

Online Appendix

The Online Appendix is divided in two sections.

First, Appendix A reports additional details and results. In particular, Section A.1 details the construction of the managerial ability index; Section A.2 discusses the robustness of our grid-cell approach; Section A.3 reports the comparison with satellite data; Section A.4 discusses the robustness of the estimated profitability returns from locating on large roads to sorting on productivity; Section A.5 gives details of our results on adaptation; Section A.6 shows that worker sorting across firms plays a limited role in explaining the adaptation results; Section A.7 presents additional details on our counterfactual exercises; and Section A.8 shows additional results on perceptions about pollution that motivate and complement the experiment.

Second, in Appendix B we report additional appendix figures and tables cited in the main text.

A Additional Details and Results

A.1 Managerial Ability Index

We develop a composite index of managerial ability largely in line with the methodology used in McKenzie and Woodruff (2017) and de Mel et al. (2019). The index comprises of several component scores including scores for marketing, stock, recording, financial and forecasting abilities of firm owners/managers.⁷⁶ We use a standardized index of the sum of these component parts, where the total sum ranges from a minimum of -1 to a maximum of +27.

- The *marketing* score ranges from a minimum score of 0 to a maximum score of +7 (with 0 indicative of the lowest possible attainment in this category). The score is calculated by adding one point for each of the following activities that the business may have implemented in the *three* months preceding the date of the survey (unless explicitly stated otherwise):
 1. The firm owner/manager visited at least one competing firm to see what prices they were charging.
 2. The firm owner/manager visited at least one competing firm to find out what products they had available for sale.
 3. The firm owner/manager spoke with existing customers to ascertain if there were other products they would like the firm to sell or produce,

⁷⁶Our approach differs from de Mel et al. (2019) in some areas, particularly with regard to calculations of the recording score, the financial score and the forecasting score.

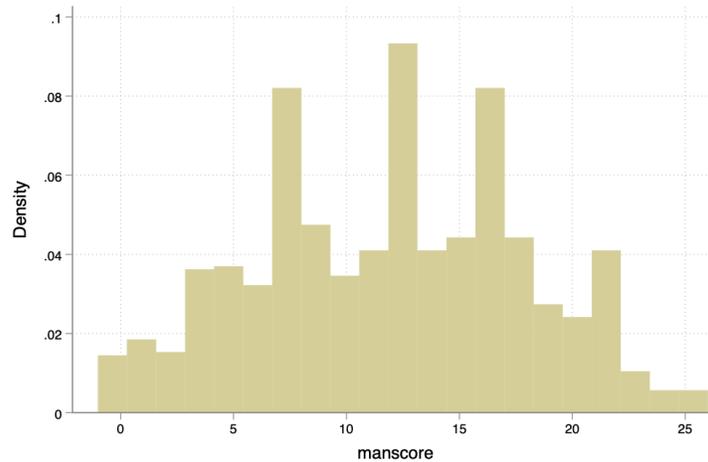
4. The firm owner/manager asked any of their former customers why they stopped buying from the business.
 5. The firm owner/manager asked any of the company's suppliers which products were selling well in the sector.
 6. The firm owner/manager attracted new customers by providing special offers.
 7. The firm spent any money in marketing/advertising its products in the past *six* months.
- The *stock* score ranges from a minimum of -1 to a maximum of +2. One point is subtracted (-1) if the owner/manager reports that the firm ran out of goods, inputs, or materials at least once a month (specifically, that this occurred weakly more than three times in the three months preceding the survey). One point is added (+1) if the owner/manager ever tried to negotiate a lower price with a supplier of material inputs in the past three months. A point is also added (+1) if the owner/manager asked at least one alternate domestic or foreign supplier (whom the firm was not sourcing from at the time of the interview) for a price quotation any time over the past year.
 - The *recording* score ranges from a minimum score of 0 to a maximum score of +7. The score is calculated by adding one point for each of the following business practices reported at the time of the survey:
 1. The firm owner/manager kept written track of the performance of the business, in terms of its output, revenues and profits.
 2. The firm owner/manager maintained written records of every input purchased and every product sold by the business.
 3. The owner/manager reported they were able to infer how much cash on hand the firm has at any point in time using the written records.
 4. The owner/manager regularly utilized the firm's written records to monitor if the sales of a particular product were increasing or decreasing from one month to the next.
 5. The owner/manager typically worked out the costs of each main product sold by the firm.
 6. The owner/manager maintained a written budget with records of how much was owed each month for rent, electricity, equipment maintenance, transport, advertising, and other indirect costs.

7. The owner/manager kept written records that would allow one to gauge how much money was left each month after paying off business expenses, which could be used as documentation to apply for a loan.
- The *financial* score ranges from 0 to +6, and is calculated as follows:
 1. Add up to three points depending on how frequently the owner or manager reports having reviewed the firm’s financial performance. That is, add 0 if the respondent reports “never” and +1, +2 or +3 if he/she answers “once a year”, “two or three times per year” or “monthly or more often”, respectively.
 2. As above, add up to three points depending on how frequently the owner/manager compares the firm’s performance to a sales target (if any).
 - The *forecasting* score ranges from a minimum score of 0 to a maximum of +5. The score is calculated by adding one point for each of the following activities reported by the firm owner/manager at the time of the survey:
 1. The firm had set a target for sales over the forthcoming year.
 2. The firm had a budget of the likely costs it would incur over the next year.
 3. The firm maintained an annual profit and loss statement.
 4. The firm kept an annual statement of its cash flow.
 5. The firm had an annual balance sheet.

Appendix Figure A1 shows the distribution of our raw managerial ability index for all firms in our survey. There is considerable overlap of the managerial ability index distribution across sectors.⁷⁷ In our analysis we standardize the managerial ability index across all firms in our sample.

⁷⁷The average ([Q25, Q75]) raw managerial ability score index is 11.6 ([8, 16]) for carpentry, 11.9 ([8, 16]) for metal fabrication and 12.6 ([7, 18]) for grain milling.

Figure A1: Managerial Ability Index Distribution



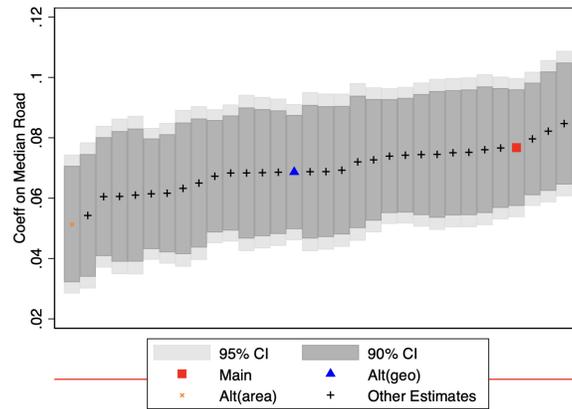
Notes: This figure shows the distribution of our managerial ability index for all firms in our survey (not standardized).

A.2 Grid Construction and Robustness Checks

As described in Section 4.2, we adopt a grid cell approach in order to create neighborhood-level measures of firm density, pollution and road size. Do do so, we draw a rectangle (grid) containing 500m x 500m cells covering all 179 urban and semi-urban parishes in our 52 sampled sub-counties, as well as all neighboring parishes containing at least one surveyed firm.

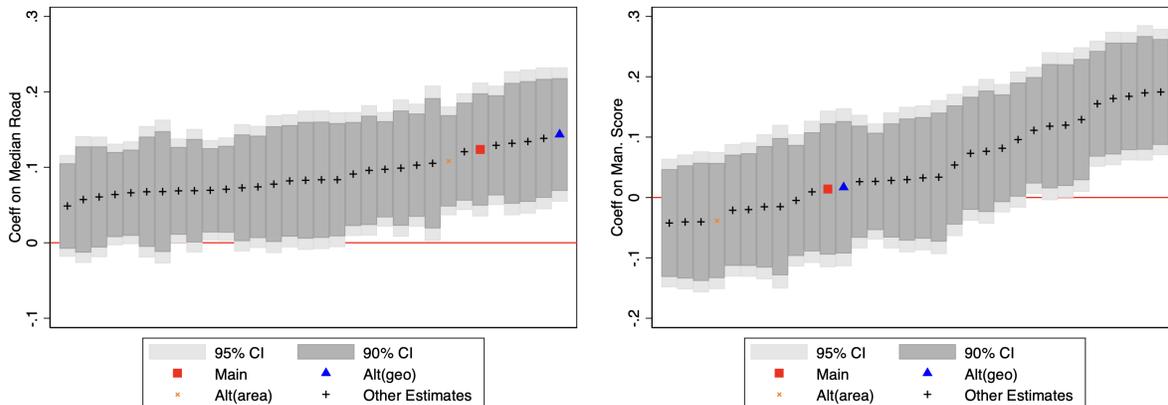
By default in the software used to generate the grids, the bottom-left grid cell matches the bottom-left corner of the smallest rectangle covering these sampled parishes. The grid starting point (i.e., coordinates of the bottom-left corner) may mechanically affect the aggregation of firms, pollution and road measures at the grid cell level. To address the arbitrariness of such starting point, we check that our results are robust to alternative starting points of the covering grid. More specifically, to mirror the software default, we build one grid such that the top-right corner (as opposed to the bottom-left corner) of the smallest rectangle covering these parishes matches a full grid cell, as well as 30 random starting points for the covering grid. Among these, we also highlight results for the randomized grid with the largest average and median grid cell area, to ensure that our results are robust when the distribution of grid cell areas is closest to the ideal one, i.e., the one where all grid cells have a size of exactly 500m x 500m. Of course, we note that reaching the ideal distribution is not possible given that the area of the sampled parishes cannot be divided exactly in grid cells by 500m x 500m. We present below our main coefficients susceptible of being affected by these changes. Overall, we see that our main results are robust to these alternative starting points for the calculation of the grid cells.

Figure A2: Average Log Pollution Residual/Cell on Median Road Size/Cell (Table 1, col 1)



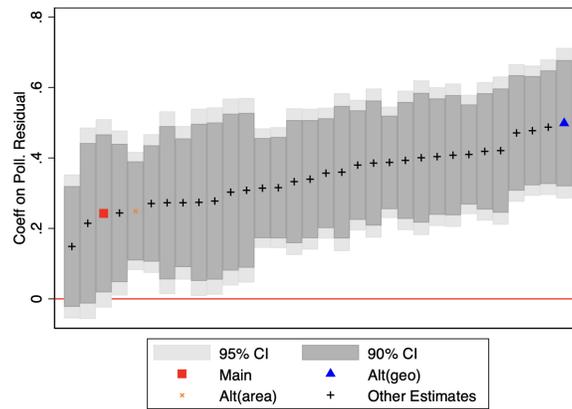
Notes: We run the specification in Table 1, Column 1 for different starting points of the covering grid. The red square is the estimate from our main specification. The blue triangle corresponds to the mirroring specification as described in Appendix A.2. The orange cross corresponds to the randomized grid with the largest average and median grid cell area as described in Appendix A.2, and black crosses represent coefficients for the 29 other randomly picked starting points for the grid. 90% and 95% confidence intervals are displayed.

Figure A3: Log Firm Density per Grid Cell on Median Road Size and Average Managerial Score (Table 2, col 5)



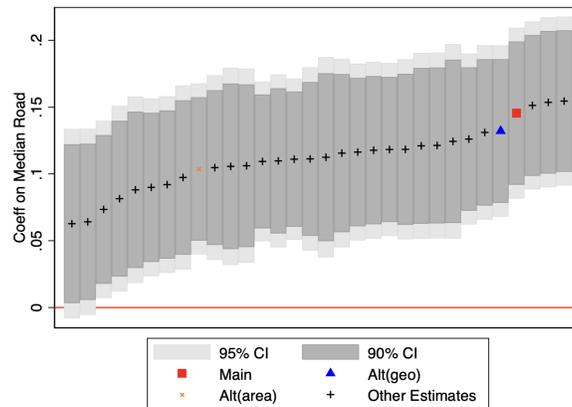
Notes: We run the specification in Table 2, Column 5 for different starting points of the covering grid. The red square is the estimate from our main specification. The blue triangle corresponds to the mirroring specification as described in Appendix A.2. The orange cross corresponds to the randomized grid with the largest average and median grid cell area as described in Appendix A.2, and black crosses represent coefficients for the 29 other randomly picked starting points for the grid. 90% and 95% confidence intervals are displayed.

Figure A4: Log Firm Density per Grid Cell on Average Log Pollution Residual (Table 2, col 6)



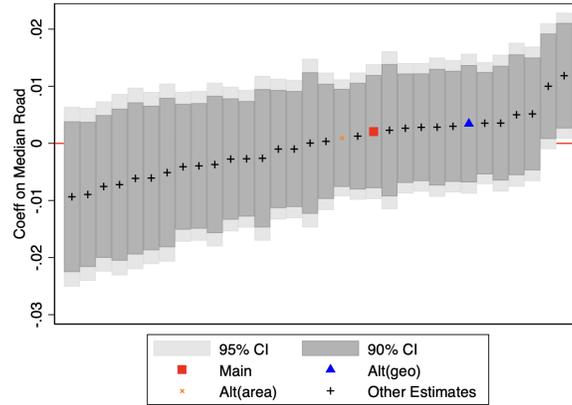
Notes: We run the specification in Table 2, Column 6 for different starting points of the covering grid. The red square is the estimate from our main specification. The blue triangle corresponds to the mirroring specification as described in Appendix A.2. The orange cross corresponds to the randomized grid with the largest average and median grid cell area as described in Appendix A.2, and black crosses represent coefficients for the 29 other randomly picked starting points for the grid. 90% and 95% confidence intervals are displayed.

Figure A5: Log(Profit) on Median Road Size/Cell (Table 3, col 1)



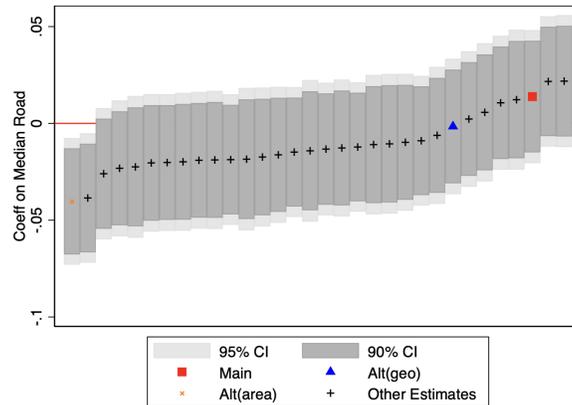
Notes: We run the specification in Table 3, Column 1 for different starting points of the covering grid. The red square is the estimate from our main specification. The blue triangle corresponds to the mirroring specification as described in Appendix A.2. The orange cross corresponds to the randomized grid with the largest average and median grid cell area as described in Appendix A.2, and black crosses represent coefficients for the 29 other randomly picked starting points for the grid. 90% and 95% confidence intervals are displayed.

Figure A6: Manager’s Use of Protective Equipment in the Firm on Median Road Size/Cell (Table A4, col 1)



Notes: We run the specification in Table A4, Column 1 for different starting points of the covering grid. The red square is the estimate from our main specification. The blue triangle corresponds to the mirroring specification as described in Appendix A.2. The orange cross corresponds to the randomized grid with the largest average and median grid cell area as described in Appendix A.2, and black crosses represent coefficients for the 29 other randomly picked starting points for the grid. 90% and 95% confidence intervals are displayed.

Figure A7: Protection of Employees from Pollution on Median Road Size/Cell (Table A4, col 2)



Notes: We run the specification in Table A4, Column 2 for different starting points of the covering grid. The red square is the estimate from our main specification. The blue triangle corresponds to the mirroring specification as described in Appendix A.2. The orange cross corresponds to the randomized grid with the largest average and median grid cell area as described in Appendix A.2, and black crosses represent coefficients for the 29 other randomly picked starting points for the grid. 90% and 95% confidence intervals are displayed.

A.3 Comparison of Satellite and On the Ground Pollution Measurements

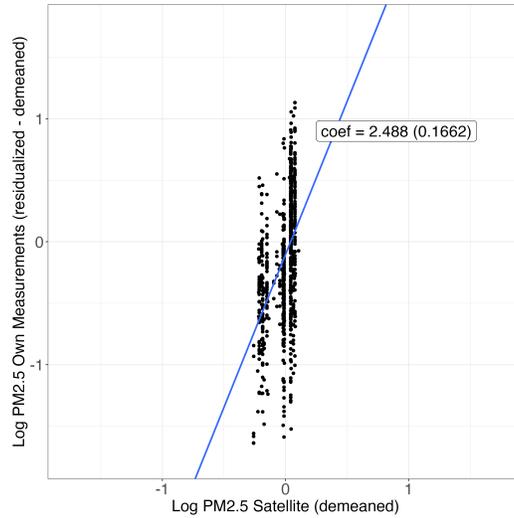
We measure air pollution using on the ground monitors rather than relying on satellite estimates. We show that (i) our measurements are highly correlated with satellite data overall and that (ii) unlike our measurements, satellite data does not feature substantial within-sub-county variation, making it unsuitable to the study of local pollution heterogeneity.

We retrieve PM2.5 satellite estimates from van Donkelaar et al. (2021)’s 2018 global dataset (V5.GL.02) in our sample areas.⁷⁸ We map the satellite data to the grid-cells in our sample and compare them with grid-cell averaged PM2.5 from our own measurements. To recover grid-cell average PM2.5 levels from our own measurements, we start by residualizing log pollution at the measurement level to net out day and time fixed effects. We then average the residuals at the grid-cell level to obtain the grid-level average on-the-ground pollution used in our main analysis. To compare these residuals to PM2.5 estimates from the satellite measurements, at the grid-cell level, we remove the average PM2.5 residual and add back the grid-cell level average raw log pollution. Finally, we take the exponential to recover PM2.5 levels. The results are analogous when using our raw pollution measurements instead.

With this grid-cell level datasets in hand, we first show that our measurements are strongly correlated with satellite estimates. Figure A8 displays the grid-cell level relationship between satellite-estimated (x-axis) and our own (y-axis) log PM2.5. Variables are demeaned by their national average. The correlation between the two sources is strongly positive and statistically significant (2.48 (0.16)). In Figure A9, we repeat the exercise but demeaning each variable by their sub-county’s average. While our measurements retain within sub-county variation, this is not the case for satellite estimates as all points shrink to around 0 on x-axis.

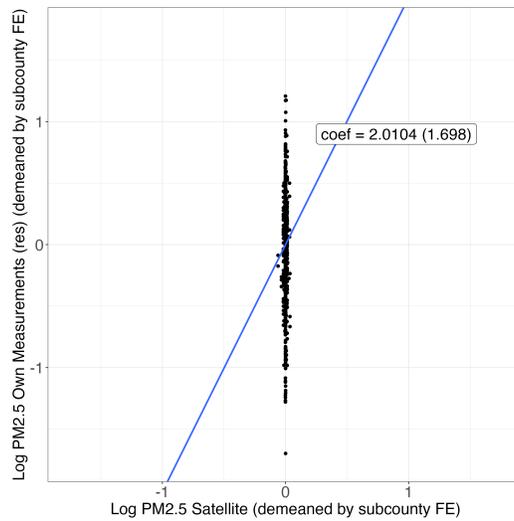
⁷⁸van Donkelaar et al. (2021) combine Aerosol Optical Depth retrievals from the NASA MODIS, MISR, and Sea WIFS instruments to estimate PM2.5 levels.

Figure A8: Our Ground PM2.5 Measurements are Strongly Correlated with Satellite Estimates



Notes: Satellite data come from van Donkelaar et al. (2021). We restrict the sample to grid-cells with average raw PM2.5 from our own measurements below $150\mu\text{g}/\text{m}^3$ (99.5th percentile at $142.3\mu\text{g}/\text{m}^3$). We subtract national grid-cell averages to both measures.

Figure A9: Satellite PM2.5 Estimates Do Not Feature Significant Within Sub-County Variation



Notes: Satellite data come from van Donkelaar et al. (2021). We restrict the sample to grid-cells with average raw PM2.5 from our own measurements below $150\mu\text{g}/\text{m}^3$ (99.5th percentile at $142.3\mu\text{g}/\text{m}^3$). We subtract sub-county grid-cell averages to both measures.

A.4 Returns from Locating on Large Roads: Robustness to Sorting on Productivity

One important identification assumption to causally establish the relationship between road size and profitability is the absence of sorting on major roads based on underlying firm productivity. In this section, we provide three pieces of evidence that reassure us that sorting on (observable or unobservable) productivity is not likely to bias the results in Table 3.

In Appendix Table A1 we investigate the correlation between road size and several firm owner and worker characteristics that are plausible proxies for productivity. In column 1 we focus on the managerial ability of the firm owner. The coefficient on median road size shows that an increase in one unit in the size of the median road in the grid cell is associated with an increase of 0.0558 standard deviations in our index of managerial ability. This effect is rather small, and is not significant at conventional statistical levels. In columns 2-8, we show that there is also no correlation between road size and owner’s age, education and gender, as well as employees’ age, education, gender and vocational training: all coefficients are small in magnitude and far from statistical significance.

The lack of significant sorting on the wide range of observable proxies for productivity studied in Table A1 indicates that any substantial sorting on unobservable proxies for productivity is also unlikely, to the extent that observable and unobservable proxies for productivity are correlated. Nevertheless, to assess the importance of any remaining selection on unobservables, we follow Oster (2019) and calculate lower bounds on the coefficient on the median road size in the cell in specification 4, by making assumptions on the relative importance of selection on observables and unobservables. Specifically, Oster (2019) shows that movements in the coefficients of interest and in the R-squared when additional controls are included are informative of selection on unobservables, once assumptions on the relative importance of selection on observables and unobservables are made.

To use this method, we need to make assumptions on: (i) the degrees of proportionality between selection on observables and unobservables (δ), and (ii) the maximum R-squared (R_{max}) from a regression that in addition to controlling for all the variables already included in our equation 4, was also controlling for other unobservable determinants of profitability correlated with median road size. We follow the author’s recommendation and set $\delta = 1$ (so that selection on observables and unobservables are equally important), and $R_{max} = 1.3 \times \tilde{R}$ where \tilde{R} is the R-squared from a regression of profits on median road size like equation 4, but where sub-county and sector fixed effects are netted out before running the regression.⁷⁹ We also show robustness to using the more conservative assumption of $R_{max} = 2 \times \tilde{R}$ and even $R_{max} = 3 \times \tilde{R}$,

⁷⁹Since our analysis is always conditional on sub-county and sector fixed effects, we first net out sub-county and sector fixed effects from both the dependent and independent variables to make sure that these are not taken into account in the computation of \tilde{R} .

which assumes that if we were able to fully control for all unobservable determinants of profits correlated with median road size in the cell, the R-squared from such hypothetical regression would be twice and even three times as large, respectively. We recover a lower bound on the correlation between road size and profits that accounts for selection on unobservables under these assumptions.

The results are displayed in Table A2. In columns 1 and 2 we report the lower bound on the coefficient on the median road size in the cell under the assumption of $R_{max} = 1.3 \times \tilde{R}$. In column 1 we include the exact same controls as in Table 3. In column 2, we additionally control for firm owner’s age, gender and education. The lower bound on the estimated elasticity between profits and road size in columns 1 and 2 ranges between 0.144-0.142, which remains very close to the magnitude of the elasticity in the main specification of Table 3, which is 0.145. This is consistent with the lack of significant selection on managerial ability and other observable proxies for owner and worker productivity shown in Table A1, and with the fact that the coefficient on median road size in column 1 of Table 3 changes very little once we control for our index of managerial ability in column 2 of Table 3: since selection on observables is limited, the Oster procedure then implies that any selection on unobservables is also likely limited. Columns 3 and 4 of Table A2 show that our main elasticity of interest remains above 0.13 even under the more extreme assumptions of $R_{max} = 2 \times \tilde{R}$ and even $R_{max} = 3 \times \tilde{R}$, which further reassures us that any selection on unobservables is not first order.

Finally, in Table A3, we estimate a version of equation 4 where we add an interaction between managerial ability and median road size in the cell, thus allowing the returns from locating near a major road to be heterogeneous by managerial ability. We focus on profits and profits per worker, which are our key outcomes summarizing the economic benefits of locating near larger roads. We find no evidence that the returns from locating near major roads are larger for higher ability managers. These results are again consistent with the lack of sorting near major roads based on managerial ability, and therefore reinforce our confidence that the positive relationship between major roads and profits estimated in Table 3 does not suffer from significant selection bias.

Table A1: Sorting on Large Roads Based on Productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Man. Score	Man. Age	Man. Educ.	Man. is Male	Emp. Age	Emp. Educ	Vocational Training	Emp. is Male
Median Road Size/Cell	0.0558 (0.0378)	0.332 (0.395)	0.108 (0.147)	-0.00175 (0.00657)	0.156 (0.208)	-0.101 (0.0819)	-0.00658 (0.00707)	-0.00103 (0.00284)
N	950	978	972	1007	2615	2633	2627	2657
R2	0.185	0.197	0.163	0.151	0.165	0.145	0.110	0.0584
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Firm	Firm	Employee	Employee	Employee	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Employee Controls					No	No	No	No

Notes: OLS regression coefficients. Standard errors are clustered at the grid cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. All specifications include sector and sub-county fixed effects. Road size goes from 1 (Trail/Track) to 5 (Highway). Dependent variables in columns 1 to 4 (5 to 8) are related to manager (employees) characteristics. Education is measured in years.

Table A2: Returns from Locating on Large (and Polluted) Roads - Oster (2019) Lower Bound

Dep. Var:	Log(Profit)			
	(1)	(2)	(3)	(4)
		Oster Lower Bound		
Median Road Size/Cell	0.144	0.142	0.141	0.136
N	967	967	967	967
R2 baseline (within subcounty & sector)	0.0938	0.106	0.0938	0.0938
R2 max	1.3 * baseline	1.3 * baseline	2 * baseline	3 * baseline
Additional Controls	No	Yes	No	No
Level of Observation	Firm	Firm	Firm	Firm

Notes: The additional independent variables included in columns 1, 3 and 4 include: dummy for whether the grid cell contains any road; dummy for whether the grid cell is incomplete (i.e., 500m x 500m); area of the grid cell; dummy for whether the grid cell falls in our main surveyed area; standardized index of managerial ability (see Appendix A.1 for details); log distance to main city in the region; dummies for missing values in any of the covariates. In column 2 we further control for firm owner's age, gender and education (and corresponding dummies for missing values). To compute the Oster lower bound (Oster 2019) for the elasticity of profits to road size, we first net out both the dependent variable and all independent variables from sub-county and sector fixed effects. The R-squared displayed corresponds to the residual variation of the dependent variable explained by the independent variables. We set $\delta = 1.0$ and R-max as shown in the table. The Oster method compares the size of the coefficient on median road size in the cell and the R-squared when the additional independent variables are added to the regression. In the initial (uncontrolled) regression that serves as starting point in the Oster procedure, we still control for a dummy for whether the grid cell contains any road and for a dummy for whether the grid cell falls in our main surveyed area (in addition to controlling for the size of the median road in the cell).

Table A3: Returns from Locating on Large (and Polluted) Roads - Heterogeneity

	(1)	(2)
	Log(Profit)	Log(Profit / Worker)
Median Road Size/Cell	0.146 (0.0325)	0.0803 (0.0328)
Man. Score	0.209 (0.0631)	0.103 (0.0572)
Man. Score \times Road	0.0119 (0.0224)	0.0120 (0.0205)
N	967	967
R2	0.537	0.483
Sector FE	Yes	Yes
Sub-county FE	Yes	Yes
Level of Observation	Firm	Firm
SE clustering	Grid Cell	Grid Cell

Notes: OLS regression coefficients. Standard errors are clustered at the grid-cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. All specifications include sector and sub-county fixed effects. We control for missing managerial score (dummy). The top and bottom one percent of all monetary dependent variables are trimmed. Road size goes from 1 (Trail/Track) to 5 (Highway). Man. Score \times Road corresponds to the interaction between managerial ability and median road size in the grid cell.

A.5 Adaptation Results: Details

We use our survey data to study the adaptation that takes place, and whether this differs for high- and low-ability owners. We estimate firm- and worker-level regressions analogous to equation 4 but with various measures of adaptation from our survey as outcomes.⁸⁰

The dependent variable in column 1 of Table A4 is a dummy equal to one if firm owners report providing any pollution protective equipment to their workers, such as air filters or masks. The mean of this variable shows that only 5% of owners engage in such investments. The estimates show that a one standard deviation increase in managerial ability is associated with an increase of 1.9pp in the probability of providing such equipment, corresponding to an increase of 40% over the mean. We also asked workers whether they do anything to protect themselves from air pollution on days when air quality at the firm premises is bad, such as wearing a scarf or a mask.⁸¹ Consistent with the results in column 1, column 2 shows that employees working for higher ability owners take more protective measures themselves.

In columns 3 to 5 we focus on organizational strategies to limit exposure. Workers were asked if avoiding pollution on the commuting route was an important reason why they could arrive late at work and/or may leave work early (column 3), and if owners allow them flexibility in working hours to avoid being exposed to such pollution (column 4). The means of these variables are again low: only around 6-13% of workers are allowed such flexibility. The coefficients on our measure of managerial ability are positive and significant in both cases. For instance, column 4 shows that a one standard deviation increase in managerial ability leads to an increase in the probability that workers are granted flexibility in commuting by 5.3pp, or 40% relative to the mean. In columns 2-5, we include a host of employee controls to disentangle whether this effect is driven by higher ability managers actually treating their workers differently rather than differential worker sorting across owners.⁸² Our coefficient of interest is remarkably stable when employee-level controls are excluded (not shown), which confirms that the results are more consistent with higher ability owners treating their workers differently. In Appendix A.6,

⁸⁰As shown in Table 2 and discussed more in detail in Appendix A.4, we note again that managerial ability does *not* predict location choices, which justifies looking at the role of managerial ability for adaptation conditional on location choice.

⁸¹Appendix Figure A10 reports the breakdown of workers' answers. Almost half of the workers report taking some protective measures. Dominant strategies are wearing a scarf/tissue, which are unlikely to be very effective. Wearing a mask is also relatively common among those who protect themselves. Notably, very few workers report staying inside the firm premises when air quality is bad, which is consistent with work being predominantly outdoor. Figure A10 also shows that the availability of larger (and more expensive) technologies such as air conditioners is extremely limited. As the firms in our sample operate at small scale and mostly outdoor, this might prevent them from overcoming the fixed costs of purchasing these types of lumpy equipment. In the context of households, Sun et al. (2017) show that richer individuals in China are more likely to invest in lumpy pollution-abating technologies such as air filters.

⁸²Employee controls include the employee's education, age, age squared, cognitive ability (measured through a Raven matrices test), tenure (in years), vocational training (dummy). When explicitly noted, we also control for the employee's log salary.

we perform additional checks to show that the role of worker-firm sorting in explaining our adaptation results is limited. Finally, in column 5 we create a dummy equal to one if the worker reported that their firm owner is careful in avoiding exposing them to pollution. Our index of managerial ability is again a significant predictor in this regression.⁸³

Taken together, these results show that while investments by owners in protecting workers are overall low, higher ability owners are better able to protect their workers from pollution exposure. This is not just the consequence of higher ability owners having more financial resources to purchase protective equipment; rather, it also reflects the adoption of different organizational strategies to avoid pollution exposure.

Finally, we note that our measures of road size are always positive throughout Table A4, although they are largely insignificant. These results on lack of significant spatial heterogeneity in adaptation are consistent with the evidence from Panel D of Table 4 that pollution levels are not a relevant factor in the firm location choice, and confirm that the reason why wages are on average only marginally higher near larger roads is not that workers receive more (or better) protection from air pollution.

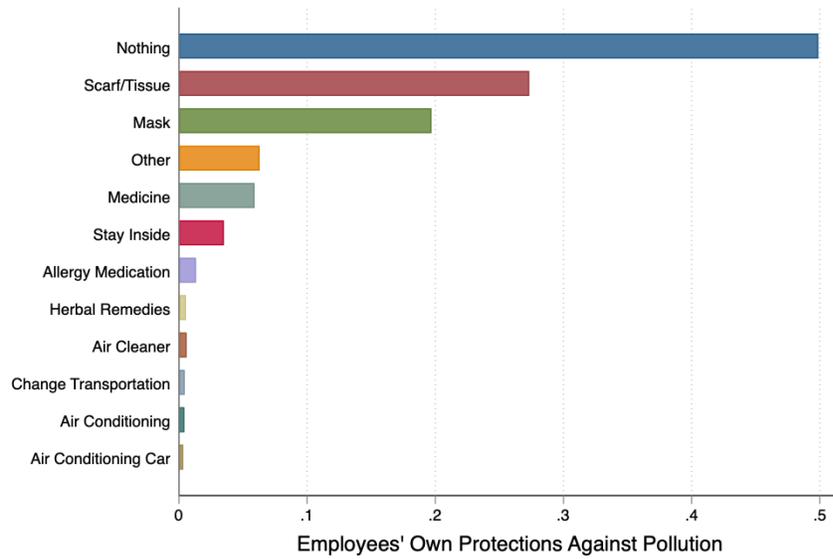
⁸³It is worth noting that columns 2-5 of table A4 are obtained from a survey of workers, and do not use, apart from the independent variable (i.e., managerial ability), any information provided by firm owners. Therefore, our results cannot be contaminated by any reporting bias correlated with managerial ability.

Table A4: Correlation Between Firm Owner's Ability and Protective Investments

	(1)	(2)	(3)	(4)	(5)
	Poll Equipment	Own Protect	Late Commute	Flex Commute	Managers Careful
Median Road Size/Cell	0.00206 (0.00600)	0.0125 (0.0145)	0.0135 (0.00748)	0.0142 (0.0134)	0.0146 (0.0119)
Man. Score	0.0194 (0.00686)	0.0450 (0.0182)	0.0260 (0.00883)	0.0529 (0.0146)	0.0633 (0.0153)
N	1000	2045	2020	2002	1959
R2	0.105	0.205	0.0972	0.186	0.142
Sector FE	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes
Level of Observation	Firm	Employee	Employee	Employee	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Employee Controls		Yes	Yes	Yes	Yes
Mean(dependent var)	.047	.523	.056	.132	.21
Answer scale	Dummy	Dummy	Dummy	Dummy	Dummy

Notes: OLS regression coefficients. Standard errors are clustered at the grid cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. Employee controls include education, age, age squared, vocational training (dummy), cognitive ability and employee tenure. We control for missing managerial score (dummy) and missing employee controls (dummies). All specifications include sector and sub-county fixed effects. Road size goes from 1 (Trail/Track) to 5 (Highway). The dummy dependent variables are defined as follows: Poll Equipment is equal to 1 if any anti-pollution technology or equipment that can be used by individual workers (e.g., masks) is provided by the firm; Own Protect is equal to 1 if the employee reports doing anything to protect herself against air pollution; Late Commute is equal to 1 if the employee reports that avoiding pollution on the commuting route is an important reason why she may arrive (leave) late (early) at work; Flex Commute is equal to 1 if the employee reports that her manager allows her to come in or leave early or late to avoid pollution on the commuting route; Managers Careful is equal to 1 if the employee thinks that her employer / manager is careful with trying to avoid exposing her to pollution.

Figure A10: Workers' Own Protective Measures Against Pollution



Notes: In the baseline survey, workers were asked whether they do anything to protect themselves from air pollution on days when air quality at the firm premises is bad. If the answer was positive, they were invited to give up to three examples. The histogram plots the share of workers in our sample listing a given protective measure as part of their strategy. About half of the workers take protective measures against pollution, and the dominant strategies are to use a scarf, tissue or mask. Less than 4% of workers address air pollution by staying inside the firm's premises.

A.6 Limited Role of Worker Sorting in Explaining the Results

As discussed in section A.5, the inclusion of worker-level controls in the regressions in Tables A4 and A8 barely affects the coefficient on the managerial ability index. This is consistent with the sorting of workers to managers not being a driver of the results in these two tables.

We conduct further checks to shed more light on the potential role of sorting in driving our results. First, we look for direct evidence of sorting. We do so in Appendix Table A5, columns 3-8. In columns 3 and 4, the dependent variable is a measure of employee awareness of pollution that we argue is plausibly pre-determined with respect to their current employer. That is, each worker was asked whether low exposure to pollution was an important consideration in deciding where to live.⁸⁴ We construct a dummy equal to one for those who answered positively to this question, and use this as dependent variable. The results in columns 3-4 show no evidence of sorting between higher ability managers and workers based on this (pre-determined) measure of pollution awareness. Columns 5-8 instead show that there is sorting by age and education.⁸⁵ The lack of sorting on our pre-determined measure of employee pollution awareness limits concerns that the specifications in Tables A4 and A8 with employee controls might capture sorting. Nevertheless, in Appendix Table A6 we verify that the results in Table A4 are robust to controlling for our pre-determined measure of employee pollution awareness (even columns), as well as to controlling for our standardized index of employee awareness that combines the outcome variables in columns 3-6 of Table A8 (odd columns). This further reassures us that the results on owners' adaptation are not primarily driven by sorting.

Columns 3 and 4 of Table A5 also show that there is no sorting of employees near larger roads based on our pre-determined measure of pollution awareness. This helps the interpretation of the results in Table 3, by ruling out that compensation for pollution exposure is low because polluted areas attract workers who are less aware of pollution as a problem.

⁸⁴18% of workers report that pollution was an important consideration in their location decision.

⁸⁵Appendix Table A7 shows that employee age and education do predict awareness as pollution as a problem.

Table A5: Correlation Between Firm Owner Ability and Employees' Awareness of Pollution

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Poll Awareness At The Firm	Poll Awareness At The Firm	Poll Awareness At Home	Poll Awareness At Home	Age Employee	Years Schooling Employee	Age Employee	Years Schooling Employee
Median Road Size/Cell	0.0440 (0.0326)	0.0469 (0.0319)	0.00615 (0.0114)	0.00560 (0.0115)	0.160 (0.205)	-0.121 (0.0825)	0.0845 (0.199)	-0.103 (0.0834)
Man. Score	0.288 (0.0332)	0.272 (0.0324)	0.00588 (0.0165)	0.00979 (0.0151)	0.121 (0.229)	0.207 (0.0791)		
Age Manager							0.0873 (0.0195)	
Years School. Man.								0.0656 (0.0218)
N	2045	2045	2045	2045	2615	2633	2615	2633
R2	0.166	0.181	0.113	0.122	0.166	0.151	0.175	0.150
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of Observation	Employee	Employee	Employee	Employee	Employee	Employee	Employee	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Employee Controls	No	Yes	No	Yes	No	No	No	No
Mean(dependent var)	-0.019	-0.019	.175	.175	27.59	9.13	27.59	9.13

Notes: OLS regression coefficients. Standard errors are clustered at the grid cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. Employee controls include education, age, age squared, vocational training (dummy), cognitive ability and employee tenure. All specifications include sector and sub-county fixed effects. We control for missing managerial score (dummy) and missing employee controls (dummies). Road size goes from 1 (Trail/Track) to 5 (Highway). The dummy dependent variables are defined as follows: Poll Awareness - At the Firm is a normalized average of the dependent variables in columns 3-6 of Table A8 (mean 0, sd 1). Poll Awareness - At Home is a dummy variable equal to one if the employee reports that air pollution, solid water pollution or water pollution have affected her home location choice.

Table A6: Correlation Between Firm Owner Ability, Employees' Awareness of Pollution, and Protective Investments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Own	Own	Late	Late	Flex	Flex	Managers	Managers
	Protect	Protect	Commute	Commute	Commute	Commute	Careful	Careful
Median Road Size/Cell	0.0111 (0.0141)	0.0131 (0.0141)	0.0117 (0.00736)	0.0130 (0.00751)	0.0113 (0.0133)	0.0138 (0.0135)	0.0118 (0.0121)	0.0130 (0.0120)
Man. Score	0.0302 (0.0189)	0.0447 (0.0182)	0.0148 (0.00867)	0.0235 (0.00864)	0.0360 (0.0139)	0.0492 (0.0141)	0.0498 (0.0156)	0.0582 (0.0153)
Log Salary	-0.0198 (0.0300)	-0.0107 (0.0301)	0.0329 (0.0108)	0.0362 (0.0111)	0.0582 (0.0221)	0.0624 (0.0222)	0.0634 (0.0241)	0.0667 (0.0239)
Poll Awareness - At The Firm	0.0599 (0.0158)		0.0321 (0.00650)		0.0481 (0.00968)		0.0314 (0.0130)	
Poll Awareness - At Home		0.127 (0.0366)		0.00505 (0.0162)		-0.0332 (0.0242)		0.0164 (0.0325)
N	2045	2045	2020	2020	2002	2002	1959	1959
R2	0.220	0.216	0.120	0.104	0.212	0.197	0.153	0.148
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of Observation	Employee	Employee	Employee	Employee	Employee	Employee	Employee	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell					
Employee Controls	No	No	No	No	No	No	No	No
Mean(dependent var)	.523	.523	.056	.056	.132	.132	.21	.21
Answer scale	Dummy	Dummy	Dummy	Dummy	Dummy	Dummy	Dummy	Dummy

Notes: OLS regression coefficients. Standard errors are clustered at the grid cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. Employee controls include education, age, age square, vocational training (dummy), cognitive ability, employee tenure and log wage. We control for missing managerial score (dummy) and missing employee controls (dummies). All specifications include sector and sub-county fixed effects. Road size goes from 1 (Trail/Track) to 5 (Highway). The dummy dependent variables are defined as follows: Own Protect is equal to 1 if the employee reports doing anything to protect herself against air pollution; Late Commute is equal to 1 if the employee reports that avoiding pollution on the commuting route is an important reason why they may arrive (leave) late (early) at work; Flex Commute is equal to 1 if the employee report that their manager allows her to come in or leave early or late to avoid pollution on commuting route; Managers Careful is equal to 1 if the employee thinks that her employers / managers are careful with trying to avoid exposing her to pollution. Poll Awareness - At the Firm is a normalized average of the dependent variables in columns 3-6 of Table A8 (mean 0, sd 1). Poll Awareness - At Home is a dummy variable equal to one if the employee reports that air pollution, solid water pollution or water pollution have affected her home location choice.

Table A7: Correlation Between Employees' Characteristics and Perceptions of Pollution as a Problem

	(1)	(2)	(3)	(4)
	Concerned Poll Health	Ideal Job Low Poll	Concerned Poll Planet	Gov Address Poll
Years Schooling	0.0169 (0.00959)	0.000982 (0.00375)	0.0358 (0.00980)	0.00491 (0.0101)
Age	0.0122 (0.0157)	-0.0132 (0.00588)	0.0124 (0.0170)	-0.0120 (0.0210)
Age ²	-0.0000509 (0.000220)	0.000213 (0.0000804)	-0.0000601 (0.000242)	0.000173 (0.000308)
Vocational Training (Dummy)	0.210 (0.0844)	-0.0132 (0.0349)	0.163 (0.0951)	0.0165 (0.100)
N	2052	2045	2053	2053
R2		0.115		
Sector FE	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes
Level of Observation	Employee	Employee	Employee	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Mean(dependent var)	3.735	.298	3.964	4.045
Answer scale	0-5	Dummy	1-5	1-5
Model	O. Probit	OLS	O. Probit	O. Probit

Notes: Standard errors are clustered at the grid cell level and displayed in parentheses. We control for log distance to the main city in the region. The dependent variables are defined as follows: the employee is asked how concerned she is about the effects of air pollution on her health (column 1) and on the health of the planet (column 3); whether her ideal job features low levels of air pollution (column 2) and to what extent she agrees that the government should do more to promote and encourage a better air quality even if her taxes have to go up slightly (column 4). For non-dummy variables, an ordered probit model is used, while we use OLS when the dependent variable is a dummy. All specifications include sector and sub-county fixed effects.

A.7 Counterfactual Exercise: Predicting Pollution and Profits

In Table 6, we conduct a series of back of the envelope analyses where we predict pollution and profits from road traffic in each grid cell using the estimated elasticity of pollution to road size from Table 1, column 1, and the elasticity of profits and wage to road size from Table 3, respectively. Here we give more details on the calculations.

Predicting Profits

In Table 3, column 2, we estimated a version of the following regression for firm i , in grid-cell c , where $Y \in \{profit, salary\}$, controlling for sub-county fixed effects (γ_s) and firm characteristics (X_i) (where we ignore the error term for simplicity):

$$\log Y_{i,c} = a + b \times MedianRoad_c + \eta \times X_{i,c} + \gamma_s$$

This is equivalent to normalizing the dependent and independent variables by their sub-county average, denoted by an upper bar and super-script s :

$$\log Y_{i,c} - \overline{\log Y_{i,c}}^s = \underbrace{a - \bar{a}^s}_{=0} + b \times (MedianRoad_c - \overline{MedianRoad_c}^s) + \eta \times (X_{i,c} - \overline{X_{i,c}}^s)$$

We consider a firm with average characteristics in each sub-county, such that $X_{i,c} - \overline{X_{i,c}}^s = 0$, and average characteristics at the grid-cell level c , so that Y_c is the profit in grid-cell c for a firm with average characteristics $X_{i,c}$:

$$\log Y_c - \overline{\log Y_c}^s = b \times (MedianRoad_c - \overline{MedianRoad_c}^s)$$

To predict grid-cell level profits, $\log \hat{Y}_c$, in deviation from their sub-county average, we recover the left hand side of the above equation using the estimated elasticity \hat{b} , such that

$$Y_c - \hat{Y}_c^s = [\exp(\hat{b}) - 1] \times \underbrace{[MedianRoad_c - \overline{MedianRoad_c}^s]}_{\text{data}}$$

Finally, we multiply by $AvgY_c$ to get from percentage change to levels. We apply a similar methodology for predicting worker salaries (where we use the elasticity of salary to median road size from column 3 of Table 3.).

Predicting Pollution

In Table 1, we estimated a version of the following regression, at the grid-cell level c , where res_c is the average pollution residual in grid-cell c and γ_s the sub-county fixed effects:

$$res_c = a + b \times MedianRoad_c + \gamma_s$$

This is equivalent to normalizing the dependent and independent variables by their sub-county average, denoted by an upper bar and super-script s :

$$res_c - \overline{res_c^s} = b \times (MedianRoad_c - \overline{MedianRoad_c^s})$$

Unlike for profits, the dependent variable is in levels rather than in logs, so we recover the left hand side by directly using the estimated elasticity \hat{b}

$$res_c - \hat{\overline{res_c^s}} = \hat{b} \times \underbrace{(MedianRoad_c - \overline{MedianRoad_c^s})}_{\text{data}}$$

However, we are interested in pollution levels, rather than pollution residuals. Remember that the following relationship holds at the mobile pollution measurement level m at time t (see Section 5.1):

$$res_{m,t} = \log poll_{m,t} - FE'_t$$

where FE'_t correspond to hour and day fixed effects estimated using the stationary monitors. To convert $res_c - \hat{\overline{res_c^s}}$ into $poll_c - \hat{\overline{poll_c^s}} + avgpoll_c$, or the predicted pollution (in levels) at the grid-cell level, adjusting for deviation of the sub-county average $\overline{poll_c^s}$ compared to the overall average $avgpoll_c$, for average FEs, we calculate:

$$poll_c - \hat{\overline{poll_c^s}} + avgpoll_c = \exp[res_c - \hat{\overline{res_c^s}} + \text{avg} \log poll_c]$$

Finally, we use a linear relationship between PM2.5 concentration and loss of life expectancy (LLE, in months) (Ebenstein et al. 2017) to go from pollution levels to LLE:

$$LLE_c = \frac{poll_c - \hat{\overline{poll_c^s}}}{10} * 0.98 * 12$$

Computing Counterfactuals

After predicting pollution (and LLE), profits and salary for each grid-cell in our sample, we contrast these average predicted outcomes in three scenarios. First, we compute average predicted exposure, profits and salary given the observed distribution of firms in our sample. For each sub-county s , we compute the average predicted outcome \hat{Y}_{actual}^s , $Y \in \{poll, profits, salary\}$,

given the total number of firms in sub-county s , N_s , and the number of firms in each grid-cell c , $n_{c,s}$:

$$\overline{\hat{Y}}_{actual}^s = \frac{1}{N_s} \sum_{c=1}^{C_s} (n_{c,s} \times Y_{c,s}^{\hat{}}),$$

where C_s is the number of grid-cells in sub-county s and $Y_{c,s}^{\hat{}}$ is the predicted outcome in grid-cell c in sub-county s , following the procedure described above. $\overline{\hat{Y}}_{actual}^s$ is effectively a weighted average across grid-cells, where the weights are the number of firms in each grid-cells.

We compare $\overline{\hat{Y}}_{actual}^s$ to the average predicted grid-cell level outcome in sub-county s

$$\overline{\hat{Y}}_{random}^s = \frac{1}{C_s} \sum_{c=1}^{C_s} Y_{c,s}^{\hat{}}.$$

$\overline{\hat{Y}}_{random}^s$ corresponds to the average predicted outcome if firms were randomly located because it is a simple average that weighs equally all grid-cells in a sub-county. The difference between the two, $\Delta \overline{\hat{Y}}_{random-actual}^s = \overline{\hat{Y}}_{random}^s - \overline{\hat{Y}}_{actual}^s$ corresponds to the change in exposure resulting from firms relocating randomly within a sub-county from their observed location. We average across sub-counties by maintaining the number of firms in each sub-county:

$$\Delta \overline{\hat{Y}}_{random-actual} = \frac{1}{N} \sum_{s=1}^S [N_s \times \Delta \overline{\hat{Y}}_{random-actual}^s],$$

where S is the number of sub-counties in the data and N is the total number of firms in the data.

We also implement an analogous exercise comparing firms' predicted outcomes from their actual location, $\overline{\hat{Y}}_{actual}^s$, to the average predicted outcome if all firms were to actively avoid polluted and busy roads and move to grid-cells with a median road size at the 10th percentile, within their sub-county: $\overline{\hat{Y}}_{random}^s$ is replaced by $\overline{\hat{Y}}_{p10}^s$. We then average across sub-counties as above.

A.8 Perceived Costs of Pollution and Pollution Levels

The perceived costs of pollution depend on managerial ability. In Table A8, we study firm owners' and employees' perceptions of pollution as a problem, and how this varies by managerial ability.

First, owners were asked how concerned they are with the effects of air pollution on their workers' productivity and health. Both questions were asked using a 0-5 likert scale, where higher values indicate higher concerns about pollution. Columns 1-2 show that concerns about the costs of pollution are relatively high among all firm owners, with the average score for productivity and health concerns reaching 2.9 and 3.4 out of 5, respectively. Higher ability owners report higher productivity and health concerns, although the coefficient on the managerial ability index is not significant, potentially due to the low sample size in these regressions.⁸⁶

Analogously, workers were asked how concerned they are with the effects of pollution on the planet and on their own health (using a 1-5 scale and a 0-5 scale, respectively).⁸⁷ Columns 3-4 show that employees working for higher ability owners are significantly more concerned about the effects of pollution on the planet and on their own health. In column 5 we use as dependent variable the answer to a question about whether the worker thought the government should do more on pollution (using a 1-5 scale). We again see a positive and significant coefficient on managerial ability. Finally, workers were asked to indicate the characteristics of their ideal job, selecting from a list which included also low exposure to pollution as an option. We create a dummy equal to one if workers selected exposure to pollution among the characteristics of their ideal job, and use this as dependent variable in column 6. We find that workers employed by higher ability owners are substantially more likely to indicate exposure to pollution among the characteristics of their ideal job. Interestingly again, omitting employee controls barely alters the coefficients on our index of manager ability (not shown). This suggests that the effects are driven by higher ability owners being relatively more aware of pollution as a problem and thus affecting the perceptions of their employees, rather than by differential sorting of workers to managers of varying ability. See Appendix A.6 for more details on how we address the role of worker sorting.

Firm owners underestimate pollution but perceive its link with access to customers.

We investigate whether firm owners underestimate pollution or fail to perceive the bundling of pollution and access to customers. First, we compare firm owners' perceived levels of relative pollution near their firm to actual relative pollution, as measured by our data. To construct the dependent variable in Table A9, we ask firm owners whether they think air pollution near the premises of the firm is low, average or high compared to other locations in their sub-county. The

⁸⁶Owners were asked about their perceived costs of pollution during the follow-up phone survey.

⁸⁷Workers were asked about their perceived costs of pollution during the baseline survey.

variable takes values 1 (low), 2 (average) or 3 (high).⁸⁸ Analogously, within each sub-county, we categorize grid-cells into low (1st tercile), average (2nd tercile) or high (3rd tercile), based on the actual measurements from our mobile pollution monitors (net of time variation, as described in Section 4.1). The dependent variable – perceived relative pollution – has a mean of 1.7. This implies that owners overall *underestimate* relative air pollution at the premises of their firm.

First, we establish that firm owners correctly perceive that pollution is higher near major roads by regressing perceived relative pollution near their firm on median road size in the grid cell (column 1). In line with this, firm owners are more likely to answer that their location is relatively polluted if it is actually polluted (column 2). The low significance of the coefficient on actual relative pollution may be explained by the small sample of firms for which pollution data is available.⁸⁹ In columns 3 and 4 we study whether firm owners perceive the bundling of pollution and profitability through road traffic by regressing perceived relative pollution on perceived relative profitability (column 3) and perceived relative traffic (column 4). Both variables are built similarly to the dependent variable, but using questions on perceived profitability and traffic near the premises of the firm, respectively. The coefficients are positive and statistically significant and imply that the residual correlation of perceived relative pollution and profitability is 0.336 (SE 0.0465) and 0.471 (SE 0.0434) for pollution and traffic, respectively.

These results confirm that while firm owners overall tend to underestimate relative pollution, they are aware of the correlation between pollution, road traffic, and profitability. Interestingly, we do not find that managerial ability predicts awareness of pollution throughout Table A9. This suggests that the higher levels of adaptation by higher ability owners documented in Table A4 are the result of higher awareness of pollution as a problem for productivity and health (as shown in Table A8), rather than of higher awareness of relative pollution levels per se.

⁸⁸This information was collected in the follow-up survey.

⁸⁹As explained in Section 3.2, information on pollution is available in 32 of our 52 sampled sub-counties, while road size is available in all sub-counties.

Table A8: Correlation Between Manager Quality and Managers' and Employees' Perceptions of Pollution as a Problem

	(1)	(2)	(3)	(4)	(5)	(6)
	Concerned Poll Productivity	Concerned Poll Health	Concerned Poll Planet	Concerned Poll Health	Gov Address Poll	Ideal Job Low Poll
Median Road Size/Cell	0.0151 (0.0474)	-0.0286 (0.0487)	0.0691 (0.0349)	-0.00189 (0.0372)	-0.000193 (0.0350)	0.0282 (0.0127)
Man. Score	0.0654 (0.0507)	0.0300 (0.0521)	0.310 (0.0367)	0.210 (0.0464)	0.119 (0.0411)	0.0607 (0.0145)
N	652	646	2045	2044	2045	2045
R2						0.157
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Employee	Employee	Employee	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Employee Controls			Yes	Yes	Yes	Yes
Mean(dependent var)	2.876	3.34	3.964	3.735	4.045	.298
Answer scale	0-5	0-5	1-5	0-5	1-5	Dummy
Model	O.Probit	O.Probit	O.Probit	O.Probit	O.Probit	OLS

Notes: Standard errors are clustered at the grid cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and for a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. All specifications include sector and sub-county fixed effects. Employee controls include education, age, age squared, vocational training (dummy), cognitive ability, employee tenure. We control for missing managerial score (dummy) and missing employee controls (dummies). Road size goes from 1 (Trail/Track) to 5 (Highway). The dependent variables are defined as follows: the manager is asked how concerned she is about the effects of air pollution on the productivity (col 1) and the health (col 2) of her workers; the employee is asked how concerned she is about the effects of air pollution on the health of the planet (col 3); to what extent she is concerned about the effects of air pollution on his own health (col 4); to what extent she agrees that the government should do more to promote and encourage a better air quality even if her taxes had to go up slightly (col 5); and whether her ideal job features low levels of air pollution (col 6). Columns 1-4 report ordered probit coefficients; column 5 reports OLS coefficients.

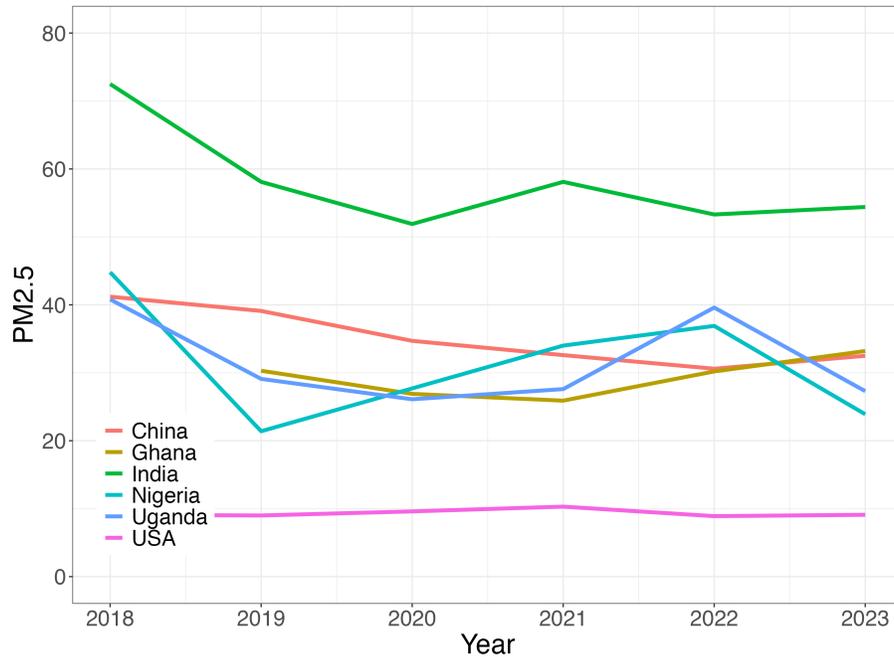
Table A9: Firm Owners Perceive the Positive Correlation Between Pollution, Profitability, and Road Traffic

	(1)	(2)	(3)	(4)
	Perceived Rel Poll	Perceived Rel Poll	Perceived Rel Poll	Perceived Rel Poll
Median Road Size/Cell	0.0589 (0.0346)	0.0378 (0.0501)	0.0523 (0.0322)	0.0315 (0.0301)
Man. Score	-0.00630 (0.0334)	-0.0351 (0.0511)	-0.0283 (0.0299)	-0.0175 (0.0320)
Actual Rel Poll		0.0762 (0.0559)		
Perceived Rel Prof			0.336 (0.0465)	
Perceived Rel Traffic				0.471 (0.0434)
N	677	336	677	660
R2	0.192	0.157	0.285	0.372
Sector FE	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Firm	Firm
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Mean Dep Var	1.689	1.689	1.689	1.689
Scale	[1;3]	[1;3]	[1;3]	[1;3]

Notes: OLS regression coefficients. Standard errors are clustered at the grid cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. We control for missing managerial score (dummy). Road size goes from 1 (Trail/Track) to 5 (Highway). The dependent variable is obtained from the follow up phone survey, where owners are asked whether they think air pollution at the premises of the firm is low (1), average (2) or high (3) compared to other locations in their sub-county. Owners are asked analogous questions for relative profitability (Perceived Rel Prof) and relative traffic (Perceived Rel Traffic). Actual Rel Poll is a grid cell's average relative pollution (tercile) calculated from our pollution data, within the grid cell's sub-county.

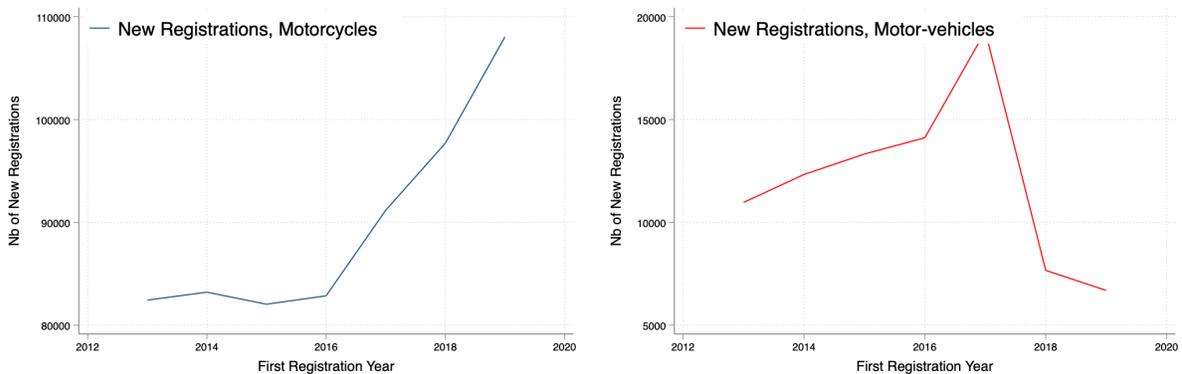
B Additional Appendix Tables and Figures

Figure B1: Average Annual Pollution Over Time in Selected Countries



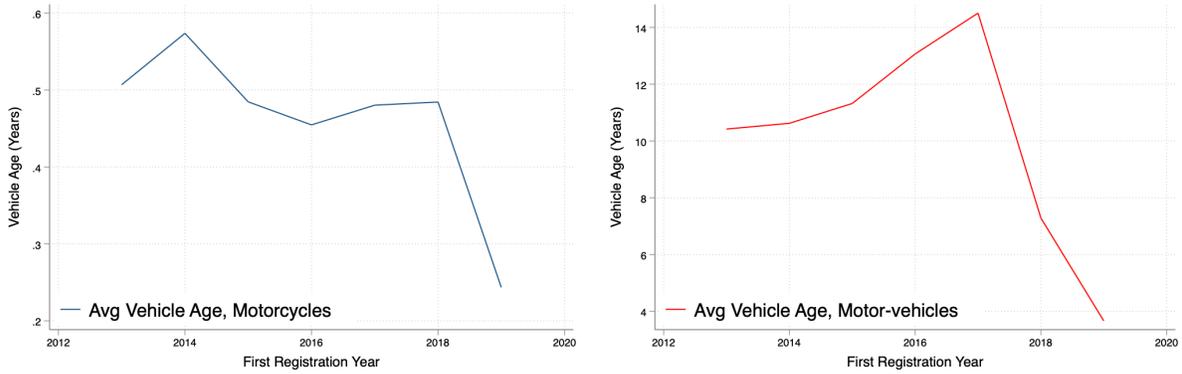
Notes: Average PM2.5 concentration (microgram per cubic meter) in selected countries over time since 2018.
Source: IQAIR (2019).

Figure B2: Vehicle Registrations Over Time in Uganda



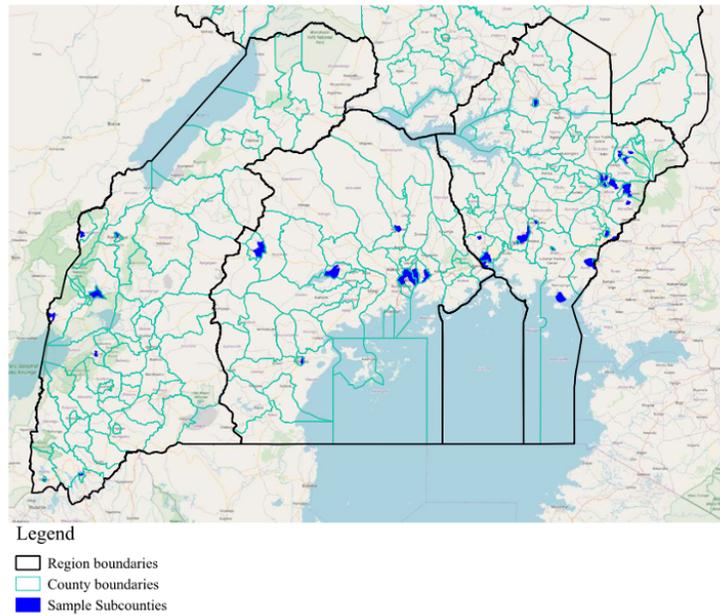
Notes: Annual number of first registrations for motorcycles (left panel) and motor-vehicles (right panel) from 2013 to 2019. The number of new motorcycle registrations has been sharply increasing since 2016. The number of newly registered motor-vehicles peaked in 2017. Source: Uganda Revenue Authority (URA).

Figure B3: Average Vehicle Age at Registration Over Time



Notes: Average vehicle age at first registration in the country for motorcycles (left panel) and motor vehicles (right panel). The 2018 ban on imports of motor vehicles older than 15 years significantly decreased the average age of newly registered vehicles. Source: Uganda Revenue Authority (URA).

Figure B4: Geographical Scope of the Survey



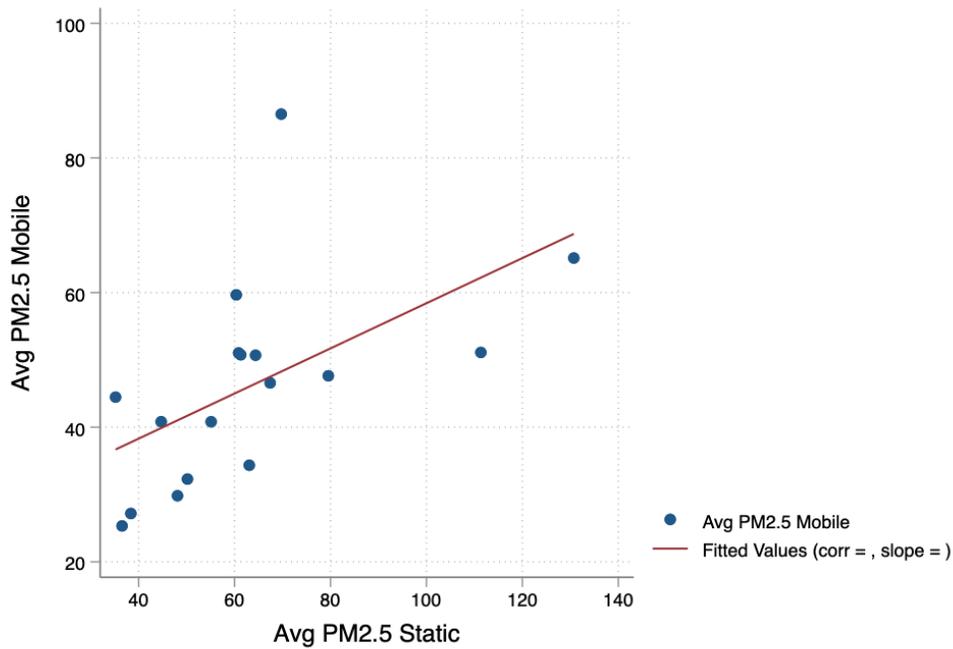
Notes: The figure shows in dark blue the sub-counties in our sample. The figure highlights that our sample region is scattered across three of the four regions of the country (Central, Eastern and Western).

Figure B5: Stationary and Mobile Monitors



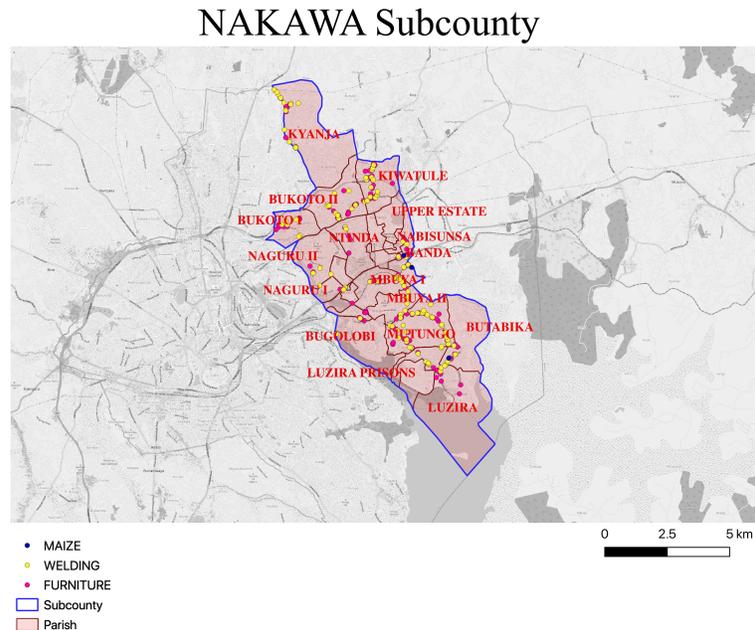
Notes: Photos of AirQo stationary (left panel) and mobile (right panel) pollution monitors.

Figure B6: Correlation Between Average Measurements from Stationary and Mobile Monitors at the Sub-county Level



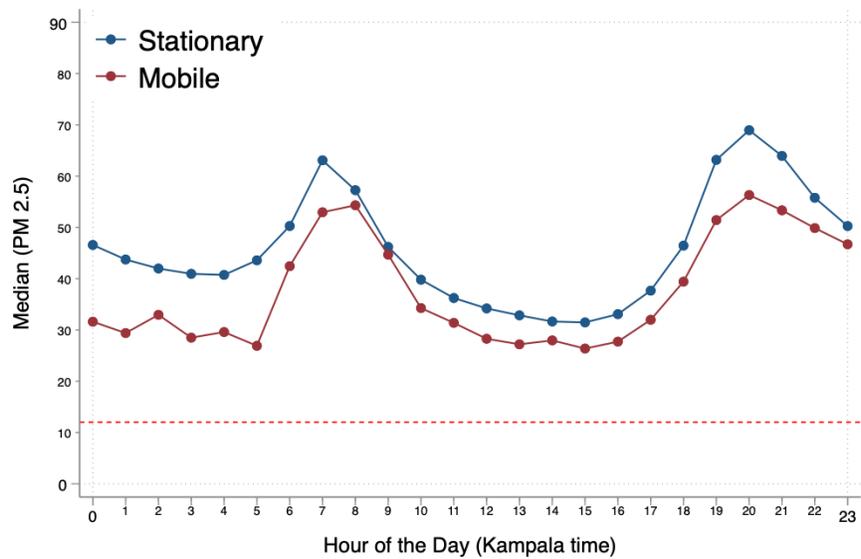
Notes: Data is from the full sample of PM2.5 measurements from the stationary and mobile monitors. We create sub-county level averages of pollution measurements from both types of monitors and plot them against each other. The figure shows that the two are positively correlated.

Figure B7: Example of Listing Exercise in One Sampled Sub-county



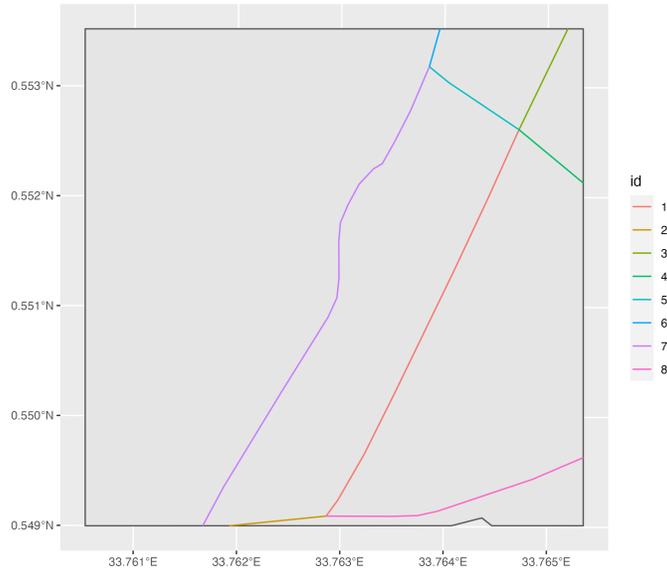
Notes: The figure shows the location of the firms identified in our initial listing in one sampled sub-county.

Figure B8: Hourly Fluctuation in Pollution Within the Day (Medians)



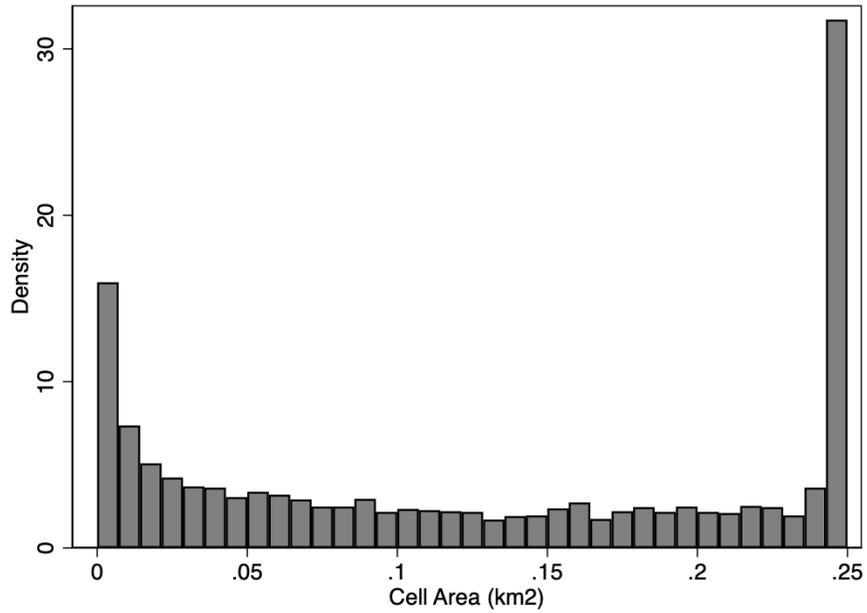
Notes: Medians of PM_{2.5} measurements from our stationary and mobile monitors are plotted for each hour in Kampala time. The dotted orange line corresponds to the 2021 EPA guideline for average annual PM_{2.5} values.

Figure B9: Illustration of Road Definition



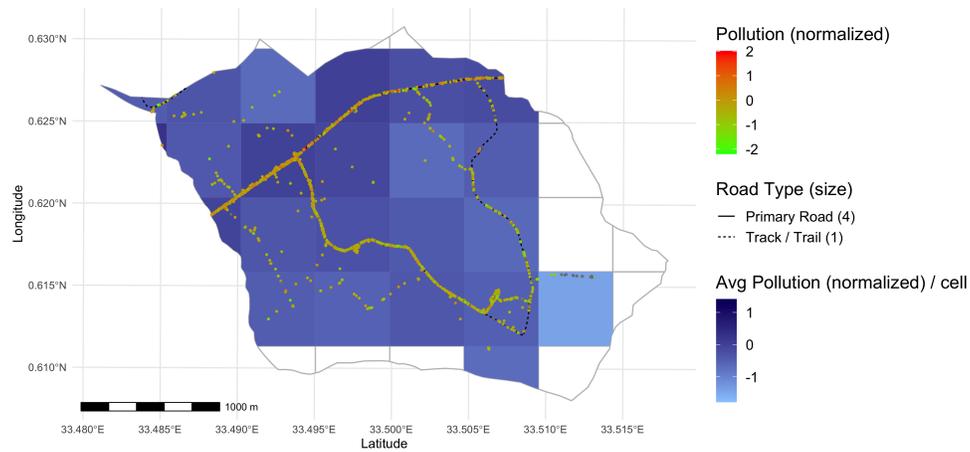
Notes: Each color represents a different road as defined in our dataset by a road segment not intersected by any other road. This grid cell, part of Bugiri Eastern Division, contains eight different roads. The median average grid cell in our sample contains 6 roads (average 11).

Figure B10: Histogram of Grid Cell Areas



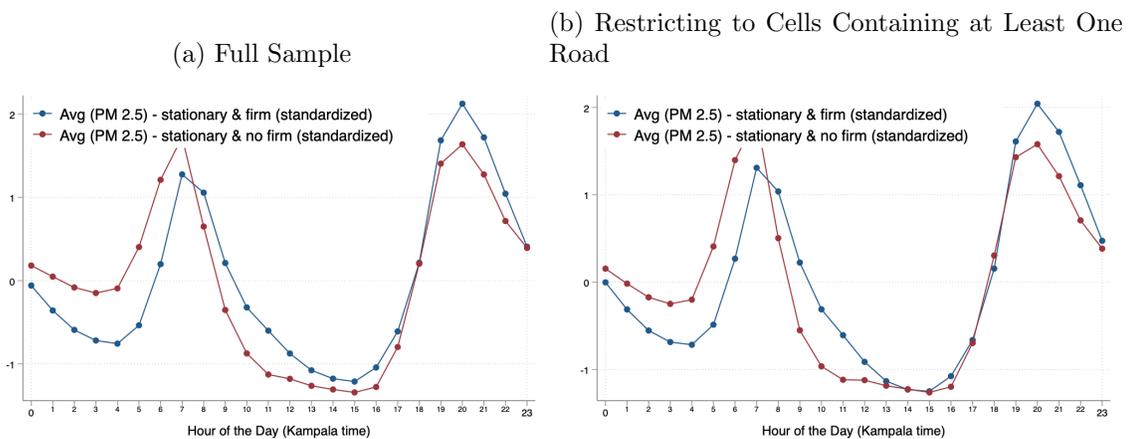
Notes: Distribution of grid cell area in km2 in our data. Our sample contains 3,936 grid cells in total.

Figure B11: Residual Pollution and Road Size in a Sampled Sub-county



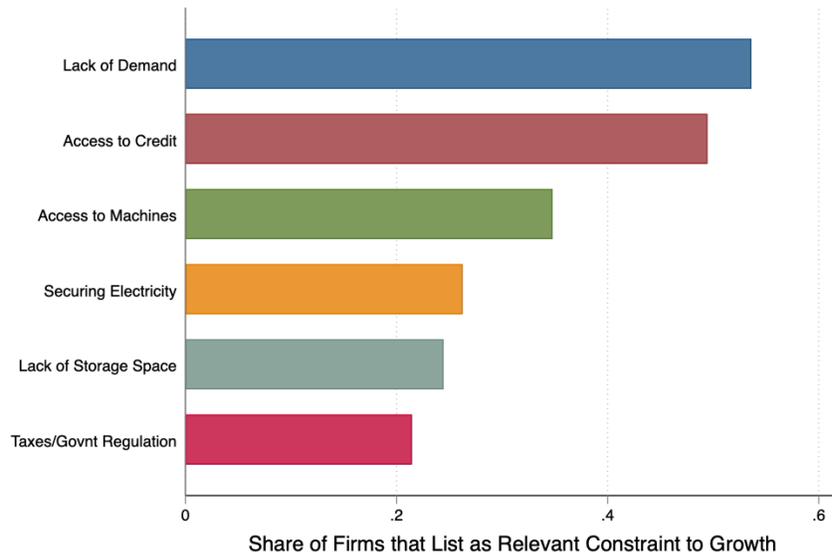
Notes: Location of roads, location of pollution measurements from mobile monitors and average pollution residual per grid cell for the sampled parish in Nakalama sub-county (Iganga District). Road sizes are defined in Section 3.4 and the computation of pollution residuals is described in Section 4.1. Grid cell dimensions are 500m x 500m.

Figure B12: Cyclicity of Pollution Does Not Depend on Firm Density



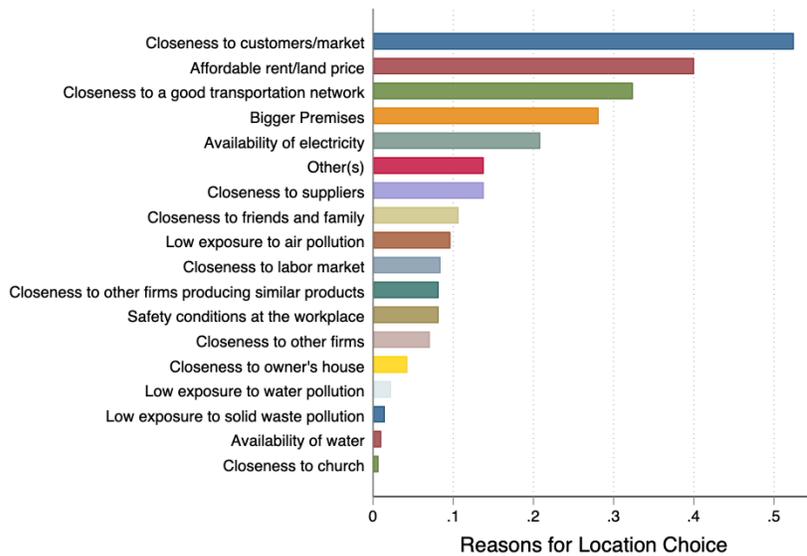
Notes: Avg (PM2.5) is the standardized mean PM2.5 measurement from stationary monitors by grid cell and hour. Grid cells with (without) firm correspond to grid cells containing at least one (no) firm from our initial listing. Normalizing PM2.5 concentrations allows us to focus on pollution cyclicity. In the right panel, the sample is restricted to grid cells containing at least one road.

Figure B13: Lack of Demand is the Main Reported Constraint to Firm Growth



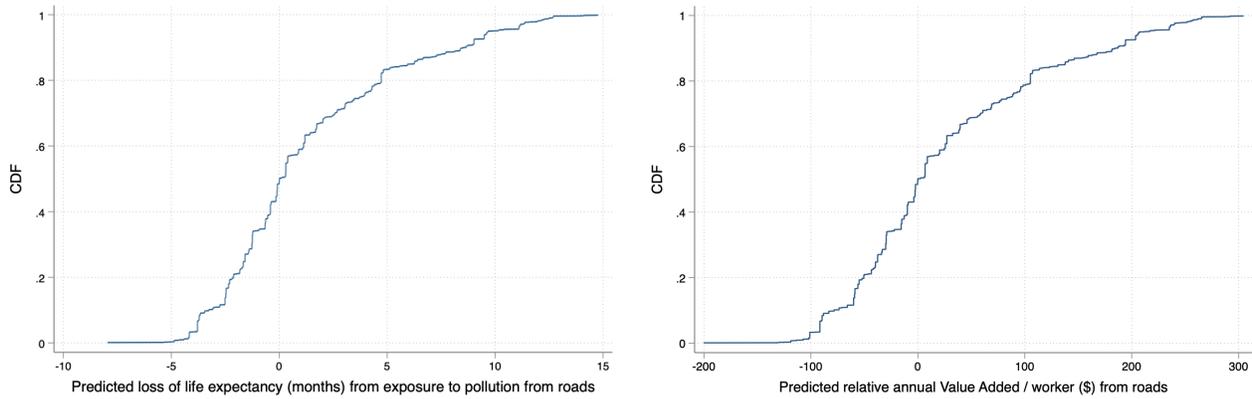
Notes: In the baseline survey, firm owners were asked about the main perceived constraint when thinking about increasing the profitability of their business. Managers could choose among a list of 14 possible constraints, indicating up to three constraints. For each potential constraint, we report the share of firms that listed it among the top three most important ones. We only report in the graph the six most common constraints.

Figure B14: Reasons for Location Choice



Notes: In the baseline survey, firms that had relocated (or considered to relocate) their premises in the previous year (138 firms) were asked which factors affected their decision of where to set up the firm. They were invited to give up to three factors. The histogram plots the share of firms in our sample listing the reason as one of the factors affecting their location choice.

Figure B15: Distribution of Predicted Health Costs and Profits from Road Size



Notes: The level of observation is the grid cell. Road size at the grid cell level is defined as the size of the median road in the grid cell, as in the main analysis. The distribution of predicted loss of life expectancy from traffic on roads (left panel) is obtained by applying the estimated elasticities between pollution and road size, to the grid cells in our sample. The distribution of predicted annual value added per worker from traffic on roads (right panel) is obtained by applying the estimated elasticities between profits and road size, and salary and road size, to the grid cells in our sample. To get to value added per worker in a firm, we average predicted profits and predicted salary, weighting by the average number of employees in a firm (4.9). We multiply by 12 to go from monthly to annual value added. As these elasticities are obtained with sub-county fixed effects, in practice, we first apply the elasticities to grid cells' median road size in deviation from their sub-county's average, and then rescale it using the averages for our entire sample to go from percentage deviations to interpretable magnitudes. Data on roads is available in all sub-counties in our sample. We restrict observations to grid cells containing at least one road.

Table B1: Firm Descriptives

All Sectors	Mean	Sd
Number of firms	1,027	
Carpentry (%)	49.3	
Metal fabrication (%)	37	
Grain milling (%)	13.7	
<i>Panel A: Firm characteristics</i>		
Number of employees	4.9	3.1
Monthly revenues (USD)	1,481	1,645.4
Monthly profits (USD)	243.6	262
Firm age (years)	10.1	9
<i>Panel B: Owner characteristics</i>		
Owner is male (%)	96.1	
Owner age (years)	40.3	12.5
Owner years of education	10	3.6
Owner hours usually worked per day for the firm	9.2	3
<i>Panel C: Employee characteristics</i>		
Employee is male (%)	98	
Employee age (years)	28.5	9.3
Employee years of education	9.3	2.4
Employee hours usually worked per day for the firm	9.9	1.6
Employee monthly wage (USD)	71	48.8

Notes: Descriptive statistics across firms in our firm survey. Firm, owner and employee characteristics are reported in Panels A, B and C, respectively. Statistics for the average firm are shown. Monetary amounts, originally in UGX, are converted to USD using the exchange rate 1 USD = 3,800 UGX. The data was obtained during our baseline survey.

Table B2: Attrition Table - Follow-up Phone Survey

	(1)	(2)	(3)
	Surveyed	Surveyed	Surveyed
Man. Score	-0.0392 (0.0251)	-0.0299 (0.0212)	-0.00950 (0.0173)
Median Road Size/Cell	0.00462 (0.0244)	0.0281 (0.0207)	0.00675 (0.0172)
Treatment Pollution	-0.00249 (0.0448)		
Treatment Profitability		-0.0355 (0.0395)	
N	499	615	1027
R2	0.0899	0.102	0.102
Sector FE	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes
Standard Errors	Robust	Robust	Robust
Model	OLS	OLS	OLS
Sample	Pollution Treatment	Profitability Treatment	All
Mean Dep Var	.679	.699	.677

Notes: Robust standard errors are in parenthesis. For the follow-up survey, we attempted to reach the 1,014 firms with valid phone number at baseline, out of our initial 1,027 firms. The dependent variable is a dummy equal to one if the firm was successfully surveyed at follow-up, and zero otherwise. 499 out of these 1,014 firms were randomized into treatment or control groups for the pollution experiment. We excluded firms in sub-counties with strictly less than three grid cells with pollution measures. 615 out of these 1,014 firms were randomized into treatment or control groups for the profitability experiment. We excluded firms in the maize sector because the limited number of such firms prevented us from computing a robust measure of each firm's profitability. We also excluded firms with missing information on revenues at baseline or outliers (top and bottom 1%), and firms in sub-counties with less than three grid cells with sector-specific profitability. See Section 7 for more details on the sample and randomization for the experiment. We control for missing managerial score (dummy) and for whether the grid cell contains any road (dummy). All specifications include sector and sub-county fixed effects.

Table B3: Kilometers by Road Size

Road Type	Corresponding Size	Length (km)	Share	Length (km) U	Share U
Motorway	5	8	0.003	55	0
Primary Road	4	670	0.243	1,280	0.011
Secondary Road	3	503	0.183	3,056	0.025
Tertiary Road	2	534	0.194	11,824	0.098
Track / Trail	1	1,039	0.377	104,996	0.866
Total		2,754	1	121,211	1

Notes: This table presents summary statistics about the number of kilometers per road type and the corresponding share of total kilometers, both for the country as a whole and for our sampled area (grid). Our sample contains 2,754km of roads, or about 2 percent of Ugandan roads, and roads are larger in our sample than in the rest of the country: 24 percent of the roads in our sample are primary roads and only 38 percent are classified as track/trail, while the corresponding figures for the country as a whole are 1 and 87 percent, respectively. Reflecting our sampling strategy, this shows that our sample is more urban, and therefore denser, than the average Ugandan geographic area. Kilometers of road per road size, both for our sampled area (grid) and the whole country. Source: WFP on OSM.

Table B4: Returns from Locating on Polluted Roads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Profit)	log(Profit)	Nb Customers	Log(Price)	Log(Input Price)	Input Accessibility	log(Salary)	log(Rent)
Avg log(Poll) Resid./Cell	0.234 (0.132)	0.250 (0.129)	0.0635 (0.352)	-0.0518 (0.0748)	0.0951 (0.0886)	-0.0238 (0.0148)	-0.0402 (0.0649)	0.00743 (0.124)
Man. Score		0.196 (0.0378)	0.428 (0.119)	0.0618 (0.0215)	0.106 (0.0396)	0.0107 (0.00710)	0.0563 (0.0230)	0.0854 (0.0422)
log(Size Premises)								0.0369 (0.0238)
N	591	591	475	450	3621	4126	1359	411
R2	0.417	0.441	0.291	0.948	0.391	0.142	0.370	0.405
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Firm	Firm	Firm x Input	Firm x Input	Employee	Firm
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Employee Controls							Yes	
Input FE					Yes	Yes		

Notes: OLS regression coefficients. Standard errors are clustered at the grid-cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. All specifications include sector and sub-county fixed effects. Employee controls include education, age, age squared, any vocational training (dummy), cognitive ability (measured through a Raven matrices test), employee tenure. We control for missing managerial score (dummy) and missing employee controls (dummies). The top and bottom one percent of all monetary dependent variables are trimmed. For regressions at the Firm x Input level, we include input fixed effects, as well as controls for the quantity of input purchased and the input unit. Input Accessibility is a standardized index of seven variables reflecting input accessibility. Analogous regressions for each individual variable can be found in Appendix Table B5. The procedure to construct pollution residuals is detailed in Section 4.1. The number of observations is lower in Table B4 than Table 3 because, as described in Section 3.2, information on pollution is available in 32 of our 52 sampled sub-counties, while road size is available in all sub-counties.

Table B5: Input Accessibility near Large Roads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Input Quality	Direct Suppliers	Replace. Supplier	Nb Suppliers	Size Supplier	Rel. Size Supplier	Modern Supplier
Median Road Size/Cell	0.00416 (0.00375)	-0.00308 (0.00648)	-0.0216 (0.0173)	0.00435 (0.00787)	0.00390 (0.0106)	0.00387 (0.00870)	0.00357 (0.00811)
Man. Score	0.00660 (0.00390)	-0.00574 (0.00789)	-0.0301 (0.0176)	0.0501 (0.00959)	0.0598 (0.0122)	0.0335 (0.0105)	0.0205 (0.00977)
N	5763	5800	5776	5711	5071	5767	5741
R2	0.110	0.106	0.162	0.188	0.256	0.218	0.243
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Firm	Firm	Firm	Firm	Firm
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Input FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: OLS regression coefficients. Standard errors are clustered at the grid-cell level and displayed in parentheses. Man. Score is a standardized index of managerial ability constructed using our survey (see Appendix A.1 for details). We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road. We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. All specifications include sector, sub-county and input fixed effects. We control for missing managerial score (dummy). Road size goes from 1 (Trail/Track) to 5 (Highway). The variable *Input Accessibility* in Table 3 Column 6 is a weighted average of the dependent variables in this table. *Input Quality* is a dummy variable equal to 1 if the firm reported using the highest quality input available in the past 3 months for this input. *Direct Suppliers* is a dummy variable equal to 1 if the firm reported finding new domestic suppliers of this input in a way that may be facilitated by its location near large roads (by going to fairs/exhibitions, by waiting for the supplier to come to the firm, or by visiting a neighborhood where suppliers are). *Replace. Supplier* is a dummy variable equal to 1 if the firm reported taking less than median time (1-2 days) to find a new supplier for this input. *Nb Suppliers* is a standardized continuous variable from 0 to 1 corresponding to the firm's number of suppliers for this input during the last year. *Size Supplier* is a standardized continuous variable from 0 to 1 corresponding to the size (number of employees) of the firm's typical supplier for this input. *Rel. Size Supplier* is a standardized continuous variable from 0 to 1 corresponding to the relative size of the representative firm's suppliers of this input, compared to other suppliers of this input.

Table B6: Location Choice - Proximity to Home

	(1)	(2)	(3)	(4)
	Log dist work	<2km from work	<1km from work	Motorized to work
Median Road Size/Cell	0.0361 (0.0247)	-0.0222 (0.0175)	-0.0296 (0.0150)	0.0476 (0.0157)
N	988	988	988	988
R2	0.183	0.160	0.176	0.231
Sector FE	Yes	Yes	Yes	Yes
Sub-county FE	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Firm	Firm
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell

Notes: OLS regression coefficients. Standard errors are clustered at the grid cell level and displayed in parentheses. Road size goes from 1 (Trail/Track) to 5 (Highway) and is averaged within a grid cell. We control for log distance to the main city in the region and a dummy for whether the grid cell contains any road (dummy). We also control for a dummy for whether the grid cell is incomplete (i.e., 500m x 500m), its area, as well as a dummy for whether it is in our main surveyed area. All specifications include sector and sub-county fixed effects. In our baseline survey, we asked firm owners how far they live from work (in km) and how they go to work. Log distance to work is the log of reported distance to work +1. Median (q1) distance to work is 2km (1km).

Table B7: Robustness to Road Definition

	(1)	(2)	(3)	(4)
	Log(Profit)	Perceived Rel Poll	Poll Equipment	Own Protect
Closest Road Size	0.146 (0.0305)	0.0865 (0.0435)	0.0117 (0.00578)	0.00117 (0.0160)
Man. Score	0.232 (0.0308)	-0.0349 (0.0510)	0.0186 (0.00673)	0.0453 (0.0181)
Actual Rel Poll		0.0453 (0.0531)		
N	967	336	1000	2045
R2	0.539	0.164	0.108	0.206
Sub-county FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Level of Observation	Firm	Firm	Firm	Employee
SE clustering	Grid Cell	Grid Cell	Grid Cell	Grid Cell
Employee Controls				Yes
Mean(dependent var)	13.145	1.689	.047	.523
Answer scale		[1;3]	Dummy	Dummy

Notes: Standard errors are clustered at the grid cell level and displayed in parentheses. We control for log distance to the main city in the region. The dependent variables are defined as in table 3 - col 1, table A9 - col 2, table A4 - col 1 and table A4 - col 2, respectively. *Closest Road Size* is the size of the road that is the closest to the firm. Road size goes from 1 (Trail/Track) to 5 (Highway). We control for missing managerial score (dummy). Profits are trimmed at the top and bottom 1%. All specifications include sector and sub-county fixed effects and the regressions are weighted by firm weight.

Table B8: Balance Table - Pollution and Profitability Information Experiments

	Control			Treatment			p-value
	n	mean	sd	n	mean	sd	
<i>Panel A: Pollution</i>							
Man. Score	245	-0.00	0.97	225	-0.05	0.93	0.40
Profit (Thousand UGX)	254	961.5	946,3	236	982,5	1,049.2	0.20
Revenues (Thousand UGX)	252	5,961.9	6,387.2	237	5,796.0	6,135.6	0.79
Nb Employees	258	5.83	3.18	241	5.84	3.54	1.00
Firm Age (years)	255	10.40	9.61	240	10.19	8.87	0.52
Owner Age (years)	249	39.05	10.59	231	38.93	10.84	0.60
Owner Education	250	10.15	3.48	231	9.93	3.44	0.55
Poll. Protective Equipment	257	0.04	0.20	240	0.04	0.20	0.80
Joint							0.66
<i>Panel B: Profitability</i>							
Man. Score	286	-0.17	0.98	298	-0.01	0.95	0.16
Profit (Thousand UGX)	302	1,000.1	968.5	307	1,024.8	1,085.4	0.37
Revenues (Thousand UGX)	304	5,687.7	5,706.4	311	5,613.1	5,785.4	0.87
Nb Employees	304	5.45	3.07	311	5.66	2.80	0.44
Firm Age (years)	304	9.13	8.43	307	10.41	9.65	0.27
Owner Age (years)	292	38.29	9.83	302	37.60	10.91	0.24
Owner Education	291	9.75	3.61	303	9.91	3.48	0.74
Poll. Protective Equipment	303	0.05	0.21	311	0.03	0.16	0.44
Joint							0.25

Notes: The samples in panels A and B correspond to the two samples of firms used for the pollution and profitability information experiments, respectively. 499 and 615 firms out of the 1,027 were included in the pollution and profitability experiments, respectively. The treatment assignment was stratified by sector and sub-county. The displayed p-values are for the predictive power of the variable on the treatment status, controlling for stratification variables and with robust standard errors. Profits and revenues are trimmed at the top and bottom 1%. The joint p-values are from a joint F-test of significance of all the variables considered for the balance checks in predicting treatment assignment, again controlling for stratification variables and with robust standard errors.