**Air Pollution and Economic Activity**

The Data Lab is aiming to conduct a research project

**Research Objective**

Nitrogen Dioxide (NO2), a biproduct of combustion has been used to improve measurement of economic activity ([Erzan, I et. al., 2023](https://openknowledge.worldbank.org/server/api/core/bitstreams/d4f3bb17-905e-44c2-b7c2-15794db39cca/content)). The short atmospheric life of NO2 (less than a day) means that densities are closely correlated to emissions (Seinfeld and Pandis, 2016). It is also a globally available dataset through satellite imagery making it a valuable resource for many data-poor countries.

Our hypothesis is that NO2 values can be used to supplement other variables such as Nightlights to show changes in economic activity, especially in countries where frequent, subnational GDP values are not available. The research objective is to ascertain the relationship between NO2 and economic activity.

**Background**

**Industrial Production contributes to economic activity**[[1]](#footnote-1). Industrial production refers to the output of industrial establishments and covers sectors such as mining, manufacturing, electricity, gas and steam and air-conditioning. Most of these activities produce NO2 as a biproduct. There is existing research, albeit limited, that shows that NO2 correlates with industrial production[[2]](#footnote-2),[[3]](#footnote-3). Reviewing this literature, and identifying a standard methodology that can be used to utilize the value of NO2 data for economic trend monitoring would be useful to many country teams at the World Bank.

**Economic activity and people’s mobility are highly intertwined**. Investments in transportation infrastructure which improve job accessibility can increase the economic activity of a city, see London’s Crossrail analysis in Stopher & Stanley, 2014. However, the opposite can also happen, a reduction in mobility, like the one caused by COVID-2019 pandemic, can result in a reduction of the economic activity (Fadly, 2020). Getting access to people’s mobility data is challenging thus, finding a proxy for it is ideal. Reasearch has shown that NO2 and mobility are highly correlated (Seto, 2020) and this is the relation we want to explore, how to use NO2 to predict economic activity.

**Research questions**

1. What are the factors that influence the production and measurement of NO2
2. Can we attribute NO2 levels from satellite imagery to its main contributors of Industrial Pollution and Mobility spatially and temporally?
3. What are the methods and datasets we can use to validate the relationship between NO2 and economic activity?
4. What are the limitations and assumptions of using Air Pollution, along with nighttime lights to study trends in economic activity?

**Case Studies**

1. Baghdad: The Baghdad Transportation Planning team has been working with the Data Lab to use alternate data sources that can inform investments in transportation planning. This proposal allows access to Waze data (Jams) and NO2 data.
2. West Bank: The Middle East and North Africa Country team has been collaborating with the Data Lab to use Air Pollution data to estimate changes in mobility. Through this project, we will be able to access Mapbox Movement data and NO2 data.
3. Ethiopia: The Ethiopia Country Economists’ Office has been working with the Data Lab to combine insights from Nighttime Lights and Air Pollution to identify any changes in economic activity because of recent economic reforms.

All these case studies rely on alternate data for ‘additional’ insights that can supplement their main data sources. It is ideal to be using these three countries for the analysis because the Country Office Economists would likely be interested in using the insights for their reporting.

**Project Team**

**Imperial College, London**

* Prof Marc Stettler, Transport and Environment
* Liang Ma, Research Associate, Transport Strategy Center

**World Bank**

* Claudia Calderon, Acting Program Manager, Data Lab
* Sahiti Sarva, Data Scientist (Coordination and Data Science Support)
* Maria Sol Tadeo, Data Scientist (Data Science Support)
* Nistha Sinha, Senior Economist, Ethiopia Country Office (Advisory support)

**Appendix**

1. **Expected Outputs**

|  |  |  |  |
| --- | --- | --- | --- |
| **SNO** | **Component** | **Description** | **Format** |
| 1 | Literature Review |  | README file for web-book |
|  | FAQs on air pollution data collection process | Answers for non-technical stakeholders. | README file for web-book |
| 2 | Data Processing/Combining | Pipeline that loads all the required datasets and produces the variables for modelling. | Nice to have: Script  Need to have: Jupyter notebook (one per variable) |
| 3 | Exploratory Data Analysis | Explore the variable’s distribution and correlations between each other | Jupyter notebook ready for deployment |
| 4 | Model for NO2 | TBD model to explain NO2 levels | Jupyter notebook ready for deployment |
| 5 | Model for Economic Activity | TBD model for economic activity based on NO2 | Jupyter notebook ready for deployment |
| 6 | Validation | Validation for the methods. Validation sources will come out of the literature review. | Jupyter notebook ready for deployment |

1. **Current Data Availability**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Variable** | **Data Source** | **License** | **Coverage** | **Granularity** |
| Pollution | NO2, O3, CO, SO2 | [Sentinel 5-P](https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S5P_NRTI_L3_NO2) | Open | Global. | 7X7km. The granularity of this changed over the years and needs to be tracker. |
|  | NO2, PM2.5, CO, | [Plume Labs](https://plumelabs.com/en/) | Proprietary through the Development Data Partnership | Potentially global, currently requesting for Ethiopia | 40X40km |
|  | NO2, O3, CO, SO2 | [OpenAQ](https://explore.openaq.org/#1.2/20/40) | Open | Intermittently Global | Insitu measurements |
| Traffic | Jams | Waze | Proprietary through the Development Data Partnership | Currently for Baghdad, available on request for other cities | Street level |
| Socioeconomic | Population | Worldpop | Open | Global | 100 m |
| Socioeconomic | Income levels | TBD/ if available | - | - | - |
| dInfrastructure | Roads | OSM | Open | Global | Block level |
| Infrastructure | POIs | OSM |  | Global | Block level |
| Infrastructure | Buildings | Overture | Open | Global | Block level |
| Industrial Production | Subnational, sectoral emissions | EDGAR | Open | Global | Needs to be verified |

**References**

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Seto, K. C., et al. (2020). Combining remote sensing and cell phone users' mobility data to monitor the impact of transportation on NO₂ concentrations in India. Environmental Research Letters, 15(6), 064012. https://doi.org/10.1088/1748-9326/ab76d6

1. Doman, L. E. (2004). Global energy use: status and trends. [↑](#footnote-ref-1)
2. Bricongne, J. C., Meunier, B., & Pical, T. (2021). Can satellite data on air pollution predict industrial production?. [↑](#footnote-ref-2)
3. https://blogs.worldbank.org/en/developmenttalk/what-nitrogen-dioxide-emissions-tell-us-about-fragile-recovery-south-asia [↑](#footnote-ref-3)