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Can we decentralize transport taxes and infrastructure supply?

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ABSTRACT

This paper studies analytically a tax reform where federal gasoline and car taxes are replaced by tolls decided by local authorities. This is particularly relevant in countries with high gasoline taxes like the EU or countries that introduce gasoline taxes like China. One of the major barriers in the reform is the allocation of revenues: when the goal of the federal government is to keep the gasoline tax revenue constant, a vertical tax conflict reduces the efficiency gains of the new instruments. Another barrier is the presence of spillovers: it elicits tax-exporting behavior by regional governments and the high taxes overly discourage traffic. We find the efficiency loss of the first barrier to be small and spillover inefficiency to be larger. When infrastructure capacity is flexible, the spillover inefficiency tends to be larger if pricing and capacity decisions are decentralized and smaller if only pricing or capacity decisions are decentralized.

1. Introduction

Current transport taxes offer a real patchwork of gasoline taxes, car ownership and purchase taxes, parking fees and a rare congestion toll.[1] Gasoline taxes have been the dominant instrument to raise tax revenues from car users and to correct various externalities such as congestion, air pollution, noise, climate change and accident costs. In the EU, the tax rate on gasoline was some 3.7 eurocents/vkm to be compared with external costs in rural conditions of 2.1 eurocents/vkm but up to 245 eurocents/vkm in urban peak conditions,[2] which shows how the current gasoline taxes in Europe are an imperfect signal for the external costs of different types of trips. They are an appropriate instrument for addressing climate change but an imperfect instrument for addressing congestion because they do not vary by time of day and by location. Car ownership and purchase taxes and parking fees are not very selective either.

Most of these taxes are organized at the federal level for different reasons, including revenue needs and avoidance of horizontal and vertical tax competition. But the most important externality that is congestion, needs a locally differentiated solution. Over time, technological progress has made the implementation of smarter local instruments such as congestion charges much easier; urban road tolls are already introduced in some major cities such as Singapore, London, Stockholm, Milan and Göteborg. It is expected that further progress in pricing technology as well as public acceptability can lead to a generalized use of congestion pricing by local governments.

This brings us to our major research question: can federal governments leave the use of these policy instruments to the local authorities? What results can be expected from the generalized introduction of congestion taxes by local governments on top of federal fuel taxes? Will the overall tax level be excessive? Under what conditions will the correct charges and tax levels be generated at different government levels? How does the violation of these conditions affect the results? What restrictions can the federal level impose to improve the equilibrium? Under what circumstances will one type of decentralization be preferred over the other options?

In this paper we study the transition problem of moving towards better pricing systems using a stylized model of a country where there are urban regions with more traffic congestion than the rural regions. Each region is homogeneous in terms of population. First, we study the efficiency and acceptability of the different allocations of tax instruments for fixed road capacity. Next, we look into choice of decentralization options when capacity is flexible. The analytical model is complemented with a small numerical illustration.

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[1] A restricted sample of current car tax institutions is given in Appendix A.

[2] The tax rate (3.7 eurocents/vkm) is based on excise tax on gasoline in Belgium in October 2015 and fuel efficiency of 6l/100km. External cost data is based on European Commission (2014) and represents the sum of different external costs: 0.8 eurocents/vkm climate damage (at 25 euro/ton of CO2), 0.7 eurocents/vkm (rural) to 1.3 eurocents/vkm (urban) for other air pollution and external accident costs and for congestion 0.6 eurocents/vkm (rural and off-peak urban) and up to 243 eurocents/vkm (urban peak).

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We obtain the following findings. As expected, when the federal government controls all instruments, adding congestion tolls, conditional on the implementation costs, increases welfare. Indeed it allows for lower gasoline taxes in rural areas and better targeting of congestion taxes in urban areas. In the non-cooperative equilibrium where tax instruments are decided by different levels of government, the same tax equilibrium as with full federal tax control will be reached when certain conditions are satisfied. Important conditions are the absence of spillovers, governments maximizing the welfare of their voters, and tax revenues that are returned to the region that is paying them. In our simulation, we find that the efficiency loss of decentralized implementation is significant in the presence of spillovers whereas the loss from having a revenue-constrained federal government is much lower.

When next to pricing also road capacity can be decentralized, we find that, under the same conditions, decentralization options remain efficient. In the presence of spillovers, the efficiency loss can be contained if only pricing or only capacity decisions are decentralized.

2. Literature review

The optimal pricing of road transport externalities and its relation to road capacity are well covered in transport economics textbooks such as Small and Verhoef (2007). The transition between the second best gasoline taxes we encounter in the real world and the more fine-tuned congestion taxes is studied much less. For the transition problem we study, we will make use of two strands in the literature. The first pertains to the optimal level of a gasoline tax when it is the only instrument that can be used. The second relates to the specific public finance issues that arise when the tax authority is shared by different levels of government.

Parry and Small (2005) looked into the optimal levels of gasoline taxes for the UK and the US. The optimal tax is defined as the tax that internalizes the main externalities associated with the use of fuel: climate damage, other air pollution, energy market issues, and those externalities specific to the use of a car, accidents and congestion. In addition, the derivation of the optimal gasoline tax also takes into account the revenue-raising objective. Although many effects enter the optimal gas tax, the marginal external congestion cost is the main driver of results. The main conclusion is that the UK gasoline tax is too high but the US tax is way too low. In our paper we relax specifically the spatial uniformity constraint imposed by the national gasoline tax by adding more regionally specific tax instruments.

The issue of sharing tax authority among different levels of government is studied in fiscal federalism. In the fiscal federalism literature, the emphasis is on the revenue raising and revenue sharing issues as surveyed in Dahlby (2008). When the tax authority is shared among different levels of government, this creates vertical tax interactions. This means that one government level's tax increase will decrease the tax base and revenues of the other level, which will affect their respective supply of public goods. In this paper we focus on a specific type of tax (externality tax) and on congestible local public goods. These two categories are crucial for road transport but received much less attention in the fiscal federalism literature. The separation of revenue-raising decentralization and expenditure decentralization has been widely studied in fiscal federalism literature such as Boadway and Shah (2009) but not for congestible public goods. As we want to focus on the correction of congestion externalities, we minimize the role of other taxes.

De Borger and Proost (2012) survey the policy interactions between different government levels in a transport policy context and distinguish between horizontal and vertical tax competition issues. There is an abundant literature on horizontal pricing and capacity competition (see for instance, Grahn-Voorneveld (2013), Ubbels and Verhoef (2008), De Borger et al. (2007) and Mandell and Proost (2016)). Within this literature, one distinguishes three types of issues: the parallel network problem, the serial network problem and the spillover problem between adjacent regions. In the first two types of issues, two local governments compete for tax revenues by taxing through traffic and this is much more of a problem in a serial network than in a horizontal network because in the latter structure tax competition keeps tax rates from increasing too much. In the spillover problem, two neighboring communities end up taxing traffic too much as this allows to extract tax revenues from foreigners. Brueckner (2015) and De Borger and Proost (2016) looked into federal constraints that enhance the efficiency of decentralization in the presence of spillovers.

There is much less literature on the vertical tax interaction problems where two government levels tax the same transport activities. One exception is Proost and Sen (2006) that used a transport model for Brussels where the city center decides on parking charges and the regional government decides on a cordon charge. Gasoline taxes were kept fixed. Three types of equilibria were discussed: Nash, Stackelberg (regional government as leader) and bargaining. The Nash equilibrium was very inefficient compared to the two other equilibria because it led to taxes that were excessive.

3. A stylized model

In the stylized model a country consists of an urban region and a rural region, there is no interaction between the two regions, and the rest of the world is ignored. The extension to many regions is discussed in Section 9. The federal government has a gasoline tax as only instrument to regulate road transport. We further limit the scope of our analysis to gasoline car use, since the taxation of gasoline and diesel for passenger cars is a topic in itself.[3] Federal governments also use other taxes on car purchase and ownership. But in most countries, these are less important and have often other objectives than the regulation of transport externalities.[4]

Typically, gasoline taxes are set by federal governments at the country level for two reasons. First because local differences in gasoline taxes would induce horizontal tax competition, which would most likely result in a race to the bottom. Second, there are political economy reasons explaining why regions do not approve federal taxes that are differentiated by region (De Borger and Proost, 2016). Indeed in a federation, each region wants to avoid that a representative of another region that comes into power at the federal level can set federal taxes that discriminate among regions. While gasoline taxes are uniform, road pricing tolls are typically set by local governments because traffic conditions vary strongly among regions. A gasoline tax acts as a distance-based charge. It has low implementation and transaction costs because it imposes excise taxes at the refinery gate or at the import point. We analyze two additional stylized tax instruments. The first instrument is a flat toll, a non-time differentiated road toll, which decreases congestion levels but does not affect departure times. The second instrument is road pricing of the fine toll type (see Arnott et al. (1990)). It strongly enhances efficiency since it also affects departure times within the peak, but it is more costly to implement. At the local level, the main “tax” instrument on car use is on-street parking fees. They address the congestion due to cruising for parking but this is only one of the sources of local road congestion.

More simplifying assumptions are introduced: first, agents are immobile and homogeneous in the sense that they all have the same utility function but their local traffic conditions can differ, being either urban or rural. Agents do not move to other regions and within a region they all make the same trips in terms of length. Second, all governments maximize the welfare of their own residents.[5] Third, congestion is of the bottleneck type and all trips have the same desired arrival time. There is congestion in

[3] The diesel car issue is mainly a European issue and is partly the result of tax competition for truck fuel (Mandell and Proost, 2016). This issue can be solved by using a specific diesel car tax, see Mayeres and Proost (2013).

[4] In the institutional table in Appendix A Denmark and the Netherlands are countries with high car taxes.

[5] This implies that the governments use the three available instruments to address the externalities and not to pursue other objectives.