

## RESEARCH PAPER

### Restricting environmental damage resulting from economic activities: a Polanyian analysis

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#### ABSTRACT

Economic activities continue to cause considerable environmental damage. The extent of damage could be such that the environment in and around our planet will be affected, making survival difficult for human beings, for other animals, and for plants and insects. The paper reviews economic developments from the nineteenth century and how these have been influenced by orthodox economic theories. Markets are central to orthodox economics, and to policies which have been implemented recently to restrict global warming. Since the 1980s, policies based on orthodox economics and neoliberalism have been widely implemented by governments, and also by international organizations. Such policies are evaluated and found to be seriously inadequate. Studies of environmental implications of the development of two major sectors of the world economy follow. Policies which are concerned only to restrain climate change are unlikely to be adequate by themselves. Policies which take a holistic approach to considering all the important impacts of human economic activity on the environment have greater prospects of success. The paper concludes by suggesting research and analysis be undertaken urgently to assist with the design and implementation of more effective policies to reduce the damage to the environment caused by human economic activities.

#### Introduction

The environment of our planet could be affected by human economic activities to an extent which will make survival difficult – for human beings, for other animals and for plants and insects. Such damage results from global warming; it includes reduction in the diversity of animal and plant life able to survive, damage to earth and air quality resulting from the extraction of enormous quantities and varieties of minerals – in addition to coal, oil and natural gas fuels which are subsequently burned – and the dumping of waste products. The historical and economic roots of most aspects of the problem of human economic activities detrimental to the environment are common. Accordingly, an historical perspective is adopted in the attempt to identify these common roots.

Orthodox classical and neo-classical economists have based much of their analysis on the basis that land and labour behave as commodities. At many places in this paper it is emphasized that, for economic theories to reflect reality, aspects of both human activities and nature have to be taken into account. This cannot be done if land and labour are treated as if they are commodities. In 1944, Polanyi identified this fundamental error and suggested that it had infected orthodox economics. Thus, orthodox economics provides inadequate foundations on which to build strategies for reducing the extremely serious environmental problems which confront humankind.

Roots of the environmental problems we now face derive largely from the industrial revolution which started in England late in the eighteenth century. There was also a rapid rise in the world population of human beings, from about 1 billion in 1800 to about 1.5 billion in 1900 and to about 7.7 billion in 2019 (Roser, 2019). From the nineteenth century, industrial and agricultural changes developed rapidly, first in England and subsequently spreading to and developing further – in Germany, the United States and the rest of the world, in unequal patterns. This was reflected in very uneven patterns of distribution of the multiple resulting economic benefits and environmental impacts – both geographically and between various sections of the populations in each country.

A central assumption of orthodox economics from Adam Smith onwards has been the inevitable and central role of markets in economic activity. Local markets have existed for a very long time indeed. But markets only became highly significant in economic development during and after the industrial revolution (Polanyi, 2001, pp.45–6). Late in the nineteenth century, the need to transport and distribute ever-growing quantities and varieties of factory-produced goods over ever-increasing distances resulted in markets gaining strategic importance.

Markets are central to orthodox economics, and to current policies which have been implemented to restrict global warming. These policies are evaluated from the perspective of the extent to which they appear to be successful in restricting damage caused to the environment. This is followed by brief studies of the environmental implications of the development of two major sectors of the world economy: land transport, and agriculture and food. This paper concludes with preliminary suggestions about some broad areas in which empirical research and analysis need to be undertaken, with the aim of forming a sound basis for designing policies which will be effective in reducing the damage to the environment caused by human economic activities.

### Products made in factories

Schumpeter's 'avalanche of consumer goods' (see below) was a consequence of revolutions in production and products combined with numerous other important changes. These included rapid technological development, first in means of transport and then in means of communication, which resulted in enormous increases in the productivity and extent of first transport and later communications, concomitant with considerable reductions in their costs. According to Schumpeter (1954, p.67):

The capitalist engine is first and last an engine of mass production which unavoidably means also production for the masses . . . It is the cheap cloth, the cheap cotton and rayon fabric, boots, motorcars and so on that are the typical achievements of capitalist production. The capitalist achievement does not typically consist in providing more silk stockings for queens but in bringing them within the reach of factory girls in return for steadily decreasing amounts of effort.

Continual revolution in production methods and in product availability have resulted in 'an avalanche of consumer goods . . . the capitalist process . . . by virtue of its mechanism, progressively raises the standard of life of the masses' (Schumpeter, 1954, p.68).

At first, transport on land consisted largely of people walking, riding on horses and other animals, and using animals to carry people and/or goods on land and to draw carriages. In addition, boats and ships carried people and goods on rivers and seas. In England from the mid-seventeenth century onwards, ever-increasing resources were devoted to expansion of river transport and to construction of new roads and bridges. The first canals were built in the 1750s. By 1780, many major industrial centres were linked by navigable waterways and solid roads (Landes, 1969, pp.46–7). The development and use of steam engines as pumps in coal mines and then, from about 1830 onwards, the use of the Watt steam engine for transport by railway trains led to enormous increases in the mining and combustion of fossil fuel. The initial burst of railway construction in Britain was followed by huge investment in railways in the 1840s. Between 1830 and 1900, railways contributed very substantially to the creation of ever-increasing and diverse markets for an ever-widening

range of factory-produced goods. Between 1840 and 1913, railways were built in many countries, and a very large proportion of the rapid increase in traffic in Europe, North America and Britain was carried by them (Freeman and Louça, 2001, pp.190–6).

The widespread use of electricity – first produced mainly by burning coal – began towards the end of the nineteenth century. Revolutions in communications, including radio and television followed by computing and social media, started later. And production of automobiles, invented in the late nineteenth century, began to expand rapidly after the introduction of the Ford Model T in the United States in 1908. The Model T epitomized Schumpeter's revolution in production methods, which reduced the costs of production substantially so that each car could be sold in huge quantities at amazingly low prices. Such developments led to very rapid increases in the extraction and use of a changing mix of fossil fuels which aided the construction and use of a changing variety of products and services. To this was added growing household use of fossil fuels, first for domestic heating and then for air conditioning of homes for people and families with rising incomes (Landes, 1969, p.96; Dennis and Urry, 2009, p.32; Freeman and Louça, 2001, pp.188, 309–24; Zuboff, 2019, pp.29–30).

Traditional economics is wrong to assume that individuals have well-defined preferences and fully rational expectations and perceptions and that individuals know what they want. If this were so, there would be little scope for advertising. In reality, advertising can and does shape preferences (Stiglitz, 2012 pp.146–7). Towards the end of the nineteenth century, advertisements in newspapers began to be used to promote mass sales of newly developed factory-produced breakfast cereals in the United States (Lawrence, 2008, p.10). In the 1920s, after considerable controversy, radio became commercialized in the United States, with very few stations broadcasting numerous advertisements to huge audiences (Wu, 2017, pp.74–85). Television experienced a similar fate in the United States a few decades later: by 1957, television followed radio to become 'the creature, the servant, and indeed the prostitute of merchandising' (Walter Lippmann as quoted in Wu, 2017, pp.155–6). Radio and television have been followed by social media as cheap and effective ways of reaching huge audiences for advertising, first in the United States and subsequently in many other areas of the world. Thus, the worldwide pattern of excessive use of fossil fuels has not been created exclusively by consumer demand. It has also been stimulated greatly by extensive advertising and other means of promotion.

A general pattern of individualization of consumption of products, both by broadening their appeal and by varying details of their design, has been undertaken by companies to increase sales, especially since the beginning of the twentieth century. Promoting radios, televisions and mobile telephones successively to increase their appeal to specific types of business, and to individuals as well as to families, are other examples of this process. Social media have been extensively and very profitably developed in recent decades to market huge varieties of products and services to individuals.

By the twenty-first century, in contrast to the substantial benefits gained by millions of families and consumers, many such enormous developments had combined to result in substantial damage to the environment. Economic development has involved enormous quantities of fossil fuels, coal, then oil and natural gas being extracted from land and sea and then burned. This combustion has taken place in numerous rapidly growing economic activities, including construction of factories, use of many of the products made in those factories, transport of raw materials and components of those products, transport of people by water, road, rail and subsequently in the air; together with combustion to heat and – subsequently in relatively prosperous areas – also to cool people's homes, places of work and other buildings.

### **Polanyi's criticisms of laissez-faire and orthodox economics**

The drive towards laissez-faire (abstention by governments from interfering in the workings of the free market) was designed to create a self-regulating economic system motivated by individual gain. But this implied a thoroughly distorted conception of life and society, based on assumptions

that markets are institutions which had arisen naturally in the course of history, and that for people to behave as traders in markets is also natural to human beings (Polanyi, 2001, pp.276–7).

Many nineteenth-century economists assumed that an economic system consisting of markets and under the sole control of market prices, and a human society based on such markets, would be the goal of all progress. Human beings' materialistic propensities would induce them to abide by economic rationality, and all contrary behaviour would be the consequence of outside interference. For example, in relation to work, 'economic man' would expect payment for his labour, would choose lesser effort rather than greater; and in business he would strive for profit (Polanyi, 2001, pp.257–8).

Polanyi defines a commodity as something that has been produced for sale on a market. According to his definition, land and labour are fictitious commodities because they are not originally produced to be sold on a market. Polanyi's book *The Great Transformation* makes it clear that economic theories based on considering land and labour as commodities are inevitably false. In reality, labour is only one of the activities of human beings and land is only one aspect of nature. Adler (2015, p.4) summarizes Polanyi's views about this concisely and accurately:

Unlike the equipment and intermediate goods that businesses find available in the marketplace, natural and human resources are not truly commodities – they are not produced for sale on the market. On the contrary, natural resources are given by nature, and human resources are nurtured by families and communities. They are 'fictitious' commodities, to use Polanyi's term: they are resources whose treatment as commodities contradicts the actual conditions of their production and exchange.

Polanyi considers that the social conditions created by the industrial revolution and its widespread introduction of factory production involved a 'veritable abyss of human degradation'. Large parts of the country 'were rapidly disappearing under the slack and scrap heaps vomiting forth from the satanic mills'. Ordinary people, especially workers – many of whom had lived previously in rural environments – had been 'dehumanized . . . crowded together in new places of desolation' in slums in the industrial towns of England. This was a catastrophe involving 'an avalanche of social dislocation' (Polanyi, 2001, pp.41–2).

In contrast, the analysis of the pioneering economist Adam Smith (e.g., in *The Wealth of Nations*, first published in 1776) could be based on observation only of economies before and during the period when he was writing. For several centuries, traditional products, such as wheat, wool, meat, beer had been supplied in horse-powered vehicles made by traditional methods in small quantities using traditional materials. Nevertheless, he also observes some new economic developments. For example, he is well aware of the significance of the division of labour in increasing productivity. Indeed, this is the subject of the first chapter of *The Wealth of Nations*, in which he reports his observations of the division of labour in pin-making (Smith, 2010, book 1, pp.4–11). He next introduces the concept of 'the invisible hand', suggesting that 'It is not from the benevolence of the butcher, the brewer or the baker that we expect our dinner, but from their regard to their own interest' (Smith, 1910, vol. 1, p.12). His rhetoric is magnificent in reaching the conclusion (expressed here in modern language) that self-interest combines with the division of labour to promote economic growth:

As every individual . . . endeavours much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value; every individual necessarily labours to render the annual revenue of the society as great as he can. . . . By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases led by an invisible hand to promote an end which was no part of his intention. (Smith, 1910, vol. 1, p.400)

Adam Smith assumes that the division of labour is primarily the consequence of the human 'propensity to truck, barter and exchange one thing for another' (Smith, 1910, vol. 1, pp.5–12). This may have been a reasonable assumption towards the end of the eighteenth century when *The Wealth*



*of Nations* was being written. But the industrial revolution had barely begun by 1776 when *The Wealth of Nations* was first published. The number of factories in existence then was tiny, and Smith could not possibly have been aware of their future economic significance. Nevertheless, Adam Smith's observations, rather than his preaching, could have formed the basis for later economic analysis based on empirical observation.

Not, however, until 1944 did the first publication of Polanyi's *The Great Transformation* make it clear that the tendency to barter, on which Adam Smith relied heavily, has never been a tendency of human beings in economic activities (Polanyi, 2001, pp.45, 258). The significance of this criticism was later expanded by Guy Routh (1989), who diagnoses Adam Smith as having suffered from 'a curious conflict in beliefs'. While he preached that 'only government interference hindered the invisible hand from guiding mankind along the road to plenty', Adam Smith's often acute observations of how the economy actually works suggest that his fundamental beliefs were false. For example, many of those whom the 'invisible hand' should force to compete for the benefit of the public in practice often conspire to fleece the public (Routh, 1989, p.103). In his next chapter, titled 'From propaganda to dogma', Routh provides several examples in considerable detail of how Adam Smith's curious conflict in beliefs was continued and amplified by numerous subsequent classical and neo-classical economists (Routh, 1989, pp.104–7).

Polanyi observes that fossil fuels have existed for thousands of years below ground as part of the land and of nature; they were not created for the purpose of being bought or sold in markets. However, during the industrial revolution and subsequently, rapidly increasing quantities and types of fossil fuels were extracted, priced, sold in markets and subsequently burned. Polanyi argues that, without protections, 'nature would be reduced to its elements, neighborhoods and landscapes defiled, rivers polluted, military safety jeopardized, the power to produce food and raw materials destroyed' (Polanyi, 2001, p.76).

The development of mass production and the distribution of factory-produced products during the first half of the nineteenth century, together with mass marketing towards the end of the century, should have been observed and taken into account by later orthodox economists. They should have noticed that these rendered some of Adam Smith's assumptions invalid. By the end of the eighteenth century, laissez-faire, supported by numerous orthodox economists, had triumphed in Western Europe and the United States. Capitalists now had political power with which to promote their wealth (Routh, 1989, p.105). 'The spiritual blindness which made possible the general acquiescence in the horrors of the early factory system was, not a novelty, but the habit of a century' (Tawney, 1926, p.196).

By the time of the early factories, it was generally believed that a science had been discovered which put the laws governing man's world beyond any doubt. With compassion removed from their hearts prosperous people had become morally degraded, denying all responsibility for the welfare of their fellows. A society which had previously been influenced by Christianity had gradually been transformed into one dominated by the new secular religion of laissez-faire. Human solidarity was renounced 'in the name of the greatest happiness of the greatest number . . . the new creed was utterly materialistic and believed that all human problems could be resolved given an unlimited amount of material commodities (Polanyi, 2001, pp.42, 106–7, 143). As pointed out by Pigou (1951), 'Economics was consolidated into dogmas which provided blunt instruments with which to bludgeon at birth useful projects of social betterment'.

Moreover, even if an invisible hand had existed before the industrial revolution, it is difficult to see how there can possibly still be an invisible hand which can ensure that consumers are benefiting from the purchase of heavily promoted, factory-produced goods in the twenty-first century, goods specifically designed to increase the profits of the companies producing and marketing them. Blythman gives numerous very detailed examples of how the characteristics of a huge variety of mass-produced, processed food have been adapted and changed with the intention of increasing the profits of those producing and marketing these products. Such changes in characteristics can have severe adverse effects on consumer health (Blythman, 2015).

A central problem is that orthodox economists – first classical and subsequently neo-classical – persisted in developing their theories and analyses on the basis of false assumptions. Neo-classical economists devoted far too much attention to theoretical development, and far too little to observing the fundamental ways in which economies changed during the nineteenth century and subsequently. During the nineteenth century, economists should have observed the rapid and extensive changes in the path of economic development caused by the industrial revolution. They should also have observed new findings from research in such disciplines as economic history, anthropology, psychology and sociology, which had become increasingly relevant to the analysis of economic phenomena. Such observations could have helped neo-classical economists to realize that the theoretical structure which they were spending so much time and effort erecting and elaborating was built on unsound foundations.

### Neoliberalism's influence on policy

*The Great Transformation* was first published by Polanyi in 1944, three years before neoliberalism came into existence. But it is necessary to consider neoliberalism briefly in this paper because, although most orthodox economists claim to reject neoliberalism, it now exerts substantial influence on many of those who make economic policy. The ideas behind neoliberalism were formed by a group of intellectuals – including Friedrich Hayek and Milton Friedman – who formed the Mont-Pèlerin Society in 1947. Their ideas exerted little influence on economic policy until they began to be adopted by the governments of the United States and the United Kingdom in the 1970s and 1980s (Jones, 2012). Neoliberals do not advocate laissez-faire and are even less inclined to advocate restraints on corporate behaviour than neo-classical economists. They consider that governments should confine themselves to safeguarding individual and commercial liberty and strong property rights; that market mechanisms are the best way to organize all transactions involving goods and services; that free markets and free trade liberate the creative, entrepreneurial spirit which exists in human society; and that this freedom can lead to greater well-being and better allocation of resources (Thorsen, 2010, p.204).

But governments which now follow policy advice from the policymakers convinced of the benefits of neoliberalism by no means always follow coherent policies which accord with neoliberal advocacy of free markets and free trade. This is because there can be conflict between the neoliberal state's aim to create a society with an atmosphere favourable for business to work in and invest in, and at the same time to cope with needs to protect the environment and to protect workers' rights and quality of life. Harvey (2005, pp.70–1) observes that, in cases of conflict arising from 'treatment of labour and the environment as mere commodities', the neoliberal state assigns relatively low priority to labour's needs and environmental considerations. George (2015, pp.5, 123–31) goes further, suggesting that neoliberalism deters both national governments and international policymakers from even thinking about implementing tough legislation to restrain global warming.

Government reluctance to restrain global warming is exemplified in the persistence of huge government subsidies for fossil fuels throughout the world. Any government action that lowers the cost of fossil fuel energy by raising the price received by producers or lowering the price paid by consumers may be classified as a fossil fuel subsidy. Such subsidies are so huge, diverse and complex that it is impossible to get an accurate picture of their global scale and effects. The most conservative estimates are that these subsidies amount to less than 5% of global gross domestic product, but some estimates suggest that they amount to well over 5 trillion dollars – about 6.5% per cent of global GDP. It has been estimated that more than half of government fossil fuel subsidies are for oil products, with the rest split almost equally between natural gas and electricity. There are international agreements, in particular the United Nations Framework Convention on Climate Change Paris agreement (2015), which have set targets for emission reduction. But several countries with large emissions – such as Australia, Brazil and the United States – have either not signed up to these agreements or made very modest commitments to CO<sub>2</sub> reduction. In principle, it is possible to conceive of international tariff policies which could contribute to emission reduction.

But so far climate agreements have made little reference to trade. Moreover, tariff reduction seems to have increased trade in carbon-intensive and environmentally destructive products, such as fossil fuels and timber, more than in environmental goods. Further, several governments have invoked the world trade organization settlement mechanisms to challenge policies designed to stimulate CO<sub>2</sub> emission reduction in China, India, Canada, EU member states and the US, on the grounds that both subsidies and offering domestic priorities for renewable energy violate the free trade principles to which they subscribe. Neoliberal policies of government unwillingness to intervene in the operation of markets are widely entrenched in policymakers' thinking, causing reluctance to promote legislation to reduce environmental damage, although neoliberal attitudes do not appear yet to have had any significant impact in terms of reducing fossil fuel subsidies: indeed, the international monetary fund anticipates that large fossil fuel subsidies are likely to continue (Dawar *et al.*, 2019, pp.5–14, 21–3; Coady *et al.*, 2019, pp.5, 29).

### Current policies intended to reduce global warming

Joseph Stiglitz, an eminent economist, contributed a foreword to the 2001 edition of Polanyi's *The Great Transformation*, in which he suggested that:

the issues and perspectives Polanyi raises have not lost their salience. Among his central theses are the ideas that self-regulating markets never work; their deficiencies, not only in their internal workings but also in their consequences (e.g., for the poor), are so great that government intervention becomes necessary; and that the pace of change is of central importance in determining these consequences. Polanyi's analysis makes it clear that popular doctrines of trickle-down economics – that all, including the poor, benefit from growth – have little historical support. (Stiglitz in Polanyi, 2001, p.vii)

However, subsequently Stiglitz – unlike Harvey (2005) – failed to indicate sufficient appreciation of some central features of Polanyi's analysis: that the treatment of labour and land as commodities in orthodox economic analysis contradicts the actual conditions of their production and exchange. In a recent paper, Stiglitz wrote:

if we 'ruin' this planet through an excessive emission of greenhouse gases, we cannot move to another. This means that from a social point of view we should be especially focusing on innovations that reduce emissions; but so far, without a carbon price, firms have little incentive to do this. (Stiglitz, 2017, p.631)

Accordingly, it is not surprising that, in accordance with such thinking, policies involving carbon markets and prices in the shape of emission trading systems have been recommended by economists and adopted in order to counter threats of climate change with the aim of reducing greenhouse gas emissions and protecting society. Indeed, such policies are encouraged by article 6 of the Paris climate agreement of the twenty-first conference of the parties of the United Nations framework convention on climate change (2015). In a recent paper, an eminent climate scientist, James Hansen, has supported such policies. He writes that climate science shows unambiguously that global fossil fuel emissions must decrease rapidly over the next few decades, if young people are to avoid climate calamities. 'Economists say that such a change is not only possible but makes economic sense, because economies are more efficient if subsidies are eliminated and externalities are included in prices' (Hansen, 2018, p.52). While few rational people would question Hansen's great expertise as a climate scientist, this latter statement must have been made on the basis of the advice of the economists Hansen consulted. That the economists did not take sufficient account of the enormous difficulties in measuring sufficiently consistently, accurately and reliably the huge number and variety of enormously complex externalities is not surprising. As we have seen, for more than three hundred years, economists – as in this case – generally advocate ineffective market

and price solutions in an attempt to solve society's problems in preference to regulation. This preference is reflected in the advice given to Hansen.

Similarly, the international carbon action partnership (ICAP) suggests that emission trading systems (ETSS) are already delivering cost-effective fossil fuel emission reductions in several sectors in numerous countries (ICAP, 2020). ETSS and other policies are not independent of each other; they interact in many ways (ICAP, 2020, p.5). Carbon markets, however, represent an expansion of markets that fails to address the underlying contradictions involved in the commodification of nature. Various types of market fundamentalism attempt to expand commodification, and to subject society and nature to market rules. Thus, a market-based problem gets a market-based solution. There is an abundance of evidence which supports the conclusion that 'further attempts to commodify carbon emissions through carbon markets will fail to address climate change' (Stuart *et al.*, 2019, p.91). Moreover, carbon markets also increase risks to society by preventing or delaying alternatives with the potential for transformative reductions in greenhouse gas emission. Extensive research on the effectiveness of the largest ETS in the world, the EU emissions trading system, concluded that it has been almost entirely ineffective in reducing emissions. Numerous environmental and economic justice groups have called for it to be abolished (Klein, 2014, p.225).

## Two sector studies

Two short studies based on examination of empirical data are presented below. They are intended as a basis for preliminary assessment of how better to approach the design of environmental damage reduction policies. In addition to the combustion of fossil fuel used to facilitate production and/or use of numerous products and service, many types of metal are extracted from the earth to make components for a huge variety of manufactured products, from jewellery to semiconductor components. These aspects are only touched upon in this paper, but the first case study below (of the automobile industry) includes preliminary consideration of the environmental impact of mineral extraction. And the second case study (of agriculture and food) also includes preliminary consideration of some biodiversity aspects.

### *Sector study 1: land transportation – the automobile versus public transport*

Between the 1840s and the 1880s, the development of railways was the principal factor in enormous and rapid growth in the number of horses in the narrow streets of large cities throughout the world. Huge numbers of horses and carts were needed to take goods from where they were produced to railway termini; to deliver goods from railway termini to their consumers, and also to transport rail passengers between homes, offices and railway stations. The horses used for such purposes were causing major pollution problems in cities and large towns, which represented a significant threat to human health and welfare. By the 1890s, cities were desperate to find a solution to these problems (Thompson, 1976; Morris, 2007).

A few years later, motor cars provided solutions to these severe problems. The development, mass production and mass marketing of extremely cheap and reliable petrol-driven motor cars in the United States stimulated the creation of the automobile society, first in the United States and then in the rest of the world. The Ford Model T was first produced in 1908. It incorporated some important principles of production engineering which were well established by then – in particular, standardization of design, and incorporation of precisely interchangeable component parts. Ford also incorporated a moving belt assembly line in the production process. These developments enabled Ford to produce Model Ts profitably at much lower prices than any car had previously been produced. Production of the Model T increased to over 350,000 in 1915.

But cars remained a luxury product in Britain for much longer than they did in the United States. In 1912, British production of motor vehicles was only about 5% of production in the United States (Savage, 1966, pp.92–7). By 1939 there were still only about 2 million cars in Britain compared with 27 million in the United States in 1940. Ford's methods of production had resulted in the ability to make cars which could be sold at a profit at very low prices,



methods that were copied first in the United States and later in Britain and other countries (Savage, 1966, pp.92–7). Car production increased much faster in the United States than in Britain and other countries because other US companies copied Ford in adopting assembly line production more quickly than automobile producers in other countries. The domination of cars over public city transport was secured initially in the United States by car manufacturers and their component suppliers conspiring effectively to buy up and destroy competition from electrified buses and trams. Not until 1955 were these companies found guilty of the Sherman Anti-Trust Act, but by then car domination was firmly established and the fines the companies had to pay were very small. Car culture became dominant as an expression of the good life, most especially in America, but also throughout most of the rest of the world (Dennis and Urry, 2009, pp.35–7). This is reflected in enormous expenditure by most governments to support the use of cars. Dwight Eisenhower, a five-star general during the second world war, had been greatly impressed by the world's first superhighway system, the German *reichsautobahn*. After his election as president of the United States, Eisenhower pressed hard for a national system of superhighways to be built there. The interstate highway act was passed by Congress in 1956, and this project – the largest in the nation's history – was undertaken, building 46,000 miles of road at the cost of over \$130 billion dollars of federal government money (Schlosser, 2002, p.22).

When automobiles were introduced to cities, they represented enormous improvements in terms of pollution reduction (Jacobs, 1964, pp.356–7). Automobiles and lorries could get to places which railways could not reach and did jobs trains could not have done. Their potential for improved transport productivity and efficiency over the horses and buggies which they replaced was enormous. But each horse was replaced by too many automobiles, vans and lorries. The resulting traffic and parking congestion means that vehicles may move little faster than the horses they replaced.

More and more land goes into parking to accommodate the ever-increasing numbers of vehicles while they are idle. . . . the more space that is provided for cars in cities, the greater becomes the need for use of cars, and hence for still more space for them. (Jacobs 1964, pp.363–5)

During the twentieth century, automobiles and trucks became the dominant mode of land-based transport for both people and goods. Indeed, automobiles and other vehicles driven by internal combustion engines provided unexpected solutions to the many problems of pollution and traffic congestion in cities caused by the use of horses. But within a few decades of their introduction, the rapid growth of human populations and automobile use in cities caused further, different problems in cities. There are now many millions of these vehicles throughout the world, each driven independently. Most governments encourage private car use and many have undertaken extremely large highway construction projects. In 2002, the average car user in the United States conducted 86% of journeys by car and on average, each adult travelled 13,500 miles by car annually. With the exception of Denmark and the Netherlands, private car ownership and use is increasing rapidly, especially in previously communist states, such as Poland. Similarly, car ownership is increasing in Africa and Asia, especially where there are population increases and industrial growth. China is now second only to the United States in car ownership (Dennis and Urry, 2009, pp.28–30, 44).

Unlike public transport vehicles (such as trains, trams, buses and taxis), most cars spend nearly all their time parked. In the minority of time they are travelling, they often cause considerable congestion, mainly in cities, but in rural areas also. The road space constructed for these vehicles covers an increasing proportion of total land area. Just as important, the availability of this highly flexible individual mode of transport has had important implications for town planning – and its neglect. Many supermarkets have been built in locations only easily accessible by car. Insufficient attention is paid to minimizing the need to travel by locating residential accommodation, work, shopping and recreational facilities in close proximity. Perhaps worst of all, in the United States – and increasingly in other countries, especially highly populated ones – over-dependence on automobiles is becoming increasingly destructive of water, air and land (Jacobs, 1972, p.117).

The use of automobiles requires the manufacture of a box, usually made of steel, but also including many other materials (such as rubber and plastic), together with the incorporation of electronic control equipment. This manufacture involves extensive mineral extraction around the world, with consequent pollution of land, water and air; it also causes disruption to communities previously living and working on the land from which the minerals are extracted. Major corporations are engaged in manufacturing cars; numerous other major corporations are engaged in the manufacture of the cars' components, and still other major corporations are engaged in extracting minerals – principally oil – and converting these minerals into fuel to power these cars. In developed countries, and increasingly in developing countries, cars are second only to housing as the most expensive item of individual consumption. The environmental impact of cars arises from extraction of the raw materials required for their manufacture, from the production process, the operation and maintenance of the vehicle, and from the construction and maintenance of roads. To make a typical car demands nearly a ton of metal, together with 90 kg of plastics, 45 kg of rubber and more than 8,000 kilowatt hours of energy. Car use also causes many human deaths and injuries through road accidents, and also health problems arising from air pollution (Dennis and Urry, 2009, pp.36, 45).

The total world car fleet was about 1 million in 1930. Eighty years later – by the middle of 2010 – it was about 1 billion, a thousand times greater. By 2019, it had grown further to about 1.3 billion. At present, the majority of the world's car fleet is still concentrated in rich countries. Principal growth is now expected in large poorer countries, such as China and India, where millions more people are expected to become sufficiently prosperous to buy and run cars. The world passenger car fleet is expected to grow much further, perhaps to about 1.8 billion by 2035. In 1930, there was about one car for 2,000 people worldwide. The proportion had increased to about one car for 50 people by the 1950s. By the first decade of the twenty-first century, this had grown to about one car for every eight people worldwide.

State funding of car manufacturing is immense throughout the world. Every car manufacturer in Europe has received subsidies for establishing car manufacturing plants from the governments of the country in which they are located. Similarly, new car manufacturing plants in Brazil, China and India benefit from substantial state subsidies. Nowhere are such huge subsidies offered for investments in public transport (Whitelegg and Haq, 2003, pp.286–7; Lindeman, 2018; Scalzaretto, 2019; Roser, 2019). It is widely believed that rapid growth in the production, sale and use of road vehicles is essential to meet people's needs for transport. Yet, governments must meet targets for reducing greenhouse gas emissions, to improve air quality in towns and cities and to satisfy the demands of consumers. As a consequence, many vehicle manufacturers are building hybrid and electric vehicles (hybrid vehicles are powered for part of their journeys by petrol motors and for part of their journeys by electricity from batteries).

More than one million electric cars were sold in 2017, and by 2019 there were about three million electric cars on the world's roads. At present, electric cars are high specification, top-of-the-range vehicles offering consumers advantages in the relatively low cost of fuel in the electricity they consume. Customers may also reap some satisfaction from helping to mitigate global warming. Similarly, manufacturers of electric cars persuade governments to facilitate strategies to encourage electric car manufacture. The cost of the batteries used to power electric cars makes the car very expensive, though the cost of batteries is falling fast. By 2025, the price of an electrically powered car may be similar to that of a fossil fuel car. Ten years later, there could be one car for every five people on the world's roads (Eckart, 2017, Katwala, 2018; Coren, 2018, 2019).

China and Norway have been prominent in offering incentives, penalties and encouragement to stimulate shifts from fossil fuel cars to electric cars. China is the world's largest market for cars, representing nearly a third of world car sales. Production of cars in China, for both home and export markets, has been growing in recent years. Nevertheless, the Chinese total home market for cars was lower in 2019 than in 2018, and is expected to be still lower in 2020. But the proportion of electric cars bought in China is much higher than in most other countries, at over 4.5%, and the proportion grew a little in 2019. This is largely the consequence of government

incentives encouraging the purchase of electric and hybrid cars combined with incentives to encourage manufacturers to produce electric and hybrid cars and legislation to deter them from making cars powered by fossil fuels (Holland, 2020; McDonald, 2019; Lindeman, 2018). Nevertheless, in 2015 the Chinese government provided far larger subsidies for fossil fuel than any other country in the world (Coady *et al.*, 2019, p.5).

Regulations controlling emissions have been introduced in many areas of Europe resulting in increased demand for electric cars. For example, in London, electrically powered and hybrid cars are exempt from the congestion charge levied on fossil-fuel powered cars. Norway still offers extremely generous incentives to buyers of electric cars and penalizes people who continue to use gas or diesel cars. The capital, Oslo, offers toll-free roads, free parking and free charging for electric cars. At present, half of all new cars sold to Norwegians are either fully electric or hybrid. But it seems that Norwegians are beginning to realize that the principal problem is to reduce the total number of cars circulating in cities, not to switch cars from fossil fuel to being powered by electricity. Oslo is now planning to make its whole downtown area car free, and is reducing the benefits offered to electric car drivers (Lindeman, 2018; Wu *et al.*, 2019).

Most of the batteries being used to power electric cars are now lithium-ion. Production of lithium-ion batteries is very energy intensive. Lithium is a scarce mineral. Production of one ton of lithium requires either the mining of 250 tons of the mineral ore spodumene, or the pumping out of 750 tons of mineral-rich brine. However, should electric cars become widespread, recycling the lithium from old batteries would reduce the need for mining or pumping out minerals from brine (McManus, 2012; Harper *et al.*, 2019). Extensive research and development is under way to develop more efficient batteries (such as sodium-ion) to replace lithium-ion batteries.

For this and many other reasons, it is extremely difficult to forecast the proportion of the world car fleet that will be electrically driven. Recent forecasts vary widely, the highest being about 500 million, or roughly one-third of the total world fleet forecast by 2035 (Coren, 2019). The net contribution cars make to global warming could then increase significantly even if a substantial proportion was electrically powered. Nevertheless, given that most public transport and goods vehicles are much larger and more intensively used than private cars, the reduction in global warming resulting from changing these vehicles from fossil fuel to battery propulsion might be significant. Accordingly, from an environmental point of view, government encouragement of production and use of electric vehicles may well be justifiable. Systems for de-privatizing cars such as car-sharing, co-operative car clubs and smart car-hire schemes are being developed and are growing fast in some rich societies. Some cities in Europe and North America have been experimenting with bicycle sharing (Dennis and Urry, 2009, pp.94–6).

Reduction in the contribution of land transport to environmental damage requires complex combinations of measures worldwide. These could include reducing people's needs and desires to travel by transforming land use, together with measures to increase other means of personal mobility, at the same time as measures to increase substantially public transport's share of those journeys still needing to be undertaken. In the 1890s, few realized that automobiles – of which only a few primitive models had been produced – might solve the pollution problems caused by horse traffic in the world's largest cities within a few decades. Similarly, the research now being carried out could conceivably change road transport in ways impossible to anticipate. But despite the numerous uncertainties, a wise course would include planning for substantial reductions in the number of cars in the most prosperous regions of the world.

## *Sector study 2: sustainability of agricultural and food industries*

Changes in dominant patterns of agricultural production and consumption during the last five hundred years have involved massive transfers of land away from peasants and small farmers. But they have also involved substantial agricultural innovations which have made possible enormous increases in agricultural productivity. During the last century, the world's agricultural and food

system, dominated by capitalism, increased food production immensely to cope with rapid growth in world population. Substantial changes have often been caused by changes in land ownership.

But food has not been distributed in accordance with people's need for healthy nutrition. Less than 60% of the world's population consumes an adequate amount and quality of food to maintain health. About 28% of consumers eat too little food and 15% consume too much, which can result in obesity and such chronic conditions as type 2 diabetes and cardiovascular disease. These effects are also partly the result of fast-food consumption, which has been increasing in many countries (Schlosser, 2002, pp.241–2; Foresight, 2011, pp.9–10). Production of food which, instead of meeting people's food needs, makes them obese and unhealthy is a waste of resources: inevitably it creates unnecessary global warming, pollution and other environmental damage.

After the first world war, some Americans, enthused by the Soviet Union's centralized industrial farming on a massive scale, were convinced of the obsolescence of the small farmer (Scott, 1998, pp.197–9). The rationale was the belief that small farmers' food production methods were inefficient and obsolete, and that their land could be better worked by large organizations. Mechanization has replaced many jobs which involved hard manual work, workers preferring more attractive non-farming jobs elsewhere. In many places, expansion of corporate capitalism is

transforming the very way in which countries farm. Many national systems have been converted to export-oriented agriculture, at the same time as the countries have been forced to open their own markets to food imports, including imports dumped on them by US and EU companies at less than the cost of production. As a result, millions of small farmers have seen their livelihoods destroyed. (Branford, 2011, p.4)

Moreover, about one third of global greenhouse emissions are now created by the industrial food system in agricultural production, land use change and deforestation, and processing, transport, packing and retail (Crippa et al, 2021).

Despite widespread declining trends, the number of small farmers and peasants living and working in developing countries is still enormous – more than two billion people out of a world population of over seven billion (Mashishi, 2016). Indeed, there are, and have always been, huge numbers of small local markets in which buyers can buy and eat sustainable, yield-rich food grown locally in relatively small ecological farms according to the natural cycle of the seasons (Patel, 2007, p.246).

The history of post-WWII food governance is essentially one of selling out public responsibility to markets and corporations. It is one of progressive disempowerment of the primary food security actors: the small-scale producers and the family units . . . Unprotected by state and intergovernmental directives, small scale producers are being driven off their land and out of their markets with the allegation that they are inefficient and archaic, ignoring the fact that they are responsible for producing some 70 per cent of the food consumed in the world. Increasingly, not only individual families but even nations have lost control over the aggregate body of factors that determine the food security of their populations . . . The food crisis is global, but it is rooted in local and national struggles against dispossession. (McKeon, 2015, p.3)

However, especially in less industrialized countries, small farmers and peasants have combined to form organizations to promote their interests. For example, the international peasants' movement claims that, with more than 200 million members of 182 organizations in 81 countries, it is the largest movement of peasant farmers and artisanal food producers in the world (Gomez, 2011; International Peasants' Movement, 2020). In summary, here are its principles of food sovereignty:

1. Everyone must have access to safe, nutritious and culturally appropriate food in sufficient quantity and quality to sustain a healthy life with full dignity.
2. Agrarian reform to give landless and farming people ownership and control of the land they work and returning territories to indigenous people.



3. The sustainable care and use of natural resources, especially land, water, seeds and livestock breeds.
4. National agricultural policies must prioritize production for domestic consumption and food self-sufficiency.
5. The control by multinational corporations is harmful to food sovereignty and should be curtailed.
6. Food must not be used as a weapon.
7. Smallholder farmers must have a direct input into formulating agricultural policies at all levels. (Branford, 2011, p.29)

On this basis McKeon (2015, p.198) has developed a hypothesis

that the food sovereignty movement constitutes a counter-force that has the potential of substantially altering the basis of food regime organisation by helping to fragment global hegemony and reconstitute a territorially rooted and governed approach to food provision. . . . [Food sovereignty] is attentive to ecology, the environment and biodiversity. It fights climate change and builds resilience. It is territorially rooted, bridges the distance between producer and consumer and furnishes healthy food for all. It binds agro-ecological modes of small-scale production with modes of processing and distribution that are appropriate to them and that create employment and stimulate local economies. It operates against inequalities.

Nevertheless, the barriers to the achievement of food sovereignty are considerable. For example, the International Peasants' Movement proposes – not unreasonably – that, to achieve food sovereignty, 'genuine agrarian reform is necessary which gives landless and farming people ownership and control of the land they work and returns territories to indigenous people' (Branford, 2011, p.29). But displacement of populations of small farmers and peasants to make room for the expansion of corporate agriculture is a world trend. Companies expel peasants and pastoralists from their land to secure large areas to produce food for export to rich countries or crops to be converted into fuels. Many farms – especially large ones – use intensive production methods, often focusing on monoculture. These farms require large inputs, such as water, fertilizers and pesticides (McKeon, 2015, p.4). The food they produce is generally not particularly conducive to human health, especially when it is subjected to intensive manufacturing processes before it reaches consumers (Blythman, 2015). Rationalization and intensification of farming and food production have occurred on a massive scale in relation to animal food as well as arable agriculture. They have resulted in extensive air, water and land pollution and environmental degradation, food poverty (especially in poorer countries) and poor conditions and low pay for workers in slaughterhouses and factory farms (Cudworth, 2013, pp.47–60).

Farms which use intensive production methods create huge quantities of noxious outputs, such as manure, and air and water pollution, which are seriously damaging to the environment. An increasingly intensive agricultural system is dominant throughout the world. This is mainly because its operators and proponents, including large farmers and suppliers of inputs (such as fertilizers herbicides and pesticides) in cooperation with state governments and international agencies such as the WTO, world bank and the international monetary fund, control the levers of economic power (McKeon, 2015, p.18). In summary:

The challenges remain daunting: corporate influence in politics at all levels and control of global food chains (and those for non-food agricultural products), as well as markets for inputs, especially seeds; the industrial 'cheap food' model on which too many consumers still rely out of necessity, preference or habit; the tenacious defence of globalized agricultural trade by influential states and powerful multilateral agencies, with their robust judicial apparatuses and dispute resolution and enforcement mechanisms; and the fact that biophysical threats to production from climate change are intensifying and beginning to wreak havoc on production in many of the world's poorest regions. (Edelman *et al.*, 2014, p.927)

Modern farming uses monoculture and intensive methods of farming and mechanized tillage. Such methods also tend to make heavy use of chemical inputs, such as fertilizers and pesticides, and to cause soil erosion and depletion of nutrients in the soil. Biodiversity is diminished by concentration on a very restricted range of crops, produced using capital-intensive and input-intensive, large-scale methods. In contrast, traditional farming systems used by peasants and smallholders typically involve greater diversity of crops, year-round vegetation cover, lower levels of inputs, including energy, and less unused waste. For such reasons, they tend to be far less damaging to the environment.

The global food system is manipulated by corporations, together with other financial and powerful political actors serving their own interests. Despite overwhelming evidence to the contrary, it is still widely assumed that markets provide neutral and efficient arbitration. The present global food system is unsustainable environmentally and thoroughly inequitable. There is urgent need for reform. Food sovereignty offers the possibility of drawing on agro-ecological approaches to production, concentrating on local, national and regional markets, and emphasizing access to and control of natural resources by local populations (McKeon, 2015, pp.3–8).

## Discussion

Economic organization changed radically throughout the world with the industrial revolution. In order to make, promote and supply large quantities and varieties of new products, companies needed to pay the people to manufacture them, to finance the factories and the machinery to make them, together with the transport to carry products to customers and the publicity to inform people that the products were available. Considerable skill and ingenuity were required in choosing and developing the products to make.

To have ensured, in addition, that the population of first England and then the rest of the world benefited more from the enormous increases in productivity which resulted from the industrial revolution would have required substantial capital expenditure. It would have required the construction of comfortable houses near factories; the prevention of environmental destruction and pollution caused by the construction of factories and other worksites and by their production processes; and regulations, together with encouragement for the growth of trade union power, to make sure that the conditions and pay of workers were fair. What actually happened was just about the opposite of this.

By the late twentieth century, after many political and economic twists and turns, *laissez-faire* followed by various neoliberal creeds had been adopted by many governments, including in Russia and the former satellite states of the Soviet Union following the end of the communist 'experiment'. Locations of production change as capitalists in search of profits close down production facilities in some countries and establish new ones in other countries; for example, because labour costs may be lower in new countries. Both gaining and losing major employment opportunities causes huge disruption in people's lives and the environment. It is probable that the worldwide application of food sovereignty principles would result in a far more effective system of agricultural and food production involving substantially less damage to the environment than the present system. This is thoroughly dysfunctional from every point of view except that of large corporations.

Neo-classical economists continue to assume (at least implicitly) that there is always an invisible hand which assures that consumer demand is the main driver of production in capitalist economies. Such an assumption may have had some validity in the late eighteenth century, being based on contemporary economies in which traditional products were often made locally in small quantities by traditional methods out of traditional materials. But well before the end of the twentieth century, mass factory production of new products manufactured by new methods, using new materials and components, together with enormous expansion of transportation of materials, components marketing and advertising, had rendered the assumption invalid. Strategic developments had come to be implemented by companies, often in consultation with governments and with substantial financial support from them, but with little input from consumers. And monumental expenditure on

advertising and other forms of promotion surely had substantial influence on consumers' decisions. Few decisions made by companies and governments take environmental considerations into sufficient account. Parts of the same government's policies may have contradictory environmental effects. For example, China's government is the most prominent in the world in promoting production and sales of electric cars, ostensibly to reduce cars' impact on the environment. At the same time, the Chinese government also provides the world's largest fossil fuel subsidies.

This paper – in particular the sector studies – demonstrates that restricting the damage to the environment resulting from human economic activity is a complex problem. The principal solutions offered by economists have involved the creation of carbon markets. Such measures are both ineffective now and unlikely to be effective in the future because of complications involved in implementation and serious inaccuracies in assumptions on which they are based. Current policies to restrain environmental damage focus very strongly on attempting to contain global warming; but there are other policy issues, in particular related to the damage caused by mineral extraction and by reduction in biodiversity. Solutions to the world's environmental problems must be holistic. It will not, for example, be enough to develop policies to restrict the damage caused by climate change if such policies do little to contain the problems caused by mineral extraction.

Some governments are anxious to restrain global warming and environmental pollution. But governments efforts to move in such directions have been severely restricted by the ability of major corporations to offer the incentive of economic growth in return for not interfering with their operations. Foley *et al.* (2016) argue that the focus of companies must be less on increasing shareholder value and more on the benefits for all stakeholders, but it is difficult to see what stimuli might drive such radical change.

Following Polanyi's line of reasoning, we are led, I believe, to conclude that the nature of the capitalist system drives far too many enterprises toward environmentally destructive practices, drives far too few enterprises toward stewardship practices, and ensures that governments will fail to meet the resulting sustainability challenge. My reading of Polanyi suggests that enterprises in a capitalist economy cannot change their environmental practices far or fast enough to avert environmental crisis - neither spontaneously under the influence of wiser corporate leaders, nor pushed by greener consumers, and not even forced by more active government regulation. (Adler, 2015, p.4)

Adler also identifies the need for global integration over many years to allow 'the massive R&D effort needed to develop new energy and CO<sub>2</sub> absorption technologies to be funded', and 'to drive a rapid transformation of our power, water, industrial, housing, agricultural and transportation systems' (Adler, 2019, p.137).

Many economists believe that market and price changes could make very substantial contributions to the solution of environmental problems and such views are highly influential in the formation of policies. This paper casts doubt on their efficacy. It concludes that international multi-disciplinary teams of scientists, technologists, engineers, historians and social scientists should be established. They should be asked to assess the damage to the environment caused by human economic activities, and to advise on the best approaches to reduce the damage. Their research and analysis need to be holistic and broad-ranging, concentrating on empirical and historical analysis rather than theory – and on presenting results clearly to wide audiences, including policymakers, as soon as possible.

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