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Asbestos, leaded petrol, and other aberrations: Comparing countries' regulatory responses to disapproved products and technologies

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Industrial innovation churns out increasingly unnatural products and technologies amid scientific uncertainty about their harmful effects. We argue that a quick regulatory response to the discovery that certain innovations are harmful is an important indicator for evaluating the performance of an innovation system. Using a unique hand-collected dataset, we explore the temporal geography of regulatory responses as evidenced by the years in which countries introduce bans against leaded petrol, asbestos, DDT, smoking in public places, and plastic bags, as well as introducing the driver's seatbelt obligation. We find inconsistent regulatory responses by countries across different threats, and that countries' level of economic development is often not a good predictor of early bans. Moreover, an early introduction of one ban is not strongly related to the relative performance in regard to another ban, which raises possible questions about the coherence of regulatory responses across different threats.

Keywords: Innovation, regulation, government regulatory capacity, innovation systems, ban, manufacture of doubt

JEL Codes: O38

1. Introduction

Industrial innovation requires the continual invention and production of increasingly unnatural products and materials, such as chemicals like leaded petrol or glyphosate, or processes like fracking. As the simplest and naturally occurring substances and products are the ‘low-hanging fruit’ that are discovered and commercialized faster, subsequent innovation is increasingly artificial. Innovation from simple recombinations of basic elements occurs first, and more complex recombinations occur later (Weitzman 1998). These innovative technologies and products can be approved for sale if they are useful in satisfying certain needs, although the processes of evaluating their safety are increasingly difficult and uncertain (Mulgan 2016). Although they may pass initial regulatory approval, nevertheless it is not always the case that these innovative new products and processes are harmless to humans, animals, and the wider environment, or that they can be easily broken down and reintegrated into the environment at the end of the product’s life course.

The challenge for business firms, who, despite the current salience of grand sustainability challenges, have for long prioritized profit-maximising goals over social and environmental well-being (Giuliani 2018; Wettstein et al. 2018), is to push these products through a few hoops of regulatory approval, after which they can be unleashed in markets. The longer-term environmental and public health effects of new technologies, including the possible interactions of these materials and chemicals, may not be well understood from regulator’s laboratory tests. Furthermore, the assessment of emerging technologies is difficult because it is not clear how technologies will evolve, it is hard to predict who will benefit or suffer, and it is impossible to define what the counterfactual to any innovation is (Mulgan 2016). Moreover, once these products are released into the economy and the environment, the political difficulties of changing consumer habits, as well as industrial organization of production and distribution, will hinder attempts to remove these products from circulation even if they are discovered to be harmful. Furthermore, it is very difficult to prove that a substance is actually harmful – for example, Imbens (2010) explains that there remains a lack of convincing evidence that smoking truly causes cancer, according to the usual standards for medical evidence, because of ethical difficulties in setting up a randomized controlled trial (if individuals in the treatment group are obliged to become smokers). For society to benefit from 'responsible' innovation, new technologies should be assessed not only at the time of their introduction, but also in the years after introduction, as new information emerges regarding their evolving uses and wider consequences (Stilgoe, Owen, and Macnaghten 2013).

A further complication is that innovating firms may have strong interests in promoting their sales, and engage in lobbying and rent-seeking behaviours, often exploiting their economic power to gain or influence political power (Zingales 2017) and to build favourable relations with regulators to the dissemination of deliberately misleading information (Monbiot 2006). For example, Goldenberg (2013) reports that, between 2002 and 2010, anonymous billionaires donated $120m to more than 100 anti-climate groups working to discredit climate change science. Their investments appear to have paid off, because in 2017 the Trump administration withdrew from the Paris agreement on climate change, and the White House no longer seems to take climate change seriously (Malakoff and Mervis 2017). Economic analysis of the regulation of harmful products and technologies amid uncertainty and deliberately manufactured doubt is still underdeveloped, however (Bramoullé and Orset 2018).

Alongside the trends of increasing innovation and the multiplication of new molecules, chemicals and products, new illnesses and diseases are emerging in modern societies, including those of affluent countries (Luzzati, Parenti, and Rughi 2018), and their origins are not well known. For example, the prevalence of allergic sensitization has increased in most developed countries over the last century (Holbreich et al. 2012).[1] A recent meta-regression analysis reports a significant decline in sperm counts in the last 50 years, driven by a 50–60% decline among men unselected by fertility from North America, Europe, Australia and New Zealand (Levine et al. 2017). Anaphylactic shocks, which are life-threating allergic reactions, and for which the causes are unknown in 32-50% of cases, have seen their frequency jump from 20 to 50 per 100’000 per year over the period from the 1980s to the 1990s (Simons 2009). More worryingly, the World Health Organization (WHO) has estimated a total of 7 million premature deaths in 2016 due to exposure of individuals to fine particulates (WHO 2017) – half a million in Europe alone (EPA 2017). Exposure to toxic emissions of chemical and other plants has generated an impressive death toll in Russia in the pre-Gorbacev period and more recently in China, with the emergence of hundreds of cancer villages in the vicinity of industry sites (Liu et al. 2010), whose existence the Chinese Ministry of Environmental Protection had to acknowledge in 2013, even though evidence of their existence started to emerge in the 1970s (Nguyen 2015). This could indicate that modern technologies have harmful health effects in ways that our regulators still do not fully understand. It also underlines the importance of an effective regulating body that can swiftly act to ban certain products and technologies when public health risks are discovered.

Given the unpredictability of the harmful impacts of certain innovative products and production processes, we argue that a quick regulatory response to the discovery of a harmful impact is an important indicator for evaluating the performance of an innovation system. A ‘laissez faire’ approach to the regulation of new technologies has not worked in any known society (Mulgan 2016). To the extent that the goals of an innovation system are overall societal prosperity and well-being, the ideal innovation system will produce many new welfare-

[1] Meanwhile, through the lens of a natural experiment, the Amish – a society that has rejected modern technologies – have lower rates of asthma (Holbreich et al. 2012); although it is not clear exactly why.

increasing innovations while simultaneously banning those innovations that are discovered to be harmful.

We contribute to the literature by providing a quantitative analysis of countries' responses to the challenge of banning harmful technologies, as well as focusing on several technologies at the same time, to investigate whether countries' regulatory responses are coherent across technologies. These contributions are important given the limited statistical analyses in the previous literature. One of the few statistical contributions to the cross-country analysis of environmental regulatory response and economic performance is Esty and Porter (2001), who focus on air pollution (urban particulates and urban SO_2 concentrations) and energy usage per unit of GDP. Other studies have looked into the impact of environmental regulations on firm-level response in terms of e.g. innovative inputs as R&D expenditures (Jaffe and Palmer 1997; Lanoie et al. 2011) or innovative outputs such as patents (Brunnermeier and Cohen 2003; Johnstone and Haščič 2010; Lee, Veloso, and Hounshell 2011), often reporting compelling evidence that regulations have positive influence on environmental-friendly innovations (Ambec et al. 2010; Porter 1991; Porter and van der Linde 1995; Brunel 2015; Brunnermeier and Cohen 2003; Lanjouw and Mody 1996; 1996; Popp 2005). However, as suggested by Esty and Porter (p. 78), environmental policy making has been 'more an art than a science' and 'statistical analyses of the determinants of environmental performance across nations have been rare - indeed, almost non-existent'. These considerations are still largely valid today, as to the best of the authors' knowledge, most research in this area of inquiry has traditionally relied on anecdotal evidence and case studies. To address this gap, we focus on the dates when countries implemented regulatory bans of specific products and technologies, focusing on asbestos, leaded petrol, DDT, tobacco (smoking bans), seatbelt obligations and plastic bags.

The paper is organized as follows. Section 2 develops our hypotheses. Section 3 describes how the database was assembled. Section 4 presents our non-parametric and parametric analysis. Section 5 concludes.

2. Conceptual framework

2.1 Background literature

The probability that a country endorses the 'precautionary principle' (Stirling 2017) and introduces a regulatory ban amid the ambiguities and uncertainties of assessing the technology, depends on many factors. On the one hand, there is uncertainty regarding the reliability of emerging scientific evidence of harmful effects. Uncertainty is reduced by scientific progress and the accumulation of knowledge, and possibly also by imitating other countries in the context of international policy diffusion, where other countries may have access to superior knowledge bases.[2] On the other hand, uncertainty may be increased by misinformation propagated by corporate lobbyists and their thinktanks. The wilful production of ignorance, known as 'the manufacture of doubt' (e.g. Bramoullé and Orset 2018), has been a feature of industry since at least the appearance of evidence on the harm of cigarette smoking in the early 1950s (Proctor 2012; Harford 2017). In the 1940s, for example, German tobacco manufacturers established their own 'scientific' journal and also a 'scientific' academy to support the tobacco industry, then under siege from public health activists (Proctor 2012). Uncertainty generally trends downwards over time, as scientific knowledge accumulates, although may be stirred up

[2] Although countries may have access the same global scientific knowledge base, as published in international scientific journals, nevertheless countries may look for different answers to different questions and they may interrogate different evidence bases (Millstone et al. 2004, 2009), and the databases used to make regulation policy may be proprietary and hence confidential (Myers et al. 2016). This would further dilute any relationship between scientific evidence and policymaking.

by misinformation strategies. Hence there is a struggle between a mounting scientific evidence base, on the one hand, and corporate misinformation, on the other.[3]

Another factor is the efficiency of a country regulatory institutions, in the face of corruption and bribery. The capacity of countries to keep pace with technologies that are proven to be harmful is important and, traditionally, economists have considered regulatory action to be one fundamental way to address the negative externalities of the business sector (Friedman 1970). More recently, this view has been subject to criticism because, as business activities became more globally dispersed, it became clear that the negative impacts of harmful innovations could also affect countries with poor regulatory capacity and governance gaps (Scherer and Palazzo 2011), while also countries with strong institutions have also sometimes proven to be too slow to address regulatory problems (Hart and Zingales 2017).

Still another factor could be opposition to the ban from the public domain. This could be due to consumers who do not wish to change their habits (for example in the case of the indoor smoking ban), possibly spurred on by advertising efforts by firms. Note also that employees at firms that produce toxic substances may be opposed to regulation if they fear losing their jobs (Dodic-Fikfak et al. 1999).

The probability of a ban is therefore increased by the advance of science and by strong regulatory institutions. In contrast, firms fearing regulatory action may seek to stir up uncertainty and doubt, to invest in lobbying, and generate and distribute misinformation and false research publications also to influence public opinion. If scientific knowledge remains uncertain, and public opinion remains confused, firms may succeed in delaying regulation even if the gains for the firm are small in regard to the benefits for society as a whole. For example,

[3] "As scientists become increasingly convinced that the activity is harmful, the industry first devotes more and more resources to falsely reassuring the citizens. This yields increasingly large welfare losses. When scientists' belief reaches a critical threshold, however, countering the scientific consensus becomes too costly and the industry abruptly ceases its miscommunication." (Bramoullé and Orset 2018, p120).

Needleman (2000) writes that firms resisted regulation against leaded petrol even though the estimated R&D costs for developing alternatives were only thought to be $100 million.

2.2 Stylized regulatory scenarios

Based on these considerations, we consider two stylized possible scenarios: a first scenario (i.e. the standard scenario) is the most simplistic but also the most aligned with conventional, 'trickle down' economics, where economic growth is seen as a key driver of institutional fixes, and, under this scenario, the most economically advanced countries are expected to be the first to ban because they have well-functioning institutions (including the institutions of economic regulation), a better innovation system that provides alternatives to the contested technologies, and the population have progressive values that exert pressure upon regulators to fulfil their expected roles. Against this background, we envisage a second scenario where the response from countries is more fragmented (i.e. the fragmented scenario), such that economically advanced ones are not expected to respond more promptly than other less economically developed ones to the threats posed by harmful innovations. We discuss these two scenarios below.

2.2.1 The standard scenario

The evidence in Esty and Porter (2001) shows that wealthy countries have better environmental regulation than poorer countries, and better environmental performance in terms of levels of urban particulates, urban SO_2 concentrations, and energy usage per unit of GDP. Relatedly, the literature on policy diffusion suggests that late policy adopters tend to be poorer than early adopters (Shipan and Volden 2012).

Advanced countries may therefore be better positioned to take strong regulatory action in the case of harmful innovations. This could be because the level of economic development of a country (proxied by GDP per capita) reflects the strength and reliability of a nation's institutions. Alternatively, this could be because their innovation systems are more efficient with regards to the introduction as well as the withdrawal of new products and technologies, and also because these countries – positioned at the global knowledge frontier – can better access and interpret the scientific evidence that a particular innovation is harmful. In this case, the probability of a ban would be increased because uncertainty is low. According to this first scenario, therefore countries with a higher level of economic development will be early to ban harmful technologies. We consider that under this scenario, the country regulatory responses will be coherent across threats: i.e. countries that are early to ban one harmful technology will be early to ban another harmful technology.

2.2.2 The fragmented scenario

Another scenario is also possible. It comes from distinguishing between countries according to the priorities given to the economic domain in contradistinction to the domain of social welfare and public health. This could be reflected in terms of public opinion being aligned to corporate interests, and firms making large profits and being able to effectively invest these in direct political influence and manipulation of the evidence base, in the context of a populist rather than technocratic government (Bramoullé and Orset 2018).

In 'pro-business' countries, previous efforts along certain technological trajectories (Dosi 1982) will result in accumulated capabilities, industrial assets and capacity, and – more generally – path-dependence and vested interests of profit-seeking firms. Innovation often requires large investment in sunk costs, but once the product is developed and commercialised, it generates large revenues for the innovating firm. Countries that contain a lot of innovating firms will therefore be under pressure (from firms, as well as employees and consumers) to continue allowing the sale of these innovations, even after they are discovered to be harmful to public health. For example, countries where large firms have strong vested interests in potentially harmful products may develop an elaborate infrastructure of think-tanks, lobbying groups, and fake grassroots community groups[4] funded by dark corporate money, to oppose the inconvenient scientific evidence. Monbiot (2006) describes how the same individuals and think-tanks, and the same strategies ('doubt is our product…'), were used by tobacco companies (in opposition of passive smoking regulation) as well as oil companies (in opposition to climate change awareness). Hence, 'pro-business' countries may have a well-developed 'denial industry' (Monbiot, 2006) that is not restricted to any particular industry but can be hired to prevent and delay regulation against a wide array of contentious products.

Other countries, that place more importance on social welfare as opposed to commercial interests, may have relatively under-developed firms, and (given their priorities) will not hesitate to regulate in favour of society rather than commercial interests, thus leading to earlier bans on harmful innovations. Hence, under this second scenario, the level of economic development may not be such a strong predictor for a regulatory ban; it is possible that the regulatory responses will be diverse across countries with similar levels of economic development. For instance, D'Orazio and Popoyan (2019) show that low-income countries and emerging economies are more active than high-income countries in adopting 'green regulations' in the financial system, which they explain based on the different goals played by central banks and the higher climate risks faced by banks in the lower income economies.

In this scenario, because of the different forces at play, we envisage that there will be a higher fragmentation in the regulatory responses across different threats, as, for instance, countries may have vested interests lobbying against one particular ban, but not against others, or its innovation system may have developed innovative skills to address the transition from a

[4] For example, Koch-financed activists of local chapters of the group 'Americans for Prosperity' knock on the doors of selected individuals to mobilise local opposition to public transport projects such as light-rail trains and bus routes (see https://www.nytimes.com/2018/06/19/climate/koch-brothers-public-transit.html).

banned technology to a new one, but it may not be equally capable of fostering such a transition in other industries, thus having less interest in favouring the ban in the latter case. Hence, to summarize, we see two alternative scenarios: the standard and the fragmented. In the standard scenario we expect countries with higher level of economic advancement to be first to ban, and to ban technologies coherently across threats. In the fragmented scenario, we expect to find more variability, such that regulatory responses across threats will be highly diversified and not correlated with countries' levels of economic development. We seek to assess which scenario fits best with our data.

3. Data on regulatory bans

Our unit of analysis is the product or technology. This bears some similarity to Comin and Hobijn (2010) on rates of technology adoption across countries, or Farmer and Lafond (2016) on rates of technological progress (i.e. Moore's law for various technologies). These technologies must be in use in a relatively large number of countries, before a regulatory response is implemented, so that there are sufficient observations for an econometric comparison across countries.

We focus on regulatory bans, rather than softer restrictions or phasing-out programmes, to have a relatively unambiguous dichotomous measurement of regulatory action. A ban is a low-complexity policy (Makse and Volden 2011) that is relatively easy to observe. The year of the ban reveals the national capability in taking regulatory action. However, even focusing on bans can be problematic. Sometimes partial bans are in place even if total bans are not in place. For example, there is sometimes confusion between when DDT was banned for agricultural use and when it was banned for any use (e.g. against mosquitos for purposes of disease vector control). In the US, asbestos is banned for some uses, although it is generally considered that, overall, asbestos has not been banned in the US (White 2004). We therefore seek to focus only on total bans. Where possible, we sought to ensure that the definition of the ban was coherent across countries regarding the regulation of the product or technology. Ideally there would be only one date for each country regarding the introduction of the ban, although this was not always clear. In the case where a country introduces its own ban years before signing an international convention (such as the Stockholm convention regarding the banning of DDT), we would prefer to focus on the year of the country's first ban, although if this information is not available, a unified database that reports the years when countries signed an international agreement such as the Stockholm convention could be useful, because it would be a consistent and standardized indicator across countries.

3.1 Criteria for choosing Technologies and Products

A first criterion for choosing technologies and products is that the phenomenon must be relatively recent, otherwise the issue might be seen as irrelevant today. The slave trade could be seen as a socially toxic process technology and bans on slavery display interesting statistical variation across a fair number of countries, although the long time elapsed since the slave trade suggests that it is of limited value for comparing innovation systems today.

A second criterion is that there should be sufficient variation across countries to enable a meaningful quantitative analysis. This requirement would not be satisfied in the case of the non-steroidal anti-inflammatory drug Vioxx (Rofecoxib), because there was only one producer, Merck, who publicly announced its voluntary withdrawal of the drug from the market worldwide on September 30, 2004. (Vioxx was withdrawn because of the discovery of undesirable side effects including increased risk of heart attack and stroke.) Another innovative product which would not satisfy this criterion would be chlorofluorocarbons (CFCs), for which production of new stocks ceased in virtually all countries at around the same time under the Montreal Protocol. Similarly, the Waste Electrical and Electronic Equipment (WEEE)

Directive was set up among European states to encourage the safe disposal and recycling of waste electronic and electric goods. WEEE was transposed into law by all 25 EU member states at the same time, in 2005, with the sole exceptions of Cyprus (1 year early, in 2004) and the UK (1 year late, in 2006).[5] WEEE therefore displays insufficient statistical variation across countries for our quantitative analysis.

A third criterion is that the public health concerns surrounding the technology must be sufficiently advanced that a sufficient number of countries have taken steps against the technology. For example, there is increasing concern about the public health risks of glyphosate (see e.g. Myers et al. 2016). In March 2015, Glyphosate was classified as ‘probably carcinogenic in humans’ by the World Health Organization's International Agency for Research on Cancer. At the time of writing, however, only 6 countries have taken, or threatened to take, regulatory action against glyphosate.[6] Neonicotinoids are another example where regulatory action has been introduced by a handful of countries only recently.[7] The herbicide Paraquat has also been banned by a number of countries because it is toxic to humans and animals, although we could not find data on many countries.[8]

Based on these criteria we decided to focus on bans, namely leaded petrol, asbestos, DDT, tobacco (smoking bans), seatbelt obligations and plastic bags.

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[5] See https://en.wikipedia.org/wiki/Waste_Electrical_and_Electronic_Equipment_Directive [accessed 26 July 2016].

[6] Those 6 countries are Colombia, Bermuda, El Salvador, France, the Netherlands and Sri Lanka (see https://en.wikipedia.org/wiki/Glyphosate [accessed 22 July 2016]).

[7] Those countries are: Canada, Italy, France, Germany and Switzerland introduced restrictions on neonicotinoids. See https://en.wikipedia.org/wiki/Neonicotinoid [accessed 31 October 2016].

[8] For example, only 12 distinct countries, mainly in Africa, have banned (types of) Paraquat: http://www.pic.int/Procedures/NotificationsofFinalRegulatoryActions/Database/tabid/1368/language/en-US/Default.aspx.

3.1.1 Leaded petrol

Leaded petrol is a suitable case because it is now banned by many countries. Tetraethyl lead was added to petrol to improve its combustion performance. However, doubts about the toxicity of leaded petrol started in the 1920s, it started to be phased out in the 1970s, and was only completely banned in the USA in 1995. It took over two decades for the US to remove lead from petrol, despite international evidence on the harm to child cognitive function and behaviour from lead exposure (Wilson and Horrocks 2008). In the US, aggressive lobbying was undertaken by the lead industry (Reyes 2015). It seems that safer additives to substitute for tetraethyl lead were not developed because of concerns about R&D costs (Needleman 2000).

Leaded petrol is a powerful neurotoxin, even at low doses (Aizer et al. 2018), with its strongest effects on young children. Reyes (2015) calculates that the *partial* phase-out of leaded petrol in the US during the 1980s had a causal effect of increasing each child's IQ by 6 points – a huge effect. Regrettably, leaded petrol is still widely used in a few countries (Iraq, Yemen, Algeria) despite the evidence on its subtle and insidious neurotoxic effects (lower IQ, antisocial behaviour, and even violent crime; Nevin 2000, 2007; Reyes 2015). Leaded petrol was also reintroduced in 2000 in the United Kingdom after pressure from classic-car lobby groups.[9] Leaded petrol continues to be used by small aircraft, which is detrimental to public health (Wolfe et al. 2016).

[9] The website of the Federation of British Historic Vehicle Clubs explains that: "The withdrawal of lead from petrol raised very real concerns about engine damage from exhaust valve seat recession (VSR) in older engines with cast-iron cylinder blocks and heads ... the Federation lobbied successfully to secure an EU concession for the sale of leaded petrol in the UK, a concession which survives to this day, although current sales outlets are few in number, and the uptake of the product is quite small." http://fbhvc.co.uk/legislation-and-fuels/fuel-information/ [accessed 25 Oct 2016].

3.1.2 Asbestos

Asbestos is a naturally occurring mineral has been used by humans for at least two millennia, once being hailed as a 'miracle mineral' for its ability to withstand fire and heat. However, asbestos exposure can cause serious and fatal illnesses such as lung cancer, mesothelioma, and asbestosis, with symptoms often emerging decades after exposure has ceased.[10] The toxicity of asbestos has been known for a long time. Insurance companies in the US and Canada stopped selling life insurance to asbestos workers during the 1920s (White 2004). Hence, if anyone was applying the 'precautionary principle', it was life insurance companies, not government regulators. Asbestos has now been banned by 55 countries worldwide[11] (with Australia being early to ban blue asbestos in 1967), but asbestos is yet to be banned in the USA where it is still used in construction. Asbestos comes in several different forms (six naturally-occurring silicate minerals, commonly known as white asbestos, blue asbestos, brown asbestos, and green asbestos), has many different uses (e.g. insulation, automotive brake shoes and clutch plates), and has been used in a wide range of countries in both tropical and cold climates. The most comprehensive dataset regarding asbestos bans refers to total bans. This encourages us to focus on the years when countries implemented total bans, rather than the first ban of a certain type or usage of asbestos. The USA was the second country to impose a partial ban of asbestos in 1973 (i.e. a ban regarding spray-applied surfacing asbestos-containing material for fireproofing/insulating purposes).[12] However, the USA is generally seen as being one of the last industrialized countries to ban asbestos (White 2004). Therefore, we focus on the years when a country implements a total ban on asbestos.

[10] Van den Borre and Deboosere (2014) write that mesothelioma has an average latency period of 37–45 years.
[11] http://www.asbestosnation.org/facts/asbestos-bans-around-the-world/.
[12] http://ibasecretariat.org/asbestos_ban_list.php.

3.1.3 DDT

The discovery of dichlorodiphenyltrichloroethane (DDT) in 1940s opened a new era of chemical control of the land, leading not only to its industrial mass production and consumption but also to the development of numerous other synthetic organic pesticides (Özkara, Akyıl, and Konuk 2016). DDT was initially used during the World War II to control malaria and typhus among civilians and troops, but was largely employed for its broad-spectrum activity against pests as an agricultural and household pesticide. Yet, as DDT became widespread, myriad problems in terms of human health and environmental hazard were being discovered and were discussed by Rachel Carson in her 1962 book 'Silent Spring.' DDT persists and bio-accumulates, as it has been found among animals across the whole food chain (Jensen et al. 1969). A biological study conducted in the 1950s showed increasing DDT levels in most human communities, mainly due to exposure to residues in food (Walker, Goette, and Batchelor 1954). Recognized as a global concern, during the 1970s and 1980s, agricultural use of DDT was banned in most developed countries, beginning with Hungary in 1968 followed by Norway and Sweden in 1970. In 1972, the U.S. Environmental Protection Agency (EPA) issued a cancellation order for DDT based on its adverse environmental effects. The worldwide ban for agricultural uses occurred by the 2001 U.N. Stockholm Convention on Persistent Organic Pollutants. Even today, DDT remains widespread in the environment especially in developing countries where it continues to be used for vector disease control (Beard 2012).

3.1.4 Tobacco

The cigarette is the deadliest artefact in the history of human civilisation (Proctor 2012). Smoking bans reduce exposure to second-hand smoke, which lowers the risk of heart disease, cancer, emphysema, and other diseases. Indoor smoke free legislation reduces health care costs, improves worker productivity, reduces the risk of fire in vulnerable areas, improves cleanliness, and reduces energy use via lower ventilation requirements. Research by tobacco companies has even shown that a number of well-established carcinogens are present at higher concentrations in second-hand smoke than in mainstream smoke.[13]

Smoking bans are included here because they show how a country's regulators respond to scientific evidence about the public health concerns of a certain activity. While bars and restaurants were initially concerned that smoking bans would affect their revenues, econometric analysis suggests that this is not the case, neither for early adopters nor for late adopters (Nikaj et al. 2017). Smoking bans have been implemented in a large number of countries, with Malaysia (1983) and Peru (1993) being the first to ban. To be precise, we focus only on bans relating to cigarette smoking in enclosed public areas such as pubs and restaurants (although these latter may have a dedicated smoking area).

3.1.5 Seatbelt obligation

Here we refer to the regulatory decision that made the wearing of seatbelts compulsory – which can be seen as a ban on driving without wearing a seatbelt. According to the Royal Society for the Prevention of Accidents (Rospa), Volvo's standard three-point belt design has by now saved one million lives worldwide.[14] Geels and Penna (2015) also consider that the introduction of seatbelts is an interesting case of innovation, socio-political mobilization and adoption of new technologies. To be precise, we focus only on the legal obligation for the driver to wear a seatbelt.

[13] https://en.wikipedia.org/wiki/Smoking_ban [last accessed 6th Nov 2017].
[14] http://news.bbc.co.uk/2/hi/uk_news/8197875.stm [last accessed 6th November 2017].

3.1.6 Plastic bags

Our final case focuses on the phase-out of single-use lightweight plastic bags as the most used packaging material worldwide. Single-use plastic bags are made by low-density polyethylene (LDPE) which besides the excellent properties in terms of costs and effectiveness, may pose serious environmental threats as a consequence of their disposal, as they are resistant to biodegradability. Major environmental concerns related to the disposal of single-use plastic bags involves their potential of clogging waterways, choking marine life and providing a breeding ground for malaria-carrying mosquitoes (Xanthos and Walker 2017). According to the United Nations Environment Programme (UNEP), 4 to 5 trillion plastic bags are distributed each year (UNEP 2018), which makes their ban particularly meaningful. We note that single-use plastic bags bans are particularly widespread in Africa. This could be partly explained by the poor waste-collection process and low recycling rates which make the problem of plastic waste more visible, and partly explained by the fact that Africa exports very little plastic and lacks a strong industry lobby pressure (Economist 2019).

3.2 Variables

3.2.1 Dependent variable

Our dependent variable is the year of the regulatory ban, for the cases of leaded petrol, asbestos, DDT, indoor smoking, plastic bags and the seatbelt obligation. We have one observation for each country – i.e. the year of the ban. For countries that we know have not yet implemented the ban, the value of the dependent variable is censored at the time of the analysis (i.e. 2017). Data sources consulted to establish the year of ban are available upon request by the authors are included in the online supplementary file.

3.2.2 Explanatory variables

We elaborated two possible opposite scenarios, where we predict opposing links between a country's level of economic development and its regulatory action. To measure the level of economic development of a country we use several indicators. We draw economic data from the Penn World Tables (PWT) 9.0 (Feenstra, Inklaar, and Timmer 2015). Hence, we use the PWT indicator of (the natural logarithm of) *GDP per capita* **(***LOG_GDP_PC***)** as our indicator of economic development (following Esty and Porter 2001). An alternative measure of a country's level of economic development is the natural logarithm of Total Factor Productivity (TFP), also from PWT 9.0.[15] However, TFP is highly correlated with GDP per capita, and furthermore it has a higher number of missing observations, therefore we do not include it alongside log of GDP per capita.

We also consider *Human capital* (*HUMAN_CAPITAL*) as an alternative indicator of economic development, because it is a key input to a national innovation system. Likewise, we consider *Patent applications per capita (PATENTS_PC)*, calculated as number of patent applications of residents divided by the aforementioned population variable, using World Bank data,[16] [17] because this also reflects the country's innovative capabilities which may influence the time to ban.

To account for the differences that might exist across countries' institutional strengths (*INSTITUTIONS)*, using a composite indicator that is generated by principal components analysis (PCA). The raw variables are the following six variables that are reported in the World

[15] To be precise, we use the variable cwtfp which indicates the welfare relevant TFP level, and which compares living standards across countries in each year.

[16] Data are from the World Bank, https://data.worldbank.org/indicator/IP.PAT.RESD. Indicator code: IP.PAT.RESD: "Patent applications, residents." The variable is defined as follows in the source notes: "Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention - a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years." Source: World Intellectual Property Organization (WIPO), WIPO Patent Report: Statistics on Worldwide Patent Activity. The International Bureau of WIPO assumes no responsibility with respect to the transformation of these data.

[17] Repeating the analysis using log of patent applications per capita did not affect much the results.

Bank's Worldwide Governance Indicators.[18] The six dimensions are: Rule of Law; Political Stability and No Violence; Voice and Accountability; Government Effectiveness; Regulatory Quality; and Control of Corruption. We take the first PCA-generated component, which explains 84.82% of the variance.[19]

We also include a number of additional control variables, from the PWT dataset (see Section 4.4). The natural logarithm of *population* (*LOG_POP*) is taken as an indicator for the size of a country. To the extent that larger groups are more difficult to coordinate and organize, we might expect that larger countries are slower to implement nationwide regulatory action such as product bans.

We do not have detailed data on national productive capacity or imports over years for the particular technology being assessed (tetraethyl lead, asbestos, etc.). Domestic producers could in principle lobby hard to delay or block any regulatory action affecting their products. Unfortunately, we do neither have industry employment in the affected sector, nor lobbying expenditures by the affected firms. Collecting this data would be extremely difficult, and evidence suggests that national productive capacity, which can be used as a proxy for lobbying, is not always a decisive dimension in blocking a ban: in the case of asbestos, Australia was the first country to ban (blue asbestos was banned as early as 1967) despite being a large asbestos producer; Slovenia was early to ban asbestos in 1996 because of the efforts of an asbestos-cement producing factory in *initiating* the ban (Dodic-Fikfak et al. 1999). Hence, in some cases, lobbying is explicitly mentioned as an obstacle to regulatory action (e.g. Needleman 2000 for the case of leaded petrol). In other cases, though, it could be merely the forces of consumer habit, and political inertia, which drive resistance to regulatory intervention.[20]

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[18] https://info.worldbank.org/governance/wgi/.

[19] The loadings of the six variables onto this PCA-generated component are as follows: Rule of Law 0.4335; Political Stability and No Violence 0.3619; Voice and Accountability 0.3868; Government Effectiveness 0.4240; Regulatory Quality 0.4153; and Control Of Corruption 0.4234.

[20] Gilbert et al. (2005) show that it took decades for paediatricians to change their recommendations concerning infant sleeping position and SIDS (Sudden Infant Death Syndrome), whose evidence of a statistical connection

Against this background, clearly our estimates will be affected by some omitted variable bias. Our estimates should therefore be taken as tentative and indicative of partial associations, with a fair amount of caution, rather than being interpreted as causal effects.

4. Analysis

We begin with descriptive statistics and non-parametric analysis before presenting regression results.

4.1 Descriptive statistics

Table 1 below presents summary statistics, for the cases of bans. For each of the cases, there is a considerable range between the minimum and maximum values, and also a reasonably large standard deviation, suggesting that there is sufficient variation across countries to engage in meaningful quantitative analysis. Table 1 also shows that the number of observations varies substantially across cases, from 145 observations for smoking bans to only 54 observations for plastic bags bans.[21] Figure 1 below provides further information on the variation across countries.

was available already by 1970. Conservative estimates suggest that earlier recognition of the available scientific evidence regarding the risks of front sleeping 'might have prevented over 10'000 infant deaths in the UK and at least 50'000 in Europe, the USA, and Australasia.' (Gilbert et al. 2005, p. 874). In this case, the poor use of health research evidence by paediatricians is considered to be among the most credible responsible factors for the delay in recommending anti-SIDS sleeping positions, not lobbying.

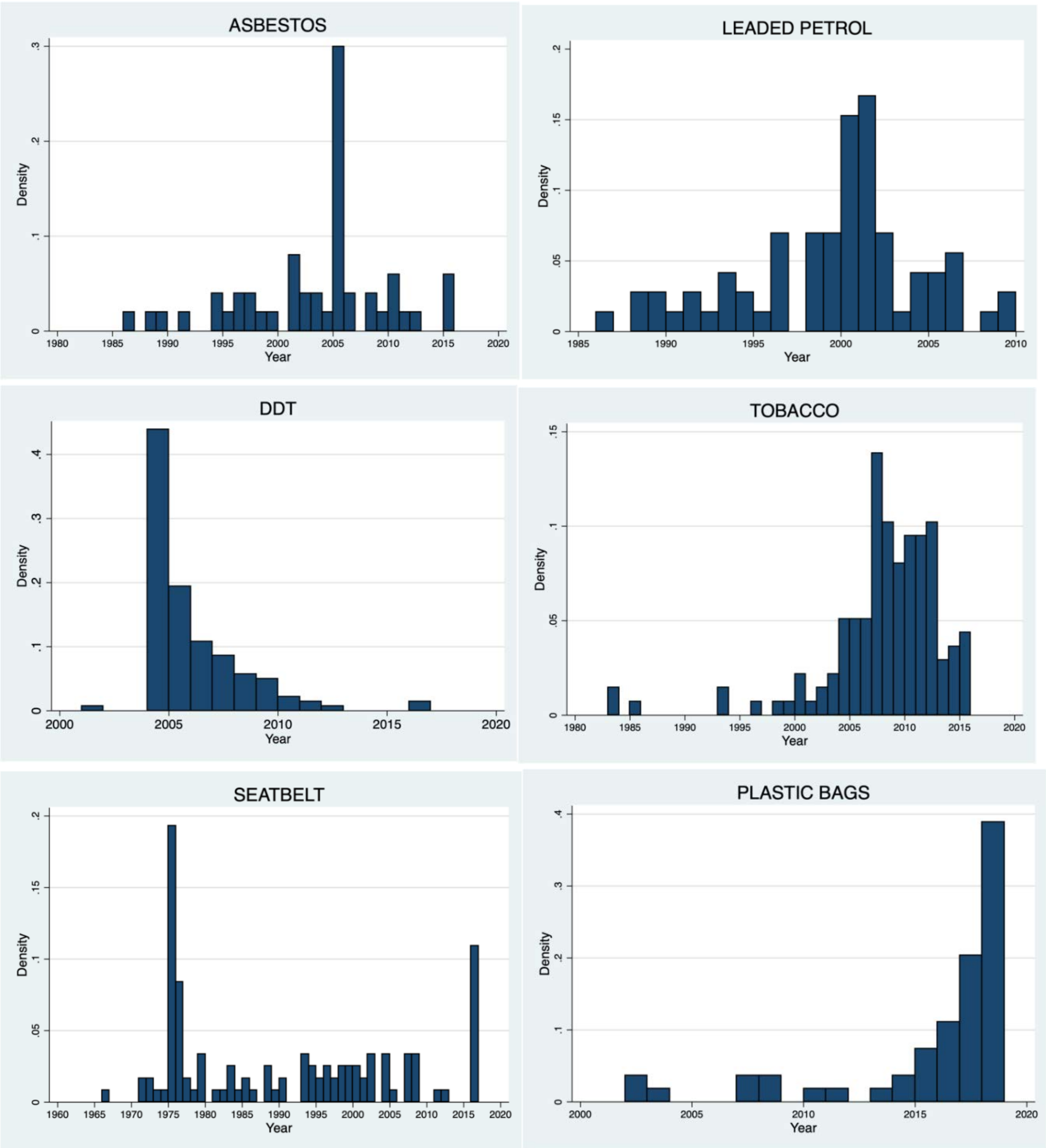
[21] Plastic bag bans have boomed recently: countries banning them are 54 in 2019.

Table 1: Summary statistics.

	Mean	**Median**	**Std. Dev.**	**Min**	**Max**	**Obs.**
Asbestos	2011.97	2017	7.86	1986	2017	139
Leaded Petrol	1999.80	2000	6.17	1986	2017	75
DDT	2005.60	2005	2.31	2001	2017	139
Smoking	2008.17	2009	5.78	1983	2017	145
Seatbelt	1990.50	1989	15.05	1966	2017	119
Plastic Bags	2015.463	2017	4.52	2002	2019	54

Notes: Countries that have not yet introduced a ban (denoted here as '2017', or '2019' for the case of plastic bags) are included in this summary statistics table, because these are observations that are included in the regressions (but not the scatterplots). '2017' (or '2019') refers to non-missing observations where we know that the country has not yet taken regulatory action. Countries where we have no confirmation of either a ban or no ban are classified as missing observations.

Figure 1: Distribution of years when countries implemented the regulatory action, for countries that have implemented a ban by 2017 (or 2019 in the case of plastic bags).



Note: Top left: Asbestos ban; Top right: Leaded Petrol ban. Centre left: DDT ban, Centre right: Smoking ban (Tobacco). Bottom left: Seatbelt law. Bottom right: Plastic bags ban.

Table 2 shows some positive and significant correlations, with the expected sign, between the following pairs: Asbestos-Seatbelt; Leaded Petrol-DDT; Leaded Petrol-Smoking; and Leaded Petrol-Seatbelt. The largest correlation is between the years of bans for DDT and leaded petrol (ρ = 0.3875, p-value = 0.0008). For the other pairs of variables, the correlations are generally far from statistically significant. Plastic bag bans do not appear correlated with any of the other regulatory actions. Taking an avant-garde stance in favour of public health with respect to one technology sheds limited light on how a country will react when considering another technology. This potentially surprising result casts some early doubt on our prediction that countries will have a similar approach to regulate different threats.

Table 2: Correlation matrix.

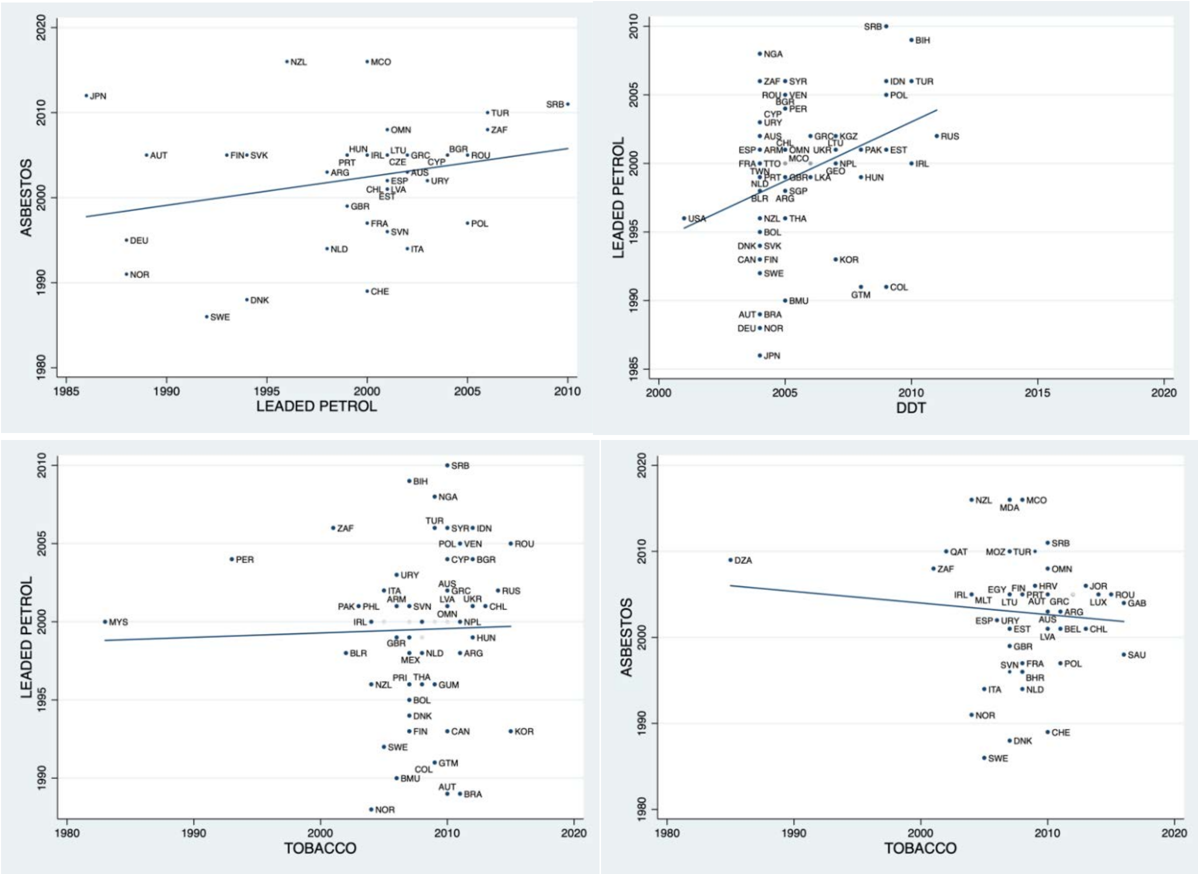
	Asbestos	**Leaded petrol**	**DDT**	**Smoking Bans**	**Seatbelt**	**Plastic Bag**
Asbestos	1					
Leaded Petrol	0.1760	1				
DDT	0.0260	0.3875***	1			
Smoking	-0.0887	-0.2751**	0.0754	1		
Seatbelt	0.3638***	0.2976**	0.0655	0.1243	1	
Plastic Bags	-0.1914	0.0348	0.0187	0.1717	-0.1048	1

Notes: Key to significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Selected information on how the years of ban vary with each other can be found in the scatterplots (Figure 2), which provide a non-parametric representation that allow to identify particular countries. Sweden and Norway were early to introduce bans in all cases.[22] Japan and Germany were early to ban leaded petrol and DDT, and to introduce the seatbelt obligation, but at time of writing neither country has introduced a nationwide ban on smoking in public places.

[22] Sweden also scores very highly in the Environmental Regulatory Regime Index in Esty and Porter (2001).

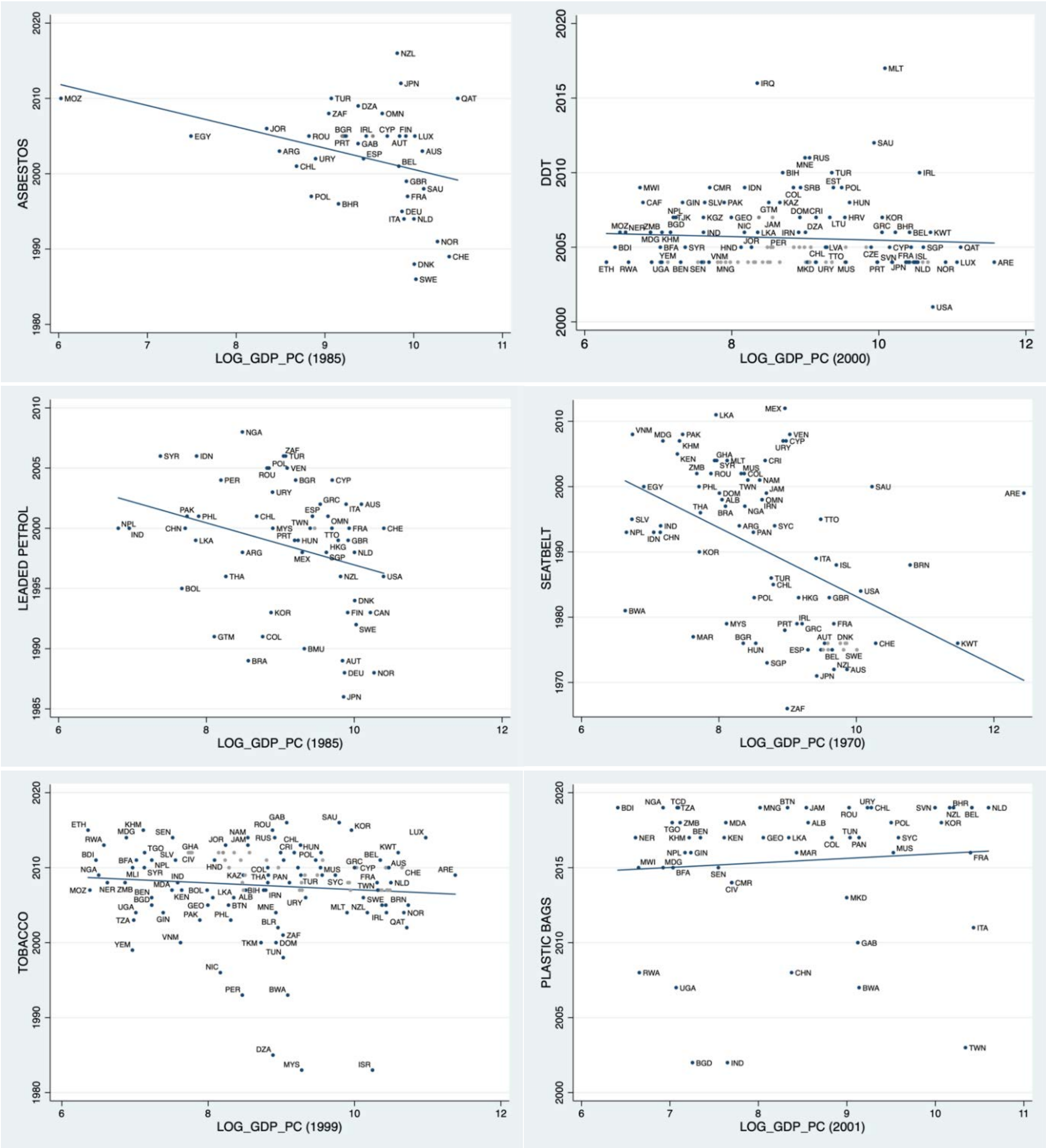
Figure 2: Some scatterplots of the dates of regulatory action, overlaid with a linear fit.



Note: Correlation coefficients and their p-values are reported in this caption. Top left: Asbestos ban vs Leaded petrol ban (ρ = 0.2554; p-value = 0.1271; 37 obs). Top right: leaded petrol ban vs DDT ban (ρ = 0.3317; p-value = 0.0057; 68 obs). Bottom left: leaded petrol vs smoking ban (ρ = 0.0268; p-value = 0.8307; 66 obs). Bottom right: asbestos ban vs smoking ban (Tobacco) (ρ = -0.0955; p-value = 0.5278; 46 obs). For the sake of clarity, grey circles identifie observations with more than one label.

In the interest of space, we show the pairwise correlations of years of ban and two dimensions of economic development, measured in terms of GDP per capita and institutional strength. Figure 3 shows the pairwise correlations of years of ban and log of GDP per capita (*LOG_GDP_PC*). If more developed countries were earlier to ban, we would expect a negative and significant relationship. The asbestos ban, the leaded petrol ban, and the seatbelt obligation are all significantly negatively correlated with log of GDP per capita (measured at the start of the period). In contrast, the year of introduction of the smoking ban and plastic bag bans are not significantly related to GDP per capita. Countries that were early to ban asbestos, leaded petrol, and driving without a seatbelt tend to be richer in terms of GDP. Sweden, Denmark, Switzerland, and Norway, in particular, were early to ban asbestos and have a high GDP per capita.

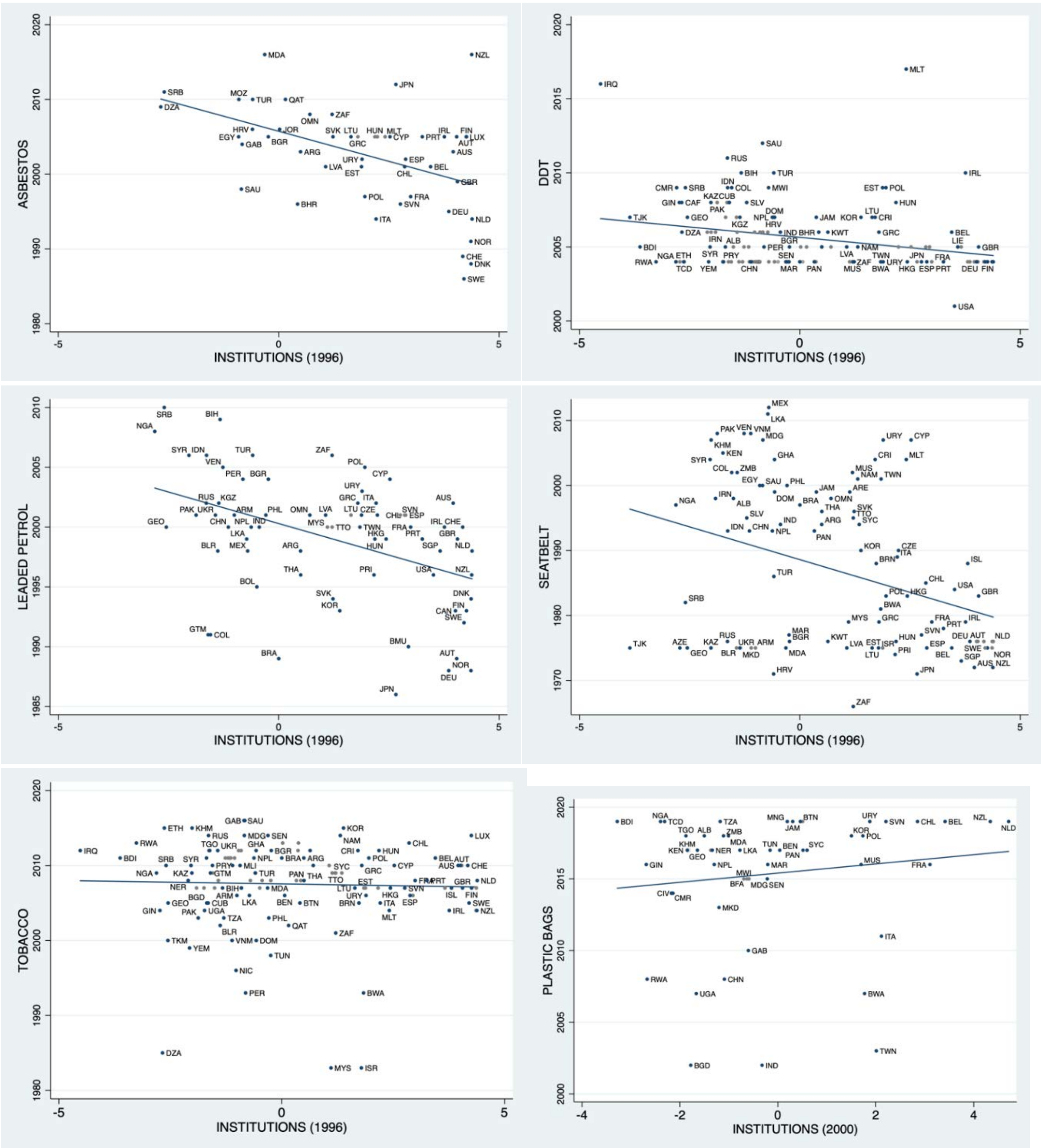
Figure 3: scatterplots of the dates of regulatory action, plotted against log of GDP per capita around the time of the start of the period.



Note: Plots overlaid with a linear fit. Correlation coefficients and their p-values are reported in this caption. Top left: Asbestos ban (ρ = -0.3465; p-value = 0.0285; 40 obs). Top right: DDT ban (ρ = -0.1132; p-value = 0.2014; 129 obs). Centre left: Leaded petrol ban (ρ = -0.2923; p-value = 0.0303; 55 obs). Centre right: Seatbelt law (ρ = -0.4682; p-value = 0.0000; 145 obs). Bottom left: Smoking ban (Tobacco) (ρ = -0.0944; p-value = 0.2933; 126 obs). Bottom right: Plastic bags ban (ρ = 0.0819; p-value = 0.5636; 52 obs). For the sake of clarity, grey circles identifie observations with more than one label.

Figure 4 shows the pairwise correlations between years of ban and *INSTITUTIONS*. Countries with better institutions are earlier to ban asbestos, leaded petrol, and DDT (the correlations are statistically significant), although there is no statistically significant relationship between institutional strengths and the smoking ban and plastic bags ban.

Figure 4: Scatterplots of the dates of regulatory action, plotted against governance (a country's PCA-generated regulatory score) around the time of the start of the period.



Note: Plots overlaid with a linear fit. Correlation coefficients and their p-values are reported in this caption. Top left: Asbestos ban (ρ = -0.4772; p-value = 0.0006; 48 obs). Top right: DDT ban (ρ = -0.3422; p-value = 0.0001; 130 obs). Centre left: Leaded petrol ban (ρ = -0.4418; p-value = 0.0001; 69 obs). Centre right: Seatbelt law (ρ = -0.3496; p-value = 0.0004; 172 obs). Bottom left: Smoking ban (Tobacco) (ρ = -0.0348; p-value = 0.6980; 127 obs). Bottom right: Plastic bags ban (ρ = 0.1351; p-value = 0.3444; 51 obs). For the sake of clarity, grey circles identifie observations with more than one label.

4.2 Exploring coherent regulatory response: Principal component analysis

We conjectured that countries would behave in similar ways to the different harmful innovations, so we explore here whether the year of ban for one case is correlated with the year of ban for the other cases. We run a Principal Component Analysis (PCA) on the data on years of ban, in an attempt to evaluate whether the variables are closely related to each other in terms of having a lot of common statistical information. When all 6 cases are taken together, there are too few observations for a meaningful PCA analysis,[23] therefore we drop the case of the plastic bags ban (which has the smallest number of observations, as shown in Table 1, owing to the fact that this is a very recent ban). PCA results are shown in Table 3. The first component explains 37.24% of the total variation, which is modest. This is more than the theoretical minimum value of 20%, but far lower than the theoretical maximum of 100%. Hence, there is a small amount of common variation across each of the cases, however there are considerable differences. The first component suggests that the smoking ban (tobacco), in particular, stands out from the other cases, because it loads negatively onto the first component. Further analysis, using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, yields a KMO statistic of 0.4830 overall, which is an "unacceptable" score that indicates that the variables have too little in common to warrant a PCA.[24] This suggests that implementing a ban for one case sheds little light on how early a country will implement bans for other cases.

Table 3: Principal Component Analysis. 65 observations.

	PC1	**PC2**	**PC3**	**PC4**	**PC5**
Asbestos	0.511	-0.170	0.406	-0.664	0.324
Leaded Petrol	0.542	-0.005	-0.477	0.402	0.564
DDT	0.443	0.543	-0.376	-0.288	-0.533
Tobacco	-0.064	0.797	0.466	0.191	0.326
Seatbelt	0.495	-0.202	0.499	0.528	-0.431

[23] There are only 18 observations when Plastic Bags is included alongside the five other cases.
[24] See https://www.stata.com/manuals13/mvpcapostestimation.pdf.

4.3 Regression analysis

In line with our descriptive analysis in the previous subsection, we now present regression analysis in our context of having one observation (i.e. year of ban) for each country. We are interested in explaining the variation in time until ban. Our dependent variable y_i measures the year that the ban was implemented, for country *i*, using the data available at time of the analyses (i.e. 2017). Note that y_i is censored at 2017 and may not take values above this (because at the time of data collection, we had no reliable information on when future bans will be implemented by countries that have not yet implemented a ban). This censoring of the dependent variable is problematic for the usual ordinary least squares (OLS) regression estimator. A standard approach for dealing with censored dependent variables is to reason in terms of a latent variable y_i*, where:

$$y_i = y_i* \qquad \text{if } y_i* < 2017$$

$$y_i = 2017 \qquad \text{if } y_i* \geq 2017$$

such that Tobit regressions can be performed on the latent variable, $y_i* = bX_i + e_i$, with an upper limit fixed at 2017, and where X_i and e_i correspond to a vector of explanatory variables and an error term respectively. More specifically, we estimate the following regression equation:

$$y_i^* = b_0 + b_1 PATENT\_PC_i + b_2 INSTITUTIONS_i + b_3 LOG\_GDP\_PC_i + b_4 HUMAN\_CAPITAL_i + b_5 LOG\_POP_i + e_i \tag{1}$$

Median regression (i.e. quantile regression at the 50% quantile) can also be applied on the censored dependent variable y_i (Yu, Lu, and Stander 2003), which is in line with the intuition that mild censoring at the extremes of a variable will not affect its median value. Median regression can only be performed if fewer than 50% of observations are censored (i.e. if only a minority of countries have not introduced a ban). The summary statistics in Table 1 show that this is true in all cases, except for asbestos.

Survival models, such as the Cox proportional hazards model, can be useful in contexts where we investigate the duration until an absorbing state is reached (such as death, or in our context a regulatory ban). Since the distribution of event times are often far from normal, this means that survival models are often superior to OLS regression.[25] One potential problem with survival models in our context, however, is that the start date for countries (corresponding perhaps to the introduction of the product or process in domestic markets) is not clearly specified, and probably varies across countries. To address this, we fix the starting period as the year before the first country implemented its ban.

To alleviate concerns about endogeneity (Friedman 1992), explanatory variables are ideally measured at the start of the period (measured in terms of 1 year before the first country implemented a ban). We therefore investigate the impact of initial conditions (in terms of initial values of log of GDP per capita, log of TFP, and other country characteristics) on the time until ban. These starting years are 1985 for asbestos and leaded petrol, 2000 for DDT, 1983 for smoking bans, 1970 for the seatbelt obligation, and 2000 for plastic bags. However, because of missing values for the explanatory variables *INSTITUTIONS* and *PATENT_PC*, these variables are calculated for the best available year, which is 1996 in the cases of asbestos, leaded petrol, and seatbelt, and 1998 for smoking bans.

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[25] https://www.stata.com/statalist/archive/2002-06/msg00131.html.

For extra precision in our statistical inference, standard errors are bootstrapped, with 1000 replications. Table 4 contains our baseline regression results. In each case, there are three regression specifications corresponding to the stepwise addition of explanatory variables (i.e. *INSTITUTIONS*, and *PATENTS_PC*), albeit at the cost of having fewer observations. Our preferred specifications are the regression models including all explanatory variables. Table 4 shows that the *INSTITUTIONS* score is associated with earlier bans in all cases except for the smoking ban. Indeed, perhaps because of opposition to the smoking ban from the smoking population, well-regulated countries may have had difficulties in implementing the ban. Our estimates suggest that (ceteris paribus) a one standard deviation increase in institutional strengths is associated with an earlier ban of 9.5 years in the case of asbestos, 3.3 years for leaded petrol, 1 year for DDT, 11.4 years for the seatbelt obligation, and 3.7 years for plastic bags.[26] Relatedly, human capital associated with earlier bans for asbestos, leaded petrol and seatbelt, but not for the tobacco and DDT, while it is positive and significant for plastic bags bans (4.425, model 16) indicating that countries with weak human capital sometimes ban earlier – in line with evidence about early bans in Africa mentioned earlier (The Economist, 2019). On balance, therefore, countries with better institutions are earlier to ban. Perhaps surprisingly, patent applications per capita are not significantly associated with bans. Human capital also does not provide unequivocal evidence about its capacity to predict bans. Log of GDP per capita is associated with earlier bans for non-seatbelt-driving and indoor smoking, and also to some extent for asbestos. On balance, the evidence suggests that log of GDP per capita is associated with earlier bans.[27] Log of population is significant only in the cases of the

[26] Coefficients are taken from the second of the three regression specifications. The standard deviation of governance fluctuates across years around the value of 2.3 (2.296 in 1996, 2.281 in 1998, and 2.313 in 2000). The effect size is 2.3 x 4.121 = 8.4 years for asbestos, 2.3 x 1.446 = 3.3 years for leaded petrol, 2.3 x 0.452 = 1.0 years for DDT, 2.3 x 4.960 =11.4 years for the seatbelt obligation, 2.3 x 1.595 = 3.7 year for plastic bags.

[27] Sometimes log of GDP per capita is weakly associated with *later* bans for leaded petrol and DDT, for models that include the governance score. This could be due to multicollinearity of log of GDP per capita with the governance score variable.

seatbelt obligation and plastic bags ban. In this case, the negative coefficient indicates that a larger population is associated with an earlier ban. Table 4 shows that the explanatory power of the regressions (i.e. the R^2 statistic) is quite low, especially for smoking bans (which are weakly related to innovation or economic variables) with an R^2 of 2% or lower, although it is slightly higher for asbestos and seatbelt obligations (where the R^2 reaches around 13-14%). This mirrors the findings in Figure 4 that there is a lot of variation among countries and that they don't closely follow the line of best fit. Bans of indoor smoking and plastic bag bans, in particular, are not strongly related to our indicators of economic development or scientific development.

All in all, we find limited support to the 'standard' regulatory scenarios, suggesting that there is heterogeneity in countries' regulatory reactions. For the bans of asbestos, leaded petrol, DDT, and the seatbelt obligation, we see that the more economically developed countries were earlier to ban, although in many cases the results were not significant. For the smoking ban and plastic ban, none of the indicators of economic development appeared to be significantly associated with the time until ban. To the extent that Table 4 shows that the same explanatory variables can predict the year of ban, this leans towards supporting a coherent response of countries to different bans, although the low explanatory power of the regressions, and the weak significance often observed for the explanatory variables and the PCA, provide support to the 'fragmented' regulatory scenario.

Table 4: Tobit regression results.

Variables	(1) **Asbestos**	(2)	(3)	(4) **Leaded Petrol**	(5)	(6)	(7) **DDT**	(8)	(9)
LOG_GDP_PC	-4.684*		-9.417***	1.413		0.611	-0.113		-0.188
	(2.624)		(3.095)	(1.428)		(1.786)	(0.221)		(0.340)
HUMAN_CAPITAL	-11.28***	-4.763	-7.546	-6.587**	-0.902	-4.417	-0.0675	0.748**	-0.151
	(3.906)	(4.847)	(4.876)	(2.599)	(2.068)	(3.444)	(0.453)	(0.356)	(0.640)
LOG_POP	-0.276	-0.310	-1.224	-0.345	-0.874	-0.159	-0.0810	-0.170	-0.179
	-1.164	-1.149	-1.463	(0.525)	(0.544)	(0.616)	(0.190)	(0.174)	(0.274)
INSTITUTIONS		-4.121***			-1.446**			-0.452***	
		-1.416			(0.689)			(0.145)	
N_PATENTS_PC			0.00546			-0.00453			-0.000386
			(0.0113)			(0.00532)			(0.00174)
Sigma	13.68***	13.44***	12.08***	5.625***	5.369***	5.508***	2.348***	2.240***	2.337***
	-1.447	-1.394	-1.820	(0.637)	(0.619)	(0.751)	(0.320)	(0.317)	(0.356)
Constant	2,086***	2,034***	2,121***	2,003***	2,006***	2,005***	2,007***	2,004***	2,008***
	(19.76)	-9.340	(24.56)	-9.591	-4.478	(12.33)	-1.356	(0.980)	-2.258
Obs.	109	108	74	55	54	50	120	119	83
Pseudo R^2	0.107	0.114	0.120	0.0432	0.0587	0.0550	0.00155	0.0234	0.00738

Note: *** p<0.01, ** p<0.05, * p<0.1, standard errors in parentheses. Dependent variable: year of ban (censored at an upper limit of 2017 (2019 for the plastic bags ban)). Standard errors, obtained after 500 bootstrap replications, appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Control variables are measured at the start of the period (t=0, measured in terms of 1 year before the first country implemented a ban), to alleviate endogeneity concerns; i.e. 1985 for asbestos and leaded petrol, 2000 for DDT, 1999 for smoking bans, 1970 for the seatbelt obligation, and 2000 for plastic bags. Due to lack of data for earlier years, *INSTITUTIONS* and *N_PATENTS_PC* are measured in 1996 for asbestos, leaded petrol, and seatbelt; and *INSTITUTIONS* and *N_PATENTS_PC* are measured in 1998 for the smoking ban.

Variables	(10) **Tobacco**	(11)	(12)	(13) **Seatbelt**	(14)	(15)	(16) **Plastic Bags**	(17)	(18)
LOG_GDP_PC	-1.313**		-1.546	-4.542**		-5.538**	-1.366		0.528
	(0.626)		(0.957)	(1.854)		-2.452	-1.224		-1.753
HUMAN_CAPITAL	1.962	0.468	3.493**	-12.90***	-3.389	-9.918**	4.425**	1.443	1.335
	-1.397	-1.301	-1.732	-2.710	-3.964	-4.239	-1.905	(0.956)	-1.996
LOG_POP	-0.0190	0.0608	0.344	-1.331	-1.831***	-0.953	-1.595**	-1.595**	-2.558***
	(0.343)	(0.322)	(0.387)	(0.862)	(0.674)	(0.834)	(0.690)	(0.691)	(0.808)
INSTITUTIONS		-0.221			-4.960***			0.249	0.715
		(0.314)			-1.004			(0.578)	-1.288
N_PATENTS_PC			0.00470			-0.00198			0.000630
			(0.00647)			(0.00506)			(0.168)
Sigma	6.298***	6.364***	6.566***	11.37***	10.28***	10.25***	5.276***	5.326***	2.786***
	(0.764)	(0.806)	-1.072	-1.049	(0.932)	-1.041	(0.782)	(0.804)	(0.633)
Constant	2,015***	2,007***	2,012***	2,059***	2,008***	2,060***	2,022***	2,017***	2,016***
	-4.134	-3.121	-7.970	(14.35)	-6.449	(16.31)	-7.219	-2.905	(12.41)
Obs.	122	121	77	88	87	66	46	45	23
Pseudo R^2	0.00420	0.000519	0.0176	0.0935	0.117	0.0935	0.0544	0.0489	0.2969

Note: *** p<0.01, ** p<0.05, * p<0.1, standard errors in parentheses. Dependent variable: year of ban (censored at an upper limit of 2017 (2019 for the plastic bags ban)). Standard errors, obtained after 500 bootstrap replications, appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Control variables are measured at the start of the period (t=0, measured in terms of 1 year before the first country implemented a ban), to alleviate endogeneity concerns; i.e. 1985 for asbestos and leaded petrol, 2000 for DDT, 1999 for smoking bans, 1970 for the seatbelt obligation, and 2000 for plastic bags. Due to lack of data for earlier years, *INSTITUTIONS* and *N_PATENTS_PC* are measured in 1996 for asbestos, leaded petrol, and seatbelt; and *INSTITUTIONS* and *N_PATENTS_PC* are measured in 1998 for the smoking ban.

4.4 Robustness analysis

Robustness of our results is investigated using alternative regression models: least absolute deviation (LAD, also known as median regression) and Cox proportional hazard survival models. These alternative regression models are useful if there are doubts about the assumption of normally distributed residuals made by least-squares estimators (such as Tobit). LAD evaluates the regression line of best fit at the median, rather than the mean, thus minimizing the influence of potential outliers. Cox proportional hazard models are semiparametric models that make no distributional assumptions about the baseline hazard rate. LAD[28] and Cox estimations provide broadly similar results to our baseline Tobit estimations.

Further robustness analysis included some more control variables, in an attempt to address possible omitted variable bias. For example, the size of the government sector may be related to its regulatory powers, or to the public support for regulatory intervention, or it may dampen the economic incentives from distributing harmful products because of higher taxes. Size of government is measured using the share of government consumption (in the PWT dataset). Also, the openness of a country may also be related to regulatory intervention, if for example a country is more open to adopting regulatory practices from abroad. Openness is proxied here by share of exports. Neither of these two variables had a strong role in predicting the years of ban.

Finally, we disaggregated the *INSTITUTIONS* score into its six components, and repeated the baseline Tobit regressions with each of the six components taken individually. However, this did not yield any striking results. Each of the six components was associated with the year of ban in some, but never all, of the six cases (asbestos, leaded petrol, etc).

[28] LAD standard errors are estimated using 1000 bootstrap replications.

5. Conclusion

Countries seem to react differently to public health threats. Plenty of anecdotal evidence suggests that some countries may say that a certain product or technology is safe – as is the case with Glyphosate in the US, while others seek to ban it –like Austria. Amidst this perceived variability, what is the bigger picture? Is there any coherence in the regulatory interventions of countries? It is already possible to guess which countries will be the last to continue using harmful technologies, even if there are alternatives?

France was the first country to ban hydraulic fracturing ('fracking') as a technology for extracting shale gas in 2011, and since then it was also banned by the US states of Vermont (in 2012) and New York (in 2014), while Scotland has placed a temporary moratorium on fracking. France has also taken a leading role concerning the banning of glyphosate. However, France is a leading producer of nuclear energy, with up to 75% of its energy coming from nuclear,[29] while neighbouring Germany has recently banned nuclear energy. Regarding other contentious products and technologies, France was only a median performer regarding the banning of leaded petrol (2000) and had a mediocre performance regarding its smoking ban (2008). Hence, France's hard regulatory stance against some technologies does not appear consistent across all problematic technologies.

More generally, this paper sought to address whether the regulatory responses of countries are coherent across different public health challenges (asbestos, leaded petrol, DDT, tobacco, seatbelt obligations and plastic bags), and to see which factors affect regulatory responses, using non-parametric plots and parametric regressions on a unique hand-collected dataset.

[29] http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx [accessed 28th October 2016].

Regression analysis suggests that a country's level of economic development (proxied by log of GDP per capita) and the quality of its institutions are slightly better predictors of time to ban than a country's innovative performance in terms of patent applications per capita and human capital. However, there is considerable variation around the expected values, our regression models have low explanatory power, and what they seem to suggest is that there is an apparent lack of coherence of regulatory responses across different threats. A country may champion one important cause but seemingly neglect other important causes.

Our study contributes to the literature in two ways. First, while there is growing evidence about the effectiveness of different types of 'green' regulatory initiatives on firm-level innovative behaviour (e.g. green patents, low-carbon investments, etc.) (Popp 2005; Ambec et al. 2010; Johnstone and Haščič 2010; D'Orazio and Popoyan 2019), there is much less cross-national research on countries' responsiveness to contested or harmful technologies (Esty and Porter, 2001). Our study contributes to fill this gap by showing how imperfect countries may be in responding to such challenges even when they should be doing so, based on their economic, institutional and knowledge solid fundamentals. Clearly, this casts doubts on 'environmental Kuznets curve' perspectives of economic growth, as in some cases advanced countries may be slow to regulate, while developing ones may be early adopters of a ban (as in the case of plastic bags). We note also that even in the case of developed countries that are early to ban (as in the case of seatbelt obligations, smoking and, to a certain extent, asbestos) earlier bans do not necessarily mean that the harmful impacts generated by the banned technology are trivial or absent. For this reason, we are sceptical about the idea that countries investing first in dirty growth in the hope that growth will subsequently contribute to stronger regulation and better environmental standards are a desirable scenario. Rather, it seems to us that all countries – rich or poor – should engage in regulatory action against toxic products as soon as possible.

Second, we emphasize that regulatory power should be properly included in innovation rankings. Regulatory power is an important facet of the performance of national innovation systems. Rankings of countries according to their innovation performance (e.g. the European Commission's Innovation Scoreboard) [30] should take into account the less glamourous, but highly important, national capabilities of regulating potentially harmful innovations. Hence, we recommend that these metrics incorporate a measure of regulatory responsiveness to ban the contested technologies following a precautionary principle, as soon as reliable scientific evidence is available on the matter – although we concur that in some cases it may be hard and time consuming for the scientific community to reach a consensus over the hazard of a technology. Our analysis is not free from limitations. First, our focus on bans means that we do not measure other types of regulatory efforts such as phasing out a harmful technology. Countries might have already phased out a harmful technology, to the extent that an outright regulatory ban on the remaining fraction is an arguably trivial and unimportant matter. Second, our focus on bans ignores that laws may be enforced more strictly in some countries than in others (e.g. the police in Kuwait are known to smoke in public places despite the ban).[31] Third, liability may be a substitute for regulation. If the regulators are captured by lobby groups, as may be the case of asbestos in the US (which is yet to be banned), then individuals can still sue producers for liability (White 2004). Fourth, our dataset does not include controls for the size of a country's domestic production capacity, which can be expected to be related to the sensitivity towards possible job destruction and the amount of resources available for lobbying.

Future work might focus on dynamic aspects of policy diffusion across countries over time, applying quantitative analysis to the literature on international policy diffusion (see e.g. Busch, Jörgens, and Tews 2005 on Eco-labels and energy taxes; Simmons and Elkins 2004;

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[30] http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en.

[31] https://en.wikipedia.org/wiki/List_of_smoking_bans [accessed 22/07/2016].

and also, Shiphan and Volden 2012). This paper takes an essentially cross-sectional econometric design, with one observation per country (i.e. year of ban), and explanatory variables measured around the start of the period of observation. Future analysis could build a longitudinal dataset with time-varying variables such as policy interventions in neighbouring countries (where 'neighbouring' refers to geographic proximity or trade intensity), to better understand the diffusion dynamics of regulatory bans. Future work could also investigate the role of industry composition (such as the shares of manufacturing, services and agriculture) and characteristics of the user base.

Future work might also suggest a typology of harmful products and technologies, depending on supply-side characteristics, the nature of the toxicity, and the characteristics and habits of the user base. Our analysis showed that economic development, quality of institutions, and human capital did not help to predict the indoor smoking ban. This could be because cigarette smoking already has a large base of addicted consumers that may join industry in opposing the ban. For similar reasons, one might expect that consumers could join industry in opposing regulatory action against petrol-driven cars and air travel in the struggle to reduce CO_2 emissions. If this is the case, our analysis suggests that it will be difficult to predict which countries will be the first to regulate against petrol-driven cars and air travel, using standard economic predictors.

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References

Aizer, Anna, Janet Currie, Peter Simon, and Patrick Vivier. 2018. "Do Low Levels of Blood Lead Reduce Children's Future Test Scores?" *American Economic Journal: Applied Economics* 10 (1): 307-41. doi:10.1257/app.20160404.

Ambec, Stefan, Mark Cohen, Stewart Elgie, and Paul Lanoie. 2010. "The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness?" *CIRANO Working Papers*. doi:10.2139/ssrn.1682001.

Beard, John. 2012. "DDT and Human Health." *Science of the Total Environment* 355(1-3): 78-89. doi:10.1016/j.scitotenv.2005.02.022.

Blohmke, Julian, Kemp Rene and Türkeli Serdar. 2016. "Disentangling the Causal Structure behind Environmental Regulation." *Technological Forecasting and Social Change* 103: 174-190. doi:10.1016/j.techfore.2015.10.013.

Brunel, Claire. 2015. "Green Innovation and Green Manufacturing: Links between Environmental Policies, Innovation, and Production." Journal of Environmental Management 248: 2-16. doi: 10.1016/j.jenvman.2019.109290.

Brunnermeier, Smita, and Mark Cohen. 2003. "Determinants of Environmental Innovation in US Manufacturing Industries." *Journal of Environmental Economics and Management* 45(2), 278-293. doi:10.1016/S0095-0696(02)00058-X.

Busch, Per-Olof, Jörgens Helge and Tews Kerstin. 2005. "The Global Diffusion of Regulatory Instruments: The Making of a New International Environmental Regime." *The Annals of the American Academy of Political and Social Science* 598: 146-167. doi:10.1177/0002716204272355.

Carson, Rachel. 2002. *Silent Spring*. New York: Houghton Mifflin Harcourt.

Comin, Diego, and Bart Hobijn. 2010. "An Exploration of Technology Diffusion." *American Economic Review* 100: 2031-2059. doi:100.10.2139/ssrn.1116606.

D'Orazio, Paola, and Lilit Popoyan. 2019. "Fostering Green Investments and Tackling Climate-related Financial Risks: Which Role for Macroprudential Policies?" *Ecological Economics* 160: 25-37. doi: 10.1016/j.ecolecon.2019.01.029.

Dodic-Fikfak, Metoda, Lidija Rahotina, Zvonimir Kristancic, and Robert Vidic. 1999. "Case Study: Slovenia—Asbestos Valley." *New Solutions: A Journal of Environmental and Occupational Health Policy* 8(4): 469-478. doi: 10.2190/604T-AMMX-81WD-CGK5.

Dosi, Giovanni. 1982. "Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinants and Directions of Technical Change." *Research Policy* 11(3): 147-162. doi: 10.1016/0048-7333(82)90016-6.

Elkins, Zachary, and Beth Simmons. 2004. “The Globalization of Liberalization: Policy Diffusion in the International Political Economy.” *American Political Science Review* 171-189. doi:10.1017/S0003055404001078.

Esty, Daniel, and Michael E. Porter. 2001. "Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness?" In *The Global Competitiveness Report 2001–2002*, edited by Michael E. Porter, Jeffrey D. Sachs, Peter K. Cornelius, John W. McArthur, and Klaus Schwab, 78–101. New York: Oxford University Press.

Farmer, J. Doine and Lafond Francois. 2015. “How Predictable is Technological Progress?” *Research Policy* 45(3): 647-665. doi:10.1016/j.respol.2015.11.001.

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review* 105(10): 3150-3182. doi:0.3386/w19255.

Friedman, Milton. 1970. “The social Responsibility of Business is to Increase its Profits.” *New York Times Magazine*, September 13.

Friedman, Milton. 1992. "Do Old Fallacies Ever Die?" *Journal of Economic Literature* 30(4): 2129-2132.

Geels, Frank W., and Caetano CR Penna. 2015. “Societal Problems and Industry Reorientation: Elaborating the Dialectic Issue LifeCycle (DILC) Model and a Case Study of Car Safety in the USA (1900–1995).” *Research Policy* 44(1): 67-82. doi:10.1016/j.respol.2014.09.006.

Gilbert, Ruth, Georgia Salanti, Melissa Harden, and Sarah See. 2005. “Infant Sleeping Position and the Sudden Infant Death Syndrome: Systematic Review of Observational Studies and Historical Review of Recommendations from 1940 to 2002.” *International Journal of Epidemiology* 34:874-87. doi:10.1093/ije/dyi088.

Giuliani, Elisa. 2018. “Regulating Global Capitalism amid Rampant Corporate Wrongdoing—Reply to “Three Frames for Innovation Policy”. *Research Policy* 47(9): 1577-1582. doi: 10.1016/j.respol.2018.08.013.

Goldenberg, Suzanne. 2013. “Secret Funding Helped Build Vast Network of Climate Denial Thinktanks.” *The Guardian*, February 14.

Harford, Tim. 2017. “The Problem with Facts.” *Financial Times*, March 9.

Harremoës, Poul, David Gee, Malcolm MacGarvin, Andy Stirling, Jane Keys, Brian Wynne, and Sofia Vaz. 2001. *Late Lessons from Early Warnings: The Precautionary Principle 1896–2000*. Copenhagen: European Environmental Agency.

Hart, Oliver, and Luigi Zingales. 2017. "Companies Should Maximize Shareholder Welfare not Market Value." *Journal of Law Finance Account* 2(2): 247–274. doi: 10.1561/108.00000022.

Holbreich, Mark, John Genuneit, Juliane Weber, Charlotte Braun-Fahrländer, Marco Waser, and Erika Mutius. 2012. "Amish Children Living in Northern Indiana have a Very Low Prevalence of Allergic Sensitization." *The Journal of Allergy and Clinical Immunology* 129(6): 1671-1673. doi:10.1016/j.jaci.2012.03.016.

Imbens, Guido. 2010. "Better LATE Than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009)." *Journal of Economic Literature* 48: 399-423. doi:10.1257/jel.48.2.399.

Jaffe, Adam B., and Karen Palmer. 1997. "Environmental Regulation and Innovation: A Panel Data Study." *Review of Economics and Statistics* 79(4): 610-619. doi: 10.1162/003465397557196.

Jensen, S., A. G. Johnels, M. Olsson, and G. Otterlind. 1969. "DDT and PCB in Marine Animals from Swedish Waters." *Nature* 224(5216): 247. doi: 10.1038/224247a0.

Johnstone, Nick, and Ivan Haščič. 2009. "Environmental Policy Design and the Fragmentation of International Markets for Innovation." *Reforming Rules and Regulations: Laws, Institutions, and Implementation* 79-103.doi:10.2139/ssrn.1370339.

Kameda, Takashi, Ken Takahashi, Rokho Kim, Y. Jiang, Movahed Mehrnoosh & Eunkee Park, and Jorma Rantanen. 2014. "Asbestos: Use, Bans and Disease Burden in Europe." *Bulletin of the World Health Organization* 92: 790-7. doi:10.2471/BLT.13.132118.

LaDou, Joseph, Barry I. Castleman, Arthur L Frank, Michael Gochfeld, Morris Greenberg, James Huff, and Tushar Kant Joshi, et al. 2010. "The Case for a Global Ban on Asbestos." *Environmental Health Perspectives* 118(7): 897. doi: 10.1289/ehp.1002285.

Lanjouw, Jean O., and Ashoka Mody. 1996. "Innovation and the International Diffusion of Environmentally Responsive Technology." *Research Policy* 25(4): 549-571. doi: 10.1016/0048-7333(95)00853-5.

Lanoie, Paul, Jérémy Laurent-Lucchetti, Nick Johnstone, and Stefan Ambec. 2007. "Environmental Policy, Innovation and Performance: New Insights on the Porter Hypothesis." *Journal of Economics & Management Strategy* 20(3): 803-842. doi:20. 10.1111/j.1530-9134.2011.00301.x.

Lee, Jaegul, Francisco Veloso, and David Hounshell. 2011. "Linking Induced Technological Change, and Environmental Regulation: Evidence from Patenting in the U.S. Auto Industry." *Research Policy* 40: 1240-1252. doi:10.1016/j.respol.2011.06.006.

Levine, Hagai, Niels Jørgensen, Martino-Andrade Anderson, Jaime Mendiola, Dan Weksler-Derri, Irina Mindlis, Rachel Pinotti, and Shanna Swan. 2017. "Temporal Trends in Sperm

Count: A Systematic Review and Meta-regression Analysis.” *Human Reproduction Update* 23(6):646-659. doi:10.1093/humupd/dmx022.

Liu, Chuan-ping, Luo Chunling, Y. Gao, Li Fangbai, L.W. Lin, C.A Wu, and Li Xiang-Dong. 2010. “Arsenic Contamination and Potential Health Risk Implications at an Abandoned Tungsten Mine, Southern China.” *Environmental Pollution* 158(3): 820-826. doi: 10.1016/j.envpol.2009.09.029.

Luzzati, Tommaso, Angela Parenti, and Tommaso Rughi. "Economic Growth and Cancer Incidence." *Ecological Economics* 146 (2018): 381-396. doi: 10.1016/j.ecolecon.2017.11.031.

Makse, Todd, and Craig Volden. 2011. "The role of Policy Attributes in the Diffusion of Innovations." *The Journal of Politics* 73(1): 108-124. doi: 10.1017/S0022381610000903.

Malakoff, David, and Jeffrey Mervis. 2017. “Lawmakers Balk at Most Trump Cuts.” *Science* 357(634): 11-12. doi:10.1126/science.357.6346.11.

Millstone, Erik, Patrick Van Zwanenberg, Claire Marris, Les Levidow, and Helge Torgersen. 2004. *Science in Trade Disputes Related to Potential Risks: Comparative Case Studies*. Brussels: (IPTS) Institute for Prospective Technological Studies.

Millstone, Erik. 2009. "Science, Risk and Governance: Radical Rhetorics and the Realities of Reform in Food Safety Governance." *Research Policy* 38(4): 624-636. doi: 10.1016/j.respol.2009.01.012.

Monbiot, George. 2006. “The Denial Industry.” *The Guardian*, September 19.

Mulgan, Geoff. 2016. *Good and Bad Innovation: What Kind of Theory and Practice do we Need to Distinguish Them?* London: NESTA. https://www. nesta. org. uk/blog/good-and-bad-innovationwhat-kind-of-theory-and-practice-do-we-need-to-distinguish-them/

Myers, John, Michael Antoniou, Bruce Blumberg, Lynn Carroll, Theo Colborn, Everett Lorne, Michael Hansen, et al. 2016. “Concerns over use of Glyphosate-based Herbicides and Risks Associated with Exposures: A Consensus Statement.” *Environmental Health* 15(1):1-13. doi:10.1186/s12940-016-0117-0.

Needleman, Herbert L. 2000. “The Removal of Lead from Gasoline: Historical and Personal Reflections.” *Environmental Research* 84(1): 20-35. doi:10.1006/enrs.2000.4069.

Nevin, Rick. 2000. “How Lead Exposure Relates to Temporal Changes in IQ, Violent Crime, and Unwed Pregnancy.” *Environmental Research* 83(1): 1-22. doi: 10.1006/enrs.1999.4045.

Nevin, Rick. 2007. “Understanding International Crime Trends: The legacy of Preschool Lead Exposure.” *Environmental Research* 104(3): 315-336. doi:10.1016/j.envres.2007.02.008.

Nguyen, Linhn. 2015. "Cancer Villages in China." In *The State of Environmental Migration 2015: A Review of 2014*, edited by François Gemenne, Caroline Zickgraf, and Luka De Bruyckere. Liège: Presses Universitaires. https://www.academia.edu/35368471/The_State_of_Environmental_Migration_2015_A_Review_of_2014

Nikaj, Silda, Joshua Miller, and John Tauras. 2017. “Exploring Heterogneity in the Impact of Smoking Bans among Early and Late Adopters.” *Economics Letters* 155: 164-167. doi:10.1016/j.econlet.2017.04.002.

Novak, Kris. 2007. “Passive Smoking: Out from the Haze.” *Nature* 447(7148): 1049-1051. doi:10.1038/4471049a.

Orset, Caroline and Bramoullé Yann. 2018. “Manufacturing Doubt.” *Journal of Environmental Economics and Management* 90: 119-133. doi:90.10.1016/j.jeem.2018.04.010.

Özkara, Arzu, Dilek Akyıl, and Muhsin Konuk. 2016. “Pesticides, Environmental Pollution, and Health.” *Environmental Health Risk-Hazardous Factors to Living Species*. doi:10.5772/63094.

Popp, David. 2005. “Lessons from Patents: Using Patents to Measure Technological Change in Environmental Models.” *Ecological Economics* 54(2-3): 209-226. doi: 10.3386/w9978.

Porter, Michael E., and Class van der Linde. 1995. “Toward a New Conception of the Environment Competitiveness Relationship.” *Journal of Economic Perspectives* 9: 97. doi:118.http://dx.doi.org/10.1257/jep.9.4.97.

Porter, Michael. 1991. “America’s Green Strategy.” *Scientific American* 264 (4): 168. doi: 10.1038/scientificamerican0491-168.

Proctor, Robert. 2012. “The History of the Discovery of the Cigarette-lung Cancer Link: Evidentiary Traditions, Corporate Denial, Global Toll.” *Tobacco Control* 21(2): 87-91. doi:10.1136/tobaccocontrol-2011-050338.

Reyes, Jessica W. 2015. “Lead Exposure and Behavior: Effects on Antisocial and Risky Behavior among Children and Adolescents.” *Economic Inquiry* 53(3): 1580-1605. doi:10.3386/w20366.

Scherer, Andreas Georg, and Guido Palazzo. 2011. "The New Political role of Business in a Globalized World: A review of a new Perspective on CSR and its Implications for the Firm, Governance, and Democracy." *Journal of Management Studies* 48(4): 899-931. doi: 10.1111/j.1467-6486.2010.00950.x.

Shipan, Charles, and Craig Volden. 2012. “Policy Diffusion: Seven Lessons for Scholars and Practitioners.” *Public Administration Review* 72(6): 788-796. doi:10.1111/j.1540-6210.2012.02610.x.

Simons, F. Estelle R. 2009. “Anaphylaxis: Recent Advances in Assessment and Treatment.” *Journal of Allergy and Clinical Immunology* 124(4): 625-636. doi:10.1016/j.jaci.2009.08.025.

Stilgoe, Jack, Richard Owen, and Phil Macnaghten. 2013. “Developing a Framework for Responsible Innovation.” *Research Policy* 42(9): 1568-1580. doi: 10.1016/j.respol.2013.05.008.

Stirling, Andy. 2017. “Precaution in the Governance of Technology.” In *The Oxford Handbook of Law, Regulation, and Technology*, edited by Roger Brownsword, Eloise Scotford, and Karen Yeung. Oxford: Oxford University Press.

The Economist. 2019. “Ever More Countries are Banning Plastic Bags: But the Environmental Impact of Such Measures is Questionable”. Daily Chart. https://www.economist.com/graphic-detail/2019/07/24/ever-more-countries-are-banning-plastic-bags.

UNEP. 2018. *Addressing Marine Plastics: A Systemic Approach - Stocktaking Report*. Nairobi: United Nations Environment Programme. https://wedocs.unep.org/bitstream/handle/20.500.11822/26746/marine_plastics.pdf?sequence=1

Van den Borre, Laura, and Patrick Deboosere. 2014. “Asbestos in Belgium: An Underestimated Health Risk. The Evolution of Mesothelioma Mortality Rates (1969–2009).” *International Journal of Occupational and Environmental Health* 20(2): 134-140. doi:10.1179/2049396714Y.0000000058.

Walker, Kenneth C., Mary B. Goette, and Gordon S. Batchelor. 1954. “Pesticide Residues in Foods, Dichlorodiphenyltrichloroethane and Dichlorodiphenyldichloroethylene Content in Prepared Foods.” *Journal of Agricultural and Food Chemistry* 2(20): 1034-1037. doi: 10.1021/jf60040a006.

Weitzman, Martin L. 1998. “Recombinant Growth.” *Quarterly Journal of Economics* 113(2): 331-360. doi:10.1162/003355398555595.

Wettstein, Florian, Elisa Giuliani, Grazia Santangelo, and Günter Stahl. 2018. “International Business and Human Rights: A Research Agenda.” *Journal of World Business* 54(1): 54-65. doi:10.1016/j.jwb.2018.10.004.

White, Michelle J. 2004. “Asbestos and the Future of Mass Torts.” *Journal of Economic Perspectives*.” 18(2): 183-204. doi: 0.3386/w10308.

WHO. 2006. *WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen dioxide and Sulphur dioxide: Global Update 2005: Summary of Risk Assessment*. Geneva: World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf;jsessionid=D44831D9403D0688D8F7BE8B572B92BD?sequence=1

Wilson, Nick, and John Horrocks. 2008. “Lessons from the Removal of Lead from Gasoline for Controlling other Environmental Pollutants: A Case Study from New Zealand.” *Environmental Health: A Global Access Science Source* 7(1): 1. doi:10.1186/1476-069X-7-1.

Wolfe, Philip, Amanda Giang, Ashok Akshay, Selin Noelle, and Barrett Steven. 2016. “Costs of IQ Loss from Leaded Aviation Gasoline Emissions.” *Environmental Science & Technology* 50(17): 9026-9033. doi:10.1021/acs.est.6b02910.

Xanthos, Dirk, and Tony Walker. 2017. “International Policies to Reduce Plastic Marine Pollution from Single-use Plastics (plastic bags and microbeads): A Review.” *Marine pollution bulletin* 118(1-2): 17-26. doi:10.1016/j.marpolbul.2017.02.048.

Yu, Keming, Zudi Lu, and Julian Stander. 2003. “Quantile Regression: Applications and Current Research Areas.” *Journal of the Royal Statistical Society: Series D (The Statistician)* 52 (3), 331-350. doi:10.1111/1467-9884.00363.

Zingales, Luigi. 2017. “Towards a Political Theory of the Firm.” *Journal of Economic Perspectives* 31(3): 113-30. doi: 10.3386/w23593.

Online Supplementary Materials

Appendix: Data sources

ASBESTOS

A useful starting point for countries with bans on all types of asbestos is here: https://www.asbestossafety.gov.au/countries-bans-all-types-asbestos.
Asbestos was completely banned in all forms by all 28 EU member states by 1 January 2005. Some EU member states banned before this date. Where there were doubts, internet searches were made to seek in which year a member state first banned all asbestos products. If no information was available regarding whether the member state banned all forms of Asbestos before 2005, then the date of 2005 was attributed (Austria, Finland).
Asbestos has been completely banned in 55 countries worldwide:
http://www.asbestosnation.org/facts/asbestos-bans-around-the-world/
Hence, for the other countries (apart from the 55 that have banned), where there is no specific mention that they have not yet fully banned Asbestos, the assumption is that they have not yet fully banned Asbestos.
The above-mentioned websites are complemented where possible with data from the following sources:
http://ibasecretariat.org/alpha_ban_list.php
http://ibasecretariat.org/asbestos_ban_list.php
http://banasbestoscanada.ca/a-timeline-of-asbestos-bans/
http://www.umt.edu/bioethics/libbyhealth/Resources/Legal%20Resources/international_ban_asbestos.aspx
https://www.anses.fr/en/content/asbestos
https://www.baua.de/DE/Angebote/Publikationen/Berichte/Gd80.pdf?__blob=publicationFile&v=8
https://www.asbestos.com/news/2016/09/12/netherlands-bans-asbestos-roofs/
http://www.independent.ie/lifestyle/health/wives-victim-to-cancer-from-asbestos-on-husbands-clothes-28958938.html
http://asbestosglobal.org/asbestos-bans/
https://en.wikipedia.org/wiki/Asbestos
[websites accessed on 27 June 2017].
See also Dodic-fikfak et al (1999), Van den Borre and Deboosere (2014), LaDou et al (2010), Kameda et al (2014) and White (2004).

LEADED PETROL (TETRAETHYL LEAD)

Data search began with Wikipedia [“Tetraethyllead”, accessed 22 July 2016] and was complemented where possible with data from the following:
http://www.lead.org.au/fs/fst27superseded.html
http://walshcarlines.com/pdf/unepgas.pdf for Slovakia,
http://news.abs-cbn.com/business/01/10/14/philippines-bans-lead-after-years-long-campaign for Philippines,
http://www.politics.ie/forum/environment/203844-lead-pollution-crime-ireland-4.html for Ireland,
http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/b09phasing.pdf , Table A1 for Bermuda, Bolivia, Guatemala
https://www.lead.org.au/PCFV/PCFV_Lead_Matrix-CEE&CA_200508.pdf for Belarus, Bulgaria, Estonia, Georgia, Latvia, Lithuania
https://books.google.com.pe/books?id=DPfYCb9IIAkC&pg=PA2003&lpg=PA2003&dq=finland+ban++leaded+petrol&source=bl&ots=OspJBWuAhB&sig=4fQvFxmPsTDwoh18R

QQ9rmNJui8&hl=en&sa=X&redir_esc=y#v=onepage&q=finland ban leaded petrol&f=false (i.e. Strategies and Policies for Air Pollution Abatement, 2006 Review prepared under the convention on Long-range Transboundary Air Pollution, Economic Commission for Europe, ECE/EB.AIR/93, United Nations (2007)) for Finland and Armenia http://gulfnews.com/news/uae/general/oman-switches-to-unleaded-fuel-today-1.422214 for Oman http://www.acfa.org.sg/pdf/acfa0507.pdf for Syria http://www.independent.co.uk/environment/un-hails-green-triumph-as-leaded-petrol-is-banned-throughout-africa-6112912.html for South Africa
DDT
Dates for when countries joined the Stockholm declaration (specifically, when the ban on DDT 'entered into force'). http://chm.pops.int/Countries/StatusofRatifications/PartiesandSignatoires/tabid/4500/Default.aspx Note that countries may have already banned DDT before they registered the ban according to the Stockholm declaration. Aldrin, Chlordane, DDT, Dieldrin, Dioxin_Furan, Endrin, Heptachlor, Hexachlorobenzene, Mirex, PCB Toxaphene: Johnson, L. (2014). National Status of the Dirty Dozen POPs regulation http://wikiprogress.org/data/dataset/environmental-performance-index/resource/aa2190bb-1a5f-404a-a743-988a93182a9c in http://archive.epi.yale.edu/content/national-status-dirty-dozen-pops-regulation-through-stockholm-convention
INDOOR SMOKING BAN
Wikipedia ["List of smoking bans", accessed 22 July 2016], Novak (2007) http://www.tobaccocontrollaws.org/legislation/country/malaysia/summary MALAYSIA http://www.tobaccocontrollaws.org/legislation/country/sri-lanka/summary SRI LANKA https://en.wikipedia.org/wiki/Philippine_Executive_Order_26 PHILIPPINES http://www.tobaccocontrollaws.org/legislation/country/pakistan/summary; https://en.wikipedia.org/wiki/List_of_smoking_bans#Pakistan PAKISTAN https://en.wikipedia.org/wiki/List_of_smoking_bans#Indonesia INDONSESIA http://www.tobaccocontrollaws.org/files/live/Trinidad%20and%20Tobago/Trinidad%20and%20Tobago%20-%20Tobacco%20Control%20Act%202009%20-%20national.pdf TRINIDAD AND TOBAGO http://www.tobaccocontrollaws.org/legislation/country/united-arab-emirates/summary UAB http://www.tobaccocontrollaws.org/legislation/country/moldova/summary MOLDOVA http://news.bbc.co.uk/2/hi/europe/3527234.stm MONTENEGRO http://news.bbc.co.uk/2/hi/europe/3527234.stm; http://www.tobaccocontrollaws.org/files/live/Mongolia/Mongolia%20-%20Law%20on%20TC.pdf MONGOLIA http://www.tobaccocontrollaws.org/legislation/country/ukraine/summary UKRAINE http://www.no-smoke.org/goingsmokefree.php?id=133 GEORGIA http://riadzany.blogspot.it/2008/07/smoking-ban-in-morocco.html MOROCCO http://www.tobaccocontrollaws.org/legislation/country/oman/summary; http://www.tobaccocontrollaws.org/files/live/Oman/Oman%20-%20Decision%20No.%20272.pdf OMAN http://www.tobaccocontrollaws.org/files/live/Tunisia/Tunisia%20-%20Identifying%20Smoke-Free%20Public%20Places.pdf TUNISIA

https://en.wikipedia.org/wiki/List_of_smoking_bans_in_the_United_States#.C2.A0California CALIFORNIA
https://en.wikipedia.org/wiki/List_of_smoking_bans_in_the_United_States#.C2.A0Guam GUAM (USA)
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https://www.azernews.az/nation/111359.html AZERBAIJAN
http://www.euro.who.int/en/countries/tajikistan/news/news/2017/05/smoke-free-in-dushanbe-a-cafe-ahead-of-its-time TAJIKISTAN
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http://www.radioaustralia.net.au/international/radio/onairhighlights/new-caledonia-bans-smoking-in-all-enclosed-public-spaces/1091794 NEW CALEDONIA https://en.wikipedia.org/wiki/List_of_smoking_bans#Israel ISRAEL http://www.tobaccocontrollaws.org/legislation/country/united-arab-emirates/sf-indoor UAB http://www.tobaccocontrollaws.org/files/live/Qatar/Qatar%20-%20Law%20No.%2020%20of%202002%20on%20Control%20of%20Tobacco%20and%20its%20Derivatives.pdf QATAR http://www.tobaccocontrollaws.org/legislation/country/viet-nam/summary VIETNAM https://en.wikipedia.org/wiki/Smoking_in_Iran IRAN https://en.wikipedia.org/wiki/Smoking_in_Ecuador ECUADOR http://www.no-smoke.org/goingsmokefree.php?id=703 EGYPT http://www.tobaccocontrollaws.org/files/live/Bolivia/Bolivia%20-%20Supreme%20Decree%20No.%2029376.pdf BOLIVIA http://www.tobaccocontrollaws.org/files/live/North%20Korea/North%20Korea%20-%20TC%20Law.pdf NORTH KOREA http://www.tobaccocontrollaws.org/files/live/Yemen/Yemen%20-%20Res.%20No.%20126.pdf YEMEN http://www.tobaccocontrollaws.org/legislation/country/philippines/summary PHILIPPINES
SEATBELT OBLIGATION
Wikipedia [https://en.wikipedia.org/wiki/Seat_belt_legislation, accessed 6 Oct 2017] http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_brazil_en.pdf BRASILE http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_mauritius.pdf MAURITIUS https://trid.trb.org/view.aspx?id=152717 AUSTRIA https://books.google.it/books?id=oJhcxeldIjsC&pg=PR39&lpg=PR39&dq=seat+belt+legislation+norway+starting+date&source=bl&ots=MTT0C7dC9V&sig=ueGFTNLpVrts1lRqw-U7AcCLVhw&hl=it&sa=X&ved=0ahUKEwj_iefk4-XWAhXEshQKHaRUBGsQ6AEIQzAE#v=onepage&q=seat%20belt%20legislation%20norway%20starting%20date&f=false NORWAY https://ac.els-cdn.com/0022437588900448/1-s2.0-0022437588900448-main.pdf?_tid=0f4a041a-ada6-11e7-bc3f-00000aacb360&acdnat=1507631619_5dc3e6dcedb31b69c3d3abb02ae2dca7 (più paesi) https://www.researchgate.net/profile/Oezlem_Simsekoglu/publication/47931272_Factors_related_to_seat_belt_use_A_Turkish_case/links/54fadc940cf23e66f0332641/Factors-related-to-seat-belt-use-A-Turkish-case.pdf TURKEY http://www.tandfonline.com/doi/full/10.1080/15389588.2010.525157?scroll=top&needAccess=true#aHR0cDovL3d3dy50YW5kZm9ubGluZS5jb20vZG9pL3BkZi8xMC4xMDgwLzE1Mzg5NTg4LjIwMTAuNTI1MTU3P25lZWRBY2Nlc3M9dHJ1ZUBAQDA= CHINA http://www.ijsrit.com/uploaded_all_files/3407625151_z8.pdf GHANA https://play.google.com/books/reader?id=apGsBAAAQBAJ&printsec=frontcover&output=reader&hl=it&pg=GBS.PA312 SOUTH KOREA http://gamapserver.who.int/gho/interactive_charts/road_safety/seat_belt_law/atlas.html (more than one country - usato per vedere quelli che non hanno legge sulle cinture di sicurezza) http://transportproblems.polsl.pl/pl/Archiwum/2013/zeszyt4/2013t8z4_11.pdf POLAND https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3138466/ TRINIDAD AND TOBAGO https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4441959/ TAIWAN

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https://timesofindia.indiatimes.com/city/mumbai/Seat-belts-must-for-all-passengers-of-new-cars-says-RTO/articleshow/47312190.cms INDIA
http://toolkit.irap.org/default.asp?page=casestudy&id=6 COSTA RICA
http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/child_restraints_malta.pdf MALTA
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http://www.citizensinformation.ie/en/travel_and_recreation/roads_and_safety/seatbelts_when_motoring_in_ireland.html CROATIA

http://www.legislation.gov.im/cms/images/LEGISLATION/PRINCIPAL/1985/1985-0023/RoadTrafficAct1985_1.pdf ISLE OF MAN
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http://www.who.int/violence_injury_prevention/road_safety_status/2013/data/table_a7.pdf BURUNDI, BURKINA FASO, BENIN
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http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_indonesia.pdf INDONESIA
http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_venezuela_en.pdf VENEZUELA
http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_albania.pdf ALBANIA
http://www.guernsey.police.uk/CHttpHandler.ashx?id=82598&p=0 GUERNSEY
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http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_iceland.pdf ICELAND
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http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_botswana.pdf BOTSWANA
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http://gamapserver.who.int/gho/interactive_charts/road_safety/seat_belt_law/atlas.html BANGALDESH, BENIN, BOLIVIA, IRAQ, JORDAN, MALI, MONACO
http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_south_africa.pdf SOUTH AFRICA
http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/seat_belt_syrian_arab_republic.pdf SYRIA

PLASTIC BAGS
Data on plastic bag bans and restrictions for different countries: https://en.wikipedia.org/wiki/Phase-out_of_lightweight_plastic_bags#cite_note-auto79-136 Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations (2015). UN Environment. https://wedocs.unep.org/bitstream/handle/20.500.11822/27113/plastics_limits.pdf?sequence=1&isAllowed=y https://www.reusethisbag.com/articles/where-are-plastic-bags-banned-around-the-world/ Data on plastic bag bans and restrictions on a single country: "Ban on production and use of plastic bags comes into effect". 17 July 2016. Retrieved 27 November 2017. https://thehimalayantimes.com/kathmandu/ban-production-use-plastic-bags-comes-effect/ NEPAL https://www.panapress.com/Niger--Govt.-bans-production,-import,-trade,-use-of-plastic-bags--12-630408542-40-lang2-index.html NIGER Opara, George (21 May 2019). "Reps pass bill banning plastic bags, prescribe fines against offenders". Daily Post. Retrieved 27 May 2019. NIGERIA https://dailypost.ng/2019/05/21/reps-pass-bill-banning-plastic-bags-prescribe-fines-offenders/ ARGENTINA https://www.boliviabella.com/la-paz-bolivia-bans-plastic-bags.html BOLIVIA https://theglobalgrid.org/city-of-sao-paulo-brazil-launches-ban-on-traditional-plastic-bags/ BRAZIL https://www.export.gov/article?id=Chad-Prohibited-Restricted-Imports CHAD https://www.firstpost.com/tech/science/chile-becomes-first-south-american-country-to-ban-commercial-use-of-plastic-bags-4895191.html MEXICO https://www.prnewswire.com/news-releases/galapagos-conserves-its-beauty-bans-single-use-plastics-300661913.html ECUADOR https://www.france24.com/en/20190403-egypt-red-sea-province-ban-single-use-plastic EGYPT http://www.xinhuanet.com//english/2017-05/22/c_136302987.htm ETHYOPIA https://globalpressjournal.com/americas/guatemala/to-help-conserve-lake-atitlan-town-bans-plastic-bags/ GUATEMALA https://hondurastravel.com/news/lifestyle/roatan-bans-plastic-bags-and-straws/ HONDURAS https://elevenmyanmar.com/news/bhutan-to-ban-plastic-bag-nationwide-from-april-asianewsnetwork BHUTAN https://phys.org/news/2018-08-burundi-plastic-bag.html BURUNDI https://www.bbc.com/news/world-africa-30198313 COTE D'IVOIRE https://www.worldatlas.com/articles/which-countries-have-banned-plastic-bags.html MOLDOVA https://www.worldatlas.com/articles/which-countries-have-banned-plastic-bags.html TAIWAN https://www.worldatlas.com/articles/which-countries-have-banned-plastic-bags.html SLOVENIA https://www.worldatlas.com/articles/which-countries-have-banned-plastic-bags.html POLAND https://www.worldatlas.com/articles/which-countries-have-banned-plastic-bags.html CAMBODIA https://www.worldatlas.com/articles/which-countries-have-banned-plastic-bags.html BURKINA FASO
ECONOMIC DATA

GDP per capita, population, TFP (welfare-relevant TFP levels at current PPPs), human capital, consumption share of government consumption at current PPPs, consumption share of merchandise exports. Penn World Tables 9.0 (Feenstra et al., 2015).
REGULATORY QUALITY INDEX
Regulatory quality index, for the year 2014. Index that captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private-sector development. Scores are standardized. Source: World Bank, World Governance Indicators 2015. (http://info.worldbank.org/governance/wgi/index.aspx#home). Global Innovation Index (2016)

JRC Mission

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