



Public transit bus procurement: The role of energy prices, regulation and federal subsidies [☆]



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ABSTRACT

The U.S. public transit system represents a multi-billion dollar industry that provides essential transit services to millions of urban residents. We study the market for new transit buses that features a set of non-profit transit agencies purchasing buses primarily from a few domestic bus makers. In contrast with private passenger vehicles, the fuel economy of public buses has not improved during the last thirty years and is irresponsive to fuel price changes. To understand these findings, we build a model of bus fleet management decisions of public transit agencies that yields testable hypotheses. Our empirical analysis of bus fleet turnover and capital investment highlights the role of energy prices, environmental regulations, and the “Buy America” mandate associated with receiving federal funding to purchase public transit buses.

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1. Introduction

In 2011, there were nearly 70,000 public transit buses operating in the United States. Public transit riders in the U.S. traveled 56 billion passenger miles. 38% of these miles were covered by public buses. Transit agencies spent about \$2.5 billion on new buses and \$3.5 billion to maintain the existing stock. In 1991, the aggregate capital and operating expenditure on public transit equaled \$36.3 billion (in 2011 dollars) and this grew to \$55 billion by

2011. These facts highlight that the public transit bus fleet is a major urban capital stock.

Both private vehicles and public buses move people within cities and the vast majority of both types of vehicles use fossil fuels as their energy source. Fig. 1 presents a thirty-year time trend in fuel economy measured as miles per gallon for three types of vehicles. It shows that the fuel economy of private vehicles (passenger cars and light trucks) in use has improved by over 40% during the last thirty years but public transit bus fuel economy has been stagnant.¹ The fuel economy of cars was increasing even when the Corporate Average Fuel Economy (CAFE) standards for cars stayed flat from 1990 to 2010.

As we show in Section 2, we find no evidence that bus fleet fuel economy responds to fuel prices or that the fuel economy tech-

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¹ Source: Transportation Energy Data Book, Oak Ridge National Laboratory, 2013. The estimates are based on fuel consumption and vehicle miles by vehicle type. The figures for buses are miles per gasoline gallon equivalent. The improvement in bus fuel economy would be less likely to be observed over time if buses become heavier due to the introduction of air conditioning and new equipment to make them wheelchair accessible.

nology improves over time. Motivated by these findings, which are in contrast with the trends for passenger cars, this paper examines transit agencies' decisions on fleet management and presents evidence on the demand and supply of U.S. public transit buses. There are at least three distinctive reasons for studying the U.S. public transit bus market.

First, public transit agencies' bus purchase decisions represent unique market transactions featuring a non-profit entity (the public transit agency), who is a local monopolist in providing transit services, purchasing expensive durable capital from for-profit firms who compete in a differentiated goods market. Transit agencies often use "other people's money" (federal transfers) for capital investment. Therefore, this sector offers an opportunity to understand the revealed preference of public decision makers and we contrast their choices with those exhibited by private vehicle buyers (McFadden, 1976).

Second, public transit agencies have to abide by the "Buy America" mandate in bus purchase decisions when availing themselves of federal funding.² The Buy America mandate has played a role in determining U.S. government procurement since 1933 and the U.S. international food aid programs since 1954. To our knowledge, this study offers the first look into the impacts of this important federal policy on the public transportation sector. Our empirical results underscore the important impacts of this mandate on both the demand and supply sides of the bus market.

Third, we know of no recent economics research investigating public bus procurement and fleet management. This research gap is notable because public buses play a central role in providing basic transportation services for a large share of the urban poor and constitute an important element of urban quality of life (Glaeser et al., 2008). Public buses also represent a viable substitute for private vehicle driving. If urban travelers substitute from using cars to riding the bus there could be significant impacts on reducing three key urban externalities: air pollution, greenhouse gas emissions from automobiles, and road congestion (Parry and Small, 2005, 2009; Parry and Timilsina, 2010).

The market for public transit buses differs significantly from that of private vehicles. The private vehicle market features private firms selling to individuals, and auto makers all over the world compete for U.S. consumers. This competition leads to a wide range of differentiated products in a rich attribute space for consumers. Consumers in this market respond to gas prices in choosing whether to scrap their existing vehicle and in choosing their new utility maximizing vehicle (Li et al., 2009). During times when gas prices are high, consumers seek out imports such as the Toyota Prius and for-profit sellers direct their product mix and innovation efforts to supply such vehicles. Such induced innovation shifts the attributes bundled into differentiated products at any point in time (Newell et al., 1999; Knittel, 2011).

In contrast, the U.S. public bus fleet is predominantly produced by domestic bus makers who focus on the U.S. market and are small in scale relative to major international bus makers, despite the fact a large number of different buses are produced around the world and highly fuel-efficient buses are produced in China, Japan and South Korea. In addition, as we document below, the bus fleet fuel economy is not responsive to fuel price changes and there is no improvement in fuel economy technology over time.

To understand these findings, we build a model of bus procurement and bus scrappage decisions for local transit agencies that yields testable hypotheses. A public transit agency has a very different optimization problem than private individuals or businesses as it trades off the costs of operating expenses such as vehicle maintenance and capital expenses; complies with Federal Clean Air Act regulation; and tries to satisfy various constituents such as labor unions and funding agencies. Transit agencies are expected to guarantee a certain level of transit service to the cities they serve. In providing this service, they recognize that past investments in mechanic human capital, spare parts for specific buses and characteristics of their repair facilities all create an asset and human capital specificity that encourages them to concentrate their bus purchases on brands they have previously bought (Williamson, 1988).

We estimate a series of reduced form models of fleet inventory dynamics and new bus demand to document the role these various factors play. Our analysis suggests: (1) transit agencies' bus scrappage and purchase decisions do not respond to changes in fuel prices; (2) transit agencies in non-attainment counties (counties designated by the EPA as having sub-standard air quality) for Ozone and PM2.5 tend to scrap their diesel buses earlier than others and more likely to buy natural gas buses; (3) transit agencies prefer purchasing buses from manufacturers whose plants are located in the same state; (4) transit agencies tend to buy buses of the same make and fuel type as what they already have, which we characterize as brand loyalty or lock-in effects; (5) the inflow of federal funding expedites the scrappage of old buses and increases purchases of domestically produced expensive and environmentally friendly hybrid buses.

Our empirical analysis highlights the lack of demand response to fuel prices and the important impacts from the rules and regulations that transit agencies face in their fleet management decisions. We argue that the Buy America mandate coupled with federal funding for domestic bus purchases reduces foreign competition, supports a concentrated industry composed of a few small domestic firms, and retards incentives for innovation. By raising the relative "effective" price of internationally traded goods (e.g., buses), the Buy America mandate causes distortions in the allocation of resources in much the same way that a tariff does (Lowinger, 1976).

In Section 2, we present a detailed analysis of the bus fleet's fuel economy dynamics as a function of energy prices and we contrast these estimates with the private vehicle stock. Section 3 describes the bus procurement environment. Section 4 provides a model of transit authority decisions to help motivate our empirical model. In Section 5, we first discuss our data and present our empirical tests regarding bus procurement practices by transit agencies. We then discuss the implications of these findings and conclude.

2. Fleet fuel economy of U.S. public transit bus is energy price inelastic

Ongoing research in environmental and energy economics has studied how the private vehicle fleet's composition and utilization responds to gas price dynamics. These studies have generally concluded that both new vehicle purchases and used vehicle scrappage respond to gasoline prices to various degrees (Li et al., 2009; Klier and Linn, 2012; Knittel, 2011; Jacobsen and van Benthem, 2013). At the intensive margin, households reduce driving where gasoline price rises (Small and Van Dender, 2007; Gillingham, 2014).³

³ Consumer responses are affected by the availability of substitutes such as public transit (Timmins et al., 2014). In addition, land use regulations and residential density are found to affect both margins and energy consumption (Brownstone and Golob, 2009; Larson et al., 2012).

² The Buy America mandate applies to mass-transit-related procurement using federal funding. It has been in effect since 1983 and was a provision in the Surface Transportation Assistance Act of 1982. This is an extension of the "Buy American Act" passed in 1933 in congress that requires U.S. government to prefer domestically made products in procurement. The 2009 America Recovery and Reinvestment Act includes a similar provision that mandates that projects funded by the stimulus package can only use domestically produced iron, steel, and manufactured goods. This provision has been argued to increase project costs and reduce the effectiveness of the stimulus package.

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