Episode 186. How US lead regulations hurt Mexican babies

[Episode webpage]

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Transcript

(lightly edited)

Chad Bown: Lead is bad for you. Lead can make you really, really sick.

In 2009, American regulators told factories that use lead that they needed to emit less of it into the air. Those American companies followed the rules, complied with the new standard, and US lead emissions fell.

But at the same time, something was happening across the border in Mexico. Lead poisoning and health outcomes in Mexico suddenly started to get worse. And this had something to do with those new US regulations as well as international trade.

This episode examines the details that connect those two events. It explains how supply chains between the US and Mexico create health linkages for people in the two countries that today's environmental regulators desperately need to worry about.

To do all that, I will be joined by a very special guest.

Eric Verhoogen: Eric Verhoogen, Columbia University.

Chad Bown: Eric Verhoogen is an economics professor at Columbia University. Eric is a trade economist, and he has studied trade and companies and people in developing countries all over the world, and especially in Mexico. And today, Eric is going to share some of his new research on trade, health, and lead.

Chad Bown: Hi, Eric.

Eric Verhoogen: Hi, Chad.

Chad Bown: You are listening to an episode of *Trade Talks*, a podcast about the economics of trade and policy. I'm your host, Chad Bown, the Reginald Jones Senior Fellow at the Peterson Institute for International Economics in Washington.

THE EPISODE

Chad Bown: Let's start off with lead. What is lead and what is it used for?

Eric Verhoogen: Lead is actually a useful chemical. It's used in paint and makes the paint brighter and spread on more easily. It's used in gasoline, it raises the octane rating of gasoline. Lead is used a lot in pipes. It makes the pipes more pliable and less corrosive.

Lead is also used in batteries, especially in batteries for cars – lead acid batteries. Lead helps the battery generate a lot of power for not very much weight. Even though car batteries weigh some, they're not as heavy as they would be if they were using some other kind of chemical mix in the battery.

Chad Bown: Lead batteries are those heavy rectangular blocks critical for internal combustion engine vehicles. If you open the car hood to change the oil or add windshield wiper fluid, there is the battery. Making those batteries is going to be a big part of this story.

Where do those lead batteries come from?

Eric Verhoogen: The battery sector is almost a closed loop. Almost all car batteries are recycled. Almost all of that secondary lead that's produced by your second batteries goes into new car batteries, i.e., goes into new lead acid batteries.

Chad Bown: In the lead car battery recycling industry, the companies take the lead out of old batteries and transform that lead to make it useful again in a new car battery.

Another part of this story involves human health. Why is ingesting lead so bad for our health?

Eric Verhoogen: Lead has been shown to affect every organ in the human body. It has especially toxic effects on the nervous system and on the development of brains. For that reason, it's especially bad for kids and for fetuses and for young kids. It's been linked to damaging IQ. It's been linked to learning disabilities. It's been linked to criminal behavior later in life. It's been linked to a bunch of different health outcomes. That link is quite well established. There's been lots and lots of research documenting links between lead exposure and those negative outcomes.

If you're paying attention to the news, you might have heard that there's still lots of talk about lead. For instance, the Flint water crisis was in large part about lead. There were other pollutants in the water and there were other potential outbreaks of diseases that happened. But lead from lead pipes was a big part of the problem there.

Chad Bown: The EPA, the Environmental Protection Agency, is the main pollution regulatory agency in the United States. When and how did the EPA really start regulating lead pollution?

Eric Verhoogen: The United States started regulating lead pollution in earnest in the 1970s. Other countries started before the United States: e.g., Australia started in the 1930s in terms of regulating lead pollution, but the US was a little slower on the uptake on that.

In 1971, there was an Act that was passed to prevent poisoning from lead paint. The EPA started moving to restrict lead in gasoline. That process took a while to phase in. It was finally completed in 1991 with the Clean Air Act. In the US there was an Act that regulated the use of lead in toys in 1974. There was the Safe Drinking Water Act also in the early 1970s.

In the United States, since the late 1970s, there hasn't been much lead use, although lead still exists in the paint in lots of old buildings. So lots of kids in the United States are still exposed to lead through paint that hasn't been removed from these older buildings.

Chad Bown: Your focus is going to be on lead in the air and the lead emissions coming out of factories like those car battery recycling plants. Tell us about how the EPA established standards for the permissible amount of lead in the air in the 1970s, how that evolved over time, and what firms emitting lead would need to do in response to changes in those regulations.

Eric Verhoogen: In 1978, the EPA established a standard, which happened to be 1.5 micrograms [of lead] per cubic meter. That stayed in place for, for a number of years.

Over time, the awareness of the dangers of lead increased to the point that people realized that the standard that had been set in 1978 wasn't sufficiently restrictive.

Starting at the end of 2007, with discussions continuing until the beginning of 2009, there was implementation of a new standard, and the standard was reduced by a factor of 10. That was a big reduction.

Firms had some time to adjust because the EPA announced near the end of 2007 that it was considering this. And then there was some debate. But then in 2009, basically the new standard took effect. And firms were on notice (and counties were on notice) that if they were out of compliance that they would have to reduce emissions pretty sharply in a pretty short amount of time.

Chad Bown: How did the lead battery recycling plants in the US respond to the new regulation in 2009? What were their options?

Eric Verhoogen: When the new regulation came into effect in 2009, battery recycling firms in the United States had to reduce emissions, and they had to do so pretty quickly.

They had a couple options when that happened. They could either install new technology to purify the air to reduce emissions. The most popular new technology is something called a baghouse system. It's essentially a system of air filters. You pass any exhaust through this system of air filters. You also enclose the factory so you don't get a lot of fugitive dust. That's the most popular technology for reducing emissions.

The baghouse system is pretty expensive. There's one estimate in the literature that for the 14 battery recycling firms that were in operation in 2009, it would've cost about $10 million, for a year, to operate these baghouse systems. That's pretty expensive, given that it's a relatively competitive industry. There are not hugely fat profit margins in this industry.

The other thing you can do is shut down the plant. Or just reduce the amount of batteries you're recycling.

Chad Bown: Your research examines what happened after the US imposed this new regulation in 2009. What do you find? And by that, I suppose the first question would be – did these lead battery recycling plants comply with the new EPA regulations by reducing their emissions? And if so, how did they comply?

Eric Verhoogen: So we have good news and bad news.

The good news is we show that compliance did increase, that firms did comply. It looks like the enforcement worked in that sense. In the United States, most of the plants that were affected by the new regulation were actually battery recycling plants. And we show that within a few years, nearly all of those plants were in complete compliance with the new standard.

The Environmental Protection Agency has monitors that monitor lead near lead emitting plants, including basically all battery recycling plants. There we show the level of the concentration of lead in the air near those plants dropped by about 40 percent.

That's including some areas where they were already in compliance and some where they were more effective, what we call the regulation being binding. So they reduced their emissions. We found that by 2013, essentially all the plants were in compliance.

Chad Bown: So the good news is compliance. Less lead in the air in the United States means better American health outcomes.

But you also said there was bad news. What was the bad news?

Eric Verhoogen: The bad news is how they complied. They could have complied by adopting new technologies that would reduce lead emissions. The most popular of those are baghouse systems that basically filter the air. But those are expensive and so many firms, rather than doing that, they just reduced output. They just reduced their recycling of batteries.

In many cases, they shut down. Of about 15 battery recycling plants around the country that were in business in 2007, about five went out of business. There were about 10 that remained in business within a few years after the regulation.

The United States Geological Survey estimates that output of – what they call secondary lead, which is lead from recycling – dropped by about 13 percent over the period of our study, which is essentially a few years after 2007.

Chad Bown: Normally, we might think that even some plants shutting down might not be all that bad.

Maybe what happened is that the worse US plants – the really dirty ones for whom it was too expensive to clean up – maybe it was those plants that went out of business. Perhaps the better US plants cleaned themselves up. Those better, lead recycling plants adopted the new technology - these baghouse filter systems - it might be expensive, but they took on the costs and stopped polluting.

The point is, when a new policy comes along, like an EPA regulation, the fact that not all companies respond the same way is quite natural in economic markets – economic researchers see that response in the data all the time.

But that wasn't just it. The really bad news is what came next.

Eric Verhoogen: For the most part, people need batteries for their cars. There's a certain amount of cars on the road. Every once in a while the battery needs to be replaced. And so consumption of batteries hasn't been affected by the new regulation.

The thing that happened is that the used lead acid batteries started getting exported to Mexico. There were already some exports to Mexico, but the exports to Mexico of used lead acid batteries went up by a factor of four over very short period of time, from 2007 to 2014.

Chad Bown: Again though, we don't normally think of booming US exports as a problem.

Why was this sudden increase in US exports of used lead batteries such a concern? Didn't Mexico also have regulations for lead emissions at its battery recycling plants?

Eric Verhoogen: Mexico had an airborne lead standard, which was at the same level that the United States established in 1978. Mexico's lead standard was 1.5 micrograms per cubic meter, which was the same as the United States. Mexico did not change its standard. Its standard remained at the same level.

So what happened is that the battery recycling that picked up in Mexico as a result of this environmental regulation in the United States was pretty dirty.

We don't have direct evidence of that because we don't have the air monitors in Mexico. In fact, Mexico, outside of Mexico City, wasn't even monitoring airborne lead.

Chad Bown: Following the new US regulation, some American plants shut down and the United States started exporting massive amounts of used lead batteries to Mexico to be recycled there instead.

But here's the problem. Mexico did have regulations for airborne lead emissions, but Mexico's regulations were only at that old 1978 standard. The new worry was that the flood of imports from the United States would increase the amount of lead in Mexico's air.

Because Mexico doesn't have lead emissions data, what other indirect techniques did you use to look at whether the situation in Mexico was getting worse?

Eric Verhoogen: We see output in the Mexican battery plants increase significantly, much more than other detailed industries in the primary metal sector.

In the Mexican industrial census data, which you can observe every five years – i.e., 2008, 2013 – we can see battery recycling plants. It's confidential. But working with the Mexican Statistical Agency, we're able to establish that the output (in terms of lead output) of those battery recycling plants shot up relative to other detailed sectors in the same broad industry category. So relative to the production of other primary metals, the production of secondary lead through battery recycling is just a huge outlier.

Chad Bown: Mexico was producing a lot more lead battery output because it was now receiving a flood of used battery inputs from the new imports arriving from the United States.

What did Mexican regulators know at this time about the emissions at the battery plants in Mexico?

Eric Verhoogen: In Mexico, they did not have good monitoring of airborne lead. Outside of Mexico City, there was not a system of air monitors tracking how much lead there was. In all likelihood, many of the battery recycling plants in Mexico were not in conformity with the existing standard, which was the same standard that the US established in 1978.

So they're dirty already. And essentially what's happening is now, with all these exports of used batteries from the United States into New Mexico, they're just being processed. So those existing battery recycling plants are just ramping up their operations in the dirty way that they'd already been recycling batteries before.

Again, there's a mix. There's going to be some plants in Mexico that are a little bit cleaner and some that are a little bit dirtier. But for the most part, there's not a lot of enforcement in Mexico. And so when you're expanding production in Mexico, which we show is what happened, that's likely to increase lead emissions in Mexico.

Chad Bown: Is there evidence out there, from other sources, about lead emissions being a problem in Mexico?

Eric Verhoogen: Since our paper came out, there's been an interesting study where, an NGO – called Occupational Knowledge International – has gone and taken soil samples from nearby some battery recycling plants, and they find that they're many times the acceptable standard (even the Mexican standard).

So, after the fact they've corroborated our findings and actually corroborated earlier findings by the same NGO saying that this is an issue, that lead is being emitted.

Chad Bown: One concern is that lead emissions in Mexico were going up. But the really big worry is that this pollution was hurting human health.

How do you examine the health impact of this increase in lead pollution? What health outcome in Mexico do you look at?

Eric Verhoogen: The health outcome we're going focus on is birth weight.

Birth weight is very well measured. It responds quickly to environmental shocks. In that sense, we're going be able to pick it up quickly. Extensive research has shown that lead exposure, especially airborne lead exposure, affects fetal health, and so it's likely to affect birth weight.

The data are very good. We can see births in birth certificate data in Mexico, which is public, which we have access to, and in the hospital discharge records from hospitals in Mexico run by the Ministry of Health.

We compare birth weight outcomes for mothers who live within two miles of a battery recycling plant to mothers who live between two and four miles – so just a little bit farther away. We can do that even within a given hospital. Within a given hospital, we can compare moms who live near the plant versus the moms who don't.

Chad Bown: What do you find?

Eric Verhoogen: The average incidence of low birth weight – by which I mean below 2.5 kilograms – the average incidence of low birth weight is about 9.5 percent. And living near a battery plant is associated with a 2 percent increase. So from 9.5 percent to 11.5 percent increase in the incidence of low birth weight.

That's very big already. Already that is very big. And that's averaging all types of hospitals.

When we look by hospital type. When we compare the Ministry of Health hospitals (which tend to serve the poorest segment of the population in Mexico) to hospitals in the social security system (which tend to serve middle income people) to private hospitals (which tend to serve the rich), we only find an effect in the Ministry of Health hospitals.

In the Ministry of Health hospitals, we find a much bigger effect. We find on a base of about 12.8 percent incidence of low birth weight, that increases by 4.8 percent. It goes from about 13 percent to about 18 percent incidence of low birth weight. Just concentrating on those hospitals and basically we don't find any effect in the Social Security hospitals or in the private hospitals, which tend to serve more advantaged segments of the population.

So this effect that we find that's concentrated in the hospital serving the poorest mothers, that's much larger in those hospitals, that's consistent with research in lots of other places, including the United States. It's quite common to find that the burden of environmental hazards is disproportionately born by the poor.

There's a whole literature on environmental justice, which is essentially making that point. With environmental hazards, it's really the poor that suffer. We're finding that. Our results are very consistent with that view.

Chad Bown: Tell us more about why the result that lead pollution in Mexico is more likely to impact the poor is so worrisome.

Eric Verhoogen: One reason why this disparate effect we're finding – the poor are more affected than middle class, or the rich, in Mexico – is important is because when the Mexican government starts negotiating over what the environmental regulations should be, it's not necessarily the interests of the poor that are being represented.

It's possible that, in the same way that in the United States environmental hazards are often born by the poor and other segments of the population, don't necessarily take that into account or not as much as maybe they should, the same thing might happen in Mexico, in the sense that the poorest people who are the moms who are giving birth in these Ministry of Health hospitals, they're don't necessarily have a

lot of political power. They don't have a lot of political leverage. They're not necessarily at the bargaining table deciding how much battery recycling do we want to have in our community.

Chad Bown: The US regulations changed in 2009. Used battery exports to Mexico increased right away, recycled battery production in Mexico increased right away, and health outcomes in Mexico – lots more low birth weight babies right next to those battery plants – deteriorated right away.

How, eventually, did the Mexican government respond?

Eric Verhoogen: Eventually, there was attention to this in Mexico. There were press reports. NGOs had reports about the level of lead pollution and lead poisoning in Mexico. And so it took a few years, but eventually Mexico did tighten regulations also. So by 2015, Mexico passed new regulations called point of production regulations.

It's not regulation of airborne lead just from a monitor in the area. They actually go to the battery recycling plants and they'll test how much lead is being emitted. That's towards the end of our period, we do find that's a little bit of a reduction in, in lead emissions in 2015. And that's consistent with that Mexican policy having an effect.

Our study stopped in 2015. We haven't been monitoring closely in the data what's been happening, but all indications are this is still a problem in Mexico.

There's been a recent report in February 2023, by Occupational Knowledge International, it's an NGO that's really following this issue closely, and they find very elevated levels of lead in the soil around battery recycling plants.

It's expensive to maintain a whole set of monitors for airborne lead. Mexico is slowly expanding its monitors, but it really doesn't have the same capacity, the same ability to monitor lead in the way the Environmental Protection Agency does in the United States. And so Mexico still has a long way to go.

Chad Bown: These results you find are amazing. But they are also stunning because they are very different from what researchers have typically found when looking for evidence of this phenomenon – what is referred to as the pollution haven hypothesis.

The theory has always been that, when countries open up to trade, the ability to trade creates new incentives for dirty, polluting industries to leave countries with high environmental standards and tough regulators like the EPA, maybe through foreign direct investment, or FDI, and move to another country with weaker environmental regulations.

How did the earlier literature tend to investigate this pollution haven hypothesis?

Eric Verhoogen: The literature has generally focused on one country at a time, like using US data, looking at whether environmental regulation leads to, say, more outgoing FDI or, say, more imports of the good that might be produced under dirty conditions.

There have been relatively few studies that have tied North to South directly. And not just are you seeing more outgoing FDI but are you seeing more outgoing FDI to poor countries with weaker regulations. There have been relatively few of those and the studies that have focused on that have typically not found that the displaced production is going especially to poor countries.

There have been findings that there's more outgoing FDI, and there's more imports of those products, but not specifically to developing countries with weaker regulations.

So it's often interpreted that there's not really a pollution haven effect. There's some displacement effect of regulation, but not necessarily toward developing countries.

I think a contribution of our paper is to show actually in this industry (that we can document very well), partly for data reasons – the data environment is rich, we can track these used lead acid batteries going across the border – but we can document well that there really is a pollution haven effect in the battery recycling industry.

And that seems important because in the policy world, there's this general sense that this is not a big issue. The World Bank put out the *World Development Report* in 2020 where it said this is nothing to worry about. This is not a big deal. There's not really pollution haven effects.

We're showing, at least in this industry that we understand well, where we can measure things well – it is a big deal.

Chad Bown: If I asked for your advice, where do you think researchers should look next?

Eric Verhoogen: We'd love to see a bunch of other studies trying to look similarly at displacement effects from North to South, where we can actually track what's happening in the industry in the United States (or some other rich country), and then follow the inputs as they're transferring across borders, and then look at what's happening in the developing country where it's going.

I suspect we're going find pollution haven effects in a bunch of sectors as well. That's a hypothesis. That's a conjecture, it's not proof yet. I would like to see more research doing that and ho but I suspect that we're going find that this is not an isolated phenomenon.

Chad Bown: Having now studied the industry, does battery recycling have special characteristics that might help researchers identify where else to look for these pollution haven effects?

Eric Verhoogen: It's possible that battery recycling is kind of special, in the sense that it's a pretty dirty industry. It has relatively high abatement costs. Adopting these baghouse systems cost a lot of money in order to reduce lead emissions. And at the same time it's pretty mobile in the sense that the inputs are easily shipped – they'll use lead acid batteries. It's not hard to ship them.

The lead itself, once it's been extracted from the lead acid batteries is not that hard to ship. The new batteries once they're produced are not that hard to ship. And so the industry is pretty mobile in that sense. It's possible that that's why we're finding these pollution haven effects in this industry, where other people looking at a more macro and aggregate level have not really found them.

That's something that needs to be investigated more at the micro level and looking at these patterns of abatement costs and tradability of the inputs and outputs in order to figure out whether there's a systematic pattern there.

Chad Bown: I now want to go back to policy. Back in 2007-09, when the US was tightening its own regulations, should it have known that all this might happen?

Could policymakers have predicted that making air quality better in the United States was going to lead to a surge in used battery exports to Mexico in particular?

Eric Verhoogen: So there's a convention from 1992 signed in Basel for the shipment of hazardous waste. The United States is not a signatory to that convention. Countries that are signatories, which is almost all countries in the world, are not supposed to accept hazardous waste from the United States, unless they have a bilateral trade agreement.

In 2007 if you had asked yourself the question – all of these used lead acid batteries, where are they going go? Based on the fact that the United States is not a signatory to the 1992 Basel Convention, but they have a bilateral trade agreement to Mexico, you could have predicted probably that a lot of these were going go to Mexico.

But to be fair the conventional wisdom was these pollution haven effects are not a thing and are not really happening. That's what the state of the literature was. And so, I'm not sure there are a lot of people in 2007 thinking, “Oh, okay, this is going be bad for Mexico!” Even in Mexico, people didn't realize that this was about to happen.

Chad Bown: As my last question, I want to ask about the main policy lessons from this episode. The US and Mexican economies are incredibly connected through their free trade agreement and the emergence of cross-border supply chains in a lot of sectors, including for lead batteries.

What do those economic interconnections mean for regulatory cooperation, including for environmental policy, between these two countries?

Eric Verhoogen: I think an important thing we're learning in this case is that trade policy and environmental policy are linked and need to be talked about in the same conversation. There's a tendency sometimes among trade people in the United States or other rich countries to say, that's a separate issue. Environmental, that's, that's a separate conversation. Let's do the trade deal and then we'll worry about the environmental stuff later.

And I think what we're learning here is that's untenable – that separation. We have to think about both, that we're linked, our fates are linked the United States and Mexico, our fates are linked, our environmental fates are linked in the same way that our trade fates are, are linked. And we need to think about these things together.

We really need a regime that where we can think about common trade regulation and common environmental regulation. Think about those two things in the same agreement.

Ideally what would've happened was somehow the battery recyclers got a stronger encouragement to clean up their acts rather than just move. Now, it's not necessarily one battery recycler, but we would like to see the industry adopt some of these baghouse systems or some of these other technologies that can reduce lead admissions in place, rather than just moving to Mexico.

Now, it's an important point that Mexico should be free, or at least have the ability, to set environmental regulations that it thinks are optimal for Mexico subject to negotiation with the United States. The level of environmental regulation that Mexico sets may be lower and may be less strict than what the US sets, partly because of income differences. They really want to grow, they want to grow quickly. Mexico should have the ability to set a different level of environmental regulation.

But the optimal level of environmental regulation, even for Mexico, is not going be zero. And it's not going to be to just take whatever comes. I think the fact that we saw Mexico adopting regulations in 2015 – it took a few years, but the fact that we saw them adopting suggests that people realized that especially battery recycling and lead emissions are extremely toxic.

Lots of Mexican babies and kids are suffering, and so they really need something to be done about it. I think what should have happened is a fuller, more robust conversation between the US and Mexico at the time regarding what's the right level of environmental regulation of lead in both places.

Chad Bown: Eric, thank you very much.

Eric Verhoogen: Thanks very much Chad, it was a pleasure.

GOODBYE FOR NOW

Chad Bown: And that is all for *Trade Talks*.

A huge thanks to Eric Verhoogen at Columbia University. Do check out Eric's new paper with Shinsuke Tanaka and Kensuke Teshima titled ""North-South Displacement Effects of Environmental Regulation: The Case of Battery Recycling." It has just been published in *American Economic Review: Insights*. I will post a link to the article on the episode page of the *Trade Talks* website.

Thanks to Melina Kolb, our supervising producer. Thanks to Nia Kitchin, on digital. As always, thanks to Collin Warren, our audio guy.

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<insert super funny double underscore joke here>. ▮

Read more…

Tanaka, Shinsuke, Kensuke Teshima, and Eric Verhoogen. 2022. "North-South Displacement Effects of Environmental Regulation: The Case of Battery Recycling." *American Economic Review: Insights* v4, n3: 271-288.