesale + Retail trade. "Financial and Other Services" = FIRE + Services
- Tradable Employment = Wholesale + Manufacturing + Agriculture + Mining
- Non-tradable employment = Retail + Finance + Services + Construction + Public Administration

Other variables derived from U.S. Census: Data on land and building prices from 1900-1950 was obtained from the NHGIS (missing post 1950). Data on median family income from 1950-2010 was obtained from NHGIS (missing prior to 1950). Data on median housing values was taken from CCDB for 1930 and 1940, and NHGIS from 1980-2010. Other years missing. Data on median rents was taken from CCDB for 1940 and 1950, and NHGIS from 1980-2010. Other years missing. Data obtained from the Bureau of Economic Analysis (BEA) include earnings, earnings per worker, personal income, and per capita personal income for 1970-2010.

A.2 Other data sources:

- County Characteristics 2005 – data on Census division, region, latitude, longitude, January temperature and other climate characteristics, topography measure, from ICPSR study 20660.[34]
- Planned highway mileage – courtesy of Nate Baum-Snow, aggregated to the county level using GIS software
- Railway straight-line mileage in 1887 – courtesy of Jeremy Atack, aggregated to the county level using GIS software
- Coastal Counties – U.S. Census Bureau and National Oceanic and Atmospheric Administration: https://www.census.gov/geo/landview/lv6help/coastal_cty.pdf

[34] http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/20660

- Port Cities – NOAA http://www.ngs.noaa.gov/RSD/coastal/projects/coastal/ports_list.html Land grant colleges - http://espnational.org/about-us/land-grant-universities.html

- County / CBSA Size: County land areas over time were derived for each 10-year interval by obtaining data on county boundaries from the Atlas of Historical Counties Project.[35] CBSAs with changes in land areas greater than three percent were dropped from the analysis.

- Geography / Human Capital: These include a dummy variable for whether a county contains a political capital city or a land grant college.[36]

- Climate and Geography: From the ICPSR's county characteristics study, I use a measure of mean January temperature. [37] Dummy variables were derived for whether a county contains a port, is located on a coast, or on a river.[38] I also control for planned highway mileage in as of 1947,[39] as well as total straight-line rail mileage in 1887.[40]

- Air Traffic Data: I use air traffic data (enplanements and operations) from the FAA's Terminal Area Forecast for 1976-2012 traffic.[41] Between 1964 and 1976, where available, I hand-collected data from annual versions of the *FAA Statistical Handbook* to obtain traffic data.

The next step is to aggregate this data to the level of the Core Based Statistical Area (CBSA). 2010 CBSA data were obtained from the National Historical Geographic Information System. The overriding goal of what follows is to create a consistent data series from 1900 to 2010 in which data are compiled for a consistent geography. This means that both the composition of counties in each CBSA and the size of each CBSA, in terms of land area, must be the same for each data point in the time series. This will allow for a consistent estimation of the effects of the airport over time. As counties form the building blocks of CBSAs, much of what follows involves operations on county level data. The steps involved are: (1) standardize county sizes, and flag counties in which counties change "too much"; (2) aggregate county-level census, employment, airport, aviation history, and county characteristics data; and (3) remove CBSAs where geography cannot be made consistent due to political changes.

County size. Counties were standardized to their 2010 land areas. County land areas over time were derived for each 10-year interval by obtaining data on county boundaries from the Atlas of Historical Counties

[35] Atlas of Historical Counties Project: http://publications.newberry.org/ahcbp/
[36] http://www.higher-ed.org/resources/land_grant_colleges.htm
[37] ICPSR County Characteristics, 2000-2007; ICPSR Study 20660.
[38] http://www.ngs.noaa.gov/RSD/coastal/projects/coastal/ports_list.html
[39] I thank Nate Baum-Snow for sharing this data.
[40] I thank Jeremy Atack for sharing this data.
[41] http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/taf/

Project. Next, for each county, a flag was created indicating if the county's area had changed more than three percent since 1930. CBSAs flagged in this way are dropped. To standardize county areas, a ratio of the then-year county area to the 2010 county area was derived. Dividing employment and population data through by this ratio yields the adjusted county level information used in the analysis. Aggregation subsequently yielded the CBSA information used in this study.

B Event-Time Difference-in-Difference

Following Reber (2005) and Mora and Reggio (2012), I implement an "event-time" version of the differences-in-differences (DD) estimator. It differs from the standard DD approach in that instead of a simple "post-treatment" indicator, I create a series of dummy variables indicating time (in decades) relative to implementation ($k = 0$ is normalized to 1950) in order to estimate the dynamic effects of the airports on their local economic outcomes. The specification is:

$$y_{it} = \alpha + \theta_i + \gamma_t + \sum_{k=-5}^{6} \lambda_k \delta_{k,it} + \epsilon_{it} \tag{8}$$

where α is a constant, θ_i is a CBSA fixed effect, and γ_t is a year fixed effect. $\delta_{k,it}$ is an indicator variable equal to 1 if the CBSA is in year k of having its airport, and 0 otherwise. In the regressions, $k = 0$ is left out as the reference year. The pattern of λ_ks describes the change in trend in the outcome of interest, y_{it}, associated with having an airport. For example, λ_1 - λ_0 gives the change in the dependent variable associated with moving from $k = 0$ (1950) to $k = 1$ (1960). Importantly, it allows for a partial test of the identifying assumption that absent receiving an airport, the growth trends of treated and control CBSAs would have trended similarly. In most cases, this condition fails, as a glance at Figure A.2 shows. In practice, many places receiving airports were smaller than average in the pre-period, relative to their eventual position in 1950, and yet were growing faster than the average. As a result, in many cases the DD specification provides another point of reference on the values obtained by IV and Caliper Matching, but in no case should these be taken as more than that. Since the entire equation is normalized to 1950 ($k = 0$), growth effects are given by λ_6 in the dynamic event-time specification.

C Alternative Model of Local Labor Markets and Airports

I use the local labor markets model derived in Moretti (2011) to model an airport as a productive amenity. I will not derive the model in full here, but rather use its main results. I focus entirely on redistributive effects and ignore agglomeration effects. I also do not explicitly model dynamic effects.

Suppose there are two cities (indexed by c) endowed with amenity A_c. Residents consume a traded good G that has the same price in all cities, say, 1. They also consume housing, H, with the price of housing varying across locations. Workers are identical in taste and skill, and supply one unit of labor. A worker in city c solves the problem

$$\max U(G, H, A_c) \text{ s.t. } w_c = G + p_c H,$$

where w_c is the wage in city c and p_c is the per-unit price of housing.

Firms produce X, a vector of goods that includes tradable goods and non-tradable goods. Tradable goods are produced in the agriculture, mining, manufacturing, and wholesale trade sectors. Non-tradable goods are produced in the construction, retail trade, finance, insurance and real estate, public administration, and services sector. (The transportation, communications, and utilities sector is considered separately.)

In the first case, suppose that one of the goods, x_1, is the traded good. The cost of producing x_1, $C(w_c, p_c, A_c)$ depends on the price of labor and also on the price of housing, which itself incorporates factors such as the price of factory space. In the Roback framework, wages and housing prices adjust to equalize utility across all cities. On the firm side, production costs are assumed to be identical everywhere. Production in city c is Cobb-Douglas with constant returns to scale:

$$\ln y_c = Z_c + hN_c + (1-h)K_c,$$

where Z_c is a city-specific productivity shifter whose effect is shared by all firms in city c. Similarly, the labor demand curve is:

$$\ln w_c = Z_c - (1-h)N_c + (1-h)K_c + \ln h.$$

Since capital flows instantaneously to the place where its return is highest, in equilibrium its return is the same everywhere. Also, assume the price of housing is given by

$$p_c = u + k_c N_c,$$

where k_c characterizes the elasticity of the supply of housing and is assumed to be exogenously determined by geography and local land regulations, and u is simply a shifter to ensure equality. In cities where constructing new housing is relatively easy, k_c is low. However, as constraints make it harder to construct new housing, k_c becomes larger.

Consider two cities a and b that are identical in Period 1. In Period 2, city b builds an airport and attracts service. In this case, the labor demand curve for city b is upward sloping:

$$w_b = w_a + (p_b - p_a) - (A_a - A_b) + s\frac{N_b - N_a}{N},$$

where N_c is the log of the number of workers in city c, and $N_a + N_b = N$ is the fixed labor supply. Assume that worker i's relative preference for city a over city b is given by $U[-s, s]$. The parameter s characterizes mobility resulting from idiosyncratic preferences. If s is large, workers have high preferences for location and thus labor mobility will be low; however if s is low, the converse will be true. As the shock only affects those firms that can benefit from it, $X_{b2} = X_{b1} + \Delta$, where $\Delta > 0$. As Δ characterizes a productivity increase, wages $(w_{b2} - w_{b1})$ will increase by that amount as well. Firms already located in city b might enjoy economic rents and be less inclined to move. Conversely, firms that could benefit from the airport would be much more likely to move to city b, increasing their demand for labor. To satisfy this, workers, attracted by higher wages, move from a to b so that, as shown in Moretti (2011),

$$N_{b2} - N_{b1} = \frac{N}{N(k_a + k_b) + 2s}\Delta \geq 0. \tag{9}$$

Equation 9 shows that as a result, employment and population are expected to increase overall in the airport city b. Additionally, wages and land prices may also increase, the magnitude of which depends on s and k. A high s, meaning people are heavily tied to their current location, or a high k, indicating a relatively inelastic housing supply, would reduce the size of final population increase.

Table A.1: **Covariates by Airport Status**

	Controls ($n = 379$)		Airport CBSAs ($n = 131$)	
Variable	Mean	SD	Mean	SD
Airport Predictors				
On 1938 Air Mail Network	0.087	(0.282)	0.679	(0.469)
On 1922 Army Air Service Defense Plan	0.026	(0.160)	0.313	(0.465)
CBSA County on 1944 National Airport Plan	0.135	(0.342)	0.092	(0.290)
Had CAA Intermediate Airfield	0.314	(0.465)	0.412	(0.494)
Transport				
Planned Highway Mileage as of 1947	18.261	(24.417)	60.267	(58.424)
Located near river	0.348	(0.477)	0.534	(0.501)
Has Port	0.032	(0.175)	0.099	(0.300)
1887 Straight-Line Rail Mileage	79.749	(63.590)	170.672	(151.773)
Geography/Climate				
Has Political Capital City	0.018	(0.135)	0.168	(0.375)
NOAA Coastal County	0.251	(0.434)	0.244	(0.431)
Has Land Grant College	0.042	(0.201)	0.153	(0.361)
Mean January Temperature	32.110	(11.119)	32.838	(11.865)
CBSA and Region				
CBSA Land Area (std. to 2010)	1440.966	(2168.268)	2571.252	(2080.955)
Region 1: Northeast	0.127	(0.333)	0.122	(0.329)
Region 2: Midwest	0.380	(0.486)	0.321	(0.469)
Region 3: South	0.314	(0.465)	0.382	(0.488)
Region 4: West	0.179	(0.384)	0.176	(0.382)

Table A.2: **Summary of Estimates: Long Difference in Sectoral Employment Outcomes, All Methods, 1950-2010**

	All Airports				
Sector/Outcome by Analysis	OLS	DD	IV	Matching	Synth
Population (Age 15-64)	0.235***	0.248***	0.255*	0.194***	0.136**
	(0.053)	(0.060)	(0.134)	(0.068)	(0.067)
Total Employment	0.292***	0.290***	0.312**	0.265***	0.160**
	(0.056)	(0.063)	(0.130)	(0.053)	(0.073)
Tradable Sector	0.311***	0.236***	0.335**	0.355***	0.255***
	(0.065)	(0.071)	(0.137)	(0.056)	(0.086)
Non-tradable Sector	0.164***	0.143**	0.178	0.149***	0.027
	(0.047)	(0.064)	(0.123)	(0.038)	(0.067)
Agriculture and Mining	0.317***	0.142	0.478***	0.283***	0.322***
	(0.068)	(0.090)	(0.116)	(0.048)	(0.100)
Construction	0.155**	0.172***	0.076	0.237***	0.151*
	(0.062)	(0.060)	(0.134)	(0.026)	(0.091)
Manufacturing	0.307***	0.030	0.240	0.315***	0.401***
	(0.083)	(0.102)	(0.161)	(0.053)	(0.133)
Transportation/Comm/Util	0.248***	0.100	0.433***	0.567***	0.333***
	(0.068)	(0.071)	(0.152)	(0.055)	(0.106)
Trade (Wholesale and Retail)	0.253***	0.068	0.095	-	0.041
	(0.067)	(0.080)	(0.160)	-	(0.095)
Services (incl. Finance)	0.149***	0.202***	0.166	-	0.100
	(0.045)	(0.050)	(0.121)	-	(0.063)

Notes: See section 4.2 of the text for details regarding each estimation strategy. OLS and IV estimates include all covariates as in specification (3) of Table 2 and 4 respectively. The difference-in-difference estimates include year and CBSA fixed effects, as well as additional controls for pre-1950 values. Matching and Synthetic Control estimates include all covariates as in specification (6) of Tables 5 and 6, respectively. All standard errors are clustered at the CBSA level (except for those from Matching, which are robust Abadie-Imbens standard errors).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: **Summary of Estimates: Long Difference in Sectoral Employment Shares, All Methods, 1950-2010**

	All Airports		
Sector/Outcome by Analysis	OLS	IV	Matching
Tradable Sector	-0.092**	-0.234**	-0.142***
	(0.040)	(0.101)	(0.015)
Non-tradable Sector	0.022**	0.038*	0.052***
	(0.010)	(0.022)	(0.005)
Agriculture and Mining	-0.068	-0.087	-
	(0.081)	(0.172)	-
Construction	-0.015	-0.120**	-
	(0.024)	(0.057)	-
Manufacturing	-0.227***	-0.618***	-0.235***
	(0.053)	(0.143)	(0.027)
Transportation/Comm/Util.	-0.087***	-0.090	-0.119***
	(0.033)	(0.073)	(0.017)
Trade (Wholesale and Retail)	0.023	-0.015	-
	(0.014)	(0.038)	-
Services (incl. Finance)	0.024**	0.028	-
	(0.011)	(0.026)	-

Notes: See section 4.2 of the text for details regarding each estimation strategy. OLS and IV estimates include all covariates as in specification (3) of Table 2 and 4 respectively. OLS and IV estimates of shares also control for log population levels between 1900 and 1950. Matching estimates include all covariates as in specification (6) of Tables 5. All standard errors are clustered at the CBSA level (except for those from Matching, which are robust Abadie-Imbens standard errors).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: **IV Results: Decade-by-Decade Effect of Airports on CBSA Outcomes, Long Differences 1950-2010 (Population and Employment Measures), By Sector**

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome by Decade	1950-60	1960-70	1970-1980	1980-1990	1990-2000	2000-10
Panel A: Change in Log Agricultural and Mining Employment						
Airport	0.0304	0.174***	0.00714	0.192***	-0.0857	0.199***
($n = 503$)	(0.0578)	(0.0574)	(0.0527)	(0.0628)	(0.0756)	(0.0645)
First Stage F	28.67	27.25	28.27	27.86	28.17	27.55
Panel B: Change in Log Construction Industry Employment						
Airport	0.272***	-0.0612	0.0238	-0.131**	0.0313	0.0108
($n = 375$)	(0.0897)	(0.0622)	(0.0639)	(0.0663)	(0.0520)	(0.0515)
First Stage F	29.06	28.86	30.61	30.43	29.51	28.97
Panel C: Change in Log Manufacturing Employment						
Airport	0.123	-0.157**	0.136**	0.0406	-0.0669	0.0958**
($n = 456$)	(0.0830)	(0.0694)	(0.0596)	(0.0559)	(0.0425)	(0.0480)
First Stage F	28.59	27.57	26.74	26.37	25.53	24.68
Panel D: Change in Log Wholesale and Retail Trade Employment						
Airport	0.0252	-0.0531	0.105**	-0.00236	-0.0385	-0.0102
($n = 446$)	(0.0495)	(0.0642)	(0.0454)	(0.0390)	(0.0346)	(0.0363)
First Stage F	32.55	31.95	31.26	30.56	29.47	28.60
Panel E: Change in Log Finance and Service Employment						
Airport	0.0258**	-0.0151*	0.102**	0.00246	-0.0376	-0.00331
($n = 485$)	(0.0127)	(0.00886)	(0.0407)	(0.0303)	(0.0296)	(0.0268)
First Stage F	34.01	33.20	33.08	32.54	32.22	30.93
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y	Y	Y

Notes: Table reports results of instrumental variables (IV) regressions of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Each specification represents one decade. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 up to the base year, in ten year increments. For example, specification (3) includes log employment controls, by decade, through 1970 in ten year increments. (Log population is substituted for log employment in Panel A.) Population controls include controls for pre-period 15-64 population, in log levels, for 1900-1950 in ten year increments. Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: **Fixed Effects Regression: Air Traffic and Sectoral Employment**

	Sector of Employment			
	(1)	(2)	(3)	(4)
VARIABLES	Tradable	Non-tradable	Total Employment	Population (Ages 15-64)
Log Enplanements Per Capita	0.0352	0.0674***	0.0660**	0.0478*
	(0.0351)	(0.0254)	(0.0267)	(0.0257)
Constant	10.05***	10.84***	11.31***	11.75***
	(0.0171)	(0.0125)	(0.0136)	(0.0135)
Observations	576	576	576	576
R-squared	0.982	0.991	0.989	0.990

Note: This table gives results from a fixed effects regression of log population/employment on log enplanements (passenger boardings), 1980- 2010. Standard errors clustered at the CBSA level. CBSA and year fixed effects are included in all specifications.
* p < 0.1, ** p < 0.05, *** p < 0.01

Table A.6: **Robustness of IV Estimates to Choice of Instruments**

Dependent Variable: Change in Log Employment, 1950-2010						
Specification	(1)	(2)	(3)	(4)	(5)	(6)
Airport	0.312**	0.329**	0.310**	0.328**	0.341	0.176
	(0.130)	(0.136)	(0.130)	(0.136)	(0.544)	(0.332)
Constant	2.347***	2.379***	2.342***	2.378***	2.403**	2.085***
	(0.478)	(0.476)	(0.477)	(0.475)	(1.124)	(0.790)
AAS Defense Plan 1922	Y	N	Y	N	N	Y
Air Mail 1938	Y	Y	Y	Y	N	N
CAA Intermediate Airfield	Y	Y	N	N	Y	N
Observations	506	506	506	506	506	506
R-squared	0.486	0.479	0.482	0.474	0.396	0.406
F-statistic	31.61	32.29	32.14	32.09	19.93	21.45
Overid Test p-value	0.906	0.981	0.660	-	-	-

Note: Table reports the first stage regressions of CBSA airport status on whether the CBSA was on the 1922 Army Air Service Proposed Airways Systems of the United States (see Figure 5), the 1938 Air Mail network (see Figure 4), or on a CAA intermediate airfield (see Figure **??**), conditional on all controls but different combinations of instruments as given above. Cluster-robust standard errors given in parentheses, clustered on the CBSA level.
* p < 0.1, ** p < 0.05, *** p < 0.01

Table A.7: **Placebo Test: Estimated Effects on Non-Commercial Airports (Long Differences, 1950-2010)**

Sector/Outcome by Analysis	OLS	DD	IV	Matching	Synth
Population	0.060	-0.007	0.165	-0.169***	-0.124
	(0.100)	(0.168)	(1.150)	(0.052)	(0.173)
Total Employment	0.085	-0.010	0.243	0.014	-0.154
	(0.122)	(0.184)	(1.165)	(0.053)	(0.176)
Tradable Sector	0.228	0.056	-0.146	-0.106	0.419
	(0.160)	(0.166)	(1.154)	(0.124)	(0.234)
Non-tradable Sector	0.010	-0.064	0.134	-0.109	0.017
	(0.115)	(0.180)	(1.165)	(0.081)	(0.213)
Transportation/Comm/Util	-0.086	-0.127	-0.191	-0.047*	0.208
	(0.149)	(0.195)	(1.446)	(0.025)	(0.172)

Notes: This table gives the results from a placebo test (where it is assumed that a non-commercial general airport CBSA is an airport CBSA) and the associated results for each outcome of interest. See section 4.2 of the text for details regarding each estimation strategy. OLS and IV estimates include all covariates as in specification (3) of Table 2 and 4 respectively. The difference-in-difference estimates include year and CBSA fixed effects, as well as additional controls for pre-1950 values. Matching and Synthetic Control estimates include all covariates as in specification (6) of Tables 5 and 6, respectively. All standard errors are clustered at the CBSA level (except for those from Matching, which are robust Abadie-Imbens standard errors).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.8: **Placebo Test: Estimated Effects on Neighboring CBSAs (Long Differences, 1950-2010)**

	Combined Sample			
Sector/Outcome by Analysis	OLS	DD	IV	Matching
Population	-0.098*	-0.081	-0.157	0.027
	(0.055)	(0.071)	(0.513)	(0.029)
Total Employment	-0.036	-0.047	-0.331	0.008
	(0.063)	(0.073)	(0.567)	(0.041)
Tradable Sector	-0.003	-0.054	-0.225	0.041
	(0.067)	(0.076)	(0.474)	(0.040)
Non-tradable Sector	-0.060	-0.049	-0.228	0.008
	(0.053)	(0.068)	(0.594)	(0.025)

Notes: This table gives the results from a placebo test (where it is assumed that a neighboring airport CBSA is an airport CBSA) and the associated results for each outcome of interest. See section 4.2 of the text for details regarding each estimation strategy. OLS and IV estimates include all covariates as in specification (3) of Table 2 and 4 respectively. Matching and Synthetic Control estimates include all covariates as in specification (6) of Tables 5 and 6, respectively. All standard errors are clustered at the CBSA level (except for those from Matching, which are robust Abadie-Imbens standard errors).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.9: **OLS Results: Decade-by-Decade Effect of Airports on CBSA Outcomes, Long Differences (Population and Employment Measures)**

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome by Decade	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10
Panel A: Change in Population (All Persons, Ages 15 - 64)						
Airport	0.0719***	0.0232	0.0459***	0.0103	0.000868	-0.00393
($n = 506$)	(0.0250)	(0.0142)	(0.0135)	(0.0108)	(0.00736)	(0.00777)
R^2	0.424	0.267	0.504	0.653	0.659	0.677
Panel B: Change in Total Employment						
Airport	0.0892***	0.0168	0.0558***	0.0167	-0.00212	0.000721
($n = 506$)	(0.0268)	(0.0137)	(0.0130)	(0.0121)	(0.00901)	(0.00918)
R^2	0.407	0.267	0.626	0.582	0.613	0.610
Panel C: Change in Total Employment to Population Ratio						
Airport	0.00302	-0.00418	0.0204***	0.0126***	0.00804*	0.0101**
($n = 506$)	(0.00810)	(0.00659)	(0.00531)	(0.00451)	(0.00424)	(0.00437)
R^2	0.168	0.151	0.554	0.392	0.399	0.389
Panel D: Change in Tradable Sector Employment						
Airport	0.110***	0.0217	0.0694***	0.0229	-0.00930	0.0245
($n = 504$)	(0.0287)	(0.0184)	(0.0205)	(0.0201)	(0.0139)	(0.0211)
R^2	0.347	0.254	0.492	0.386	0.326	0.342
Panel E: Change in Non-Tradable Sector Employment						
Airport	0.0271*	0.0138	0.0472***	0.00526	-0.00339	0.00182
($n = 494$)	(0.0140)	(0.0106)	(0.0153)	(0.0109)	(0.00961)	(0.00907)
R^2	0.542	0.362	0.534	0.546	0.561	0.525
Panel F: Change in Transportation Sector Employment						
Airport	0.0877***	0.0660**	0.0397	0.0351	-0.0398*	-6.88e-05
($n = 419$)	(0.0221)	(0.0308)	(0.0243)	(0.0232)	(0.0232)	(0.0220)
R^2	0.305	0.328	0.324	0.354	0.227	0.102
Controls:						
Pre-period Employment	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y	Y	Y

Notes: Table reports results of OLS regressions of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Each specification represents one decade. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 up to the base year, in ten year increments. For example, specification (3) includes log employment controls, by decade, through 1970 in ten year increments. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.10: **OLS Results: Decade-by-Decade Effect of Airports on CBSA Outcomes, Long Differences 1950-2010 (Income and Housing Measures)**

	(1)	(2)	(3)	(4)	(5)	(6)
	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10
Panel A: Total Payroll (County Business Patterns Measure)						
Airport	0.105*	0.0476**	0.0686***	0.0266	0.0156	0.0128
	(0.0579)	(0.0202)	(0.0264)	(0.0253)	(0.0174)	(0.0210)
R^2	0.240	0.216	0.370	0.341	0.333	0.351
Panel B: Per-Worker Payroll (County Business Patterns)						
Airport	0.0191	0.0207**	0.00519	-0.00502	-0.00235	-0.00357
	(0.0260)	(0.00803)	(0.00956)	(0.00982)	(0.00924)	(0.0111)
R^2	0.199	0.422	0.170	0.179	0.162	0.241
Panel C: Total Earnings (Bureau of Economic Analysis)						
Airport	-	-	0.0770***	0.0147	0.0123	0.00177
			(0.0222)	(0.0191)	(0.0137)	(0.0184)
R^2			0.389	0.391	0.435	0.389
Panel D: Earnings Per Worker (Bureau of Economic Analysis)						
Airport	-	-	0.0130	-0.0159*	0.00412	0.00233
			(0.00901)	(0.00960)	(0.00730)	(0.0107)
R^2			0.293	0.310	0.196	0.289
Panel E: Median Rent (Census)						
Airport	-	-	-	-0.0246	0.00555	-0.00474
				(0.0170)	(0.00934)	(0.00922)
R^2				0.470	0.399	0.292
Observations	506	506	506	506	506	506
Pre-period Population	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y	Y	Y

Notes: Table reports results of OLS regressions of log population/employment outcomes given above on an indicator variable for whether a CBSA has an airport, with various controls as indicated. Each specification represents one decade. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include population (ages 15-64) controls specific to the sector being analyzed, in log levels, for 1900 up to the base year, in ten year increments. For example, specification (3) includes log population controls, by decade, through 1970 in ten year increments. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.11: **Results: OLS Estimates of Airport Long Difference Effects By 1950 Population Quartile**

	(1)	(2)	(3)	(4)
Quartile	First	Second	Third	Fourth
Panel A: Population (All Persons, Age 15 - 64)				
Airport	0.178*	0.303***	0.247***	0.248**
	(0.0914)	(0.0806)	(0.0847)	(0.117)
R^2	0.551	0.523	0.525	0.541
n	408	408	408	407
Panel B: Total Employment				
Airport	0.266***	0.359***	0.286***	0.270**
	(0.0941)	(0.0823)	(0.0869)	(0.121)
R^2	0.500	0.471	0.473	0.490
n	408	408	408	407
Panel C: Employment to Population Ratio				
Airport	0.0640***	0.0423***	0.0301**	0.0378**
	(0.0129)	(0.0129)	(0.0142)	(0.0167)
R^2	0.527	0.520	0.514	0.519
n	408	408	408	407
Panel D: Tradable Sector Employment				
Airport	0.283**	0.374***	0.381***	0.338**
	(0.116)	(0.0882)	(0.101)	(0.133)
R^2	0.432	0.405	0.399	0.427
n	406	406	406	405
Panel E: Non-Tradable Sector Employment				
Airport	0.117	0.247***	0.186**	0.195*
	(0.0764)	(0.0746)	(0.0782)	(0.105)
R^2	0.558	0.535	0.539	0.553
n	396	398	398	397
Panel F: Transportation Sector Employment				
Airport	0.183	0.203**	0.351***	0.372***
	(0.123)	(0.102)	(0.0983)	(0.132)
R^2	0.483	0.468	0.480	0.506
n	323	330	331	329
Controls:				
Pre-period Employment	Y	Y	Y	Y
Region	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y

Notes: Table reports results of OLS regressions of log population/employment outcome on an indicator variable for whether a CBSA has an airport, with various controls as indicated, by quartile of 1950 population. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 to 1950. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* p < 0.1, ** p < 0.05, *** p < 0.01

Table A.12: **Results: OLS Estimates of Airport Long Difference Effects By Census Region**

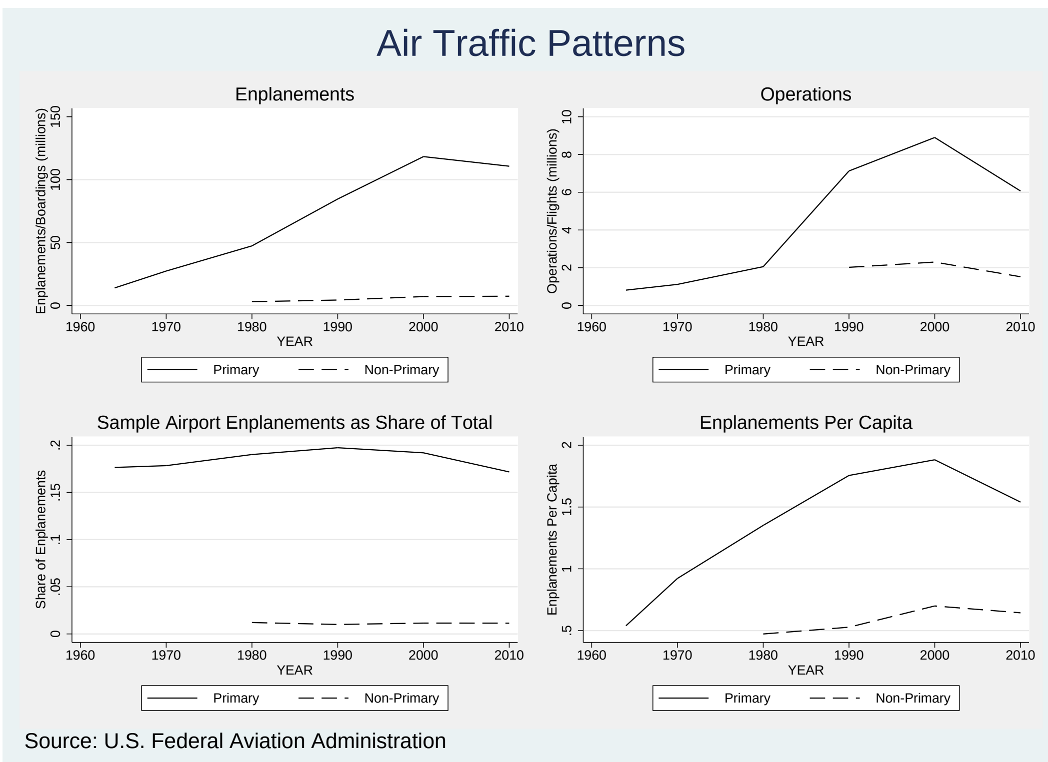
	(1)	(2)	(3)	(4)
Census Region	Northeast	Midwest	South	West
Panel A: Population (All Persons, Age 15 - 64)				
Airport	0.125	0.281***	0.302***	0.147
	(0.102)	(0.0631)	(0.0871)	(0.134)
R^2	0.527	0.517	0.535	0.562
n	391	417	425	398
Panel B: Total Employment				
Airport	0.142	0.320***	0.377***	0.230*
	(0.105)	(0.0672)	(0.0955)	(0.134)
R^2	0.469	0.463	0.482	0.521
n	391	417	425	398
Panel C: Employment to Population Ratio				
Airport	0.0197	0.0240*	0.0710***	0.0461**
	(0.0186)	(0.0131)	(0.0143)	(0.0188)
R^2	0.516	0.526	0.518	0.523
n	391	417	425	398
Panel D: Tradable Sector Employment				
Airport	0.0296	0.219**	0.496***	0.418***
	(0.126)	(0.0907)	(0.103)	(0.147)
R^2	0.404	0.387	0.413	0.471
n	389	415	423	396
Panel E: Non-Tradable Sector Employment				
Airport	0.110	0.288***	0.188**	0.0515
	(0.0998)	(0.0683)	(0.0805)	(0.107)
R^2	0.543	0.529	0.546	0.571
n	381	407	414	387
Panel F: Transportation Sector Employment				
Airport	0.0381	0.395***	0.177	0.402**
	(0.130)	(0.0849)	(0.118)	(0.179)
R^2	0.483	0.471	0.484	0.500
n	314	338	343	318
Controls:				
Pre-period Employment	Y	Y	Y	Y
Region	Y	Y	Y	Y
Geography/Transport	Y	Y	Y	Y

Notes: Table reports results of OLS regressions of log population/employment outcome on an indicator variable for whether a CBSA has an airport, with various controls as indicated, by region as given by the U.S. Census Bureau. Cluster-robust standard errors in parentheses clustered at the CBSA level. Pre-period controls include employment controls specific to the sector being analyzed, in log levels, for 1900 to 1950. (Log population is substituted for log employment in Panel A.) Region controls include dummy variables for each of the nine Census divisions and CBSA land area. Geography/transport includes controls for 1887 straight-line rail mileage, planned 1947 highway mileage, having a port, being a political capital city, mean January temperature, having a coastal location, and for close proximity to a river. Tradable sector employment is the sum of agricultural, mining, manufacturing, and wholesale trade sector employment. Non-tradable sector employment is the sum of retail trade, finance/insurance/real estate, business, professional and other services, construction, and public administration sector employment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.13: **Mean Airport Treatment Effects by Region and City Size (Synthetic Control)**

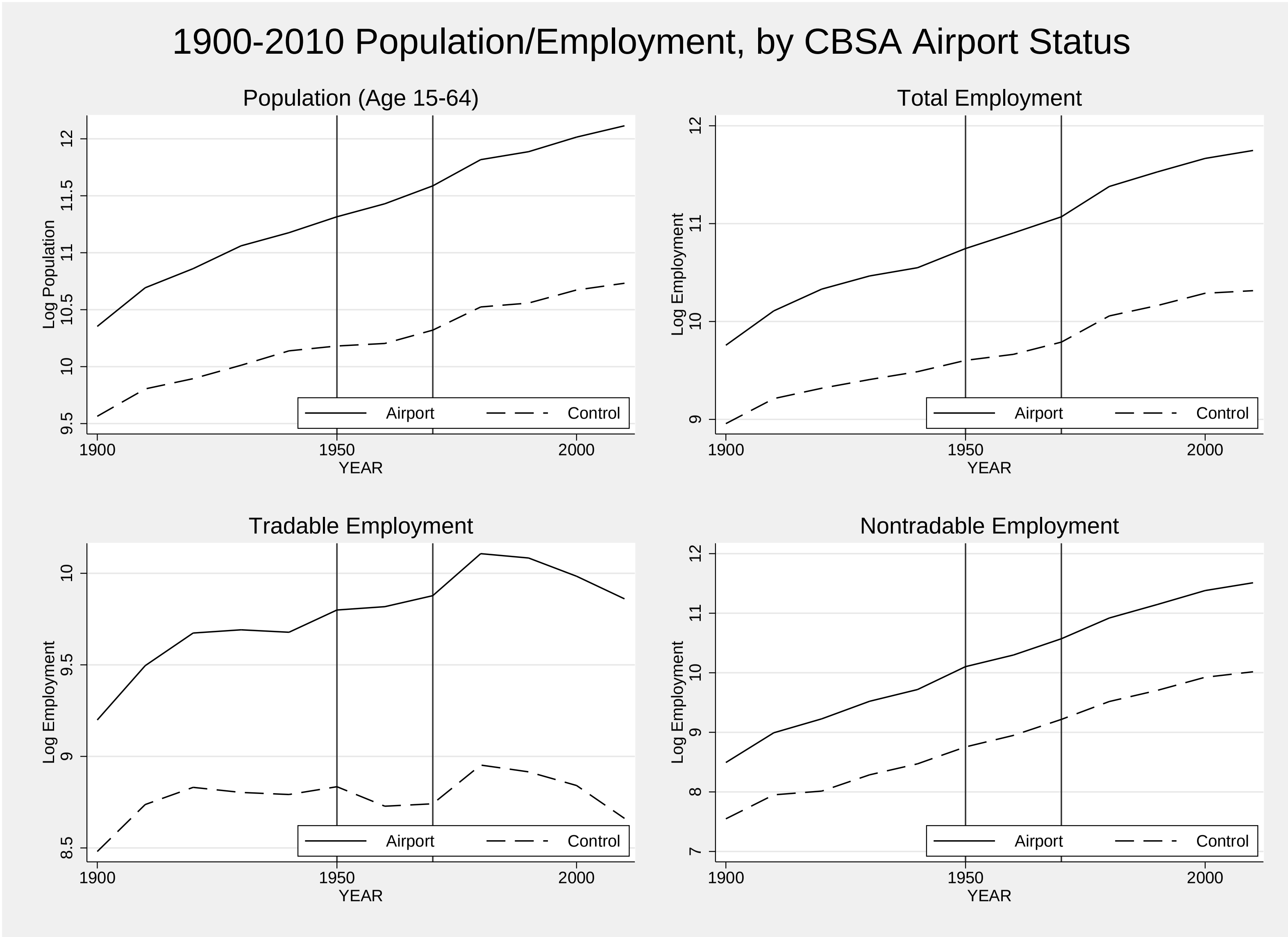
Region/Population Quintile in 1950	1	2	3	4	All Quintiles
Northeast		0.235	0.227	-0.110	0.117
Midwest	0.601	0.435	0.130	0.152	0.329
South	-0.240	0.099	0.046	0.266	0.043
West	-0.361		0.195	0.379	0.071
All Regions	0.000	0.256	0.150	0.172	0.147

Figure A.1: **Enplanements and Operations at Sample Airports**



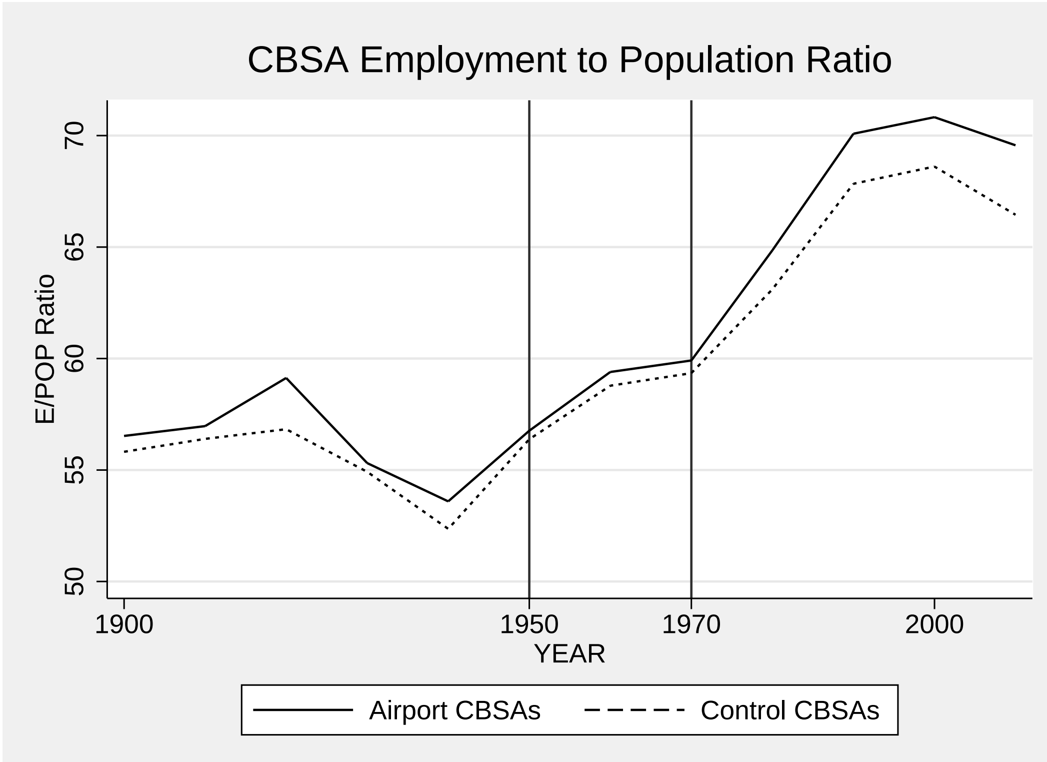
Notes: Primary airports are airports for which a full series of traffic data is available since 1964. Non-primary airports are secondary commercial airports, mostly in smaller cities, for which traffic data was not available until 1980. One enplanement is equivalent to one passenger boarding one flight at an airport. One operation is equivalent to one flight taking off from or landing at an airport. Enplanements as a share of total is simply the quotient of enplanements in the 131 airports in the sample to total enplanements at all airports. Enplanements per capita is given by enplanements in a CBSA divided by total CBSA population.

Figure A.2: **1900-2010 Population and Employment, by CBSA Airport Status**



Notes: Vertical bars at 1950 and 1970. Each series compares mean outcomes in CBSAs with airports to those without in the sample.

Figure A.3: **Ratio of Employment to Population, Airport Versus Non-Airport CBSAs**



Notes: Population is defined as all persons in CBSA, ages 15-64, as derived from Census files.

Figure A.4: **Synthetic Control Estimated Treatment Effects: Population**

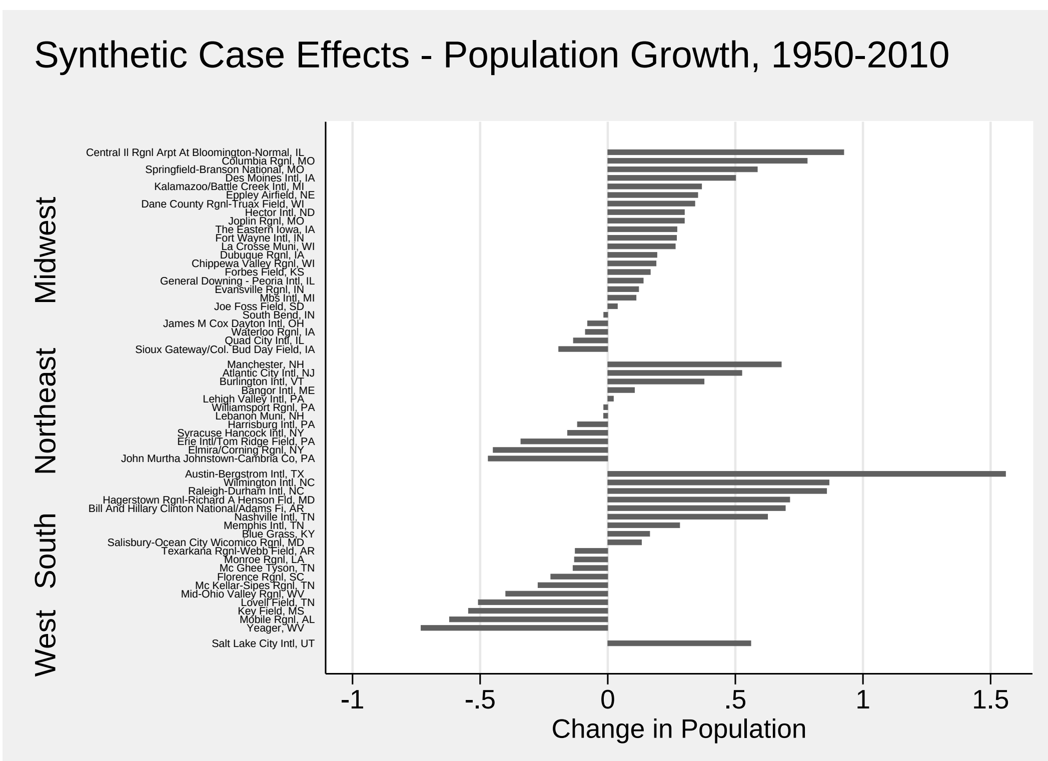


Figure A.5: **Synthetic Control Estimated Treatment Effects: Employment**

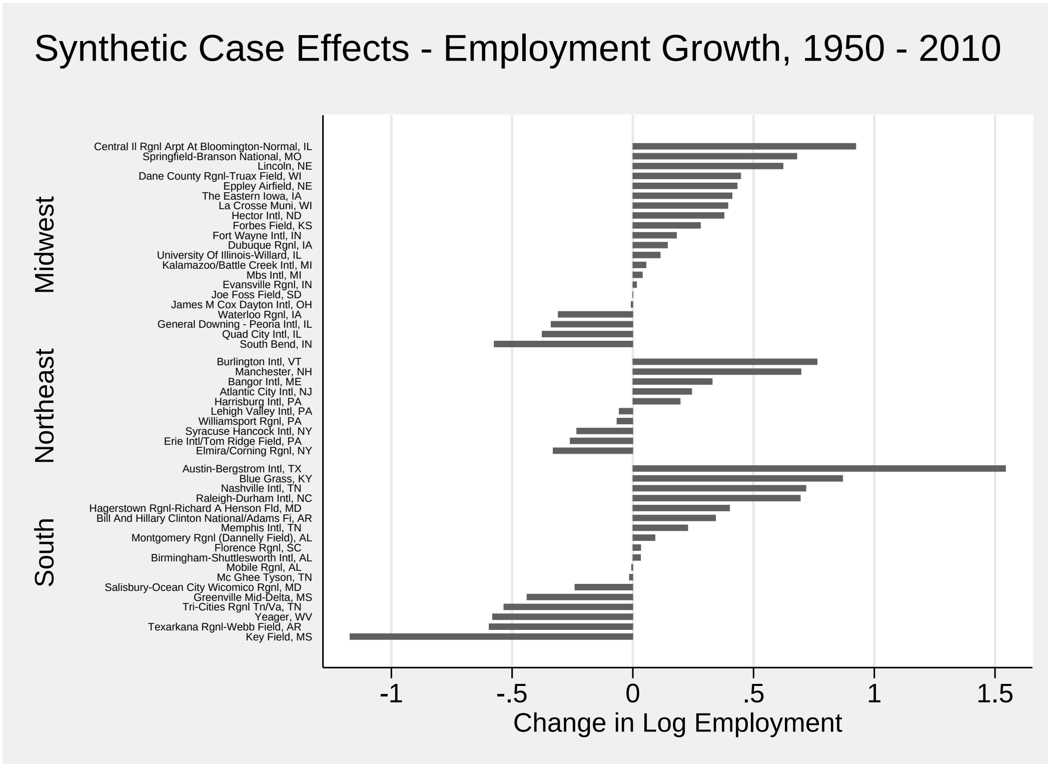


Figure A.6: **Population Treatment Effects by Initial (1950) Population Size**