TOWARDS LESS POLLUTED AND MORE LIVEABLE CITIES

THE EFFECTIVENESS OF LOW-EMISSION ZONES AND URBAN TOLLS IN MITIGATING POLLUTION AND CONGESTION: EVIDENCE FROM THE LITERATURE

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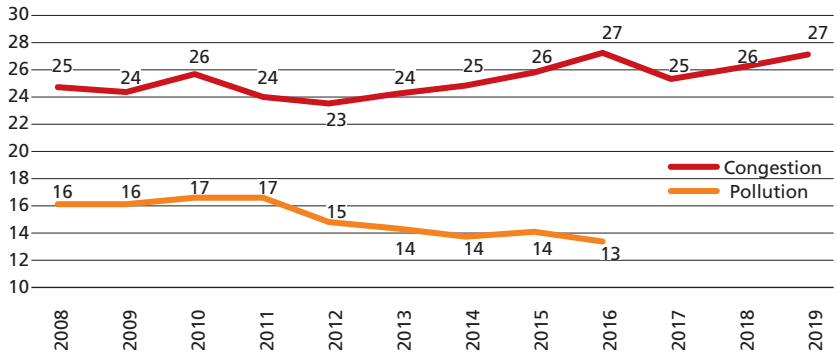
The large share of private car traffic in cities generates severe congestion and pollution. The cost of congestion for European society is estimated to be €270 billion a year (European Court of Auditors, 2020). Further, exposure to pollution, particularly fine particulate matter (PM 2.5) (EEA, 2020), is a major cause of premature death and disease that is responsible for around 400,000 annual premature deaths in the 39 member countries of the European Environment Agency (excluding Turkey). These two negative externalities of private car traffic are related, with car circulation at low speeds impacting the emission of polluting substances (Beaudoin et al., 2015; Parry et al., 2007).

Figure 1 presents the evolution of both externalities for a sample of 130 European cities of over 300,000 inhabitants. The congestion indicator is based on data obtained from the TomTom Traffic Index and shows the additional travel time a vehicle needs to undertake a trip in a certain city as compared to a free-flow situation. The pollution indicator is based on annual estimates of fine particulate matter in suspension with a maximum diameter of 2.5 µg /m³ (PM 2.5), using the method developed by Van Donkelaar et al. (2019).

Figure 1. Pollution and congestion in European cities of over 300,000 inhabitants



Source: Bernardo et al., 2021.

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Exposure to pollution, particularly fine particulate matter (PM 2.5), is a major cause of premature death and disease that is responsible for around 400,000 annual premature deaths in the 39 member countries of the European Environment Agency.

On average, the levels of congestion in European cities are very high and increasing over time, with values ranging between 23% and 27% (see Figure 1). With respect to pollution, the data shows PM 2.5 levels decreasing over time, but they are still higher than the 10 µg / m^3 threshold established by the World Health Organization (WHO) above which a clear association has been detected between prolonged exposure to PM 2.5 and cardiopulmonary diseases.

This is the context in which city councils across Europe are seeking to transition to more sustainable urban transport. Policies to reduce the share of private cars in urban mobility can be either price-based or quantity-based. The implementation of urban tolls is an example of a price-based measure. It generally involves imposing a congestion charge to enter and leave a city (typically only the city centre). Thus far, only a few cities have implemented such measures, most of them European. Urban tolls are in force in Singapore (since 1975), London (since 2003), Stockholm (since 2007), Milan (since 2008), Gothenburg (since 2013) and Palermo (since 2016). While in Italian cities the congestion charge is combined with a Low-Emission Zone (LEZ), London applies an additional charge to the congestion toll depending on the emission level of the vehicles. Of the quantity-based measures, LEZs are the most widespread implemented in Europe, with more than 280 in place in urban areas. To reduce pollution, LEZs involve banning polluting vehicles from a determined urban area, mainly city centres. However, there is no uniformity in the application of LEZs, and they differ in size and the types of vehicles and emissions thresholds banned.

The research done so far does not seem to consistently demonstrate the effectiveness of congestion tolls and LEZs in targeting both pollution and congestion.

In the literature analysing the impact of urban tolls on congestion, there is consensus that the policy is effective in reducing congestion. For example, studies of London and Stockholm report a reduction in congestion of 20%–30% (Eliasson, 2008; Santos & Fraser, 2006; Börjesson et al., 2012 and 2014), while analyses for Milan and Gothenburg find a reduction of about 10%–15% (Andersson & Nässén, 2016; Gibson & Carnovale, 2015; Rotaris et al., 2010; Percoco, 2013). In a Europe-wide study, Bernardo et al. (2020b) show reductions in congestion after the implementation of tolls of 29% in Gothenburg and 19% in Palermo. Yet, these numbers must be treated with caution. As toll revenues are typically used to improve public transportation, the measured reductions correspond to the direct effect of tolls as well the indirect effect derived from improvements in public transportation.

Fewer studies exist on the effectiveness of tolls in reducing pollution, but all find the measure to be effective for emissions reduction. Gibson and Carnovale (2015) report a fall in pollution of between 6% and 17% in Milan, depending on the pollutant. Simeonova et al. (2019) find a reduction of between 5% and 19% in Stockholm. Moreover, additional benefits of congestion tolls reported in the literature include fewer accidents in the case of London (Green et al., 2016) and improved children's health (especially fewer children suffering from asthma) in the case of Stockholm (Simeonova et al., 2019).

Regarding LEZs, previous studies suggest that they are an effective measure for reducing pollution and improving air quality. Studies of German cities report a reduction ranging from 4% to 13% (Malina & Scheffler, 2015; Morfeld et al., 2014; Wolff, 2014). Other studies present similar results for Amsterdam (Panteliadis et al., 2014), London (Ellison et al., 2013), Rome (Cesaroni et al., 2012) and Madrid (Lebrusan and Toutouh, 2021). However, there is no clear evidence of the effectiveness of LEZs in reducing congestion. The three studies done so far report on average no reduction in congestion after the implementation of an LEZ.

In a panel data study of 130 European urban areas during 2008–2016, Bernardo et al. (2020a) conclude that, on average, LEZs are ineffective in reducing congestion. Moreover, analysing the average effect at city level for the 2008–2019 period, the same authors conclude that there is a high level of heterogeneity in the evolution of congestion in LEZ cities when compared to similar cities that have not implemented an LEZ, with a prevalence of LEZ cities experiencing increased congestion (Bernardo et al., 2020b). Similarly, in a detailed data study of the LEZ implemented in central Madrid from December 2017 to December 2019, Tassinari (2021) finds no effect of the measure on the city's overall level of congestion. The author concludes that while the flow of cars within the restricted area was reduced, this occurred at the expense of increased traffic in the surrounding areas, meaning the effect for the city as a whole ended up being null.

The main lesson from the literature is that while both policies seem to be effective in fighting pollution, only urban tolls seem to effectively reduce congestion. However, at European level an increasing number of cities are creating LEZs while congestion tolls have only been introduced in a few cities.

What is the reason for this policy choice? Fageda et al. (2020) argue that it has to do with public acceptance of LEZs being easier to achieve than of congestion tolls. There appears to be public consensus that, firstly, pollution is a more severe externality and, secondly, that quantity measures are more effective in curbing pollution. The authors suggest that this public consensus is also strongly related to the fact that LEZs only ban a share of vehicles from the designated area (the most polluting ones), which only affects a limited number of commuters (while tolls affect all commuters). The majority of medium and high-income commuters who own newer and less polluting cars continue commuting after the creation of an LEZ in their city. Other reasons for the popularity of quantity measures are that they are more cost-effective to implement, as they are not expected to be accompanied with investments in public transportation. Finally, quantity measures spur the renewal of the car fleet, as older and more polluting cars are replaced by newer and cleaner ones. They are thus in the interests of the vehicle manufacturing industry and often supported by it.

To conclude, there is evidence that congestion tolls are more effective than LEZs in targeting both pollution and congestion. In this sense, even though LEZs are effective in reducing pollution, it would be advisable to consider a combination of both tools to deal with the negative externalities of private vehicles in urban settings.

Policies to reduce the share of private cars in urban mobility can be either price-based or quantity-based.

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