



Harvard Business Review

REPRINT **F17028**
PUBLISHED IN HBR
MARCH-APRIL 2017

ARTICLE **DEFEND YOUR RESEARCH**

Air Pollution Brings Down the Stock Market

An Interview with Anthony Heyes by Scott Berinato

DEFEND YOUR RESEARCH

When University of Ottawa economics professor Anthony Heyes and his colleagues compared daily data from the S&P 500 index with daily air-quality data from an EPA sensor close to Wall Street, they found a connection between higher pollution and lower stock performance. Their conclusion:

AIR POLLUTION BRINGS DOWN THE STOCK MARKET

PROFESSOR HEYES, DEFEND YOUR RESEARCH

HEYES: The effect was strong. Every time air quality decreased by one standard deviation, we saw a 12% reduction in stock returns. Or to put it in other terms, if you ordered 100 trading days in New York from the cleanest-air day to the dirtiest-air day, the S&P 500 performance would be 15% worse on the 75th cleanest day than it was on the 25th cleanest day. We also replicated this analysis using data from the New York Stock Exchange and Nasdaq, and saw the same effect.

HBR: How could a few more dirty particles in the air cause such big dips in market returns? We think there are two mechanisms at work, both of which have been researched quite a bit. One,

being exposed to bad air, even for a day, affects your emotional state. It puts you in a more depressed mood. It also reduces your cognitive capability. It negatively affects how you feel and how good you are at thinking. Two, bad moods and lower cognitive capabilities tend to reduce your appetite for risk. Low risk tolerance is associated with lower returns. And that's what we saw.

But you measured only the air near traders' workplaces. Given that they work inside, how much of that air are they actually breathing? What about the air near where they live? That's part of why we chose New York City. Most traders there live in Manhattan or

nearby. And we compared the stock index performance not only with air quality at the one EPA station near Wall Street but also with the average from stations across Manhattan, and we got the same result. It's a robust result.

How do you know this correlation is the one that matters? What if it was temperature or precipitation, and the dirty air was a coincidence? Of course, we attempt to control for all the things that might be important, like temperature or weather. That's what research is about. We present findings, and people challenge us with alternative explanations that we have to test for. It's hard to control for everything; no one does it perfectly, but that's why we also do falsification checks. One of those checks focused on rain. We reran the tests only for days with no precipitation on that day or the day before. We still got a similar result.

Your colleagues must come up with some hard-to-test or unexpected variables that you should control for—but didn't. We hope they do. That's how you progress. The best answer a researcher can give on controls is that we controlled for everything we could think of. On this, we believe we've fairly convincingly eliminated other explanations, like weather. Traffic was another variable we checked.

Where did you get the idea to study this? All three of us—myself along with my colleagues Soodeh Saberian here at Ottawa and Matthew Neidell from Columbia—are interested in understanding the nonhealth outcomes of bad air. For a long time people have researched how poor air quality affects health outcomes like strokes, heart attacks, depression, suicide, and so on. Now we want to see how bad air affects things like productivity and performance at school. There's so much to examine.

What do we know about nonhealth outcomes of pollution? The research is growing. We know, for example, that animals that breathe polluted air fight more than those that breathe cleaner air. We want to see if pollution has a connection to violent crime. In general, research

FOR EVERY STANDARD DEVIATION INCREASE IN POLLUTION, THE MARKET PERFORMED 12% WORSE.

shows that people perform less well across a variety of tasks on polluted days than on less polluted days. Peach pickers pick fewer peaches. Baseball umpires are worse at calling balls and strikes. Call center employees field fewer calls.

We want to push the boundary of understanding pollution's effects. I think we'll see that air quality affects a rich set of outcomes. Fundamentally, we already know humans are very sensitive—more sensitive than they think—to the environment they're in.

Do you know if there's some pollution threshold—some parts per million—where the effect on the stock market kicks in? No. Our understanding of it so far is relative. We always look for nonlinear effects and try to uncover where the thresholds might be, though. When you're dealing with humans, you usually have strong nonlinear effects. For example, behavior changes dramatically once it's warmer than 85 degrees out, but less so before that. With hearing you can tolerate up to about 185 decibels, but quickly after that your eardrums will rupture. With pollution we haven't yet seen that nonlinear threshold. So far it looks mostly linear: double the pollution, double the effect.

So somewhere half as polluted as New York will have half the problem? We're not ready to generalize like that. This is a paper about New York. Each place where trading occurs is unique: How much trading is electronic? Where do people live, and how do they get to work? We did study the effects on stock performance in one other city, Toronto. We got similar results. But I can't say it will apply to all places.

So should traders be advocating for cleaner air policies to increase their returns? Maybe there are some arbitrage opportunities here, but I'm an economist and I think about it in terms of efficient markets. I'm not interested in just saying, "Hey, let's clean the air." I'm interested in saying that if the air is cleaner, the index value of these 500 firms represents their

real value. A stock market sends signals out about the correct set of prices for investments. It's supposed to follow the market fundamentals. What we're saying is that if there are visceral, transient factors like air pollution that affect the market, that's a bad thing for the efficiency of the market. If prices are going up or down because of behavior arising from pollution, because it's really hot, or because the traders' favorite team lost a football game, that's a market inefficiency.

I would not say that cleaner air will make stock prices go up. I would say that cleaner air, particularly in New York, will make the stock market work better. Prices will reflect the reality of the market better. We're doing another project, looking at decisions by immigration judges. It's the same thing: We don't care about the numbers of positive or negative decisions. We care about more-correct decisions.

Should we expect more of this kind of research in the financial sector? To me, behavioral finance, which is what this is, is an exciting trend. In the traditional models for financial markets, especially those built more than 15 years ago, human beings didn't look like human beings. They used to call the people in those models *homo economicus*. They didn't have emotions. They didn't get upset about the Yankees' losing. They didn't have bad days or good days. Now finance models are building in real human behavior and the factors that affect it. It's a complicated task. But that's the agenda for behavioral finance—to take on this complexity. To move from a rather dry *homo economicus* model to one where we can say, "Actually, these agents act like people."

Should I go to Nova Scotia, take some big gulps of crisp Canadian air, and then write up this interview? It will turn out better. No joke. We studied the speeches of Canadian MPs, using linguists' measurements of speech quality. When air pollution was over 15 micrograms per cubic meter, which up here is a pretty dirty day, MPs' speeches scored much lower on the linguists' scales. Come to Canada, and you'll be a better writer. ☺

Interview by **Scott Berinato**
HBR Reprint F1702B

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Words to the Wise Harvard Business Review

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