Transportation Research Part E 82 (2015) 1–18

Contents lists available at ScienceDirect

Transportation Research Part E

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

Modelling spillover effects of public transportation means: An intra-modal GVAR approach for Athens ☆

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ARTICLE INFO

Article history:
Received 21 January 2015
Received in revised form 8 June 2015
Accepted 10 July 2015
Available online 3 August 2015

Keywords:
GVAR
Shocks
Modes
GDP
Athens

ABSTRACT

In this work, we employ the GVAR model in order to analyze demand aspects of a multi-modal public transportation system. The methodology is applied to the Athens region, Greece. GVAR provides a relevant econometric modelling framework for assessing relationships between economic entities, such as transportation modes, by analyzing the relative shocks and channels of transmission mechanisms among them. According to our findings, which are consistent with the existing literature, the system of all public transportation modes in the wider Athens region, is relatively flexible to unexpected – intramodal or macroeconomic – shocks.

1. Introduction

In a multimodal environment, different modes have differing characteristics and may operate in competition or cooperation depending on a variety of circumstances. In a multimodal Public Transport (PT) system that operates under common pricing policies, a variation in fares, or any relevant factor affects, in different ways, the demand for different public transport modes. Therefore, treating each mode of the multimodal PT system as a separate entity provides clearer information regarding the role and contribution of each mode to the system. Moreover, multimodal public transport demand analysis allows for identifying substitution and competition effects among the different modes, taking into account the particular contribution of each mode to total demand and the manner in which the demand for each mode is affected by various factors. This is particularly useful in redefining the mix of the different modes in a multimodal PT system.

The Athens multimodal public transport system consists of five modes: Metro (AMEL), Urban rail (ISAP), Bus (ETHEL), Trolley/Electric Bus (ILPAP), and Tram (TRAM). The metro system in Athens has two metro lines with a total length of 32 km and 36 stations. The frequency of the trips is approximately 3 min during peak-hour periods and 5–10 min during off-peak periods. The urban rail is the oldest Public Transport (PT) mode in the city of Athens. It consists of a single line with a length 25.6 km, which connects the north suburbs with the port of Piraeus. The Metro and the Urban Rail are connected in four central stations. The bus network includes approximately 330 bus lines covering the entire greater Athens Metropolitan

☆ We are indebted to the Editor, Jiuh-Biing Sheu, and two anonymous Referees for their constructive comments that have helped to us improve the quality of the paper significantly. The first author (P.G.M.) gratefully acknowledges the support provided by the Siemens Fellowship of Excellence (IKY). Unfortunately, our co-author Professor Matthew G. Karlaftis passed away in 2014. This paper is dedicated to his memory.

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http://dx.doi.org/10.1016/j.tre.2015.07.004
1366-5545/

Area, with a fleet of approximately 2500 buses. The Bus is the PT mode with the highest demand due to its extended network. The network of the trolley/electric bus consists of 22 lines that primarily serve the Athens city centre. The Tram has 3 lines mainly linking the south suburbs of Athens to the city center with a limited network of approximately 26 km and 48 stops. The aforementioned modes are interconnected. However, for large parts of the network, there are parallel lines of different public transport modes. Hence, there is both competitive and complementary operation of the different modes. The PT modes share similar pricing policies and are centrally regulated. The following figure summarizes the key routes in the region of Athens (see Fig. 1).

In this context, we attempt to shed light on how a change in the demand i.e. ridership of one public transportation means, will affect the ridership of the rest of the public transports. In this context, we investigate the impact that a sudden change, on the transportation network of a public transport, will have on the ridership of the rest of the public transports. The term 'sudden change' refers to unexpected/unanticipated shocks that disrupt the normal functioning of the multimodal public transport system in the region of Athens. In this framework, these shocks refer to events such as sudden strikes, sudden network malfunctions and unscheduled network maintenance or even urgent network reconstruction. Please note that these events, despite being unexpected, they could be quite long-lasting, especially in Athens, Greece.

In order to tackle the research question, we employ the Global Vector Autoregressive (GVAR) framework and apply it to the Athens region over the time period 2002–2010. The Global VAR (GVAR) model provides a useful framework for assessing the interdependence between distinct economic entities. The GVAR framework was introduced by Pesaran et al. (2004) and developed through several high quality theoretical contributions such as Pesaran and Smith (2006), and Chudik and Pesaran

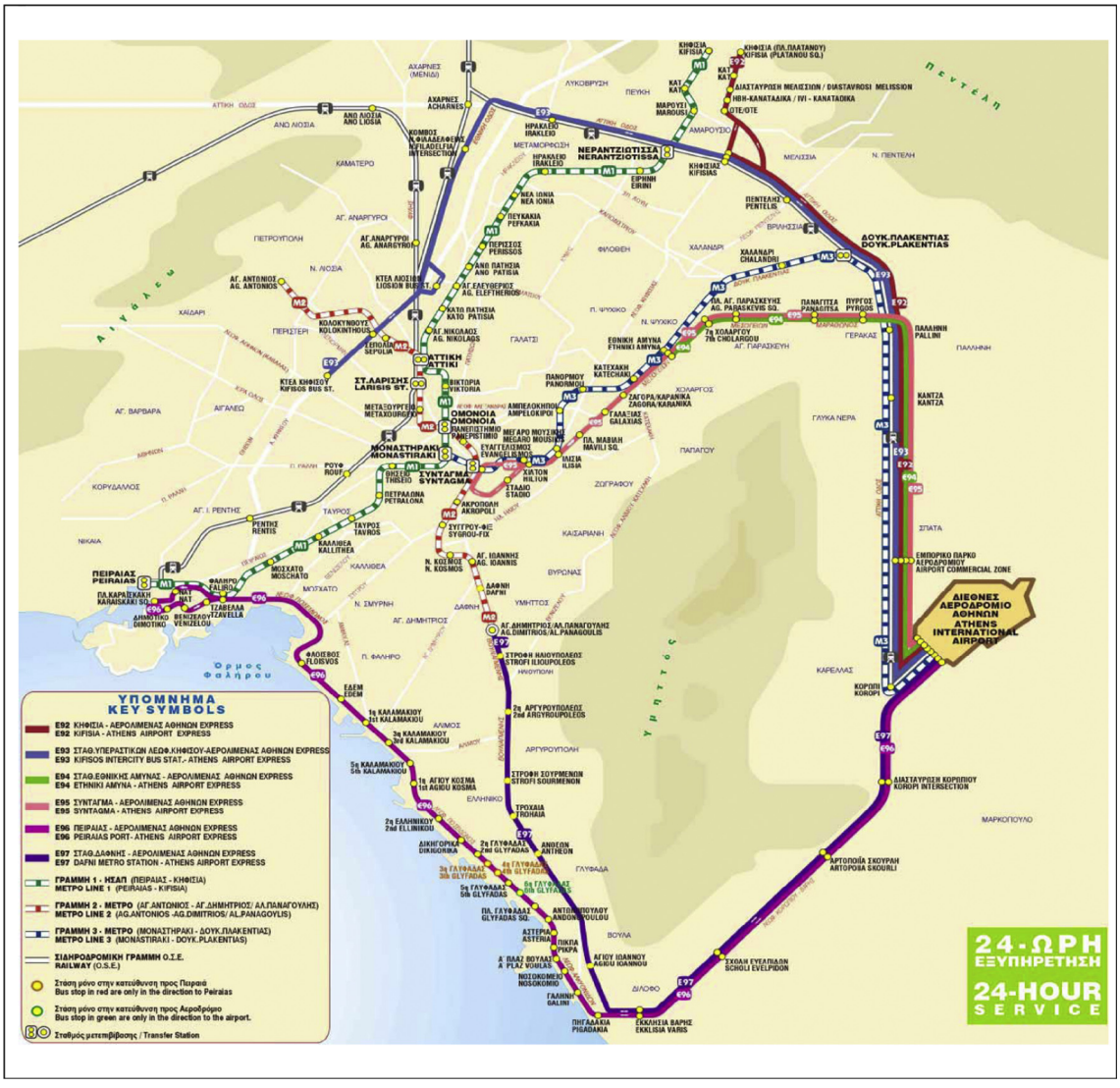

Fig. 1. Map of the various transportation modes in Athens. *Source:* http://www.greek-islands.us/athens/athens-buses.