The Impact of Air Pollution and Information Access on Women's Fertility Decisions: Evidence from Thailand

By PASITA CHAIJAROEN AND PALLAVI PANDA*

SUPPLEMENTAL ONLINE APPENDIX

In this supplemental appendix, we describe the data collection and measurement of variables in more detail for the interested readers.

Background and Context

Various sources have contributed to the high concentrations of particulate matter (PM) in Thailand, with notable differences between urban and rural areas. In urban areas, the primary sources of PM2.5 include vehicle emissions, economic activities such as construction and industrial production, and biomass burning (Ahmad et al. 2022). In contrast, rural areas are predominantly affected by agricultural burning, forest fires, and transboundary air pollution (Vichit-Vadakan and Vajanapoom 2011).

Thailand experiences seasonal patterns of PM2.5, with levels starting to rise after the rainy season in mid-October and peaking during the burning season between January and April. During this period, farmers in Thailand and neighboring countries often rely on burning practices for harvesting sugarcane. They also employ slash-and-burn methods to clear agricultural land after

* Chaijaroen: Vidyasirimedhi Institute of Science and Technology, Wangchan Valley, Rayong, Thailand. Email: pasita.c@vistec.ac.th. Phone: +66 33 01 4017
Panda: *Corresponding Author*, 117A South Hall, School of Business, State University of New York, Geneseo. Email: panda@geneseo.edu. Phone: +1-585-245-5088. ORCID: 0000-0002-3262-3232
This paper has benefitted from comments received at the LAC-DEV Conference (2024), Cornell Conference on Development Economics and Law (2024), and ASSA Annual Conference CSWEP Session (2025). All remaining errors are our own.

harvesting other field crops such as corn and maze. This time of year is also marked by dry weather, increased forest fires, and frequent thermal inversions—an atmospheric condition when warm air higher up traps cooler air and pollutants closer to the ground. Together, these factors significantly worsen air pollution during the burning season each year. In this paper, we focus on burning, forest fires, and transboundary haze that occur outside of the provinces of interest to mitigate concerns about the endogeneity of economic activities affecting both PM2.5 concentrations and our outcome variables.

PM2.5 concentrations in Thailand have been high and exceeding WHO's standards (Chaijaroen and Panda 2025) raising significant public health and other concerns. Despite persistently high levels of PM2.5 over the past decade, public awareness about the issue only began to increase in 2018 (see Figure A1). This raises the question of whether greater public awareness and information seeking behaviors might exacerbate existing concerns, such as declining fertility, or if greater awareness drives people to actively prevent the harsh effects of air pollution.

Data Details

Google Trends data were collected from trends.google.com in July 2023 in three steps. First, we collected monthly search volume data for all of Thailand for the years 2016 through 2019. This provided us with a national baseline for search trends over time. Second, we obtained the monthly breakdown of search volume by province for the same time period. Finally, we calculated the estimated monthly search volume for each province. This was done by multiplying the national monthly search volume (from step 1) by the corresponding provincial search proportion (from step 2) for each month. Note that Google does not specify the unit for this data, so we interpret it as an index. To simplify the interpretation of regression coefficients on search volumes, we scaled these

variables up by 100 times so that an increase in search volumes by 1 unit is economically reasonable when compared to the search mean.

To construct the upwind burning instrumental variable, we combine various sources of remote sensing as outlined in Table A1. Upwind burning is defined as the number fires outside of a province's border that lie within 300 km of the province centroid and within the same octant as the wind direction. In addition to this instrumental variable, we rely on remote sensing PM2.5 levels, which we construct from data in the Modern-Era Retrospective Analysis for Research and Applications Version 2 (MERRA-2). Specifically, we collect ground-level PM2.5 components from MERRA-2 monthly Aerosol Optical Depth (AOD) dataset and aggregate the components to form PM.25 concentrations following the formula in (Collow et al. 2023).[1]

In our fertility models, we control for weather conditions, namely rainfall and air temperature, from in-situ data in the Global Historical Climatology Network (GHCN) daily database. Here, we match each province to the nearest weather station using its centroid. Daily average temperature and total rainfall are then averaged to monthly and annual levels.

Variables previously described are then aggregated to province-year granularity as detailed in Chaijaroen and Panda (2025) before merging with fertility from the 2019 survey of the Thai Multiple Indicator Cluster Survey (MICS). This forms our main dataset that allows us to investigate how information seeking behaviors related to air pollution affects fertility decisions.

To examine how PM2.5 levels affect information seeking behavior, we construct a province-level panel dataset that comprises monthly search data from Google Trends, PM2.5 levels

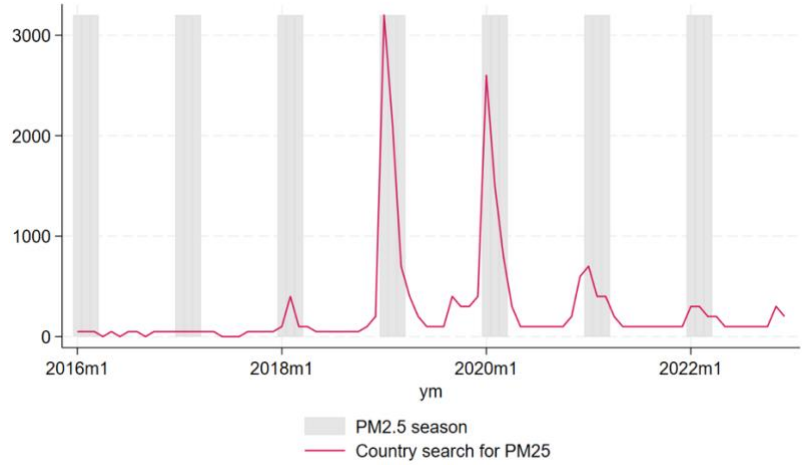
[1] We scale the organic carbon component up by 1.8 times following (Font et al. 2024).

from MERRA-2, and the monthly upwind burning IV as previously elaborated. This dataset also includes relevant socio-economic control variables as outlined in Table A1. These control variables are from various government sources and are available at a province-year granularity.

Table A1: Additional Data Sources

Variable	Source
Upwind burning instrumental variable and variables in Table 1 Panel B	
PM2.5	Modern-Era Retrospective Analysis for Research and Applications Version 2 (MERRA-2)
Fires	Fire Information for Resource Management System (FIRMS) platform
Wind direction	National Centers for Environmental Prediction (NCEP) Reanalysis 1 dataset
Average rainfall	Global Historical Climatology Network (GHCN) daily database
Average air temperature	Global Historical Climatology Network (GHCN) daily database
Provincial socio-economic control variables in Table 1 Panel A	
Household expenditure	Household Socio-Economic Survey, National Statistical Office Thailand
Average population age	House Registration, Department of Provincial Administration
Population size	House Registration, Department of Provincial Administration
Share of non-agricultural land	Land Use Statistics, Office of Agricultural Economics
Share of at least high school education	Labor Force Survey, National Statistical Office Thailand

Figure A1: Information Seeking Behavior



Note: This graph plots the number of Google Searches of "PM2.5" overtime.

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