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Environmental Challenges in India

Brookings India

20th January 2017

E. Somanathan

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Indian Statistical Institute

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Outline

- Some impacts of climate change and air pollution
- A peek at evidence – how do we know?
- Why have we got to this stage? -- Feedback processes are weak or missing.
- Improving environmental policy – transparency and public awareness
- Improving environmental policy – you get what you pay for
  - Regulatory capacity
  - Pollution charges – disposal fees, road user fees
  - Experiment. Deliver some results before raising prices.

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- Climate change dangers – strategic planning needed.
- New technologies present new opportunities. We will miss these opportunities unless we are **collectively** ambitious.

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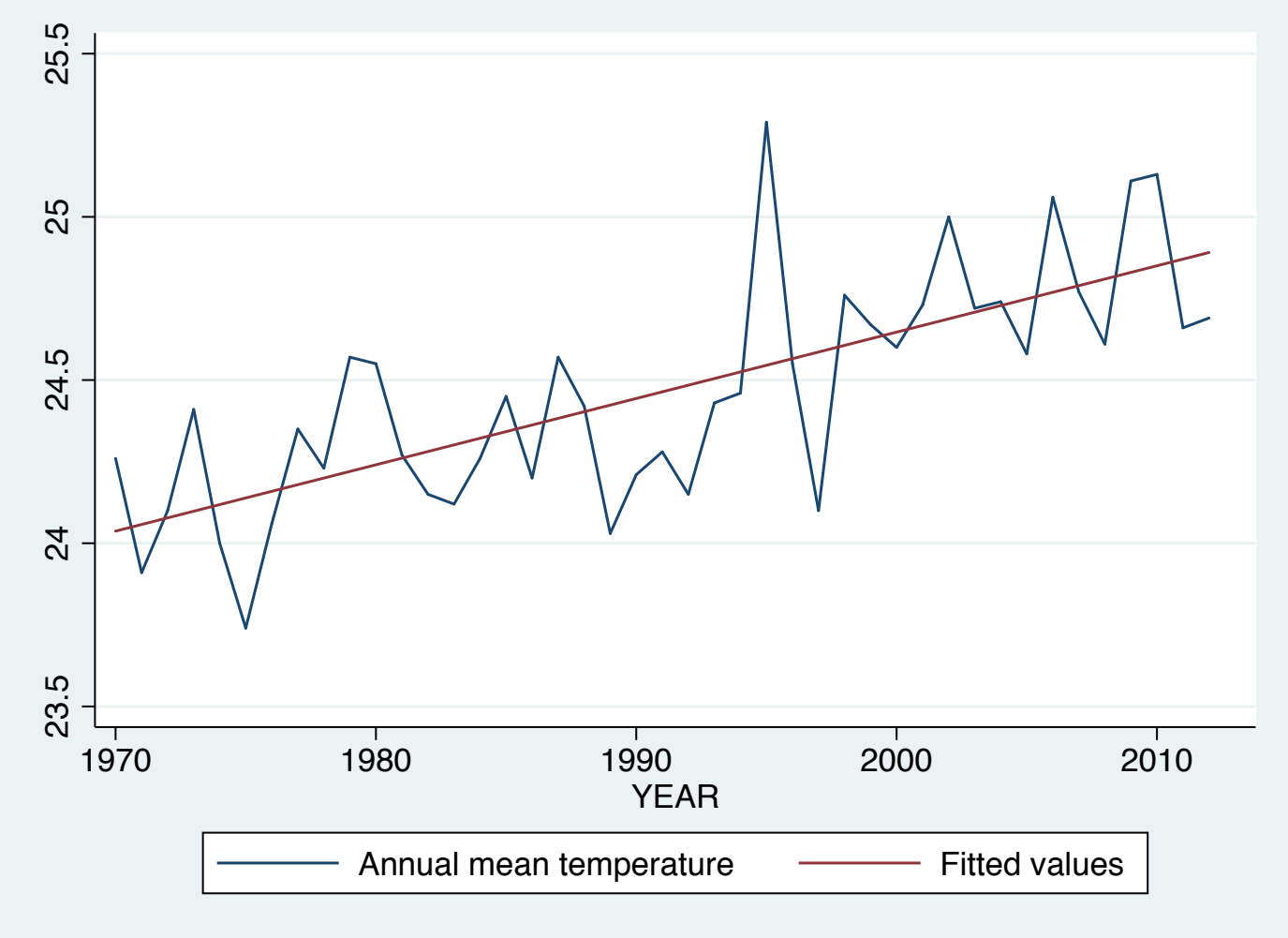
Climate change – Winter mean temperature in North India



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Global warming and local air pollution have reduced wheat yields in India

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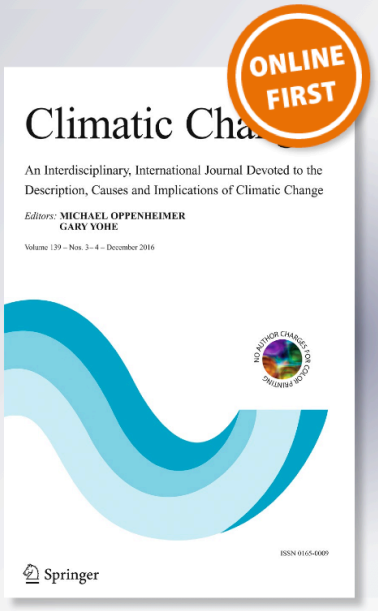
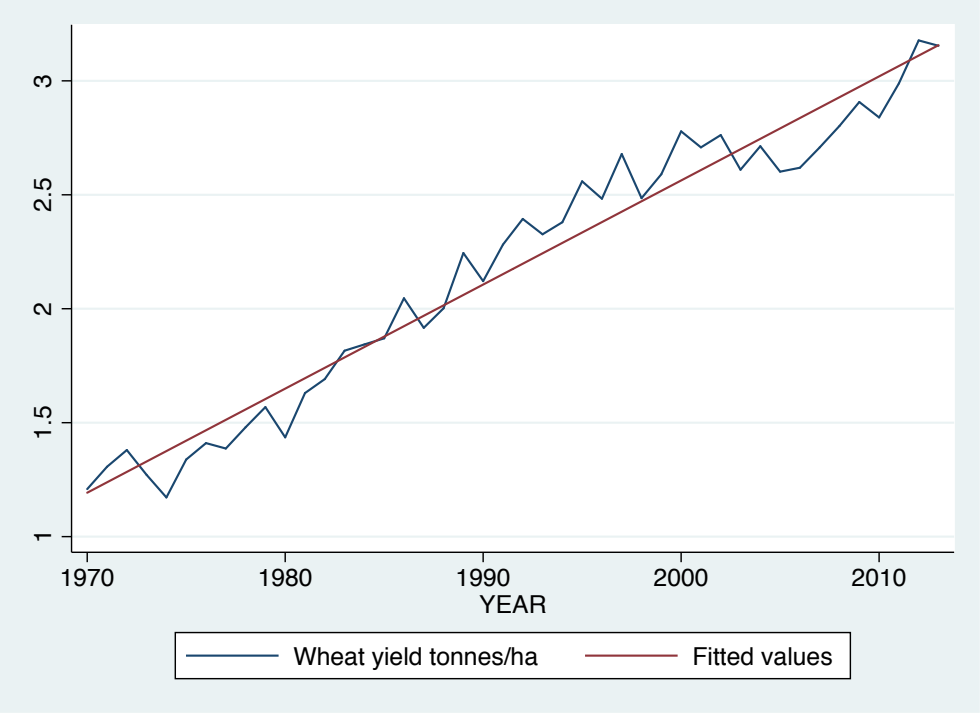


Springer

- "Yields are estimated to be about 5.2% lower than they would have been if temperatures had not increased during the study period."
- How did we arrive at this conclusion? Yields went UP along with temperatures!



- Of course, yields went up due to capital investments and technological progress, not because it got hotter.
- In order to know whether the climate has impacted yields, the data have to be *de-trended*, that is the trends in the variables have to be subtracted from the variables themselves. The de-trended variables (blue curves minus red lines) are shown in the bottom of the figure.

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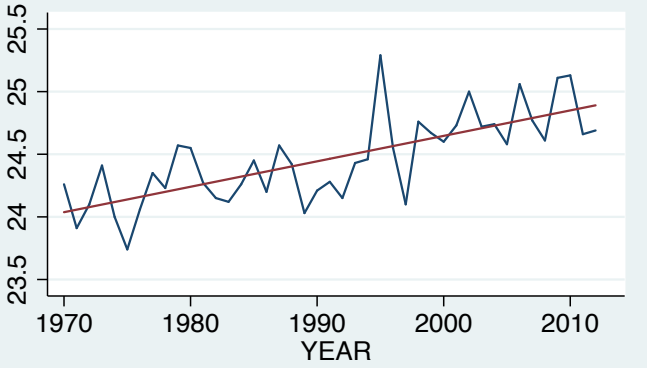
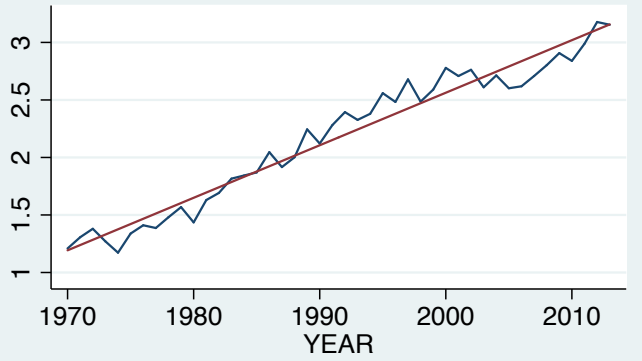
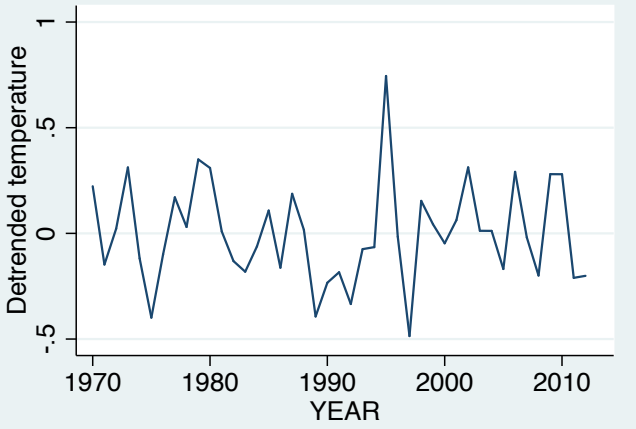
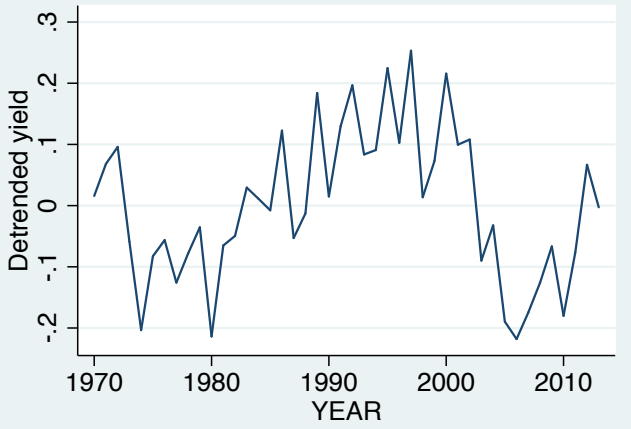
Climate change

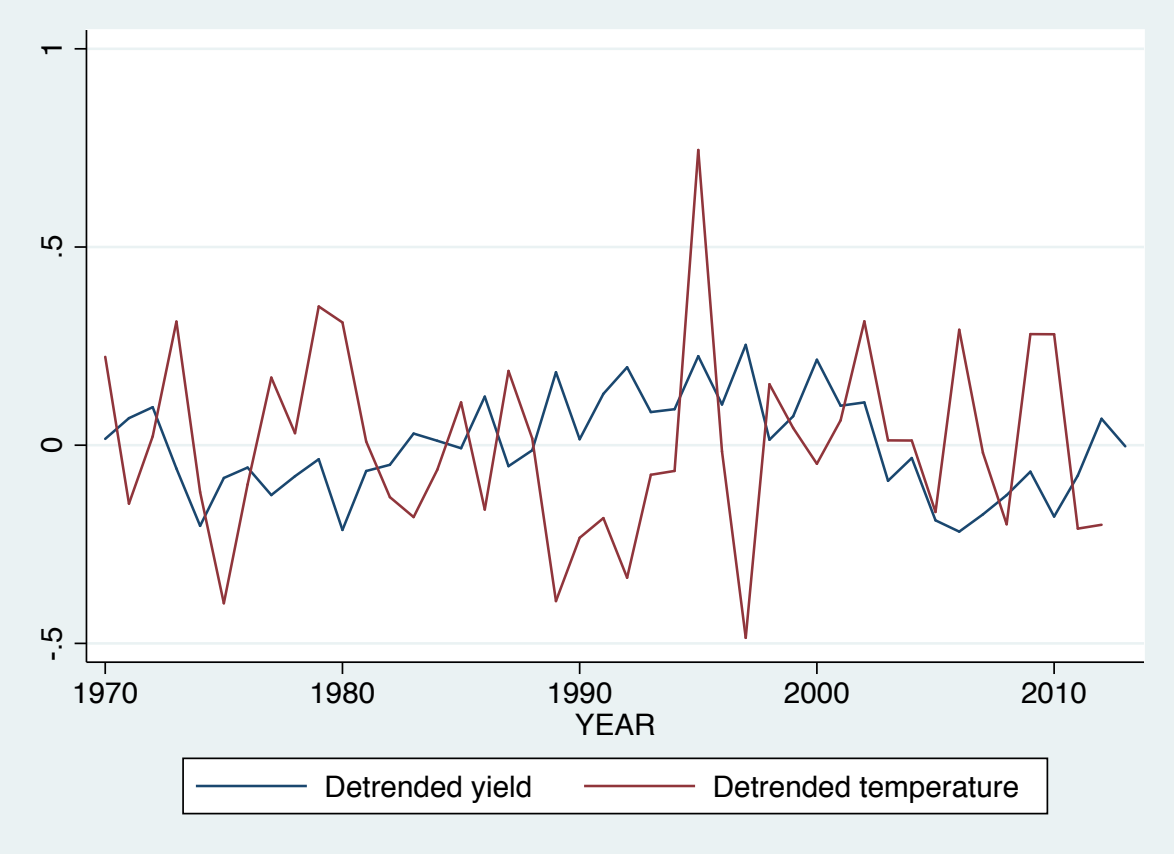








- The final step is to calculate the extent to which the yield goes down when the temperature goes up.
- Here it is seen that the de-trended yield tends to be positive when the de-trended temperature is negative suggesting a negative effect of temperature on yields.



- The illustration here used a single time series for all of India. To make the estimates more precise and reliable, econometricians prefer the use of several time series, for example, one for each district, that are together called a panel.
- In this paper, we used data for 208 wheat-growing districts over 29 years.

- But this is just one study. Other studies have found similar results on warming and wheat yields using different data sets – for example, a panel of countries.
- Rice yield and production in India have also been shown to be affected by warming and air pollution. Data used were a panel of states (Auffhammer et al, 2006). In this study, air pollution is shown to weaken the monsoon, reducing rainfall.
- Crop yield declines are of the order of a few percentage points, thus far. (Ozone pollution may have larger effects but studies based on actual farm yields are lacking.)
- Other crops have also been shown to be affected by warming – e.g. maize and cotton.

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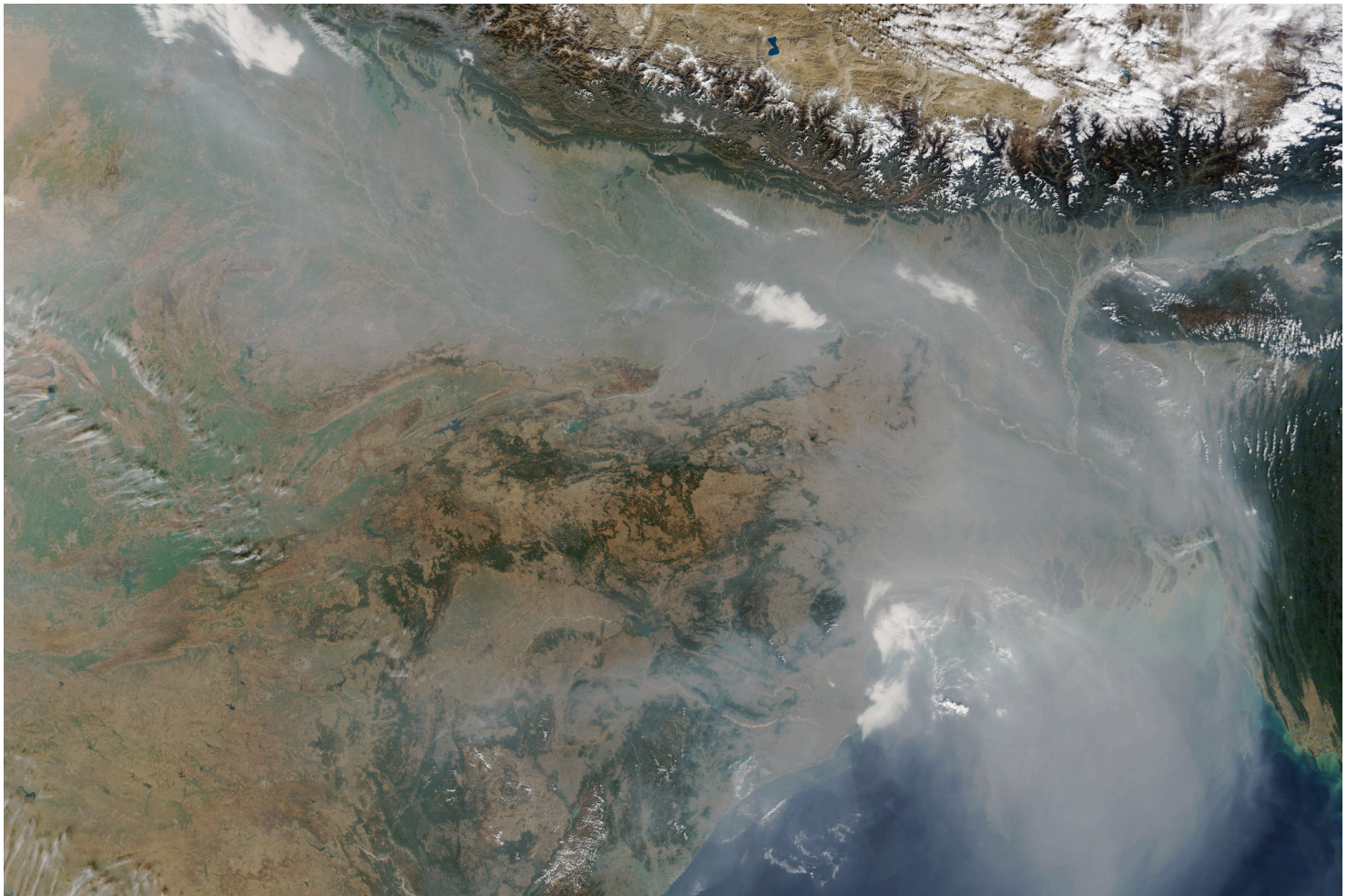
Not only agriculture

- Ambient temperatures have non-linear effects on worker productivity, with declines on hot days of 4 to 9 percent per degree rise in temperature. Sustained heat also increases absenteeism. Our estimates imply that warming between 1971 and 2009 may have decreased **manufacturing** output in India by at least 3 percent relative to a no-warming counterfactual. (Somanathan, Somanathan, Sudarshan and Tewari, 2016)

Air pollution

- A common mis-conception is that air pollution is an urban problem…



Source: NASA via Anindya Upadhyay, Bloomberg 7/7/2016.

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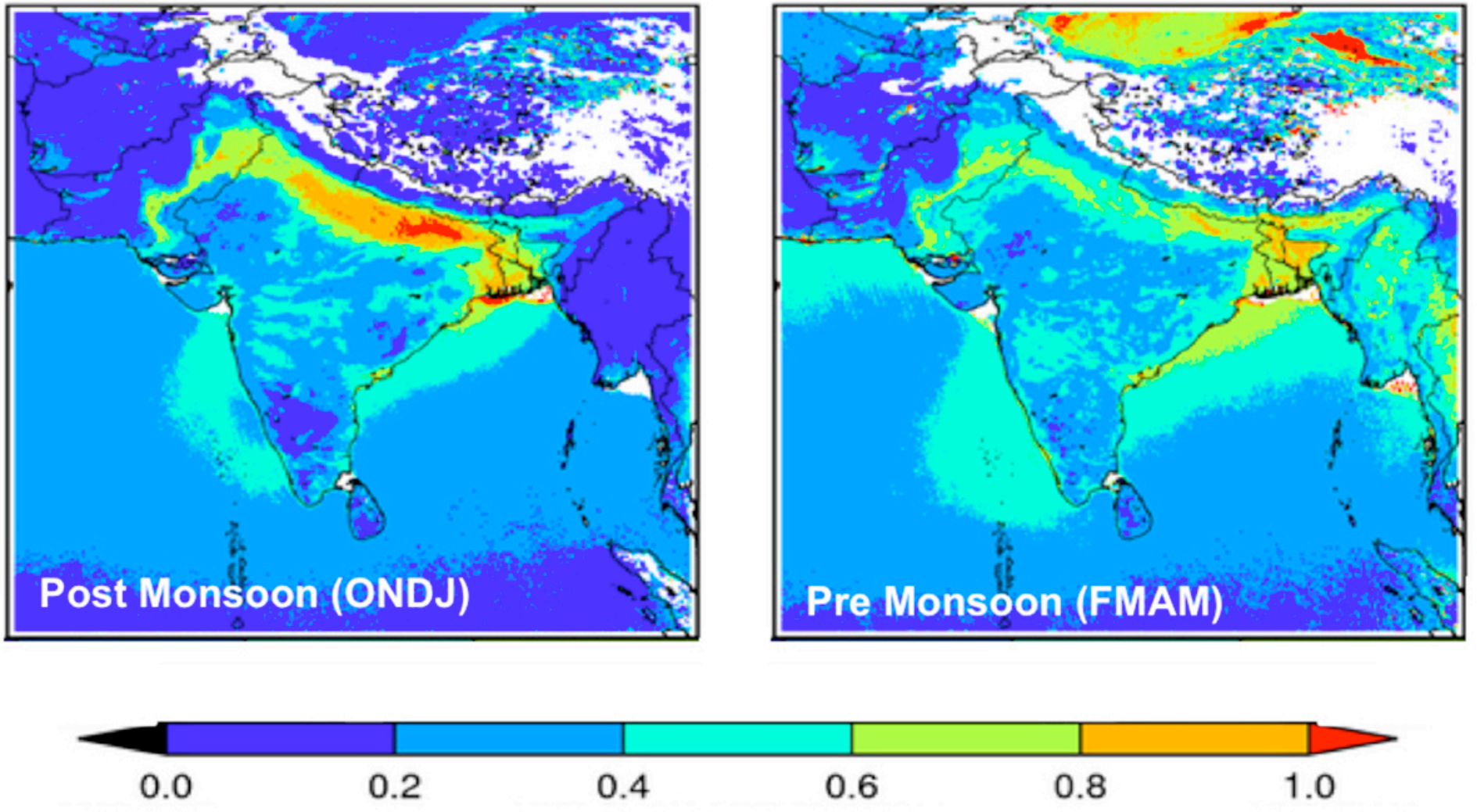
Aerosol optical depth



Source: Pawan Gupta USRA/GESTAR/NASA
via Anindya Upadhyay, Bloomberg 7/7/2016.

- We have already seen that air pollution has impacted yields of wheat and rice.
- Of course, it also affects health – increases the risk of heart attacks and strokes, and cancer, just like smoking.
- The next slide has a graphic image, so if you like, look away.

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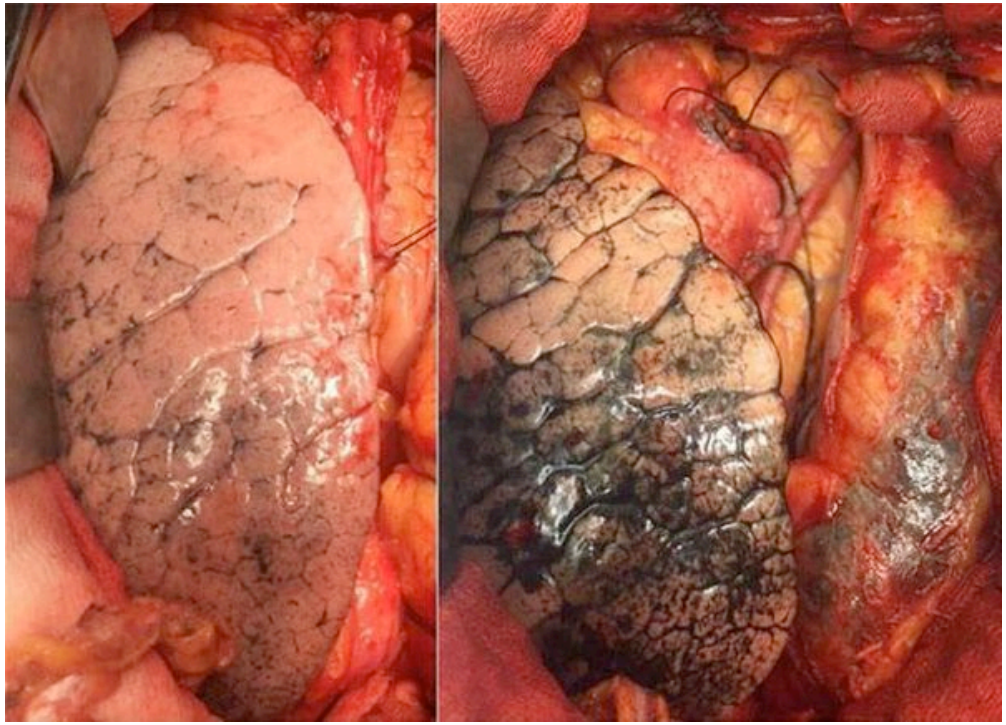
Heart surgery patients' lungs



Source: Dr Trehan, via @ArvindKejriwal

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- Unlike smoking, it's not a choice made by an individual.
- We have clearly reached a crisis stage.
- Why has this been allowed to happen?

- Reducing air pollution is complicated because it has many sources, among them
- Coal-fired power plants
- Vehicle emissions
- Crop residue burning
- Cooking and heating fires
- Rubbish burning
- Road and construction dust and field dust.

- The most important reason it is hard to tackle air pollution is that feedback processes to correct damaging behavior are weak.
- If a company sells a dangerous product (Samsung Note 7) people quickly hear about it and avoid it. The manufacturer acts fast to change the product otherwise it goes out of business.
- But air pollution doesn't kill you like a lion.
- It acts slowly and invisibly.

- And no one is selling clean air. (Except the air purifier companies.) The only practical way to reduce the air pollution is for governments to take action.
- Individual actions aren't going to happen because they don't help the individual much, they mostly help everyone else. It's easier to let someone else do it.
- But political feedback processes are much more diffuse than market feedback processes.

- To transmit what you want to a company, you simply don't buy products you don't like and buy products you like.
- To transmit what you want to a government, you can only vote in an election, or join a demonstration or sign a petition.
- But elections are about lots of issues, not just air pollution. And it's always easier to just let someone else take the trouble to let politicians know what you want.

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Improving environmental policy - Transparency

- Clearly, public awareness matters for policy-makers. No awareness, no pressure to do anything. From a politican's perspective, it's better to focus on things the public clearly cares about.
- Awareness, however, is itself affected by policy. Most obviously by monitoring and measurement. If the pollution monitors didn't show that Delhi's air quality was the worst in the world, the media and the courts wouldn't be making such a fuss about it.
- So better monitoring and **transparency** can help. Monitoring data should be on the web and easily re-transmitted.

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You get what you pay for

- Like most good things, a clean environment doesn't come for free.
- Regulatory capacity in India is low because funding is low. More funding is needed to hire many more scientists in the Pollution Control Boards, and monitoring equipment and staff.
- Most coal power plants already have electrostatic precipitators to remove smoke from the emissions. But how well are they working? The Pollution Control Boards have very limited capacity to monitor the actual functioning.
- Industries will have to be taxed to obtain a steady source of funding for regulation. This will be beneficial for industry in the long run because it will enable more scientific and efficient regulation that avoids crises and sudden clamp-downs.

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You get what you pay for

- Some pollution problems are amenable to the use of taxes or fees.
- For example, solid waste like plastic bags and bottles.
- A disposal tax on manufacturers in proportion to disposal costs would incentivize manufacturers to make biodegradable or recyclable products.
- If the revenue was distributed to municipal corporations in proportion to population, they would also have the means to collect and properly dispose of any remaining waste.

- Vehicular congestion and pollution is also best tackled through a road use tax or congestion charge.
- In the absence of a road use fee, every improvement to infrastructure encourages more driving.
- More buses would also help only a little, because only the poor would use them. It won't get anyone out of their cars.
- A road use fee would discourage driving and raise revenue for better public transport, pavements, and bicycle lanes. Unless public transport is of high quality and convenience, the upper and middle classes won't get out of their cars and use it.

Taxes work - 1

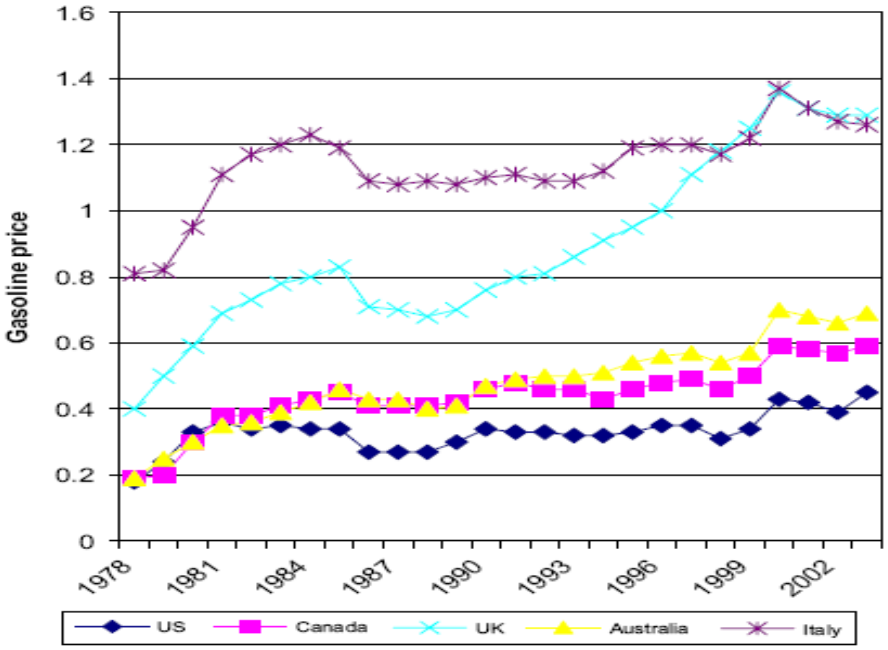


Fig. 1. Price of gasoline in selected countries. This diagram shows the nominal price paid by consumers in the five countries. Gasoline is much cheaper in the US, Canada or Australia than in the UK or Italy with the main reason for these differences being the differences in tax in each country.

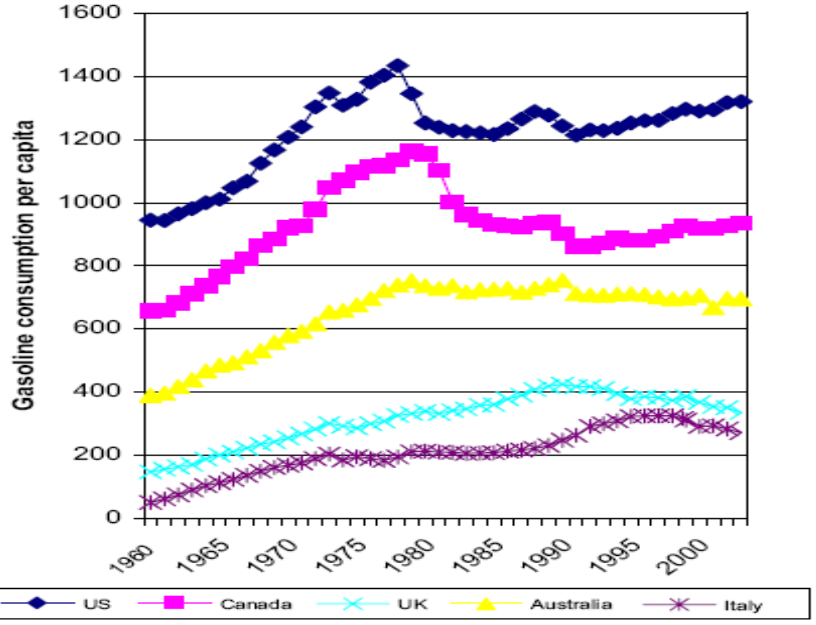
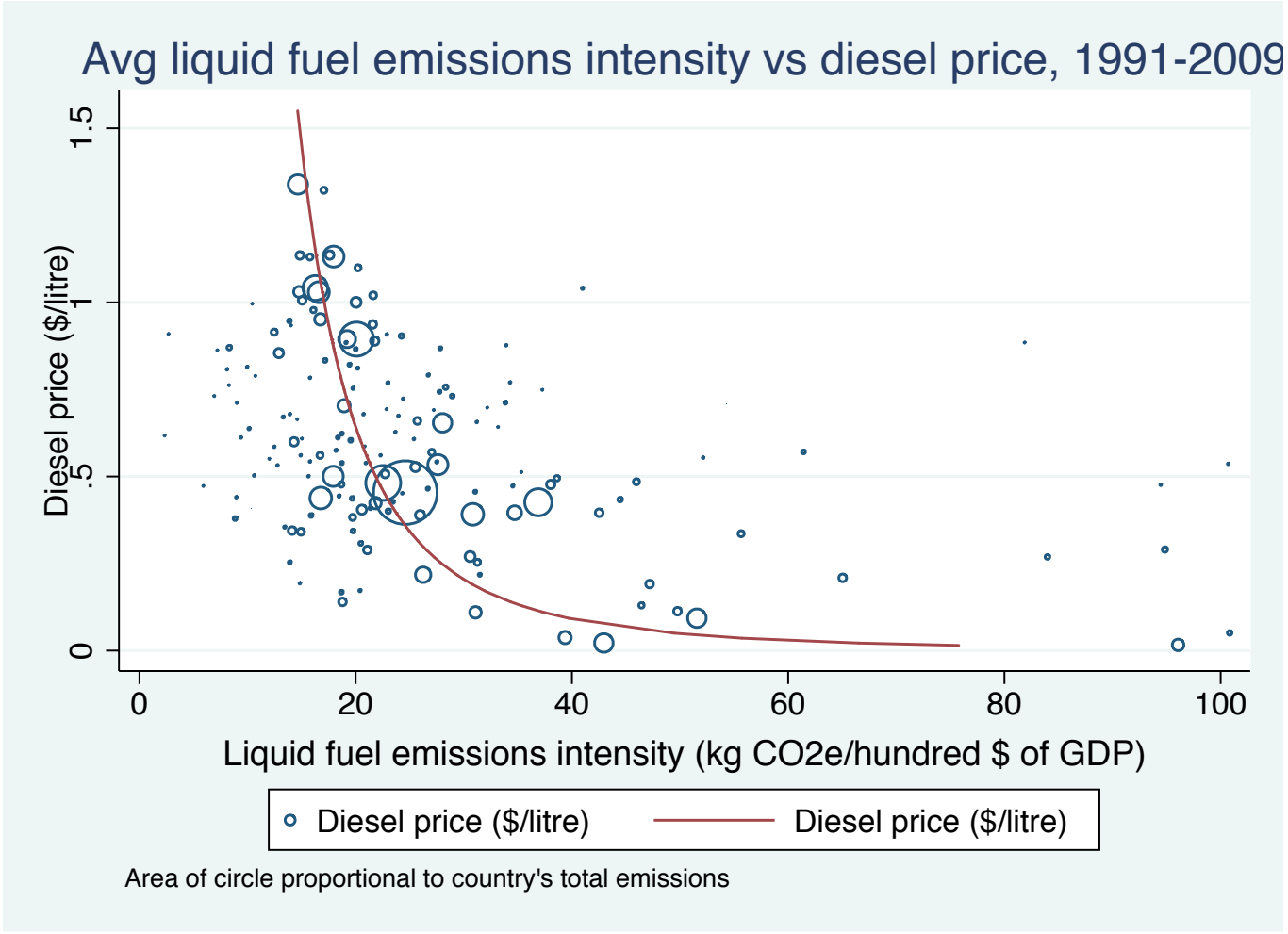


Fig. 2. Demand for gasoline in selected countries. This diagram shows the corresponding consumption of gasoline per capita in the five countries. We see that the ranking order is preserved and consumption is higher in those countries where price is lower.

- Source: Thomas Sterner (2007) Energy Policy (2007) 35: 3194–3202

Taxes work - 2



Source: Somanathan et al (2014), IPCC 5th Assessment Report, Working Group III, Chapter 15.

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Changing lifestyles

- Can be done by changing prices.
- Tax activities that should be discouraged – activities that cause pollution for example.
- Subsidise activities that are to be encouraged.
- This is likely to work better than telling people not to switch on their air-conditioners.
- Environmental consciousness and moral suasion have an important role to play.
- However, that role is mainly to raise issues to the point that they influence public discourse, that can then prompt state action through taxation and regulation.

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Raising prices - 1

- Easy to say: raise prices. That loses elections!
- Not always – gradualism helps. Diesel price increase of 50 paise/liter per month defused opposition.
- Moreover, a gradual predictable increase is always preferable because it reduces disruption. In any case, people and firms need time to change their behavior and buy new equipment.

Raising prices - 2

- An important reason that price increases are resisted by the public is that the public has no confidence that the higher prices will lead to better service.
- For example, water supply in Indian cities is of very low reliability and quality. (Reliability = quality because pressurized pipes prevent contamination from leaks and sewage).
- But low water prices means there is no money for investments to improve the quality and reliability of supply.

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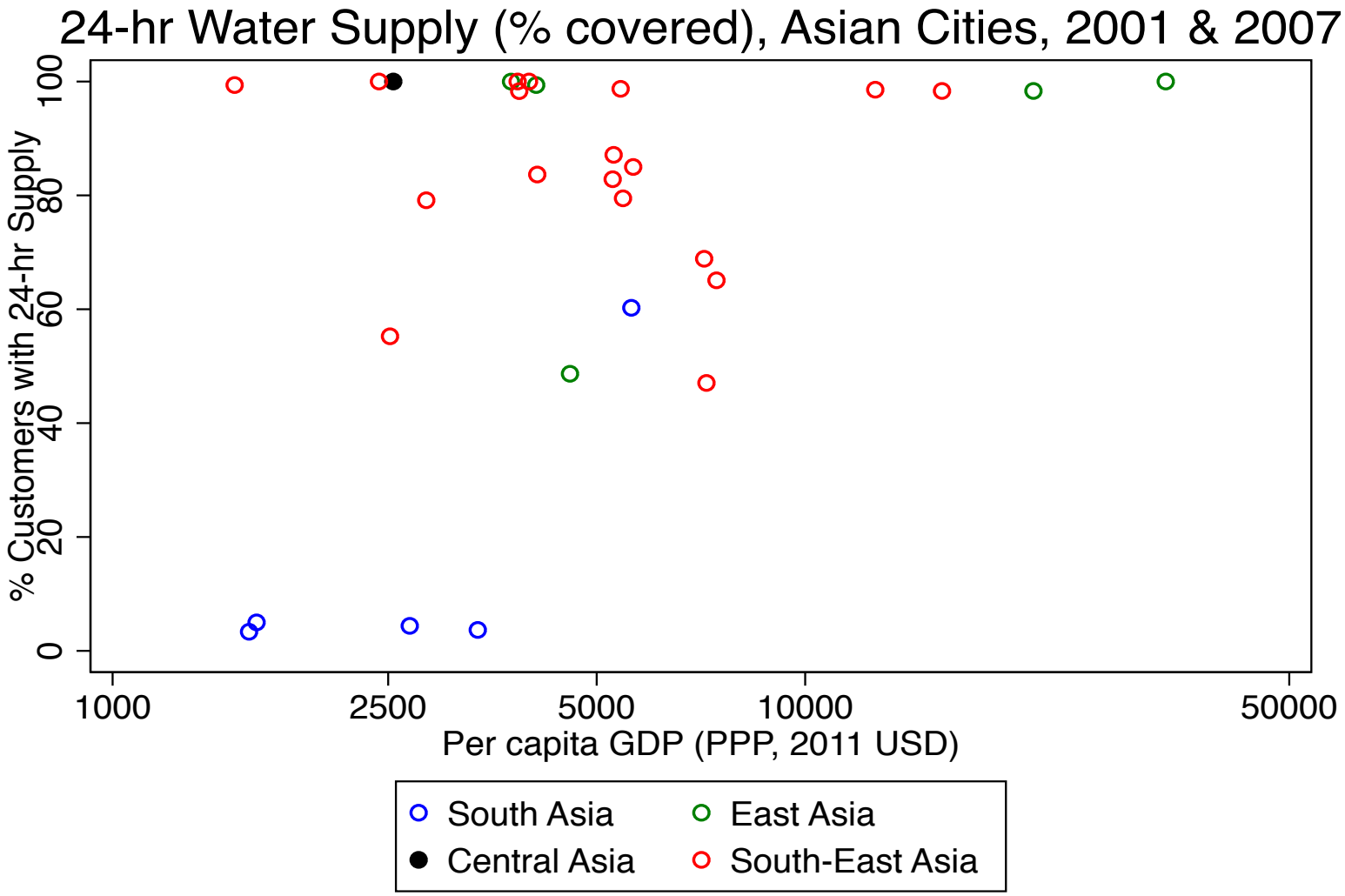
This is not just a problem of poverty



Source: Somanathan (2016). https://edi.opml.co.uk/research/path-finding-papers/

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Experimentation

- Make the investment and provide high-quality supply in a small area. Then raise the price in that area.
- Use the revenue to extend the improvements, then raise the price in those areas – etc.
- The same principle applies to electricity pricing, congestion pricing and many other pricing reforms that can improve the situation.
- But experimentation without monitoring and documentation is useless because you can't learn from either failures or successes.

- Governments are bad at experimenting because bureaucratic incentives are hostile to failures.
- Need an active policy to encourage small-scale experiments (with monitoring and documentation) that can be scaled up if they work.
- This is a major advantage of decentralized governance. It allows different localities to experiment.

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- Long-term planning is essential to reduce air pollution.
- For example, the government has moved forward the timetable for the introduction of Bharat VI standards for new vehicles and fuel quality to 2020 from 2024.
- This will take time to have an effect. Older vehicles will continue to run and pollute.
- But there are a few areas where quick progress is possible.

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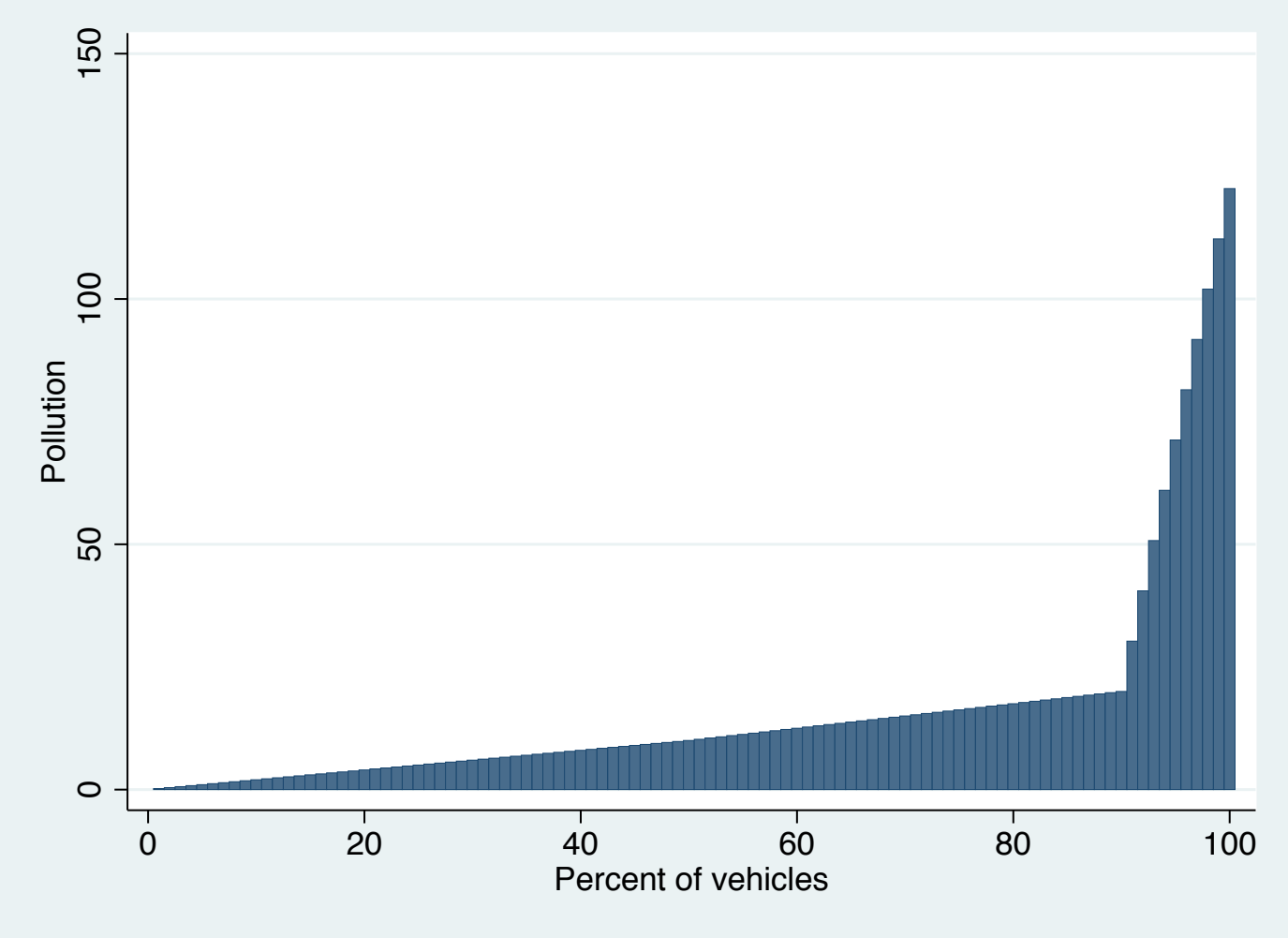
Crop residue burning

- There is a machine to sow wheat that does not require removing rice residue, called the Happy Seeder.
- No more costly than conventional seeders on net (Ridhima Gupta, *Climate Change Economics*, 2014, 5(4) 1450012).
- A concerted push to subsidize it and push it out in the north-western states could make a big difference before next winter. PAU has the expertise.

Example of pollution distribution



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- In this made-up example, the worst 10% of vehicles account for close to 50% of the pollution.
- If they are taken off the road and their registrations cancelled, it would have a noticeable effect on air quality.
- We at CECFEE are planning a study to characterize the actual pollution distribution so that vehicles can be better targeted for removal.
- Going forward, it's necessary to make registrations temporary, not permanent, and put in an annual fee. The fee can made pollution-dependent. This would encourage manufacturers to switch investments to cleaner vehicles.

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Peering into the future

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- I mentioned some losses from global warming or climate change.
- But these are, although not negligible, not the main reason that scientists are alarmed about warming.
- The far more important reason is that global warming can affect us in very many ways. It takes us into the realm of the unknown.
- For example, a rise in average temperature also implies a rise in the frequency of very hot days. Extremes also increase.
- And we will get extremes we have never experienced.

- For example, we have recently experienced a heat wave last summer in Andhra Pradesh and Telangana that may have killed thousands of people.
- What will happen when we get a much bigger heat wave that kills tens of thousands?
- This could trigger a panic.
- What if there is a major crop failure? A slide into a situation of conflict could cause investment to dry up and destroy the economy.
- Emergency options such as geo-engineering would have to be considered, and may have to be used.
- This could trigger international reactions.
- We need to plan for these eventualities treating climate change not as an environmental problem, but as a national security issue.

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Technological changes

- There are also good things coming. For example, new gene editing technologies can be used to breed new crop varieties much faster than traditional breeding.
- This could help in making crops more resistant to heat and droughts that will come with climate change.
- New technologies are allowing air pollution sensors that cost only 1% of what current technologies cost.
- Battery costs are falling rapidly and are going to soon make renewable electricity from solar and wind storable and dispatchable.

- Accelerating these developments and putting them to use for the general good will need good public policy. We need
  - a major push to develop gene-editing to breed heat and drought and flood-resistant crops.
  - Electricity pricing reforms to take advantage of renewable and battery cost declines
- This requires collective ambition that could have enormous payoffs.
- Again, we need public policy experiments to enable these development to actually happen. Otherwise, we may not reap the benefit of these developments.
- And with climate change accelerating, we may not have much time in which to do so.