The iron fist vs. the invisible hand: interventionism and libertarianism in environmental economic discourses

Philip Z. Maymin*

Department of Finance and Risk Engineering,
NYU-Polytechnic Institute,
6 MetroTech Center, Brooklyn, NY 11201, USA
E-mail: phil@maymin.com
*Corresponding author

Tai Wei Lim

Department of Japanese Studies,
Chung Chi College,
The Chinese University of Hong Kong,
6/F Hui Yeung Shing Building,
Shatin, New Territories, Hong Kong
Fax: (852)-2603-5118
E-mail: limtaiwei@cuhk.edu.hk

Abstract: Drawing from a broad range of sources, we define and discuss the two primary ways of contemplating issues related to environmental economics, namely, interventionism and libertarianism. We then interpret a cellular automaton as a model that allows for either approach, as well as anarchy, and show that interventionism exponentially reduces the number of possibilities while libertarianism, even when only probabilistically applied, tends to retain rather than destroy the underlying economic complexity. Thus, the libertarian, ex-post, remuneration approach may deserve more than the scant consideration it typically receives in such discourse, while the interventionist, ex-ante, regulation approach may have hidden long-term dangers not previously recognised. More generally, the approach outlined here may prove useful as a mechanism by which various regulatory proposals may be tested and compared.

Keywords: intervention; libertarianism; state; environment; free market; energy; innovation; climate change; efficiency; policy; pollution; welfare; economic; cellular automaton; model.

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Biographical notes: Philip Z. Maymin is an Assistant Professor of Finance and Risk Engineering at NYU-Polytechnic Institute. He is also the Founding Managing Editor of Algorithmic Finance. He holds a PhD in Finance from the University of Chicago, a Master's in Applied Mathematics from Harvard

University, and a Bachelor's in Computer Science from Harvard University. He also holds a JD and is an Attorney-At-Law admitted to practise in California. He has been a Portfolio Manager at Long-Term Capital Management, Ellington Management Group, and his own hedge fund, Maymin Capital Management. He is also an award-winning journalist, a former policy scholar for a free market think tank, a Justice of the Peace, a former Congressional candidate, a former columnist for the *Fairfield County Weekly* and *LewRockwell.com*, and the author of *Yankee Wake Up, Free Your Inner Yankee*, and *Yankee Go Home*. He was a finalist for the 2010 Bastiat Prize for Online Journalism.

Lim Tai Wei is an Assistant Professor at Chinese University of Hong Kong. He teaches survey courses on Japan and he is interested in the historiography and history of Northeast Asia (including energy, environment, regional trends, demography, etc.).

1 Introduction

Reich (1992, p.187) argues that in most contemporary economies, the state is the main platform through which stakeholders within a society determines the normative behaviour that manages and operates the market, as the lawmakers, judiciary and bureaucracy construct, deconstruct and change the way the social, economic and political system operates – typically understatedly and non-deliberately through the meticulous attention placed on the agglomeration of varying interests in the economy and society, accounting for the results of the decision-making process. Garvey (1972, p.30) puts forward the argument that state action in the economy follows the dominant trends in economic thinking as long as it meets the needs for wealth creation and self-interests in the private sphere and does not interfere with the freedom of ownership transactions, akin to the 18th century thinking of 'private vice, public virtue' and the 19th and 20th century US thinking on this subject.

Simultaneously, Stoel and Waverman (1974, p.369) point out that societal worries about environmental effects of energy consumption and non-governmental entities play the role of 'private attorneys general' utilising non-legal advisories and legal alternatives to compel state bureaucracies to adhere to environmental integrity legislations while others become activists for the same purpose. Stoel and Waverman (1974, p.368) also opined that, even in the absence of the state's role, decrease in energy usage can happen because of changes in worldviews, lifestyle values and thinking on the environment at the grassroots and individual levels emphasising less energy utilisation, or it could be a case of market forces where higher energy prices curb greater usage.

Sen (1999, p.142) touches on the sentimentality of market forces and its emotive element that stir up polemic arguments that advocate or oppose the idea of the free market, a fundamental platform through which individuals carry out activities based on economic complementarity. Agreeing with this view, Garvey (1972, p.33) noted that free market distribution of resources is optimal if the user of services and goods understands what he/she is willing to pay for actualising that need based on evaluating his/her choices of goods from the offer of a selection of alternatives; therefore in functioning free market systems, there is a connection between pricing and the benefits accrued from it through the transaction of the goods involved.

Sen (1999, p.142) argues that free market forces had been effective in operating within this system, for example in the distribution of services and public facilities like schools, physicians, and the allocation of physical space for business ventures but for such resources to be utilised effectively and distributed equitably, bureaucratic systems and their policymaking and implementation roles need to be aligned optimally with improvements and reformation of these items.

But Garvey (1972, p.33) provides the caveat that a free market system has to be based on the assumption that it is all-knowing with regards to the pricing of energy, rationality of decisions and outcomes with regards to demand and supply; however the reality is quite different with problems posed by environmental challenges and the affected consumer may not also be able to translate his health problems or lack of a clean environment into quantitative amounts and this could be the weakness and flaw of the free market system.

The limitations of market discourses are outlined by some observers. Soros (2002, p.6) argues that it may be presumptuous to rely overly on free markets because these systems promote unfettered movement and trade in products and services between interested individuals but cannot aggregate the needs of the society as a whole, including those aspects that may be considered as public goods, non-profit oriented needs. Agreeing with this, Sen (1999, p.143) argues therefore that market forces have to be tempered with outlets and vents for social mobility, law and order and the dispensing of justice. Soros's argument may be based on the impracticality of law to address the issue of justice and state intervention as an argument and advocacy is compared and contrasted with other alternatives in this aspect.

Maymin (2010) argues that Soros's claim is an example of assuming impossibility to promote legislation: the window for government intervention must be opened a crack through a theoretical argument against the inability of any alternative to succeed. Maymin (2010) elaborates that such arguments appear self-contradictory. If Soros, for example, has a better way of achieving a particular goal, one that the market does not appreciate, then rather than use force on others to coerce their participation, he ought to be able to provide it and market it in a way that appeals to those whom he is trying to convince. Otherwise, he has effectively assumed incompetence on the part of the members of society and appointed himself their trustee.

The intent of this paper is to combine and compare such disparate views in both a logical cohesive format and an experimental framework. The rest of this paper is structured as follows. The following two sections describe, respectively, the interventionist and the libertarian perspectives. Next, we offer an analogy using cellular automaton, which we describe and calibrate to the situation here. Finally, we conclude.

2 Interventionism

Sen (1999, pp.271–272) argues that Adam Smith was correct to emphasise that the push factor for market transactions is based on the convergence of priorities and needs in transactions and interactions (the element of what Smith labelled as 'self-love' at the heart of economic transactions); although in talking about distribution, equity and conditions that can resulting in greater productivity efficiency, Smith turned to other wider motivations. In these aspects, Sen (1999, p.272) pointed out that Smith emphasised

care and prudence amongst 'of all virtues' for the individual entity and he explained why "humanity, generosity, and public spirit are the qualities most useful to others".

Stoel and Waverman (1974, p.355) noted that a large number of economists do not oppose the idea of state intervention in establishing and regulating pricing for resources such as fresh air and water although the principles on which this is based on, in the case of North America, is the need for benchmarking and regulatory standards instead of the element of pricing. Soros (2002, p.5) reiterated that free markets may be optimal in facilitating prosperity but those advocating a greater state role counter-argue that it does not aggregate society's non-profit oriented needs.

Proponents of qualified state intervention argue that market fundamentalists recognise the benefits of global financial markets but ignore their shortcomings. Soros (2002, pp.5–6) noted however that the same proponents of intervention argue that the finance and banking sectors show attraction towards equilibrium and provide a balanced distribution of resources and that there is a lack of a better alternative (therefore even if markets are imperfect, this reason alone does not justify intervention). According to McDonald (1974, p.331), the US energy challenge may be attributed to the contemporary and near future need for energy resources from fossil fuels without giving up any policy and political priorities/objectives and therefore this runs against the options of restricting domestic energy extract, controlled pricing, reducing reliance on foreign sources of energy and attempts to reduce environmental negative effects.

It would seem that a problem admittedly created by government intervention could perhaps use less intervention as a possible remedy, but that is not the usual approach taken. Stoel and Waverman (1974, p.366) put forward the options of mitigating environmental challenges through intervention to curb carbon-heavy energy resources, improve environment benchmarks and standards, impose disincentives for certain categories of energy resource use and provide incentives for more environmentally friendly sources of energy. Stoel and Waverman (1974, p.366) argue that these measures may have the benefit of being clear-cut in implementation and potentially effective if the linkage between some common energy resource use and its environmental impact is well-understood and that alternatives are available.

Stoel and Waverman (1974, p.366) offer another option of mitigating pollution and that is for the state to utilise the possibility of getting the natural environment to manage pollution through policy encouragement. If the environmental needs of the communities affected by energy use cannot be quantified and mapped out, then those in favour of the state's role in regulating the market system may argue that it is a shortcoming of the market's ability to distribute the use of resources more equitably for better quality of air, water and other natural resources needed for sustenance of life and maintaining good lifestyle choices through the pricing mechanism [Friedman and Friedman, (1979), p.255].

Such an argument, of course, appears counterintuitive on its face: a scarce resource needs to be allocated among people with limited budgets, free exchange between participants leads to an allocation with which everybody is satisfied, relative to the market prices; but interventionists proclaim the resulting allocation a failure and proceed to redistribute the scarce resource in ways that they, the interventionists, prefer, while arguing that they are doing it to benefit the very people who were already satisfied with the original allocation, and all without changing the prices relative to which the original allocation was efficient.

North America is not alone in this area. Like the USA, China is a major energy consumer and is looking for a way out of overdependence on fossil fuels. Jiang (2010, p.5) argued in his book that China:

> "must pursue a new distinctively Chinese, energy development path, and I discuss developing and using coal, natural gas, and oil, as well as new and renewable energy sources such as hydro, thermal, nuclear, wind and solar power. The general line of thought is that we need to be steadfast in our conservation of energy, use it efficiently, diversify development, keep the environment clean, be technology-driven, and pursue international cooperation in order to establish a system of energy production, distribution, and consumption that is highly efficient, uses advanced technology, produces few pollutants, has minimal impact on the ecosystem, and provides a steady and secure energy supply."

For others, technological innovation is best left to market forces instead of state-centred planning. Garvey (1972, p.30) noted that there are schools of thought that market forces may be able to act as a form of aggregator of needs - that the individual pursuit of interest may translate into an overall benefit and that profit orientation can help to encourage innovation, productivity and efficiency and this may eventually edge out problems posed by goods including energy that are flawed or less than optimal pricing and quality.

Those not convinced by technologists' arguments argue that technological innovation is too slow. Friedman (2000, p.282) argues that technological innovations may not be sufficiently rapid to catch up with the effects of energy use on the environment, citing the 1998 *Time* magazine article that 50% of the global 233 primate species are in danger of being wiped out and that 52 acres of the earth's forests are cleared every 60 seconds.

Most ranking oil-consuming nations have the same goals of conservation, environmentalism and self-reliance but their solutions are conceived in different ways. Klare (2004, p.188) argues that people will be compelled by situational factors to change their lifestyles since fossil fuels supply is not guaranteed to be limitless and the faster US consumers can mitigate their use of energy, the greater yields may be reaped.

Like Klare, Jiang (2010, p.26) argues that China can promote knowledge about environmentalism, advocate conservation education and training and bank on the use of technology in public policy to preserve resources. Training should also be provided and/or managed by the state. Jiang (2010, p.86) puts forward that it is crucial to empower energy stakeholders and other manpower with quality knowledge and skills like Japan where those managing thermal energy usage have to obtain test qualifications and undertake necessary courses.

Therefore the difference with Klare is that Jiang conceives the process of ecological awareness as a state-managed policy instead of Klare's focus on ethical consciousness. Jiang (2010, p.28) also encouraged the element of curbing energy use at the individual level to mitigate fast growth in energy use, restrict energy within China's capacity in energy supply and continue with economic activities through energy efficiency and with care for the environment. He stated that "therefore, we need to guide our entire society to cultivate a mindset of consuming energy sparingly, establish rational consumption patterns and encourage reasonable and appropriate consumption behavior" [Jiang, (2010), p.28]. He argues that mitigating environmental damage is a goal for China's energy use so that climate change can also be managed through the use of clean fuels, burning coal in a more environmentally friendlier manner, reducing public infrastructure consumption of energy and protecting nature [Jiang, (2010), p.26].

Yet another argument to reduce the environmental impact of energy is to reduce the rate of growth of energy consumption. Stoel and Waverman (1974, p.367) noted that states may also manage the amount of energy used through the use of environmentally-friendly standards and the use of monetary disincentives to lessen energy use. Such actions may reduce energy use and there is a longer-term option as well which is through the use of promotional campaigns to provide public access to awareness, knowledge dissemination and economic benefits for better energy use. Stoel and Waverman (1974, p.367) also advocated the sharing of information on the energy benefit for better insulation as a form of housing policy.

Saving energy resources is also an aim amongst Chinese policymakers. Jiang (2010, p.28) detects the possibility of resources spent on looking for a way to develop the country's economy through energy saving priorities, and through a way that facilitates efficiency. Jiang (2010, p.85) advocates that every area, organisation and unit in China be required to direct state units and their personnel to actualise energy saving assignments while taking note and benchmarking against the best standards attainable emanating from both overseas and domestic sources. Jiang (2010, p.85) argues that China should emphasise energy supply to selective firms and industries, assign high priority to supplying energy resources to certain enterprises and impose punitive measures on firms that use too much energy, for e.g. reducing/cutting off supply.

Jiang (2010, p.86) advocates contests between various Chinese firms to optimise their energy-saving awareness and features while installing punitive measures for those violating this principle and providing carrots for the successful ones. In his view, local areas and units in China should spot their energy saving capabilities and capacities and then evaluate the type of policies or techniques they can best use along with the participation of specialists in this field in the process of formulating strategies for saving energy while trouble-spotting problematic areas for improvements [Jiang, (2010), p.86].

Differing from Jiang's state-centred approach, McDonald (1974, p.330) argues instead that market forces have installed strong incentives for policy improvements that encourage efficiency with the best results achievable per unit of energy spent. Economic policies may also help in reforming industrial systems and manufacturing processes to accommodate the efficient use of energy while edging out those industries and businesses that use too much energy, rewarding those that use less energy and clustering firms and industries through cooperation in interactions and exchanges between experts in industries as casting, forging, electroplating and heat treatment [Jiang, (2010), p.85].

Jiang (2010, p.49) argues that macroeconomic instruments such as fiscal policies may be useful in navigating, directing and aiding the formulation of energy blueprints. China has legislated the prioritisation of R&D and utilisation of renewable energy as a national focus and has inked a strategy to actualise this goal with near to long term objectives [Jiang, (2010), p.34]. Energy users can either be motivated or deterred from using energy in less or more quantities through pricing adjustments and McDonald (1974, p.329) emphasises that energy saving strategies are not flawless and that misplaced policy controls may interfere with the market's distribution and allocation of resources negatively.

Stoel and Waverman (1974, p.362) argued that a way to lessen environmental challenges for states is to have in place standards and benchmarks to cut the amount of carbon and other forms of environmental harm through the use of technologies that are cleaner. This appears to have been successfully implemented in Japan. After the shortage of oil supply, Japan approved legislations like the Law Concerning the Use of Energy in

1979 [Jiang, (2010), p.84]. Studying Japan amongst other examples, China installed the Provisional Regulations on Energy Conservation 1986 and the Energy Conservation Law to manage and navigate energy saving initiatives arising from these legislations [Jiang, (2010), p.84]. Jiang (2010, p.76) proposes that China should introduce its energy use status update, policies, rules and operating conditionalities into the public realm to create awareness amongst its people about the state's worldview on energy saving initiatives and encourage efforts towards this goal.

Such thinking is widely implemented in North America where benchmarks and standards that make a sizable impact on the environment and energy use are implemented and publicised on a national scale [Stoel and Waverman, (1974), p.362]. Stoel and Waverman (1974, p.365) point out the use of standards is useful in the sense that they diagnose the problem, are easy, convenient, and fast to implement and, when there are deviations from the standards, these deviations can be quantified easily.

But imposing regulatory standards may also have its drawbacks as accurate information and data with regards to the impact of pollution is not readily accessible and such unknowns or challenges in access to information may be seized upon by polluting industries who may work with political lobbyists to effect slowdown in environmental legislations and/or dilute their impact, for example the political battles over setting emissions standards [Stoel and Waverman, (1974), p.365]. Stoel and Waverman (1974, p.365) then extrapolate that, if information is not readily available and are politicised, then it is challenging to determine with precision the benefits and detriments resulting from the various differential implementation of standards. Due to the challenges in precise determination of damage, it is difficult to quantify this damage and calculate the negative impact of energy use beyond reliance on market forces [Garvey, (1972), p.34].

Another method of mitigating environmental damage is by utilising state funded studies to uncover innovative ways through which industrial activities or the public transportation facility may reduce energy use and/or enhance the environmental impact through greater energy efficiency [Stoel and Waverman, (1974), p.367]. Agreeing with this view, Jiang (2010, p.76) argues that there may be a requirement to proliferate information on how to save energy, encourage new technical advancements, and create awareness amongst individuals on how to conserve energy. The research solution may be useful as a long-term option as it could uncover innovative methods of mitigating environmental damage caused by energy use and may turn up affordable and environmentally friendlier fuels and energy commodities such as solar [Stoel and Waverman, (1974), p.367]. But Stoel and Waverman (1974, p.367) also argue that the major disadvantage lies in the long-term orientation of this option as resources and time are needed to actualise new development and it may be challenging in the meantime to evaluate the detriments and advantages of such research initiatives and also its impact accurately.

3 Libertarianism

Maymin (2008, p.20) argues that environmentalism may be split into four different kinds: First, a few polluters and a few victims. Suppose someone dumps their garbage on your lawn. The remedies are straightforward: they can be liable to you for money damages and can be arrested for criminal trespass. Injunctions and other remedies are also available to prevent future infractions [Maymin, (2008), p.20].

Secondly, Maymin highlighted the situation of a few polluters and many victims: if someone pollutes a town's reservoir, money damages for the citizens would be hard to calculate and distribute, resulting in the option of class actions and criminal penalties for redress. In Maymin's view, it is typically challenging for the state instead of market forces to spot individuals and entities who are victims in detriment resulting from a certain policy, and state efforts in reversing market flaws may result in another set of flaws caused by the government instead [Friedman and Friedman, (1979), p.255].

Agreeing with this view, Porter (1998, p.678) added that attempts to institute state-led developmental goals may backfire since the bureaucracy or technocracy is not designed to conduct and achieve research goals, even if the state has the idea of social equity in mind. Similarly, Japanese management guru Kenichi Ohmae (1990, p.249) agrees that it may not be optimal for states to interfere and determine ownership in the market realm since globalisation has created a market without clearly-defined boundaries and that the state should not have a hand in protecting a multinational enterprises; its role should be guarding the interests of its citizens who have the right to make their own choices.

Thirdly, Maymin noted the circumstance of many polluters and a few victims. The problem of controlling pollution and protecting the environment may be greatly complicated by the tendency for the gains and losses derived from doing so to fall on different people [Friedman and Friedman, (1979), pp.256–257]. Suppose you are among a few people who live next to a busy highway and you have to breathe the smog from thousands of cars a day; it may not at all be clear how to identify who to sue and how to partition the damages amongst the plaintiffs. Thus the only solution may be to sue the owner of the highway for damages [Maymin, (2008), p.21].

Fourthly, Maymin argued that environmentalist activists in the developed world are clamoring for universal environmental standards but developing economies may not be able to afford, either publicly or privately, implementing the conditions demanded by a system that may discriminate against developing economies [Soros, (2002), p.44]. Soros (2002, p.44) concurs in pointing out that this is a case in which monetary incentives may be utilised to persuade compliance – advocates of a cleaner environment ought to provide the monetary resources for reaching this goal themselves, and there are a number of non-governmental ventures in place for saving the environment, protecting its diversity and its vulnerabilities to development.

Ultimately Maymin raises the point of a situation with many polluters and many victims. Suppose developing economies are polluting the Earth and there are too many companies and countries involved. Maymin (2008, pp.21–22) argues that the easiest solution might be to negotiate sufficient payments from the developed economies to cover the costs and damages. Expectations of developing economies may be predicated on the view that these economies have witnessed the rise of the advanced economies through energy use for industrial activities and they desire the same developmental outcome for themselves and are not willing to give up economic growth due to global worries about the environment and settle for what may be perceived as a lower level of wealth [Stoel and Waverman, (1974), p.373].

The concept of a state's denizens being forced to take up the burden of sharing economic prosperity may be based on patriotism and, according to one interpretation, Adam Smith condemned English mercantilism not for diminishing the wealth of other trading nations but for reducing the wealth in English society. In this interpretation of Smith, it appears as if he did not completely exclude state intervention when it is necessary from the perspective of the nation's needs [Reich, (1992), pp.18–19].

According to Stoel and Waverman (1974, p.362), even the strongest supporter of laissez faire capitalism would admit that the free market may not be able to bring about the best possible level of environmental preservation since the private sector and individuals would have already effected what is possible under profit-orientation and actualised self-interests. However, Maymin, positing the most ardent libertarian view, disagrees, with the caveat being that it is the duty of government to protect its citizens from foreign invasion, even if that invasion is through pollution rather than armies. Indeed, the argument of Smith above may be better interpreted as suggesting that the state refrain from interventions against global free trade, rather than advocating for new state interventions.

The basic tenet of environmental libertarianism may be that the question of optimal distribution of resources answers itself, because whoever is in charge of distribution is essentially the owner: an entity can only distribute what he/she/it owns and cannot distribute the property of others any more than the reader can distribute what belongs to the author [Maymin, (2008), p.12]. When the benefits and detriments of measures taken and their beneficiaries and victims can be pinpointed, the market can then be cited for being effective in producing results where the benefits outweigh the costs overall [Friedman and Friedman, (1979), p.254].

Sometimes, even supporters of qualified regulation appear to agree with Maymin. McDonald (1974, p.329) argues that economists posit that market determination of energy costs through competition and effective capital markets can result in an effective distribution of resources as profit orientation motivates energy producers to utilise the most efficient ways of energy extraction and the market can also ensure that it is delivered most efficiently. Agreeing with this line of argument, Jones (1981, p.32) argues that regulating production according to demand is contentious in broadly free market USA and, given the global reach of the US economic system, its free market mechanisms for energy resources has been exported abroad, for, e.g., in the post-WWI situation, due to worries about supply depletion in the USA, US firms ventured overseas to the Middle East where there was affordable and plentiful crude. Up till the end of the 1950s, fossil fuels output was working well in accordance with free market mechanisms and were distributed and retailed without 'disorderly' impact on prices [Jones, (1981), p.32]. The management of air pollution is given as an example by Robert Reich of the ill-equipped rigid application of state management in distributing resources and, according to Reich (1992, p.188), after passing the Clean Air Act in 1970, the US formulated rules and conditions stipulating the upper limits of permitted air pollutant concentration in the USA and the manner through which poisonous emissions harmful to health may be released by US industries and factories. According to Reich (1992, p.188), numerous studies were carried out and the state drew up standard laws across industries and for large tracts of areas without understanding the idiosyncratic requirements of each firm or location and there were no motivations in place for these studies to uncover innovative techniques of minimising pollution at the least possible costs. Reich (1992, p.188) points out that market advocates posit that because the detriments suffered after the implementation of the Clean Air Act were more than its benefits, the state's interventionist role may be minimised but environmentalists insisted that the benefits and quantitative measure of unpolluted air should be compared with the detriments and costs to attain this goal. Therefore, he suggests the use of permits traded by emitters with pricing determined by implementing measures for cleaner emissions or purchasing permits to offset it [Reich, (1992), p.188].

Advocates of this solution also place trust in the free market mechanism to inexorably decrease pollution over time in opposition to state interventionism in stripping liberties protected by constitutionalism (e.g., the USA) or the rule of law in Western societies. Maymin (2008, p.21) argues that, in fact, the cause of pollution is often the governments themselves.

Ultimately, according to Reich (1992, p.186), an economy tackles the challenges of mitigating and managing resources through its indigenous understanding of the issues involved and sometimes not necessarily based on rationality with solutions tailored for various contexts, time and needs based on the ideas that individual societies hold dear and important according to cultural values. Between nations, it may be a process of negotiation to present a mutually agreeable front in capturing the essence of market mechanisms while meeting environmental needs.

Yet Reich's argument against a single free market is in fact a strong argument against government intervention. Markets evolve to match local customs, and can differ greatly in their design and administration, suggesting not that free markets are ineffective or illusory, but that autocratic government regulation of markets will be doomed to fail. Indeed, it is the very flexibility of market mechanisms that define their freedom.

Adam Smith's key insight was that all parties to a transaction mutually reap benefits if the exchange was voluntary and based on free will; such exchanges will arise without the need to resort to force [Friedman and Friedman, (1979), pp.19–20]. A negotiated solution in managing environmental issues, in Maymin's (2008, p.22) view, differs from paying off polluting governments in developing economies with a blank check, because unconditional payoffs may encourage other polluters hoping for a reward, whereas a negotiated payment from the polluting governments, while possibly difficult to enforce or calculate, places the payer in the moral higher ground while protecting their interests. Maymin (2008, p.22) opposes what he terms as "the common environmentalism approach" of assuming the individual in society is to blame and his/her behaviour needs modification through sanctions provided by the strength of new laws to regulate human choice and behaviour.

But, in opposition to this, Sen (1999, p.66) counter-argues that the rigid positions of libertarianism may pose issues because the results of those positions may be potentially negative due to the fact that freedom for some may lead to detriments of others if libertarian ideals are followed strictly, for e.g. in areas such as the common needs of mass education, Maslow basic needs like shelter and medical services. Sen (1999, p.66) argues that these features should not be neglected on premise of 'priority of liberty'.

But such arguments by Sen effectively presuppose their conclusion: if a particular person is deemed to have a right to being well nourished, then any activity on the part of any other person will have at least a marginal effect, perhaps by raising the relative prices of two goods that the particular person has a preference for, and thus the particular person's deemed rights take precedence over any possible liberties of any other person.

Sen (1999, p.67) argues that libertarianism as an approach may be restrictive as it downplays factors that utilitarian and welfarist theories value, and even if liberty is accorded an exceptionalised position in society and economy, Sen does not believe that it deserves complete attention to the exclusion of other competing needs as required by libertarians – justice therefore should be more pluralistic than is prescribed by liberatarians.

But again in this argument, Sen assumes his conclusion. If great importance is attached to variables which welfarists treasure, then libertarianism, i.e., the absence of

welfarism, will by definition not provide it. The true question, then, is whether it is more important to treasure welfarism or liberty.

In attempting to strike a compromise between Sen and Maymin's arguments, a common proposal of achieving environmental quality may be for government to provide economic incentives for industry to reduce pollution. According to Stoel and Waverman (1974, p.365), this may be achievable through effluent charges, tax subsidies or related instruments that are viewed positively by economists but have limited effectiveness and scope in the USA. Stoel and Waverman (1974, p.366) point out that the option of economic incentives may be useful since it positions the private sector along with the state in managing pollution and yet allows the flexibility of each industry or firm to indigenously customise their own solutions to combat pollution based on market forces and what may be reasonable for profitable production. By modifying incentives, mitigation of pollution may be based on the market determination of costs (if the mechanism works well, at the most effective cost level) [Stoel and Waverman, (1974), p.366]. But the downside of the economic incentives approach may be found in practical use because the undeterminable permutation of outcomes through which firms institute responses to individual needs result in challenges for forecasting and projecting pollution reduction extents [Stoel and Waverman, (1974), p.366]. This may be unavoidable given that information and data held by industries and the outcome of their policies and produces are generally kept as confidential data with implications for economic competition, so the lack of information makes it a challenge to evaluate and analyse the results of initiatives [Stoel and Waverman, (1974), p.366].

Moreover, Maymin is also not in favour of political ties between state and businesses for the following reasons. He argues that there should not be any public programs to assist business because they simply take money from the taxpayers by force and give it to politically favoured companies, detracting from the principle that businesses are supposed to operate in the free market providing goods and services to people who are willing to pay for them [Maymin, (2008), p.60].

Soros (2002, p.6) concurs and argues that political outcomes and lobbying typically makes market approaches less than optimal although democratic societies need these forms of negotiations and bargaining and, given that market forces are value-free and self-interest-oriented, they base market outcomes on interests without morality, judgment or imposition of a society's value system. The market does not determine subjective judgments but leaves willing participants to maximise their interests with the least amount of interference [Soros, (2002), p.6].

Sticking strictly to the free market mechanism, Maymin ultimately argues that businesses are supposed to fend for themselves. Philosophically and doctrinally, the private sector can generate benefits for themselves without state intervention even when it comes to common goods or public wants (e.g., positive environmentalism) but in reality, the private sector may actually benefit from routing the state's safety and regulatory measures if profit orientation is strictly adhered to Stoel and Waverman (1974, p.370). Luttwak (2000, p.7) points out that market mechanisms may demonstrate leanings towards illiberal outcomes, for, e.g., stronger business may grow faster than others and become natural monopolies in their industries. Specifically, the problem is not market-based monopolies, but monopolies enforced through government power, itself attained through political connections with the large businesses.

Jones (1981, p.133), however, spots differential features in responses by big transnational and small/medium-sized firms towards governmental roles in the economy

based on the general trends that large multinational companies usually attract the state's attention more than smaller scale industries. Regardless of scale, in Maymin's (2008, p.65) view, allowing elected officials and the state to determine the allocation of resources and assets will open up the process to political lobbying that may favour a smaller group on the back of tax resources. Furthermore, the determination of appropriate scale for any given project is one of many variables that may be considered by the free market, and if voluntary transactions between people suggest a smaller scale is better for a particular goal at current prices, government intervention to increase the scale too fast too soon will increase costs.

Consequently, extrapolating from Maymin's argument, state-funded programs for businesses in terms of environmental technological applications, subsidies for greening businesses, etc., may not be as effective as competitive pressures exerted by the free market for business to become more environmentally-friendly. In addition, political lobbying may influence politicians in the arena of environmental regulations to the detriment of the majority.

Agreeing with this view, Smil (1994, pp.250–251) appears to argue that lobbyists in wealthy economies ranging from professional groups to unions that have access to political and industrial power centres can influence the outcome of state positions through their dominant influence over prices and resource allocation (including energy resources). Smil argues that by expending financial resources to provide policy makers with information and quantitative data favourable to their causes and establishing personal contact with politicians while mobilising mass media and societal organisations to publicise their causes, lobbyists and interest groups have a strong influence over the outcome of political decisions on the environment [Stoel and Waverman, (1974), p.370]. Within the rubric of democracy, lobbying and interests are well within validity and legitimacy but Smil laments that counter-influence in favour of alternative positions generally is weaker and dependent on voluntary handouts and unpaid advocates who are passionate about their causes [Stoel and Waverman, (1974), p.370]. As one example Friedman (2000, pp.280–281) recalled his conversation with Agus Purnomo in the capital city of Indonesia who revealed that as the head of World Wide Fund for Nature Indonesian branch working for biodiversity, they competed with perceptions that they were against economic development and job creation.

But not all scholars agree that lobbying is necessarily a bad thing. Klare (2004, p.188) argues that energies must be expended to reach the US political elite to initiate environmental improvements at all sub-national and national levels to move quickly on alternative energy development. In this case, it is lobbying for environmental awareness. Perhaps to capitalise on collective strength, Mancur Olson defined communities of the like-minded and their cooperative stances as distributional coalitions which have a chance to proliferate in functioning social and political systems [Smil, (1994), p.251].

Other scholars may also disagree with the view of separation of state and lobbying/NGO efforts; in fact in some economies like Japan, there is functioning state-NGO cooperation in environmental-related issues for e.g. in encouraging firms and industries to install technologies that mitigate pollution in the 1970s when Japanese residing in the capital city were not able to view Mount Fuji beyond a couple of days annually – the measure proved effective and public feedback on the environment turned more positive [Duus, (1998), p.323].

Of course, the problem is not with lobbying per se, as lobbying is merely an expression of free speech; the problem is that the government is granted so much power

that lobbying is an effective means of passing unlibertarian laws, laws that transfer private property from its rightful owners to those more politically favoured.

Sometimes, equitable private sector-NGO-state tripartite arrangements can appear to be effective. With the support of Conservation International, Keith Alger and his conservation team gathered funding resources to construct Ecopark financed by donations from Ford Motor Company and Anheuser-Busch (Budweiser) (both multinationals had a stake in Brazil's environmental well-being along with business interests) cooperating with the US Government's Agency for International Development (USAID) and Brazil-based Banco Real (the proprietor of Transamerica Hotel near Ecopark) whose President informed regionally-based Brazilian civil servants: "I want my tourists to see trees in the background when they look out the window, not some moonscape that has been logged" [cited in Friedman, (2000), p.284]. This may be one example of Friedman's cited government-private sector collaborative and interactive possibilities, which bring hope to such collaborations in being mutually benefit through corporate social responsibility to the environment while keeping an eye on profit margins [Friedman, (2000), p.286].

Maymin's (2008, p.115) argument when it comes to public policy and businesses including those related to the environment and natural resources is that the free market is about millions of people offering the collective what they think they want. In this vein, Maymin's interview with Ron Paul (Republican Candidate for the US Presidential election in 2008), revealed that, if Paul was elected, he would end special interest favours and subsidies that harm the environment and that he has opposed programs to subsidised development in environmentally fragile areas with taxpayer-subsidised flood insurance, etc. [Maymin, (2008), p.163].

There are, however, some common points of agreements between the different camps of state-centredness and free market advocates. Jiang (2010, p.47), for example, does not rule out market solutions since China has a dual priority in market-based distribution of energy resource simultaneous to state-led involvement and role. Referring to market forces, Jiang (2010, p.49) argues that the private sector needs to be involved in the government's state-mandated megaprojects through funding provided by a cross section of society in addition to state funding. However, this argument seems to suggest that the private sector ought to be funded by society as a whole and through state funding, rather than emphasising that the private sector ought to be able to fend for itself with neither hindrance nor support from the state.

The balance between state and private enterprise is also examined by Soros. Soros argues that globalisation may be a desirable development in many ways. Soros (2002, p.4) argued that globalisation based on market forces unleashed innovation and entrepreneurial instincts while churning new technologies and ideas. Luttwak's (2000, p.30) widely-read writing argues that developed markets have already accepted market mechanisms as the preferred way of doing business according to rules-based restriction and that benefits-orientation may be the best way to unleash talents, resources and knowledge-based advancements to innovate new ideas and products. Value creation and product output are outcomes of such ideational ventures. The private sector may be better able to generate prosperity than state-controlled systems since the market forces supporters point out that strong state system show the potential to overuse their mandate of rule, something that can only be counteracted by individual freedom [Soros, (2002), p.4].

Even state-centrist advocates appear to acknowledge the power of the market. Jiang (2010, p.49) indicated that energy costs should be an outcome of resource availability, demand and the detriments suffered by the environment for its usage due to the fact that pricing acts as an indicator to both users and stakeholders in energy distribution that energy saving practises and logical use of such resources are in their interests in line with other participants in the global energy markets.

In the meantime, Jiang (2010, p.49) believes that the remuneration and payment for resource use and the payment system for addressing the deterioration of the environment within the context of both suppliers, consumers and environmentalists can be further aggregated to reach an equilibrium. Jiang (2010, p.76) believes that saving energy is conducive to capital accumulation because energy costs make up 8%–9% of total output value of industrial production. Garvey (1972, p.40) argues that prudent uses of energy may be important for ensuring there are sufficient resources for future use and therefore there is a need for greater energy-saving measures, more efficient use of fossil fuels and other ways to increase supply so that the problem is not postponed to future generations.

In short, interventionists believe they can better allocate resources among people than those people could do themselves, though they do not explain why the people do not rush to pay for such a valuable service voluntarily, or why the preferred allocation of the interventionists should be forced upon those who object. Thus interventionists effectively punish ex-ante through redistributions. Libertarians on the contrary believe property rights must be enforced and damages determined on an ex-post basis as a matter of justice. The remainder of this paper models a comparison between these two approaches.

4 Model

To compare the ex-ante regulatory approach with the ex-post libertarian approach on an equal footing, we need a model of behaviour on top of which we can overlay various governmental regimes.

The approach we propose relies on insights from Wolfram (2002), who has pointed out that simple rules can very often generate complexity, and that furthermore, the complexity that simple rules generate are, in a very specific technical sense, the most complex possible. Wolfram also defines cellular automaton and proves that even the simplest ones generate maximal computational complexity.

For our purposes, a cellular automaton is a sequence of black and white boxes, or cells, combined with a rule for transforming those boxes in the next time step. The rule determines a particular cell's next colour-based not only on its own current colour, but also the colour of its two nearest neighbours, one on the left and the other on the right. It turns out that of the 256 simple rules, several exhibit complexity of various degrees.

Let us reason with these cellular automaton by analogy. Suppose that each cell represents a participant in the environmental market, either a person or a corporation. Each cell can choose to pollute (black box) or not pollute (white box). And each cell determines whether or not to pollute based on whether or not it or its neighbours are currently polluting.

One might imagine different kinds of rules. One rule might say that one should never pollute, regardless of the current conditions. Or perhaps one should always pollute. Or perhaps one should only pollute if one wasn't polluting while one's neighbours were.

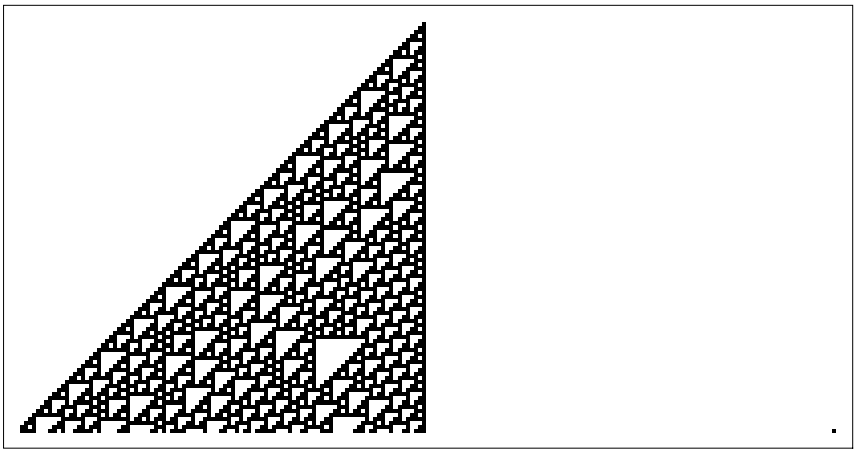
The approach advocated by Wolfram is to test every possible rule, rather than trying to determine an appropriate one ahead of time. Wolfram proves that in many cases, it is impossible to determine the result ahead of time, due to computational irreducibility.

Consider the rule known by Wolfram's numbering scheme as rule 110, which Wolfram has proven is computationally universal, in that it can in principle be used to compute any computable function. In short, it is maximally complex.

What would be the effect of overlaying either an interventionist or a libertarian government on top of it? We interpret the bare results of the cellular automaton as a form of anarchy: what people would do if there were no government and one's only option was to choose whether or not to pollute.

The bare result of the evolution of rule 110 is shown in Figure 1 labelled 'anarchy'. In this figure, we begin with all cells initially choosing to not pollute except the single cell in the middle. In the second row, the cells next to that single polluter choose to pollute. In the third row, more choose to pollute or not pollute based on their and their neighbour's then-current choice, and so on. We can see that a complex pattern emerges.

Figure 1 Anarchy



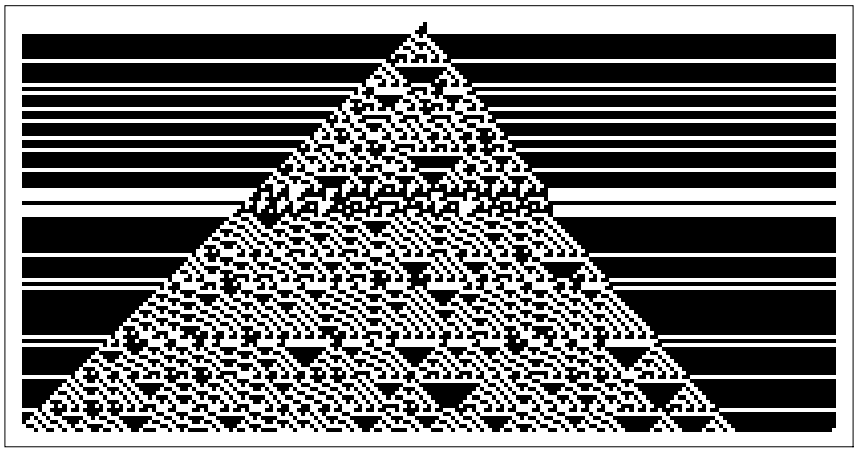
What would the effect of interventionist ex-ante regulation be? It would be to restrict the ability of cells to ever choose to pollute. In short, it would result in a box of all white cells, always. More generally, in cases where each cell has more than one choice, for example, to pollute, not pollute, or pollute a little, regulations would remove the most polluting option, leaving only the others.

But this type of regulation severely limits the possibilities for complexity. When there are only two possible choices in each cell, we have seen there are only 256 possible distinct rules. But when there are three possible choices in each cell, there are more than 7.5 *trillion* possible rules. Thus interventionism even to the degree it eliminates only a single choice reduces the possible paths by a factor of 30 *billion*. Each of those paths represented a possible technological or market innovation, cut short, never to exist, because of interventionism. Friedman's lament about the slow pace of innovation may in fact be a symptom of regulation, rather than justification for it.

What about libertarianism? A libertarian, ex-post, remuneration approach could be expressed in different ways, but one natural representation is in terms of a justice system where pollution is punished and non-pollution is rewarded. For example, polluters could be forced to pay for the effects of their damage. In the context of the cellular automaton, one could merely flip all white cells into black cells and vice versa. Furthermore, one could even allow for a 'noisy' justice system that only performs the flipping with a given probability.

Figure 2 depicts such a noisy libertarian evolution, equivalent to the same rule 110 as before, but with an 80% enforcement probability.

Figure 2 Flip



One can see that, while the evolution itself is of a different character, the underlying complexity remains. In other words, libertarianism appears to alter the underlying paths, but not destroy them. In the case of three possible choices for each cell, there would still remain all 7.5 trillion possibilities.

5 Conclusions

We have compared and contrasted the two primary methods of discourse for environmental issues, namely interventionism and libertarianism, to identify commonalities and highlight discrepancies. We have then codified the two approaches in a simple illustrative model using cellular automatons to argue by analogy. We found that, as a general matter, interventionist approaches severely restrict the number of possible future paths, thus destroying much possible innovation, while libertarianism, even when noisily applied, tends to retain the underlying character of the paths without destroying any.

The model is not intended to be viewed as a definitive description of the behaviour of economic actors; rather, it is intended to be used as a tool that can incorporate a variety of different views, and in particular legislative environments, for comparison in a common ground.

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