ASSESSMENT OF THE TRUCKING BAN IN MEDELLIN (COLOMBIA) BASED ON VEHICLE EMISSIONS

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OUTLINE

• Introduction
• Freight Externalities
• Urban freight transportation sustainable strategies
• Modelling Approach
• Case study: Medellin, Colombia
• Conclusions and Recommendations
1. INTRODUCTION

Urban freight transport (externalities)

Positive
- Economic development

Negative
- Congestion
- Noise
- Pollution
- Others...

Some strategies to mitigate negative externalities
- Time windows
- Weight and size restrictions
- Vehicle improvements
- Electric vehicles
- Traffic Ban
1.1 EMISSIONS

- Have direct impact in:
  - **Human health**: respiratory diseases (e.g., PM$_{2.5}$)
  - **Environment**: climate change (e.g., CO$_2$).

- Should be considered in the analysis of projects and government policies.

Green House Gas Emissions: Important at global scale

Other negative effects over human health
1.1 EMISSIONS

Deaths attributable to environment particulate matter pollution by year and by cause

### 2. URBAN FREIGHT TRANSPORTATION

**SUSTAINABLE STRATEGIES FOR EMISSIONS**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strict emission and fuel standards</td>
<td>Low emissions zones</td>
</tr>
<tr>
<td>Alternatively fueled vehicles</td>
<td>Non-road modes</td>
</tr>
<tr>
<td></td>
<td>Anti-idling programs</td>
</tr>
<tr>
<td></td>
<td>Comprehensive environmental impact mitigation programs</td>
</tr>
</tbody>
</table>

Sometimes these strategies are not considered by the Government....
3. WHAT IS THE GOAL OF THIS RESEARCH?

To Assess the effectiveness of initiatives based on emissions

How?

With the changes in the emissions with and without initiatives
4. MODELLING APPROACH

Regression analyses
- OLS
- Linear
- Non-Linear

EMFAC Web Database
- 2011 and 2014 models
- 64 records (2000-2015)
- 4 types of vehicles
  - Smalls trucks (LHD1 and LHD2)
  - Medium trucks (T6)
  - Large trucks (T7)

Emission model (OLS)
- PM$_{2.5}$ (dependent variable)
- VMT (independent variable)
4.1 SELECTED MODEL

\[ PM_{2.5} = 1.2313 \cdot e^{0.04825 \cdot VMT} \]

Coeff = 0.04826 (34.21)  \( R^2 = 0.949 \)  \( F \)-value = 1,170.42
5. CASE STUDY: MEDELLÍN, COLOMBIA

Medellín is the second most important city in Colombia

3.7 million inhabitants
GDP = 8,489 USD (2015)
5. CASE STUDY: MEDELLIN, COLOMBIA

**METEOROLOGY**
- Low altitude clouds
- Poor air circulation

**TOPOGRAPHY**
- Narrow valley
- Densely populated

**MOBILE SOURCES**
- 36%
- 22%
- 19%
- 10%

**FEEDBACK SOURCES**
- 79%

**EMISSIONS OF POLLUTANTS**
- Human activities outcome
- Human health effects

**PM²·⁵ Sources contributions**

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**The world’s most crowded cities**

<table>
<thead>
<tr>
<th>City</th>
<th>Population per square kilometer, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka, Bangladesh</td>
<td>44,500</td>
</tr>
<tr>
<td>Mumbai, India</td>
<td>31,700</td>
</tr>
<tr>
<td>Medellin, Columbia</td>
<td>19,700</td>
</tr>
<tr>
<td>Manila, Philippines</td>
<td>14,800</td>
</tr>
<tr>
<td>Casablanca, Morocco</td>
<td>14,200</td>
</tr>
<tr>
<td>Lagos, Nigeria</td>
<td>13,300</td>
</tr>
<tr>
<td>Kota, India</td>
<td>12,100</td>
</tr>
<tr>
<td>Singapore</td>
<td>10,200</td>
</tr>
<tr>
<td>Jakarta, Indonesia</td>
<td>9,600</td>
</tr>
</tbody>
</table>

Source: UN Urban Data
5. CASE STUDY: MEDELLIN, COLOMBIA

March 2017
Environmental red alert was declared

<table>
<thead>
<tr>
<th>CHILE</th>
<th>AMVA</th>
<th>BOGOTÁ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert</td>
<td>80-109</td>
<td></td>
</tr>
<tr>
<td>Pre-Emergency</td>
<td>110-169</td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td>&gt;170</td>
<td></td>
</tr>
</tbody>
</table>

Yellow 35.5 -55-4

Banned the circulation of vehicles

60 % of the automobiles between 7AM to 7PM (depending on the license plate’s number)

Trucks could circulate between 10AM and 5PM

Source: Alcaldía de Medellín (2017)
6. RESULTS

The facts

38,142 trucks in the metropolitan area

44% of trucks are 15 or more years old

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trucks</td>
<td>38,000</td>
</tr>
<tr>
<td>VMT</td>
<td>950,000</td>
</tr>
<tr>
<td>VMT/Truck</td>
<td>25</td>
</tr>
<tr>
<td>PM2.5 [kg/truck]</td>
<td>0.00411</td>
</tr>
<tr>
<td>PM2.5 [kg]</td>
<td>156.32</td>
</tr>
<tr>
<td>Emissions changes [%]</td>
<td></td>
</tr>
</tbody>
</table>

The PM$_{2.5}$ emissions are reduced in 24%

The PM$_{2.5}$ emissions are increased in 2%
7. CONCLUSIONS AND RECOMMENDATIONS

• A strategy that at first time appear to be a good decision, could not be a good decision in the long term. For this reason it is necessary to have a technical support and in this way prevent undesired effects.

• In this research an economy analyses of the effects of the restriction is not development, but it can be a good complement in the assessment of the effectiveness of the truck’s ban based on emissions.

• The next step of the research is to determinate the VMT for the trucks in the city with and without the restriction. After that an assessment of the restriction will be made and in the same way other strategies will be proposed.
Questions?

Daniel M. Ocampo-Giraldo, C. E., E.E.
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