POLICY DIALOGUES

The impact of extreme temperatures and air pollution on labor supply and earnings: Evidence from Vietnam

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KEY FACTS

•Extreme temperature events and air pollution are two major threats to humankind. Warmer climate can lead to more frequent temperature inversions, which increase the surface air pollution.

•Extreme heat and air pollution may reduce labor supply and productivity due to health impacts.

•This study quantifies the effect of extreme temperatures and PM2.5 (fine particulate matter) air pollution on Vietnamese labor supply, hours and earnings in 2015–2022.

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Geography Viet Nam

Key words: Air pollution, extreme temperatures, climate change, employment, labor productivity

Themes: Labor economics, environmental economics

Find out more about this project: https://www.afd.fr/en/gemmes-vietnam-analysis-socio-economic-impacts-climate-change-energy-transition-and-adaptation-strategies

CONTEXT & MOTIVATION

Vietnam is one of the most exposed countries to climate change, with losses estimated at 3.2% of its GDP in 2020.[1] Furthermore, the country's PM2.5 levels have persistently surpassed the global average for the past two decades, reaching levels comparable to China, well known for its air pollution problems.

There exists still limited evidence on how labor outcomes react to extreme temperatures or to air pollution, this being particularly scarce for low- and middle-income countries. Adverse effects of air pollution on health, especially respiratory (asthma and pulmonary diseases) and cardiovascular problems are well documented[2], but most studies treat weather factors separately.

This study[3] addresses these gaps, investigating the impact of both extreme temperatures and air pollution on labor outcomes in Vietnam.

METHODOLOGY

We use the Labor Force Surveys (LFS) from 2015 to 2022. Temperature and precipitation data come from the Vietnam Institute of Meteorology, Hydrology, and Climate Change, while daily PM2.5 levels are derived from monitoring stations and satellite Aerosol Optical Depth data.[4] These datasets are gridded and aggregated to the district level before being merged with individual-level LFS data.

We examine how district-level extreme temperatures, PM2.5 levels and other variables affect labor force participation, working hours and earnings, for individuals aged 15–64. Extreme temperatures are defined as days below the 5th percentile (cold days) or above the 95th percentile (hot days) based on a district's historical temperature distribution over the past 20 years.[5] While extreme temperatures are largely exogenous, air pollution may be influenced by population density and industrial activity, potentially introducing selection bias. We address this with an instrumental variable approach, using wind directions as an exogenous determinant of PM2.5 levels. A limitation is the inability to track effects below district level (e.g. commune or block).

KEY FINDINGS

Extreme temperatures and air pollution do not influence labor force participation, but significantly affect working hours and earnings.

We find that working hours increase in cooler months and drop in hotter ones, and these findings remain robust across various definitions, including temperature bins and extremes.

Specifically, an additional cold day increases weekly working hours by 1.07%, while an additional hot day in a month lowers them by 0.45%. Reduced working hours translate into lower earnings, with an additional hot day lowering monthly earnings by 0.71%.

Working hours and earnings respond more strongly to air pollution than to extreme temperatures. To assess the magnitude of the effects, we compute the elasticity of working hours with respect to cold and hot days, estimated at 0.012 and −0.011, respectively. These are relatively small effects, likely due to high temperatures in Vietnam not being extremely severe.

In contrast, a 1 μg/m³ increase in monthly PM2.5 concentration reduces weekly working hours by 1.2% and monthly earnings by 1.7%, with corresponding elasticities of working hours and earnings at −0.22 and −0.31, respectively.

There are also heterogeneous effects across workers.

Wage-earning workers are more affected than self-employed workers. A possible explanation is that wage-earning workers are much less capable to adapt their work performance to climate's effect, compared to self-employed workers. Self-employed workers, who are typically not full-time, adjust their schedules reducing working hours during days of extreme temperatures and high air pollution, then compensating for the lost time on other days. In contrast, wage-earners, who often have fixed schedules, cannot increase working time to compensate for reduced working hours due to illness.

To understand this result, we explore outdoor work. Despite greater exposure, outdoor workers show smaller reductions in hours than indoor workers, likely because many are self-employed and have more flexibility to adjust their schedules in response to climatic shocks. However, when focusing only on wage-earners, those with high outdoor exposure face larger negative effects of extreme temperatures and air pollution.

The impacts are also more pronounced among younger, skilled, and urban workers compared to older, unskilled, and rural workers. A possible reason is that these workers are more likely to be employed in wage jobs and, compared with the self-employed, have less flexibility to adjust their work schedules in response to environmental shocks, making their total working hours more sensitive to such conditions.

Finally, PM2.5 has a stronger effect in months without extreme temperatures, likely because extreme temperatures already reduce working hours and earnings, limiting further impact.

RECOMMENDATIONS

- **Government measures should account for workers' schedule reactiveness to air quality to mitigate the adverse effects of extreme temperature and air pollution events**, for example by expanding occupational safety and health regulations, especially related to air pollution. The government has established regulations concerning acceptable temperature ranges in workplaces, set between 16 and 34°C. [vi] However, there are currently no standards regulating air pollution levels in workplaces, with an opportunity to learn from international models where indoor or occupational air quality limits have already been implemented.

- **Since impact varies according to workers characteristics, worker support measures should be customizable**. For example, pilot schemes offering flexible hours or remote work options in wage employment contracts could be tested during high pollution periods for their effectiveness to maintain labor productivity and quality across skilled occupations or young workers.

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[1] World Bank (2022). *Vietnam Country Climate and Development Report*, CCDR Series. Washington, DC: World Bank.

[2] Dominski, F. H., Branco, J. H. L., Buonanno, G., Stabile, L., da Silva, M. G., & Andrade, A. (2021). Effects of air pollution on health: A mapping review of systematic reviews and meta-analyses. *Environmental Research*, 201, 111487.

[3] Nguyen, C. V. & Poggi, C. (2025). The impact of extreme temperatures and air pollution on labor supply and earnings: Evidence from Vietnam, *AFD Research Paper* 365.

[4] Datasets provided by (i) Tran-Anh, Q., *et al.* (2023). A 10-km cmip6 downscaled dataset of temperature and precipitation for historical and future Vietnam climate. *Scientific Data*, 10 (1), 257; (ii) Nguyen, T. *et al.* (2025) Impact of Meteorological Factors and Extreme Weather Events on PM2:5 Pollution in Vietnam, *AFD Research Paper* 364.

[5] The reference temperature range is defined as temperatures between the 5th and 95th percentiles of the temperature distribution. This range is considered the normal temperatures to which local populations are accustomed.

[vi] MOH (2016), Circular No. 26/2016/TT-BYT on Providing National Technical Regulations on Microclimate – Permissible Microclimate Values in the Workplace, Issued on 30/06/2016, Ministry of Health, Vietnam. Available at : https://thuvienphapluat.vn/banan/tin-tuc/quy-chuan-ve-dieu-kien-vi-khi-hau-tai-noi-lam-viec-quy-dinh-the-nao-8420