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LOPAMUDRA CHAKRABORTI, MICHAEL MARGOLIS AND JOSE JAIME SAINZ SANTAMARIA

Do industries pollute more in poorer neighborhoods? Evidence from toxic releasing plants in Mexico

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Carretera México Toluca 3655, Col. Lomas de Santa Fe, 01210, Álvaro Obregón, México DF, México.
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Dirección de Publicaciones
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Tel. 5081 4003

Abstract

This paper provides the first, direct evidence that poorer communities in Mexico are associated with higher toxics pollution releases. We utilize previously unused, self-reported, plant-level annual database (from 2004 to 2012) and socioeconomic characteristics of the nearby population from the 2000 Census. Our measure of "Prosperity" is linked to both a lower probability of toxic discharges into water as well as lower levels of average releases. In addition, we find that at the bottom quintile of the "Prosperity" distribution, the predicted probability that a plant discharges in the fourth quartile of the pollution distribution is somewhat higher (28%) than for the first quartile of pollution (21%). This negative association is consistent with two related findings that also indicate environmental justice concerns. A one prosperity point increase results in plants cleaning up i.e. reducing their toxic releases by as much as 10%. This order of magnitude is valid irrespective of the initial pollution levels reported by the plants. Second, it is also linked with a 0.1% reduction in the probability of inaccurate reporting. Lastly, some evidence is found on changes in socioeconomic status indicator linked to decline in pollution.

Keywords: industrial pollution; local income and unemployment effects; informal regulation; environmental justice; community pressure; toxic releases in Mexico

Resumen

Este trabajo proporciona la primera evidencia directa de que las comunidades más pobres de México están asociados con emisiones de contaminantes tóxicos más altas. Utilizamos la base de datos, no utilizados previamente, auto-reportes anuales de contaminacion de toxicos , a nivel de planta (de 2004 a 2012) y socioeconómicos características, de la población en las inmediaciones del Censo del 2000. Nuestra medida de " prosperidad" está vinculada tanto a una menor probabilidad de vertidos tóxicos en el agua, así como los niveles más bajos de emisiones promedio. Además, nos encontramos con que en el quintil más bajo de la distribución de la "prosperidad ", la probabilidad predicha de que una planta se descarga en el cuarto cuartil de la distribución de la contaminación es algo mayor (28%) que para el primer cuartil de la contaminación (21%). Esta asociación negativa es consistente con dos hallazgos relacionados que también se indican las preocupaciones de justicia ambiental. Aumento de un punto prosperidad resultados en la limpieza de las plantas es decir, la reducción de sus emisiones tóxicas en hasta un 10%. Este orden de magnitud es válida independientemente de los niveles de contaminación iniciales reportados por las plantas. En segundo lugar, también está relacionada con una reducción del 0.1 % en la probabilidad de reportes inexactos. Por último, hay evidencias que se encuentra en los cambios de indicador de estatus socioeconómico relacionadas con la disminución de la contaminación.

Palabras Clave: La contaminacion industrial, efectos de renta y de desempleo local, la regulacion informal, la justicia ambiental, la presion de la comunidad, las emisiones toxicos en Mexico

Introduction

It is widely believed that pollution is worse in poor communities. This is the pattern expected to emerge if those communities are politically weak (the "environmental justice" perspective) or if polluted environments are eschewed by prosperous families so that the local communities end up poorer (the "compensating differentials" or "sorting" perspective). Although the relative strength of these two causal forces is far from clear, the predicted correlation has been found in many studies of the United States -- e.g. Brooks and Sethi (1997) on air emissions, Arora and Cason (1998) on aggregate emissions, Helland and Whitford (2003) on emissions into air, water and land treated separately -- although not in all (Gray et al. 2012).

In developing countries, where formal regulatory mechanisms are often weak; enforcement staff deficient and corruption common (Gangadharan 2006), informal community pressure can be the principal pollution control mechanism. It seem especially likely in such cases that richer, more educated communities will persuade neighboring industrial plants to undertake more pollution abatement. Empirical evidence on the relation between pollution and poverty, from developing countries, and Latin America in particular, is both sparse and ambiguous. Dasgupta, Lucas and Wheeler (2002) find that particulate matter emissions are actually higher in higher wage (urban) municipalities in Brazil. In a confidential survey of 236 major polluters in Mexico (from 1995), Dasgupta, Hettige and Wheeler (2000) found that only about a fourth consider pressure from the neighboring community a significant factor in deciding whether to comply with environmental regulations. Also in Mexico, Blackman, Batz, and Evans (2004) report that in Ciudad Juarez the export-assembly plants known as maquiladoras contribute substantially to air pollution, but it does not seem the poor are disproportionately affected.

This paper presents direct, statistical evidence on the relation between socioeconomic status and pollution burden, in Mexico. Since 2004, most Mexican industrial plants that make use of toxic chemicals (above certain thresholds) have been required to report to the federal government the quantity of each chemical disposed of into the environment. We assign each reporting plant a "prosperity" score based on data from the 2000 Census of Population and Housing, and compare this to discharges into water of seven important toxic metals.

Subject to some caveats regarding data quality, we find that toxic releases into water have indeed been higher in less prosperous communities. For example, a one-point Prosperity increase is associated with a pollution decrease of about 10% (Cadmium) to 25% (Chromium) in semi-log OLS regressions, using the plants with non-zero emissions. The interquartile range of Prosperity is 2.8 points, so according to this model a plant at the 25th percentile of Prosperity among chromium-handling plants emits about twice as much Chromium as one at the 75th percentile. The same one-point of Prosperity is also associated with reductions of about 2% in the probability of any emissions at all in separate Probit regressions for each pollutant, or about a 5% interquartile difference.

We also find evidence that communities that were rising in relative prosperity during the first decade of the century were also moving up the scale of relative environmental quality, but it is hard to characterize this association substantively. The major difficulty is that we have only two comparable census reports, and they are timed rather awkwardly in relation to the pollution reports. We assigned the earlier census data to the first half of the pollution reports, the later census data to the second half, and examined whether the pollution-prosperity relationship was statistically significant in two-way fixed-effects regressions. It is, in all but a couple cases, and in every case it is negative.

What follows is chiefly a more detailed description of the cross sectional associations mentioned above. We also present preliminary glances at two subjects of ongoing research that indicate existence of environmental justice concerns.

The first is a step towards estimating causal effects. There is a negative association between the level of prosperity in 2000 and the change in pollution from the first reports in 2004 to the later ones. If we take it that communities were not aware of the pollution until after 2004, this may be viewed as a measure of the strength of community pressure to clean up. So interpreted, it is strong: a one Prosperity point causes a plant to reduce discharges into water about 10% in the years after its first report.

The second is an inquiry into the inaccuracies in pollution data. It is likely many firms are not taking actual measurements of their toxic discharges each year, as enforcement is quite slack. One symptom of this is plants reporting exactly the same amount discharged year after year, or across several types of pollutant. This symptom is found to a greater degree in the less prosperous communities. If indeed these communities are getting less accurate information, our main results probably understate the degree to which poor areas are more polluted .

Background and Data

Following a 2001 amendment to Mexico´s General Law of Ecological Equilibrium and Environmental Protection (Ley General de Equilibrio Ecológico y Protección al Ambiente) a rule adopted in June of 2004 requires that firms in eleven industrial sectors report on their handling of 104 toxic substances. These federally regulated sectors are: petroleum, chemicals, paints and ink manufacturing, primary and fabricated metals, automotive, pulp and paper, cement/limestone, asbestos, glass, electric utilities, and hazardous waste management. In addition, the rule applies to any facility that handles hazardous waste or discharge pollutants into national water bodies.

The information is reported to the Mexican Secretariat for the Environment and Natural Resources (Secretaria de Medio Ambiente y Recursos Naturales, SEMARNAT), where it is compiled into the Pollutant Release and Transfer Register (Registro de Emisiones y Transferencias de Contaminantes, RETC). The publicly available RETC data contains, for each substance, annual total on-site releases to air, water and land, recycling, treatment and transfers off-site for disposal. The information is updated yearly and has been freely available to the public on the internet since 2006. With a couple of years´ lag, the data is also archived by the Commission for Environmental Cooperation of North America (CEC), an intergovernmental agency established in a side accord with the North American Free Trade Agreement in 1994.

The RETC database started with 1,714 establishments in 2004; by 2013 there were 3,529 (SEMARNAT 2013). This appears to be at least partly due to spotty coverage in the early years. The CEC (2014) also judges it likely that many plants were missed at first, speculating these might not yet have installed pollution measurement equipment and in other ways required time to build capacity. As discussed in the literature (Decker et al 2005), toxic releases data exhibit a lot of variability (over time) and for Mexico there is additional variability in terms of the sample of polluters reporting annually to SEMARNAT.

Facilities use a variety of methods to measure or estimate their emissions, including emission factors, mass balance, engineering calculation, stack testing and direct measurement. When reporting under their annual operation certificates (Cedula de Operacion, COA), facilities include information about the type of method used. To date, we were unable to ascertain this information related to the database. Also, simple reporting error appear to be common--according to a SEMARNAT official, these include many “errors in the conversion of units and errors in the selection of the appropriate substance for report (substances with similar names are often interchanged)” (Eicker et al 2010, p11-12).

We focus on seven pollutants that are fairly common and pose the greatest threat to health from exposure (CEC, 2009). The metals are Arsenic, Cadmium, Chromium, Lead, Mercury, and Nickel, and their compounds; and Cyanide (organic and inorganic). According to the CEC’s online database, these 7 toxics were among the top 25 pollutants for on-site water releases, in Mexico. Hence, we expect the affected community to be concerned about the releases of these pollutants in their neighborhood.

The RETC facilities face two types of thresholds that trigger mandatory reporting--one for the total amount manufactured, processed or otherwise used, the other for total emissions. The thresholds for all six heavy metals are 5 kgs used or 1 kgs per year emitted; for cyanide they are 2500 kgs used or 100 kg per year emitted. Most of the annual pollution reports are below the emissions thresholds, for all seven pollutants we consider. According to the CEC, most of these facilities report their releases because the production threshold is binding. However, there is no publicly available information on the quantities used.

The analysis here deals only with discharges into water as the affected population in the nearby communities can be identified. The characteristics of the immediate neighborhood might matter more for on-site water and land releases in contrast to air emissions that are more dissipated. The water data also appears to be closer to complete than the others. Air emissions data are from 2007 to 2009 and most of the land releases are after 2010. There is an oddity we do not understand, in that around 2010 about a tenth of plants switched the bulk of their discharges from water to land and water releases decline substantially across plants. SEMARNAT does not have an explanation for this sudden shift in terms of changed regulation or reporting requirements (personal interviews).

Examination of individual plants turns up many other likely symptoms of error. There are some very improbable fluctuations, such as cadmium discharges at one plant of 0.37 tons in 2007, 441 tons in 2008 and 0.05 tons in 2009. There are many more cases of improbable consistency: about a quarter of the pollution reports have duplicates at the same plant out to five or six significant digits, either for other metals or other years. For example, one plant reports "161.8841" kgs of Lead for the years 2010 and 2011 and then "161.884098" kgs of Lead for the years 2012 and 2013. Another example is a plant reporting "0.0005" kg for arsenic, cadmium, chromium, nickel and lead for the year 2006. The latter example could correspond to the detection threshold on some monitoring device.

The measurement of social status in each plant's location is a fairly complex matter, thus also contributing to attenuation bias, but probably less so. The RETC database includes an identifier (NRA code) and geographic location for each business establishment. However, the same physical plant or business can have multiple NRA codes if it has multiple activities e.g. generation of electricity and treatment of toxic residuals; and each time the business changes name, ownership change, sector designation, headquarters address, etc. it gets a new NRA code. Hence, we had to manually consolidate the number of 'unique' RETC facilities (i.e. same physical plant/business) with the multiple NRA codes across the different years in the database.

The Census of Population and Housing did not directly ask questions on the income or poverty status of households. We consider census data at the AGEB level. AGEBs are fairly small urban areas designed to be relatively homogeneous with regard to socioeconomic characteristics. This homogeneity, and the observation that pollution exposure is a very local phenomenon, suggests the demographics of nearby AGEBs characterize a plant's surroundings much better than the use of municipality-level data. We therefore considered the nine variables listed in Table 2 (guided by Hamilton's (1995) analysis of economic vulnerability and willingness to engage in collective action) and summarized them in "Prosperity", their first principal component. The Prosperity score assigned to each plant is the simple average of those for AGEBs with centroids not more than a one kilometer away.

Prosperity captures about 45 percent of the total variance of the nine underlying variables. We have chosen its sign so that an increase indicates improved status. This can be seen in the strong positive correlations with computer and telephone ownership and higher education, for example. The positive correlation with unemployment is surprising, but small. The positive correlation with female headed households reflects an oddity that Mexico shares with Guatemala (at least, as of 1998): households in poverty were actually less likely to be headed by women (16% versus 20%) (CEPAL 2002, Table 6e).

Prosperity also has a strong negative correlation across municipalities -- about -3/4 -- with the marginalization index (IMU, Indice de Marginacion Urbana) published by Mexico´s National Population Council (CONAPO -- Consejo Nacional de Población). This index is based on 11 socioeconomic indicators. The strong negative correlation confirms that our Prosperity measure is indeed indicating higher socioeconomic status.

Results

Our main models make use of pollution levels averaged across the nine years which we hope will reduce the impact of some of the data problems mentioned above. We do, however, disaggregate along two other dimensions. In almost all models, each substance is treated separately, since it is likely their health impacts differ (although the SEMARNAT threshold choice, indicate aggregation of the metals is not wholly meaningless). Also, in some of the models, we break the pollution levels into several bins and examine marginal effects of Prosperity within each category. This is because the pollution data spans a very great range, from micrograms to kilograms. At the lower end, a pollution increase of, say, 300% is a change from one innocuous level to another; at the upper end it is immense. Thus we do not wish to treat the same log-difference as the same amount in these two cases.

To interpret all these numbers, note that one Prosperity point corresponds to an increase from the fortieth to the fifty-eighth percentile of the Prosperity distribution, which is close to the Normal distribution (Table 3). Very roughly, the same might be said of about a one-and-a-quarter log-point increment in the log-normal distribution of household income estimated for Mexico by Chávez-Martín del Campo and Gomez (2009), so increasing Prosperity by one point is like increasing household income some 350% (exp(1.25)□3.5). However, the summary statement "about a quantile near the middle" is probably the best intuition for defining a Prosperity point. The interquartile range is nearly three points (from -1.5 to 1.3).

The association of Prosperity with the probability that a plant reports any releases of each metal is characterized by probit regressions reported in Table 4. A one-point Prosperity increase is associated with a 2.6% reduction in the probability of emitting any Lead (Table 2, column (5)), a 2.5% reduction for Mercury (Table 2, column (6)), a 2.1% reduction for Chromium (column (3)), a 1.7% reduction for Cadmium (column (2)) and about 1.5% reduction for Arsenic, Cyanide and Nickel (columns (1), (4) and (7)). About a fourth of the annual reports had zero toxics released into water, but most of these plants reported a positive amount under other types of releases and/or transfers.

For the plants that did have positive releases into water, we regressed the natural logarithm of average releases during 2004-2012 on Prosperity using Ordinary Least Squares. The results (Table 5) indicate a Prosperity point is associated with decreased pollution of 29% of Chromium (column (3)), 27% of Cyanide (column (4)), around 20% of Arsenic and Nickel (columns (1) and (7)), 16% of Lead (column (5)), almost 15% and Mercury (column (6)), and 11% of Cadmium (column (2)). Thus, between the 25th and 75th percentiles of Prosperity, emissions of these pollutants fall by almost one half (for Chromium and Cyanide), most of them fall by more than one third, and even for Cadmium by more than one fourth.

For a less restrictive description -- i.e., dropping the assumption of constant marginal effects -- we transformed the pollution data into ordered categories (quartiles). We then estimated an ordered logit model in which assignment into pollution quartile is a linear function of Prosperity. Ordered logit coefficients are essentially uninterpretable, so we present in Table 6 the predicted probabilities of being in the each quartile at three Prosperity levels (the 25th, 50th and 75th percentiles).

Thus, for Chromium (column (3)) and Cyanide (column (4)), a community at the 25th percentile of Prosperity, has about a 28% of being in the most polluted category (4th quartile) and a 21% chance of being in the least polluted. For a substantially richer community, at the 75th Prosperity percentile, these probabilities are essentially reversed, with the cleaner category being more probable. Very similar patterns are observed for Arsenic (column (1)), Lead (column (5)) and Nickel (column (7)). Figure 1 visually summarizes that an upper-middle class region (75th percentile) has about a 7% lower chance of being highly polluted (top quartile) than does a lower-class region (25th percentile). Thus we find modest differences in the probability of suffering rather immodest differences in pollution burden.

It further appears that this difference is increasing, although the data problems become increasingly troublesome as we begin to address change. In Table 7, we present results of OLS regression of the extent to which emissions have increased (mostly negative numbers) on Prosperity. The sample is divided into three categories depending on their initial pollution levels, again because reductions from very low levels seem like they ought not to matter. Nonetheless, at all levels Prosperity is significantly correlated with cleaning up: a one-point increase in prosperity leads plants to reduce their toxic releases into water by around as 10%.

Table 8 contains preliminary evidence that poor communities were less likely to get accurate information, which presumably would mean their water was even more polluted than we estimate. The reported coefficients are from a Probit regression of the probability plants report the exact same pollution levels year after year or the exact same amount across all or several pollutants for a given year. About a quarter of the annual pollution data, across all pollutants, suffer from this potential inaccurate reporting problem. The results indicate a one-point Prosperity increase is associated with a small but statistically significant reduction (about 0.1%) in apparently inaccurate reporting (columns (2) and (4) of Table 8).

Finally, it appears that at any given level of initial Prosperity, those places growing richer were also growing cleaner. This is indicated by the evidence in Tables 9 and 10, from fixed effects regressions of emissions on Prosperity with the latter calculated by assigning community data from Census 2000 to pollution data from 2004 to 2008, and data from Census 2005 to pollution data for the years 2009 to 2012.
We drop the apparently duplicate/not-updated annual records (since the within-plant variation on which fixed effects estimates rely is likely spurious in those cases). In Table 10, we use only the sample of plants which have at least 4 out of the 9 annual reports. The estimated associations are large. For example, in the coefficient column (3) of Table 9 indicates a one-point Prosperity increase was associated with plants reducing Chromium releases into water by nearly 50% more. Most of these coefficients are also statistically significant, despite the degrees of freedom lost to fixed effects, and even with four fifths of the sample removed in Table 10.

Conclusions

Less prosperous communities in Mexico are more likely to be near polluting plant and the amount of pollution released into water by each plant is greater. The latter association is quite large. Thus, the results reported here establish a strong *prima facie* case that toxic metals in the water are among the disadvantages to being poor in Mexico. We also do not know how these differences in emissions translate into differences in human exposure. But there is substantial evidence that the range of exposure faced by Mexicans includes levels with serious health consequences (e.g., Armienta and Segovia 2008). Hence, we infer that the negative association between socioeconomic status and pollution is likely to be translated into increased exposure and health consequences for the poorer populations in Mexico.

It will require further work to determine to what extent this reflects the choice to pollute where people are poor as opposed to movement of the prosperous away from pollution. We are exploring two ways to address this issue of reverse causality and identify the causal impact of prosperity on pollution decisions. The first approach is to look at the more fundamental question of whether dirtier industries decide to locate (i.e. set up operation) in poorer or minority neighborhoods, as seen in Shadbegian and Wolverton (2010) and Wolverton (2009). In this current analysis, our focus is on investigating pollution behavior as opposed to location behavior given that we could not obtain information on when these factories began operation. However, if we can use some manufacturing database to identify when these firms were born i.e. they began polluting; we can identify the appropriate socioeconomic characteristics before the firms began operation.

Alternately, if information on even a sub-sample of the age or birth of these firms are not feasible, then we can gather data on population mobility. In the absence of information on when these plants began operation, using migration data, we might be able to isolate the effect of population sorting i.e. richer people moving away from the polluting plants rather than plants setting operation in poorer neighborhoods.

Appendix

TABLE 1: SUMMARY STATISTICS OF ANNUAL WATER POLLUTION AND PROSPERITY DATA

Variable	Obs.	Mean	Standard Deviation	Min	Max
Annual Emissions in kgs/yr, 2004-2012					
water discharges	23,617	2.497587	264.6439	4.00e-14	33917.63
Aggregate AGEB characteristics, 2000					
Prosperity	3695	-2.41e-10	2.009031	-6.248946	5.84017

TABLE 2: CORRELATION COEFFICIENT OF FIRST PRINCIPAL COMPONENT WITH SOCIOECONOMIC VARIABLES

Category or Type of Indicator	Indicators (percent, unless otherwise indicated)	Correlation with "Prosperity"
Education	Population 18 years and above with higher education	0.8999
Income/Status	Employees earning no more than twice minimum wage	-0.6156
	Households with computer	0.8940
	Households with telephone	0.9144
	Households with female heads	0.5609
Demographic	Population density (per sq. km)	0.2469
	Population under 4 years	-0.6942
	Population over 65 years	0.5919
Economic	Unemployment rate	0.0660

TABLE 3: PROSPERITY DISTRIBUTION

Percentiles	Values
1%	-3.521411
5%	-2.824293
10%	-2.425031
25%	-1.520877
50%	-.2213968
75%	1.282057
90%	2.841239
95%	3.740002
99%	5.187286

TABLE 4: PROBIT OF PROSPERITY ON THE PROBABILITY OF POSITIVE POLLUTION REPORTED

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Coefficients	Arsenic	Cadmium	Chromium	Cyanide	Lead	Mercury	Nickel
Prosperity	-0.0528***	-0.0568***	-0.0694***	-0.0544***	-0.0712***	-0.0770***	-0.0497***
	(0.0160)	(0.0158)	(0.0158)	(0.0164)	(0.0131)	(0.0144)	(0.0156)
Constant	0.834***	0.717***	0.721***	0.882***	0.387***	0.611***	0.752***
	(0.0324)	(0.0319)	(0.0318)	(0.0330)	(0.0267)	(0.0294)	(0.0313)
Marginal Effects	-0.0148***	-0.0174***	-0.0212***	-0.0146***	-0.0261***	-0.0253***	-0.0149***
	(0.00445)	(0.00481)	(0.00477)	(0.00439)	(0.00472)	(0.00465)	(0.00464)
Observations	1,951	1,874	1,902	1,937	2,356	2,110	1,989

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

TABLE 5: OLS OF PROSPERITY ON POSITIVE POLLUTANT DISCHARGES INTO WATER

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Arsenic	Cadmium	Chromium	Cyanide	Lead	Mercury	Nickel
Prosperity	-0.197***	-0.108*	-0.284***	-0.266***	-0.160***	-0.144**	-0.195***
	(0.058)	(0.058)	(0.060)	(0.056)	(0.055)	(0.057)	(0.055)
Constant	-11.556***	-9.994***	-9.309***	-10.263***	-8.468***	-12.615***	-8.163***
	(0.117)	(0.116)	(0.118)	(0.111)	(0.110)	(0.114)	(0.109)
R^2	0.01	0.00	0.02	0.01	0.01	0.00	0.01
N	1,556	1,430	1,453	1,570	1,529	1,534	1,539

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

TABLE 6: ORDERED-LOGIT-PREDICTED PROBABILITIES OF BEING IN EACH QUARTILE OF POLLUTION FOR COMMUNITIES AT THE 25TH, 50TH AND 75TH PERCENTILE OF PROSPERITY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Predicted Probabilities	Arsenic	Cadmium	Chromium	Cyanide	Lead	Mercury	Nickel
1st quartile pollution, at 25th prosperity	0.223***	0.237***	0.212***	0.218***	0.228***	0.232***	0.224***
	(0.0118)	(0.0127)	(0.0119)	(0.0116)	(0.0121)	(0.0121)	(0.0119)
1st quartile pollution, at 50th prosperity	0.245***	0.248***	0.243***	0.244***	0.247***	0.247***	0.245***
	(0.0109)	(0.0114)	(0.0113)	(0.0109)	(0.0111)	(0.0110)	(0.0110)
1st quartile pollution, at 75th prosperity	0.273***	0.262***	0.286***	0.278***	0.270***	0.267***	0.273***
	(0.0128)	(0.0131)	(0.0137)	(0.0129)	(0.0129)	(0.0128)	(0.0129)
2nd quartile pollution, at 25th prosperity	0.242***	0.246***	0.239***	0.240***	0.243***	0.244***	0.242***
	(0.0109)	(0.0115)	(0.0112)	(0.0109)	(0.0111)	(0.0111)	(0.0110)
2nd quartile pollution, at 50th prosperity	0.251***	0.250***	0.252***	0.251***	0.250***	0.250***	0.250***
	(0.0110)	(0.0115)	(0.0115)	(0.0110)	(0.0111)	(0.0111)	(0.0111)
2nd quartile pollution, at 75th prosperity	0.259***	0.255***	0.264***	0.261***	0.257***	0.256***	0.259***
	(0.0115)	(0.0118)	(0.0121)	(0.0115)	(0.0115)	(0.0114)	(0.0115)
3rd quartile pollution, at 25th prosperity	0.260***	0.255***	0.265***	0.263***	0.258***	0.257***	0.260***
	(0.0115)	(0.0118)	(0.0121)	(0.0115)	(0.0115)	(0.0115)	(0.0116)
3rd quartile pollution, at 50th prosperity	0.253***	0.251***	0.255***	0.255***	0.252***	0.252***	0.253***
	(0.0111)	(0.0115)	(0.0116)	(0.0111)	(0.0112)	(0.0111)	(0.0112)
3rd quartile pollution, at 75th prosperity	0.243***	0.246***	0.239***	0.242***	0.244***	0.245***	0.243***
	(0.0109)	(0.0115)	(0.0113)	(0.0109)	(0.0110)	(0.0111)	(0.0110)
4th quartile pollution, at 25th prosperity	0.275***	0.262***	0.285***	0.280***	0.271***	0.267***	0.274***
	(0.0130)	(0.0133)	(0.0137)	(0.0131)	(0.0130)	(0.0129)	(0.0131)
4th quartile pollution, at 50th prosperity	0.251***	0.251***	0.250***	0.251***	0.251***	0.251***	0.251***
	(0.0110)	(0.0115)	(0.0114)	(0.0110)	(0.0111)	(0.0111)	(0.0111)
4th quartile pollution, at 75th prosperity	0.224***	0.237***	0.211***	0.219***	0.229***	0.233***	0.225***
	(0.0117)	(0.0126)	(0.0119)	(0.0115)	(0.0120)	(0.0120)	(0.0118)
Observations	1,556	1,430	1,453	1,570	1,529	1,534	1,539

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

TABLE 7: OLS OF CHANGE IN WATER POLLUTION (2004-2012) ON "PROSPERITY" (2000 CENSUS), PLANTS CLASSIFIED BASED ON THEIR INITIAL POLLUTION LEVELS

Change in water pollution	Low	Medium	High
prosperity	-0.103*	-0.100***	-0.089***
	(0.059)	(0.029)	(0.031)
_cons	1.900***	-0.032	-0.862***
	(0.106)	(0.053)	(0.057)
R^2	0.00	0.01	0.01
N	901	1,536	1,621

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

TABLE 8: INACCURATE REPORTING-- ARE PLANTS LESS LIKELY TO REPORT INACCURATELY IN COMMUNITIES WITH HIGHER PROSPERITY?

VARIABLES	(1) Probit Coefficient	(2) Probit Marginal Effect	(3) Logit Coefficient	(4) Logit Marginal Effect
prosperity	-0.0303**	-0.00810**	-0.0535**	-0.00808**
	(0.0121)	(0.00323)	(0.0215)	(0.00324)
Constant	-0.895***		-1.480***	
	(0.0239)		(0.0424)	
Observations	3,695	3,695	3,695	3,695

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

TABLE 9: FIXED EFFECTS ESTIMATION OF PROSPERITY (2000 AND 2005) ON LOG OF WATER POLLUTION (2004-2012)

VARIABLES	(1) Arsenic	(2) Cadmium	(3) Chromium	(4) Cyanide	(5) Lead	(6) Mercury	(7) Nickel
prosperity	-0.597**	-0.472*	-0.495*	-0.506*	-0.511**	-0.376	-0.357
	(0.283)	(0.265)	(0.265)	(0.261)	(0.249)	(0.279)	(0.243)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Plant FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.01	0.03	0.02	0.01	0.03	0.01	0.03
N	3,533	3,060	3,121	3,574	3,396	3,388	3,439
# of plants	1,544	1,428	1,451	1,568	1,527	1,532	1,537

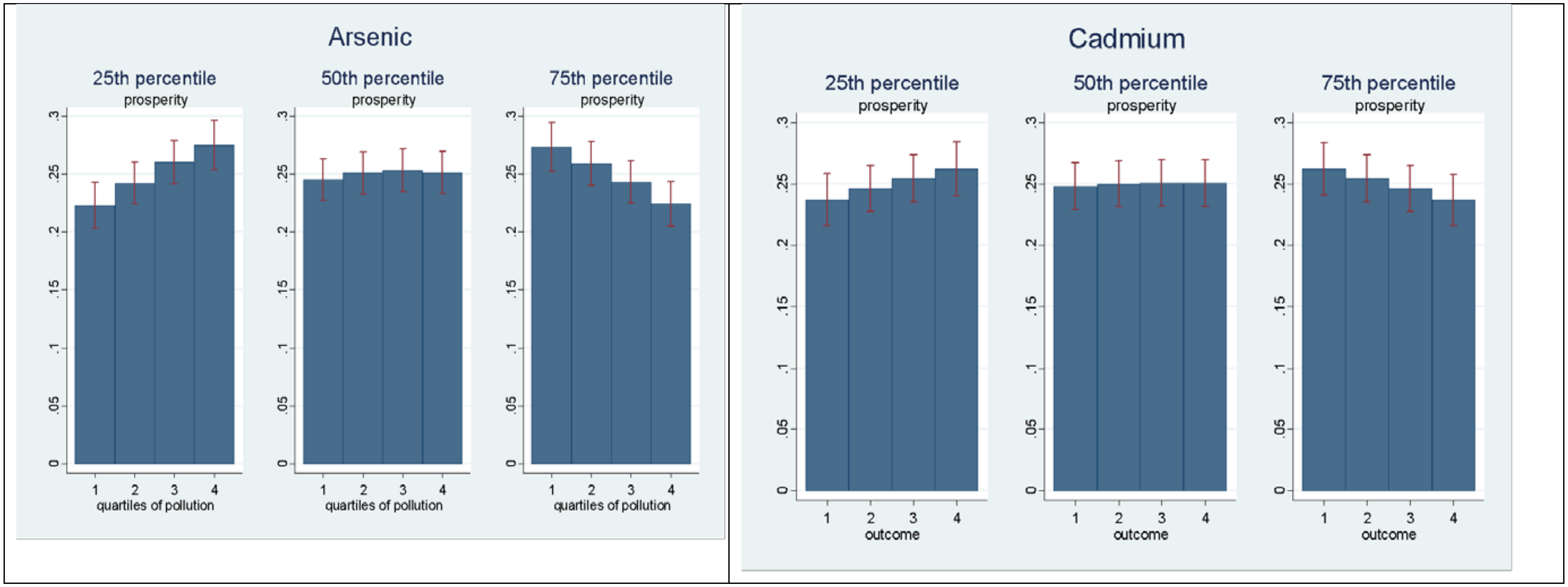
Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

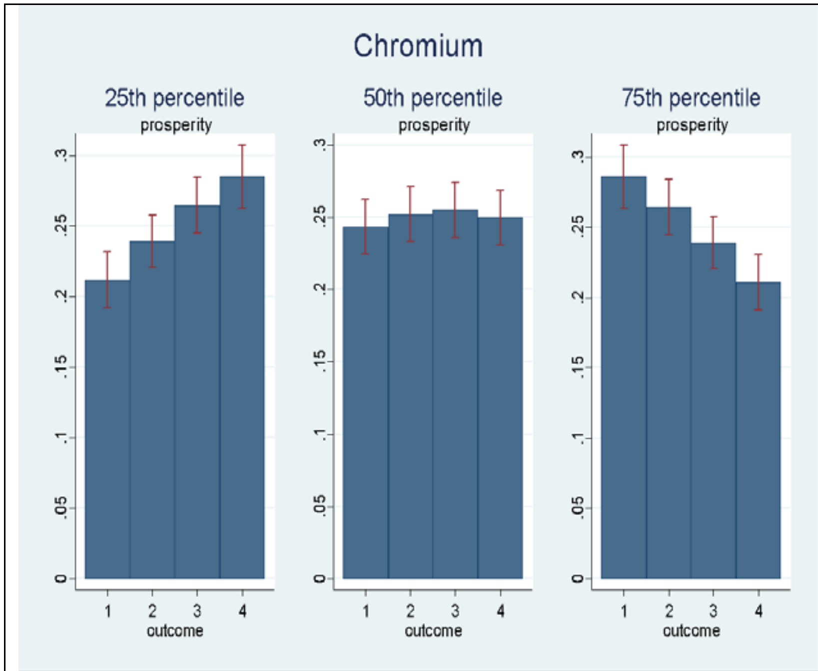
TABLE 10: FIXED EFFECTS ESTIMATION ON THE SAMPLE OF PLANTS WITH AT LEAST 4 OF 9 REPORTS

VARIABLES	(1) Arsenic	(2) Cadmium	(3) Chromium	(4) Cyanide	(5) Lead	(6) Mercury	(7) Nickel
prosperity	-0.530*	-0.534**	-0.532*	-0.569**	-0.518**	-0.482*	-0.326
	(0.289)	(0.265)	(0.271)	(0.275)	(0.257)	(0.286)	(0.250)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Plant FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.01	0.05	0.03	0.02	0.03	0.01	0.03
N	1,501	1,131	1,199	1,522	1,360	1,348	1,405
# of plants	300	229	239	304	272	270	276

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

FIGURE 1: PREDICTED PROBABILITIES OF 1ST, 2ND, 3RD AND 4TH QUARTILES OF POLLUTION, AT 25TH, 50TH AND 75TH PERCENTILES OF PROSPERITY




Chromium
25th percentile
prosperity
50th percentile
prosperity
75th percentile
prosperity
outcome
outcome
outcome

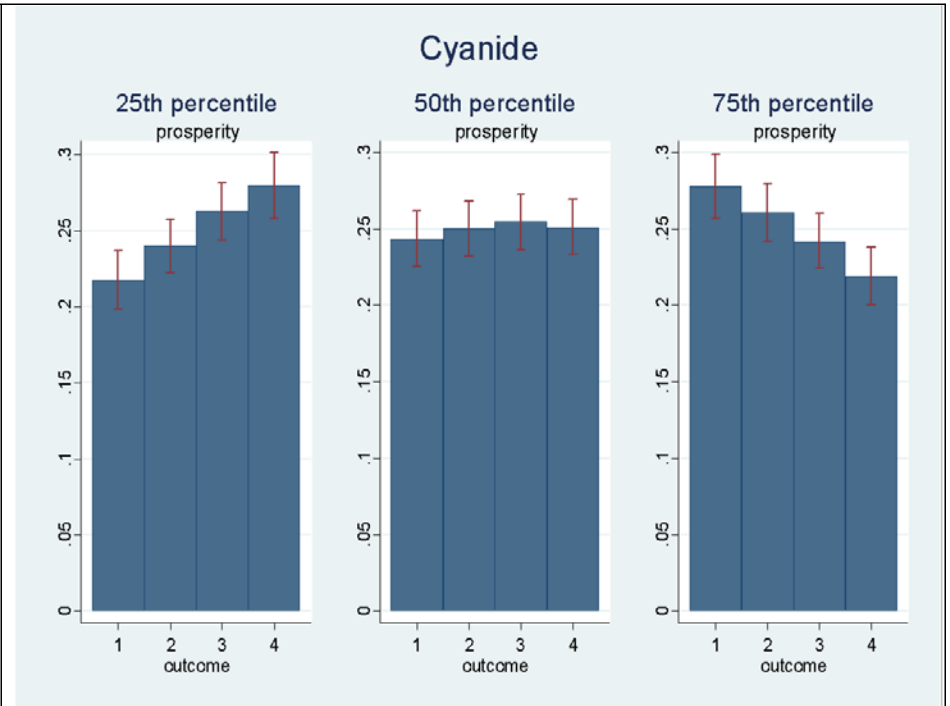
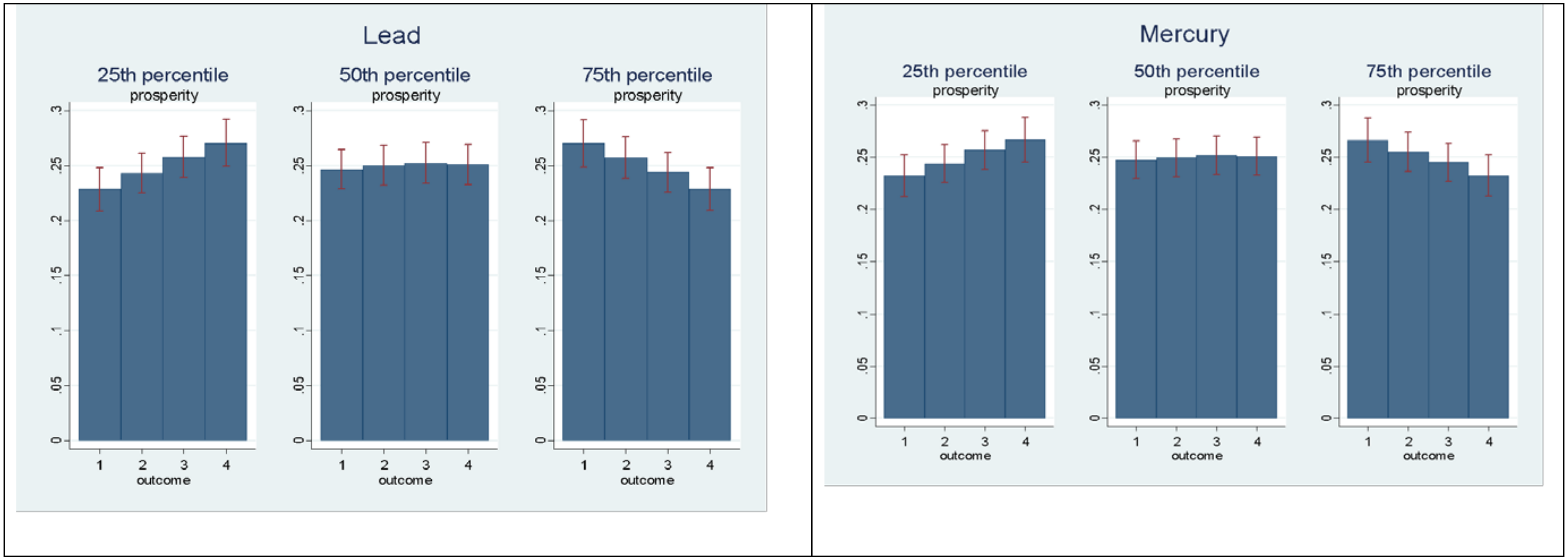
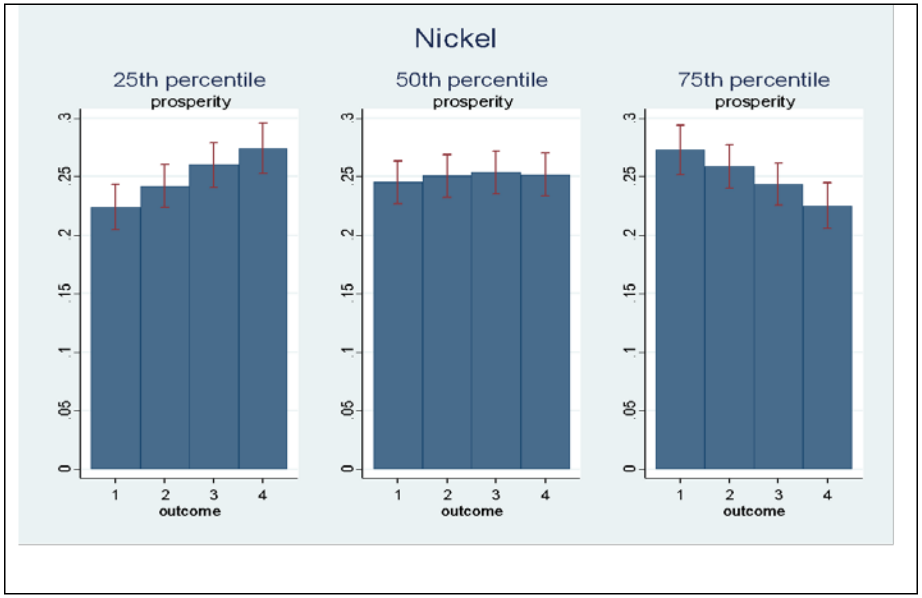

Cyanide
25th percentile
prosperity
50th percentile
prosperity
75th percentile
prosperity
outcome
outcome
outcome

FIGURE 1 CONTINUED




Nickel
25th percentile
prosperity
50th percentile
prosperity
75th percentile
prosperity
0
.05
.1
.15
.2
.25
.3
1
2
3
4
outcome

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