Regional Science and Urban Economics 60 (2016) 180–197

Contents lists available at ScienceDirect

Regional Science and Urban Economics

journal homepage: www.elsevier.com/locate/regec

Does employment growth increase travel time to work?: An empirical analysis using military troop movements☆

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A R T I C L E I N F O

Article history:
Received 6 April 2015
Received in revised form 5 July 2016
Accepted 12 July 2016
Available online 15 July 2016

JEL classification:
R40
Q50

Keywords:
Employment growth
Travel time
Military

A B S T R A C T

Employment growth is a common public policy goal, but it can lead to a number of unwanted environmental, social, and economic costs – particularly in high growth communities – due to its impact on peak-hour traffic. This paper examines the short-run impacts of rapid employment growth on travel time to work. We exploit exogenous variation in employment levels resulting from movements of military troops during the 2005 Base Realignment and Closure (BRAC) in order to identify the effect of employment growth on travel time using difference-in-difference-in-differences and instrumental variable methods. Our results show that for each additional 10 workers added per square kilometer, travel time increases by 0.171 to 0.244 min per one-way commute trip per commuter in the short run, which equates to $0.07 to $0.20 in travel time cost per commuter per day. Our estimates imply that the annualized short-run congestion costs of the 2005 BRAC were $79 to $761 million per year (in constant 2005 dollars) for military commuters and $3.15 to $6.3 billion per year (in constant 2005 dollars) for civilian commuters in BRAC-affected areas.

1. Introduction

Studies have shown that traffic congestion is the number one concern of individuals in rapidly growing areas in the U.S., often ranked higher than crime, school over-crowding, and housing shortages (Cervero, 1989; New Jersey [NJ], 2005; Government Accountability Office [GAO], 2009). Traffic congestion and long travel times are undesirable because they discourage future economic growth (Hymel, 2009; Sweet, 2011), increase vehicular emissions, increase fuel expenses, increase operating costs for both private and freight vehicles, decrease economies of agglomeration, heighten the psychological burden of travel, create a need for more emergency services, decrease the reliability of travel, and impose an opportunity cost on time (Downs, 1992; Downs, 2004; Brownstone and Small, 2005; Beaudoin et al., 2015; Beaudoin et al., 2016; Beaudoin and Lin Lawell, 2016).

Travel time is a function of both the speed of travel (which is affected by congestion) and the distance of travel. A number of short- and long-run factors influence these two variables. In the very short run – by which we mean hours to months – inclement weather, traffic accidents, special events, and road construction create a temporary lack of transportation supply for a given demand and thus reduce the speed of travel.

In the longer run – by which we mean years to decades – city-level factors change the number of travelers using a transportation network or the travel distances between locations (Federal Highway Administration [FHWA]., 2004; Downs, 2004). Examples of such long-run factors include the absolute employment level (larger metropolitan areas tend to have higher congestion); infrastructure expansion or contraction; vehicle ownership; travel preferences (e.g., younger travelers increasingly prefer active modes of transport); geo-demographics; number of two-worker households; the accessibility of the transportation network; and relative distances between jobs and housing.

A final factor that influences traffic congestion is the rate of growth in travelers using the transportation network. Communities plan for growth by adding infrastructure capacity or implementing travel demand management measures. However, when the rate of growth is higher than anticipated (i.e. an employment shock) or the community lacks the ability to respond to the growth, traffic congestion may increase.[1]

☆ We thank Gilles Duranton and seminar participants at UC-Davis for helpful comments. We greatly benefited from discussions with Joel Strickland (RPO Transportation Director, Mid-Carolina Council of Governments). We thank the NextSTEPS program at the Institute of Transportation Studies at the University of California at Davis for generous support. Lin Lawell is a member of the Giannini Foundation of Agricultural Economics. All errors are our own.

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[1] Traffic theory suggests congestion increases when vehicle volumes reach a critical density, determined by the geometry, speed law, and condition of the road.

http://dx.doi.org/10.1016/j.regsciurbeco.2016.07.007
0166-0462/

In this paper, we use one measure of growth – employment growth – to estimate how growth shocks impact travel time to work.[2] Employment growth is a common public policy goal, but it can lead to a number of unwanted environmental, social, and economic costs – particularly in high growth communities – due to its impact on peak-hour traffic. A better understanding of the relationship between travel times and employment growth would help policy-makers develop more informed growth strategies.

Our focus in this paper is on the short-run, congestion-related impacts of employment growth. In the long run, employment growth tends to increase the wealth of a community and push out the boundaries of the urban area, thereby increasing the distance of travel.[3] Although the effects of employment growth on traffic congestion may be attenuated in the long run as people may respond by moving or changing jobs, and as city planners may respond by changing transportation infrastructure, an examination of the short-run effects is important because the short-run effects of employment growth on travel time and travel time costs associated with these effects, though perhaps only incurred over a short period of time, may be high.[4]

In the past three decades, employment growth rates averaged 1.4% per year in the U.S.,[5] and some high growth communities like the city of Las Vegas in the 1990s or Atlanta in the 2000s reached employment growth rates of over 10% per year (Ruggles et al., 2015). Over roughly the same period, the congestion-related delay has increased from 2 to 5 min per one-way commute in the U.S. (Schrank et al., 2011).[6]

There are two sources of endogeneity that must be overcome when estimating the effect of employment growth shocks on travel time. First, a simultaneity problem arises if travel time has an influence on employment growth. This could occur if an increase in average travel times reduces the attractiveness of a community to potential new firms. This, in turn, reduces the number of future commuters using the transportation network (Hymel, 2009; Sweet, 2011) and incentivizes new residents and businesses to locate on the outskirts of the city or in another city altogether (Downs, 1992). A second endogeneity problem stems from omitted variables, such as transportation infrastructure, that are related to both employment growth and travel time. Any factor in a community that may have changed in anticipation of an upcoming employment boom could fall in this category.

To address these potential endogeneity issues, this paper exploits exogenous variation in employment levels resulting from movements of military troops during the 2005 Base Realignment and Closure (BRAC) process. The BRAC process provides a convenient quasi-experimental framework to measure the short-run, congestion-related effects of employment growth on travel times because it occurred largely outside of the normal transportation planning process. As we argue in the paper, these exogenous troop movements address the simultaneity and omitted variable endogeneity problems that arise when estimating the effect of employment growth shocks on travel time.

We conduct two separate analyses to measure the short-run, congestion-related effects of employment growth on travel time to work. The first uses difference-in-difference-in-differences (DDD) methods in which travel times for military individuals in communities affected by the 2005 BRAC are compared to travel times for two control groups both before and after the 2005 BRAC. In the second, and preferred, analysis, we use an instrumental variable (IV) model in which we instrument for regional employment density with the change in military troops in the 2005 BRAC. The IV method enables measurement of a causal relationship between employment density and travel time.

As we use annual data and as our data set extends a few years after the 2005 BRAC, the relevant time horizon for the "short run" that we use in this paper is on the order of a year to a few years. Even in the short run, it is possible that some people may respond to employment growth by moving; or by adjusting their work schedules to depart from home to work at a different time, or to arrive at work at a different time. Our estimates therefore measure the short-run effect of employment growth after individuals have had a chance to respond by moving or adjusting their work schedules.

Our results are quite robust across models. We find that on average in the U.S. each additional 10 workers[7] added to the transportation network per square kilometer adds 0.171 to 0.244 min per one-way commute trip per commuter in the short run which equates to $0.07 to $0.20 in travel time cost per commuter per day. Our estimates imply that the annualized short-run congestion costs of the 2005 BRAC were $79 to $761 million per year (in constant 2005 dollars) for military commuters and $3.15 to $6.3 billion per year (in constant 2005 dollars) for civilian commuters in BRAC-affected areas.

It is possible that the annual congestion costs of the 2005 BRAC may decrease over time in the long run, as more people may respond by moving or changing jobs, and as city planners may respond by changing transportation infrastructure. As our focus is on the short-run effects of employment growth, and as the BRAC occurred just recently, we are unable to estimate long-run effects. However, the short-run costs congestion costs of the 2005 BRAC are still quite high, even if they are only incurred in the first few years.

The question of how employment growth impacts region-wide travel times has tremendous relevance to city planning. Communities often prioritize job creation and give the associated traffic-induced externality less attention. This paper therefore should be useful to policy-makers who seek effective growth strategies. A better understanding of the relationship between employment growth and travel times would help planners develop effective anti-congestion measures by properly predicting expected changes in travel times due to growth.

Additionally, this paper contributes to our understanding of how military troop movements affect communities around military bases. With over 1.2 million members of the U.S. military, fluctuations in troop levels at military bases have a major impact on surrounding communities (Hampton Roads, 2007; National Academies of Science [NAS], 2011), and to our knowledge no previous academic study has looked at how the movements of troops – either from base closures or from routine deployment cycles – affect a region's transportation network.

The balance of our paper proceeds as follows. We review the related literature in Section 2. In Section 3, we make the case for the exogeneity of the 2005 BRAC. Section 4 describes our data. We conduct Granger causality tests to provide further evidence for the exogeneity of the 2005 BRAC in Section 5. Section 6 presents our difference-in-difference-in-differences (DDD) analysis. Section 7 presents our instrumental variable (IV) analysis. In Section 8, we present a back-of-the-envelope estimate of the short-run travel time costs from the 2005 BRAC. Section 9 concludes.

[2] We use travel time instead of a congestion index as the main outcome variable because it enables us to use person-level data. Additionally, despite being a simple concept in practice, traffic congestion is difficult to measure because of its heterogeneous nature across space and time (Downs, 2004).

[3] It should be noted that any short- or long-run factor that affects travel times will be dampened by the "triple convergence" in which commuters re-adjust to new travel conditions by switching routes, modes, and departure times (Downs, 1992; Choo and Mokhtarian, 2008).

[4] Morever, the costs of any long-run adjustments, which may involve building infrastructure, changing jobs, and/or moving, are also potentially very high, even if they reduce congestion costs.

[5] This number reflects the percentage increase in employed workers per square kilometer in 221 metropolitan areas between 1980 and 2012. The 221 metropolitan areas are those identified by the *pwmetro* variable in Ruggles et al. (2010)

[6] These estimates apply to two-way commute (e.g. home to work to home). They are calculated using the annual delay per commuter in 1982 and 2010 according to Schrank et al. (2011)of 15 h and 38 h, respectively. The average number of weeks worked was 44.2 weeks in 1980 and 46.8 weeks in 2012 (Ruggles et al., 2015).

[7] We define a "worker" as one who works for someone else for wages, salary, piece rate, commission, tips, or payments "in kind" (for example, food or lodging received as payment for work performed); works in his or her own business, professional practice, or farm; performs any work in a family business or farm, paid or not; performs any part-time work including babysitting, paper routes, etc.; and/or is active duty in the Armed Forces.