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Assessing the impacts of state-supported rail services on local population and employment: A California case study

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ABSTRACT

The State of California has been financially supporting Amtrak intercity passenger rail services since 1976. This paper studies the impacts of this support on local population and employment at both county and city levels. We use datasets which include geographic, transportation, and socioeconomic characteristics of California counties and cities from 1950 to 2010. Propensity score, one-to-one matching models are employed to draw units from the control group, which are counties/cities that do not have a state-supported Amtrak station, to match with units from the treatment group, which are counties/cities that do. Using regression analysis, we find that state-support Amtrak stations have significant effect on local population in the long term, and the effect increases with time. However, the effect on civilian employment is almost non-existent. This suggests that state-supported Amtrak services can provide quality rail mobility and accessibility, which attract people to live in a rail-accessible region. However, the economic influence seems limited.

1. Introduction

Passenger rail transportation in the US has experienced major upheavals in the past century. Until about 1920, intercity travel in the US had been completely dominated by rail transportation. The services were historically provided by private freight railroads that owned and maintained rail tracks and managed the operations. From 1920, rail ridership started to diminish, and this trend continued until 1934, mainly due to the rise of automobiles and increased popularity of intercity bus services (Thompson, 1993). Although railroads enhanced services in the mid-1930s with new diesel-powered streamliners, rail ridership decline continued. The share of rail transport in total passenger miles decreased to 67% in 1940, and further to only 15% in 1965. In the late 1960s, most of the passenger rail services were not able to break even, and some major rail companies became insolvent. The US federal government ultimately stepped in 1970 and President Richard Nixon signed the Rail Passenger Service Act, based on which the National Railroad Passenger Corporation, known as Amtrak, was formed to take over passenger rail operations on May 1, 1971. The total number of services was pruned from 364 to 182. Since 1971, Amtrak has been the only provider of intercity passenger rail services in the United States (Nice, 1998; Pan, 2010).

As in other states, Amtrak discontinued multiple rail services in the State of California in 1971, including Redwood, Sacramento daylight, Jan Joaquin Daylight, San Francisco Chief, El Capitan, and Del Monte. On the other hand, to foster intercity passenger rail services, the California Department of Transportation (Caltrans) has been providing Amtrak with financial support since 1976, which has helped Amtrak initiate new services, extend existing services, and improve service quality. However, the impact of this support on regional economic development is not yet well known. To fill this gap, this paper employs propensity score matching and regression modeling to study the decade-by-decade effects of state-supported Amtrak services on population and employment of California counties and cities.

Studying the economic impact of public capital has been of interest to the academic community for an extended period of time. By and large, public capital significantly stimulates the economic growth of a region (Munnell and Cook, 1990). Aschauer (1989) investigates the relationship between aggregate productivity and public/private capital stock. He shows that core infrastructures, including highways, mass transit, airports, etc., account for 55% of aggregate productivity; whereas the total share of hospitals, office buildings, courthouses, garages, etc. holds no

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more than 10%.

Many researchers have investigated the relationship between highways and economic development (e.g. Banerjee et al. (2012), Duranton and Turner (2012), Duranton et al. (2014), Faber (2014), Garcia-Milà and Montalvo (2007), and Gibbons et al. (2012)). Baum-Snow (2007) considers the 1947 US highway plan as an instrument and develops regression models to understand how construction of new, limited-access highways has influenced central city populations between 1950 and 1990. The study finds that central city population in each metropolitan statistical area was reduced by about 18% if a new highway passed through a city. However, population would increase by 8% should the highway be absent. In a similar study, Michaels (2008) investigates the impacts on domestic trade of the US interstate highway system. Highways are found to significantly impact the demand for highly-skilled, nonproduction workers in counties. Chi (2010) studies the relationships between interstate highway expansion and population change in the 1980s and 1990s in Wisconsin. Two effects of economic growth are recognized: spreading and backwash effects. The authors suggest that caveats should be considered when interpreting highway impacts as population growth in one location could lead to population decline in the surrounding areas.

In the aviation arena, it is widely believed that air transport services, by connecting urban regions, attract new business activities, thereby stimulating local population and economic development. By developing instrumental variable regression models, Brueckner (2003) finds that 10% increase in passenger enplanements elevates employment in service-related industries by about 1%. He finds no significant effect of airline traffic on manufacturing and other goods-related employment. Green (2007) develops instrumental variable regression models to study the impacts of airports on regional growth. Different measures of airport activity, including boardings, originations, hub status, and cargo volume are investigated. The author concludes that passenger activity is a statistically significant predictor of regional growth while cargo activity is not. The results indicate that increasing boardings per capita by one standard deviation will result in 8% increase in regional population in a decade. To investigate how small- and mid-size commercial airports affect local economies over the post-World War II period, McGraw (2014) develops instrumental variable regression models, and finds that existence of an airport in a Core Based Statistical Area results in 14.6%–29% population growth, and 17.4%–36.6% total employment growth. In addition, airports impact tradable industry employment to a greater extent, compared to non-tradable industry employment. Other insights about the relationship between airports and economic development are obtained in Percoco (2010), Mukkala and Tervo (2013), Cidell (2015), Sheard (2014), and Blonigen and Cristea (2015).

Because of the long-standing position of rail in the transportation system, a large body of the literature focuses on assessing the economic impacts of rail transport. Building on the general equilibrium trade theory, Donaldson and Hornbeck (2013) study how railroads have influenced America's economic growth. In the study, a change in "market access" represents aggregate impact of a change in the rail network. Removing all railroads is found to reduce average market access of counties by 63%, which in turn would decrease gross national product by 6.3%. The authors find that rail access has small positive impact on population density and boosts urbanization. On the grounds that Swedish railroads have been extended quasi-randomly, Berger and Enflo (2014) use two-stage least squares (2SLS) and limited information maximum likelihood (LIML) methods to estimate the extent to which railroads contributed to town-level growth over the last 150 years. Compared to cities with no access to rail, towns with rail access experienced large population increase in the short term. Population further spills overs to nearby towns. However, the relative differences in population among towns is largely stable in the long term despite continuous expansion of the rail network. Hornung (2012) studies the causal effects of rail station access in the German state of Prussia during the 1840–1871 period using instrumental variable regression and fixed-effects estimation techniques. Urban population growth is considered as a proxy of economic growth, and it is found that economic growth of cities with rail access is roughly 1–2% greater than cities with no rail access. Gregory and Henneberg (2010) examine whether acquisition of a rail station had significantly driven population growth in England and Wales parishes in the pre-World War I period. They find that parishes with a station early grew substantially faster than those without. Parishes gaining a station earlier had faster growth rates than gaining a station later.

For more recent passenger rail systems, Wang and Wu (2015) apply the difference-in-difference method to estimating local economic impacts of China's Qinghai-Tibet rail line. Results indicate that the rail line stimulates annual GDP per capita by about 33%. The impact is focused on manufacturing, with almost no effect on agriculture and service industries. Nordstrom (2015) uses ridership data, surveys, corridor development information, and property value assessment to explore the role and impact of commuter rail on local geography. Elkind et al. (2015) study and grade the neighborhood within 1/2 -mile radius of 489 existing stations in 6 district California rail transit systems. Sperry et al. (2013) investigate the economic impact of the Michigan Amtrak service including traveler savings, passenger spending at local businesses, and Amtrak-related expenditures in 22 communities. For further understanding of the economic impacts of rail transport, readers may refer to Atack and Margo (2009), Atack et al. (2010), Franch et al. (2013), Koopmans et al. (2012), Pereira et al. (2015), and van den Heuvel et al. (2014).

Despite the rich literature on estimating the economic impacts of rail transport, no effort is made to investigate how the state-level support of Amtrak services affects regional socioeconomic characteristics. In this paper, we make the first attempt to fill this gap. We use historic data from California to empirically investigate to what extent the presence of an Amtrak station(s) in a county or a city affects population and civilian employment of the county/city. In investigating this plausible causal relationship, two challenges need to be overcome. First, the dataset required for causal inference includes missing values, which is an important issue as the number of observations (which correspond to counties or cities) in our study is limited. Second, rail services, like other transportation services, are not randomly assigned to counties and cities (McGraw, 2014). Characteristics of the counties/cities with rail services may differ systematically from those without. As a consequence, estimating the economic effects of rail services using regression would yield biased results if no adjustment is made. To tackle these challenges, we employ the multivariate normal imputation method to fill in the missing values in the dataset. One-to-one propensity score matching models are employed to match counties/cities without rail services with counties/cities with rail services. We then perform ordinary least squares (OLS) regressions to quantify the impacts on local population and employment of state-supported Amtrak services. Fig. 1 illustrates the modeling framework.

The reminder of the paper proceeds as follows. In Section 2, we provide details on data preparation. Section 3 is dedicated to describing the theoretical background and results of multivariate normal imputation. Section 4 discusses on the principles of the causal inference framework and the matching models used. Section 5 presents the OLS estimation of the impacts on population and employment of rail station access. Summary of major findings and directions for future research are given in Section 6.

2. Data preparation

2.1. State-supported rail services in California

Currently, Caltrans provides financial support for three Amtrak rail corridors in California: Pacific Surfliner, San Joaquin, and Capitol Corridor (Fig. 2). The length, number of stations, ridership, and on-time performance of each corridor are presented in Table 1. The Pacific Surfliner serves the coastal strip between San Diego and San Louis