Impact of non-tailpipe emissions on local air pollution: Evidence from New Zealand

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Overview

Road transport is one of the primary sources of airborne particulate matter (PM), a common class of pollutant in urban environments and a primary driver of air pollution's burden of disease worldwide.[1] PM concentrations differ in particles' sources and chemical composition[2] affected by locations and meteorological conditions, such as temperature, humidity, wind speed, and rainfall[3]. While transformational technological improvements, coupled with emission control regulations and policies have led to a substantial reduction in exhaust emissions (EMs) from road traffic[4-6], currently, on-road non-exhaust emissions (NEEs), also known as NEEs such as those generated from brake, tyre, clutch and road surface wear or road dust resuspension due to traffic congestion are unabated[7]. Most recent data show a number of European cities including Berlin and London indicated that the contribution of NEEs to PM concentrations was comparable or even larger compared to Ems[8]. Empirical evidence from Auckland also indicates that coarse PM has become the dominant transport source after 2016, as NEEs increase in line with rising traffic volume[9]. However, NEEs of PM constitute a little-known knowledge and hence has been downplayed compared to EMs in the literature and transport and health policies.

EVs can improve air quality through zero tailpipe emissions[10]. However, fleet electrification would not significantly reduce PM emissions, as 1) NEEs in transport arise irrespective of the fuel source, and 2) the ever-increasing proportion of non-exhaust emissions in the total emission profile[11]. Hence, expanding the share of alternative fuel vehicles in the overall fleet will unlikely reduce PM pollution. To the contrary, PM pollution may in fact increase due to heavier vehicle weights[12]. For this reason, an improved understanding of the relationship between the sources and causes of particulate NEEs and vehicle characteristics is vital for developing appropriate policy interventions to tackle this issue.

Hence, the aim of this research is to explore and better understand the nexus between NEEs and the vehicle fleet and its implications for human health, based on econometric analysis of detailed New Zealand centric data. In particular, we are interested in: 1) quantifying the impacts of potential sources on monitored NEEs, and 2) propose specific policy recommendations in order to improve the country's air quality.

Methods

The study utilises panel data regression to examine the impact of road dust and other factors, including soil, biomass, fuel, and marine aerosol, after considering the meteorological data, such as wind speed, temperature, and humidity.

Results

- Accordingly, five factors, including soil, biomass, fuel, marine aerosol, and road dust were found statistically significant at the 1% level, while secondary sulphate was significant at 10% level. All the coefficients are positive, implying that 1% increase in soil and road dust will increase 6.2% and 4.9% of PM10, respectively.

- After adding the interaction between soil and road dust given the fixed effects, interestingly, both road dust and soil were found to be significant at 1% and 5% level, respectively. In addition, the interaction between these two variables was also significant at 1% level. It suggests that soil, jointly with road dust, positively influences the concentration of PM10.

Conclusions

The empirical results of our research would be twofold. First, they would provide the necessary and scientifically based evidence to assist urban/transport planners and policymakers in understanding the long-ignored relationship between NEEs and the vehicle fleet, in New Zealand. And second, the assessment of transport policy impacts will also offer a cost-effective way to reduce NEEs, and identify policy drawbacks before any legislative changes. Our findings will be highly relevant for transport and environmental policies.

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