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Firm Relocation as Environmental Policy: Impacts on Agglomeration, Workers and the Environment

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Firm location decisions are one of the most important decisions managers make, optimising factors such as proximity to customers, suppliers, and useful information. We use an environmental relocation policy that randomly moved over 20,000 small firms from New Delhi to industrial areas outside the city over several years. We find that a reduction in firm presence improves measured air quality but is costly for firms: relocated firms have a high rate of exit, which increases in the distance relocated. The exit effect could have been mitigated by allocating firms to plots in the industrial area optimally by industry.

Introduction

As developing countries industrialise, the trade-offs between promoting economic growth while minimising externalities such as pollution become more binding. Government policy often seeks to influence this trade-off in the social interest. Understanding the impact of these policies on environmental outcomes is important. However, since the policies also directly impact firm decisions, they provide a lens to test theories of firm interactions that contribute to our understanding of firm behaviour and economic development.

In this project we examine the effects of a policy which relocated over 20,000 firms from high-population-density areas in central Delhi to industrial areas on the outskirts of the metro area, with a main stated goal of reducing aggregate exposure to air pollution. We study how the policy impacted the relocated firms, and whether the effects of firm interactions revealed by its design imply that the design could have been improved. We also evaluate whether the policy achieved its desired goal of improved air quality.

Location restrictions that seek to limit pollution exposure have a long history, starting with the first zoning laws introduced in the early 20th century in New York in part to improve environmental quality (Wilson et al 2008). Harrison et al (2019) study how Indian Supreme Court-ordered Action Plans for 17 cities affected firm decisions in corresponding districts to exit or invest in pollution abatement. A primary means to reduce pollution mentioned in these action plans was relocation of polluting industries to certain designated areas. 14 of 17 Action Plans in major cities mention industrial relocation. Industrial relocation policies to combat pollution are also an increasingly popular policy tool across the developing world, such as China's industrial relocation policy to move polluting industries outside of Beijing city limits by 2017.

Policy and Research Design

Due to a shortage of industrial plots in the industrial areas when the Delhi policy we study began, allotment of these plots was done via a series of lotteries spanning 2000 through 2011. These lotteries provide a unique source of random variation to answer our research questions.

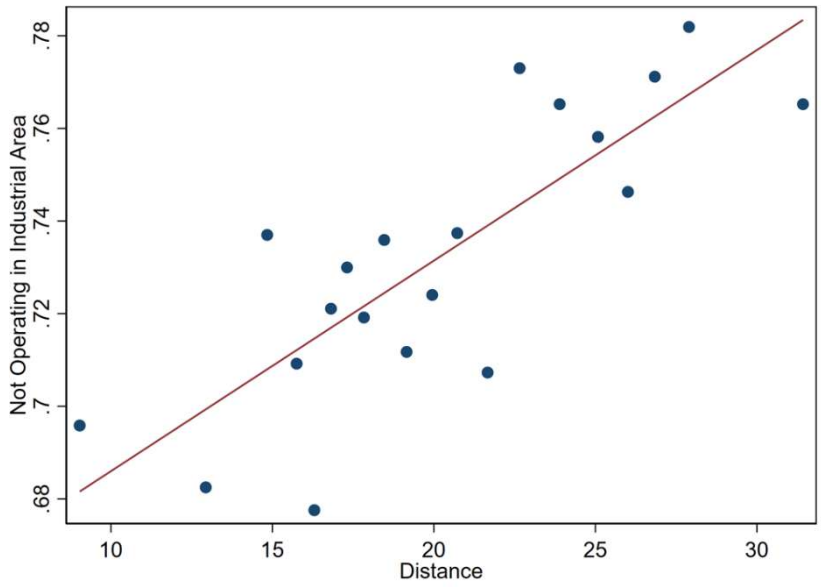
Since each plot in the industrial areas was assigned a random firm, a relocated firm's distance from its original location is random when compared to other firms from the same location. A firm's neighbours are also random, generating independent variation in neighbour characteristics and allowing us to determine how each neighbour characteristic impacts economic performance. To take advantage of this historical randomised experiment, we combine administrative data from the Delhi State Industrial and Infrastructure Development Corporation Ltd. (DSIIDC) and digitised maps of the industrial areas to identify each firm's precise location and neighbours. Using a combination of natural language processing and manual assignment, we determine each firm's industry based on a free text description the owner provided to DSIIDC.

The lotteries also mean that different concentrations of eligible firms left neighbourhoods throughout Delhi at different (random) times, creating variation in polluting firm presence by neighbourhood. To identify a firm's origin location, we geocoded the addresses they provided to DSIIDC, making on-the-ground visits to roughly half to validate our approach.

Effects on Relocated Firms

DSIIDC data from 2018 shows that 74% of firms in the largest industrial area were no longer operating in their assigned plot, roughly 10 years after firms first set up shop there. The probability of exiting is increasing in the distance between a firm's original address and their location in the industrial area, as shown in Figure 1 below. Using the random variation in distance relocated, we can infer that only between 9 and 16% of firms would have ceased operating in their original location, implying that at least 58% of relocated firms exited the market because they were relocated.

Figure 1: The Majority of Relocated Firms Were Not Operating in the Industrial Area 10 Years Later



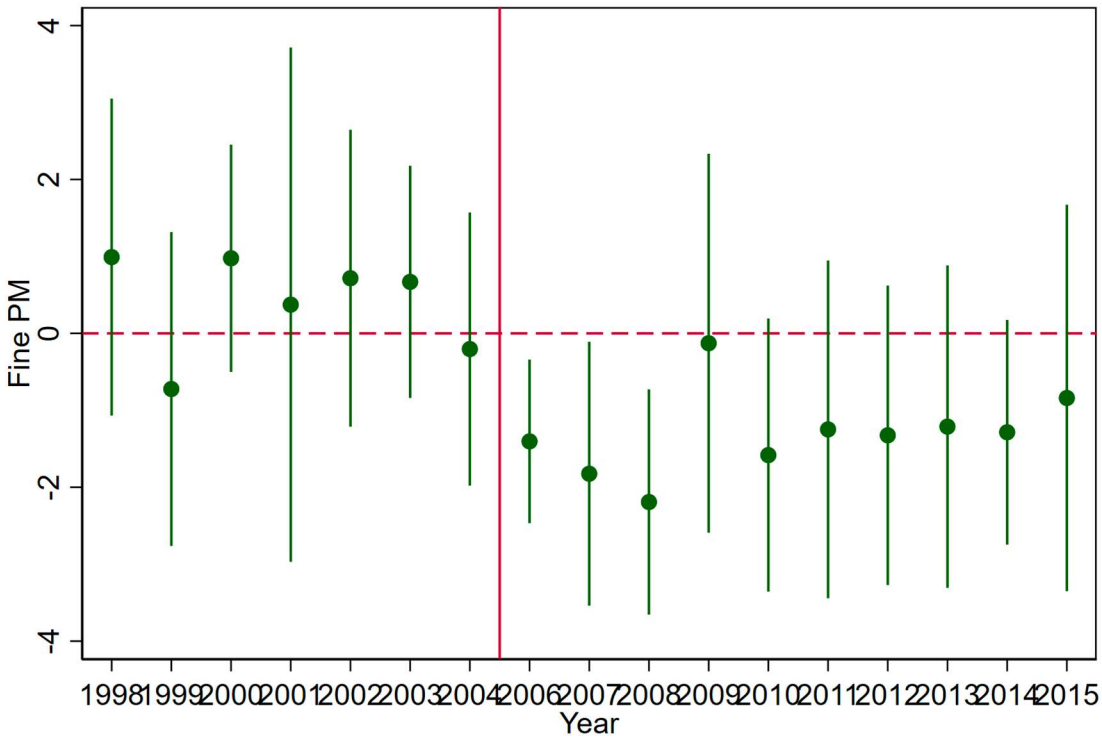
Note: binscatter of relocated firm exit rates as a function of the distance between assigned plot in the Bawana industrial area and original location, along with a best-fit regression line. Source: DSIIDC (2018), Authors' calculations.

Given that firms typically form geographic clusters by industry, how damaging was the policy's random assignment of plots to firms, which spread all industries evenly across industrial areas? We take advantage of the random assignment to identify the impact of different neighbour industrial compositions on a firm of any industry. This shows us that 1 - 3 percentage points of the effect of relocation on exit is attributable to the uniform random assignment of firms to plots. Using recent developments in non-convex optimisation theory (Xia, Vera, and Zuluaga 2020), we show that an optimal assignment of firms to parts of industrial areas would eliminate this policy design effect on exit.

Effects on the Neighbourhoods Firms Departed

At the neighbourhood level our primary outcome of interest is the fine particulate matter measure from van Donkelaar et al. (2016). Figure 2 below shows effect of having more firms winning a lottery before 2005 by year. The first firms moved into the industrial area in 2005. Neighbourhoods with a greater number of firms winning early do not have differential pollution before 2005, and exhibit lower levels of pollution after, until locations with fewer lottery winners before 2005 catch up between 2009 and 2010.

Figure 2: Neighbourhoods with More Early Lottery Winners Decrease Pollution Levels



Note: Interactions of year fixed effects with log firms relocated per sq km by 2004. 2005 is Omitted.
Grid ID and year fixed effects, as well as interactions of year fixed effects with the log of total firms relocated per sq km included.

Conclusions, and Moving Forward

We find that the presence of the polluting firms studied in this paper negatively impacts neighbourhood-level ambient environmental quality in New Delhi. The removal, however, also impacts the relocated firms, substantially decreasing their survival probabilities. Removal of firms may have important equity implications, by increasing commuting costs or moving costs for workers, as well as impacting the affordability of a neighbourhood.

Did this firm removal persist in the longer-term? In 2021-2022, we sent surveyors to original addresses of relocated firms, where they identified what was present at the original address. We found that firms were present in less than 10% of the locations.

Our results are able to say something definitive about the costs to firms of being relocated, as well as how these increase with distance. These indicate that if relocation is warranted, a focus on relocating firms closer to industrial areas would lower the burden on relocated firms. Which types of industries should be relocated to provide the maximum environmental benefits and minimize costs to firms and workers, and whether lump sum transfers instead of allocating them land in a fixed place is better for firms' survival, remain interesting questions for future work.

References

Van Donkelaar, A., Martin, R. V., Brauer, M., Hsu, N. C., Kahn, R. A., Levy, R. C., Lyapustin, A., Sayer, A. M., and Winker, D. M. (2016). Global Estimates of Fine Particulate Matter using a Combined Geophysical-Statistical Method with Information from Satellites, Models, and Monitors. Environmental Science and Technology, 50:3762–3772.

Harrison, A., Hyman, B., Martin, L., & Nataraj, S. (2019). When do Firms Go Green? Comparing Command and Control Regulations with Price Incentives in India. NBER Working Paper 21763.

Wilson, S., Hutson, M., & Mujahid, M. (2008). How Planning and Zoning Contribute to Inequitable Development, Neighborhood Health, and Environmental Injustice. Environmental Justice, 1(4), 211–216.

Xia, W., Vera, J. C., & Zuluaga, L. F. (2020). Globally Solving Nonconvex Quadratic Programs via Linear Integer Programming Techniques. INFORMS Journal on Computing, 32(1), 40–56.

Zhao, X. and Yin, H. (2011). Industrial relocation and energy consumption: Evidence from China. Energy Policy, 39(5):2944–2956.

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