Non-price policy measures to tackle accident risk and its implication for urban sprawl.

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Introduction

This paper studies the decentralization of non-price externality reducing policy measures that address accident externalities with endogenous residential location.

Building on Brueckner (2015), we consider a three-zone city: central-city, mid-city and suburb. Each zone and its population are homogenous. Individuals can choose in which zone to reside. All individuals commute to the CBD located within the central-city and transport costs consist of time and other costs to travel between zones. We study accident risks, specifically car vs car externalities, where the average cost of a car trip increases with increased accident risks between cars. Each local government can adopt traffic safety measures, some (e.g. round-a-bouts) reduce average accident risk and travel costs, thereby attracting more inhabitants to the mid-city and suburb. Others (e.g. speed bumps) may reduce accident risks but increase the average travel cost and have an opposite effect on the suburban population.

Research purpose and questions

Spillovers are common in transportation infrastructure as different links of a network are usually under the jurisdiction of different governments and most links are used by both local and through/incoming traffic. The literature shows that decentralized decision making particularly in the presence of significant spillovers, to be inefficient as local decision makers do not consider the external benefits (costs) of their policies (De Borger and Proost (2013), Proost and Sen (2006), Van Dender (2005)). However, existing economic literature largely focuses on strategic pricing behavior of governments though many road networks at the local level are controlled via non-price policy measures (e.g. traffic lights, speed bumps). Moreover, the implications of these measures on land use and land values in urban areas has not been studied yet. Hence, this paper contributes to existing literature by ascertaining whether the decentralization of non-price externality reducing policy measures in the presence of urban land market is socially optimal.

We begin with the framework by Brueckner (2013), which studied the efficiency of fiscal decentralization choices of road capacity financed by budget-balancing user fee. We extend it by focusing on non-congestion externalities and assessing the impact of decentralized investment in non-price externality reducing measures. We also examine the effect of these measures on the urban land market.

This paper addresses the following questions:
Does the federal government’s optimum level of traffic calming measure depend on who pays for the investment cost?

Should the federal government allow local governments to determine the amount of investment on traffic calming?

How are the price of land and residential density in the long run affected by these non-price measures?

Methodology

Our model combines Brueckner’s (2015) three zones model with the non-pricing measures model of De Borger and Proost (2013). In Brueckner’s (2015) set-up agglomeration is composed of three zones (islands): central-city, mid-city and suburb. Zones are connected by “bridges” that stand for road network connecting two zones. The central-mid-city bridge falls under the mid-city’s jurisdiction, whereas the mid-city-suburb bridge falls under the jurisdiction of the suburb. All individuals commute to a CBD located in the central city. These bridges are accident-prone areas.

We start with the short run case where urban lot size and the number of people living in each zone are fixed. We then study the long run case where lot size and the number of population in each zone changes. Governments can take measures to reduce accident externalities but these measures increase the average cost of driving (speed bumps) and can be costly in terms of government investment.

First, we ascertain the first best solution where a social planner decides on the level of investment of traffic calming measures on both bridges. This serves as a benchmark.

Second, we study the optimal choice of policy measure under centralized decision making where a federal government is constrained to pay for investment via either a head tax only on residents of the regions where the investment takes place or a federal head tax on all city residents.

Third, we analyze decentralized decision making where the mid-city and suburb decide on their respective welfare-maximizing policy measures that are financed by per head tax on local residents.

Finally, we support our analytical model with numerical simulation and sensitivity analysis with respect to key parameters.

Results

The short run effect:

1. Federal optimum level of investment in traffic calming measure is equal to the first best independent of financing method.
2. Mid-city government overinvests in traffic calming than what is socially optimal. This is because: (a) it does not take into account the spillover effect of its policy measure on suburban commuters. (b) it does not take into account the investment cost of the measure as rents in the mid-city adjust to fully offset the per head tax levied on its own residents for financing the measure.

3. Assuming that land is abundant and suburban rent remains constant, investments in traffic calming measure by the suburban government corresponds to the social optimal as the suburban bridge is only used by local traffic.

*The long run effect:*

4. More people will move to the suburb and rents in the central and mid-city decrease if optimum level of traffic calming measure reduces average accident cost on the suburban and mid-city bridges more than it increases travel cost.

References


