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Policy suggestion: implementing a Pigouvian tax on meat.

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INTRODUCTION

Over recent decades, global awareness regarding sustainability has surged and among the many sources of greenhouse gases the animal rearing industry has been identified and a significant contributor. This increasing consciousness encompasses the ethical treatment of non-human animals, public health and environmental preservation. The first official report that underlined the importance of livestock farming as one of the main drivers of climate change is *Livestock's long shadow* (FAO, 2006). This report declared that «[…] environmental issues linked to livestock have not generally received an adequate institutional response - neither in developing nor in developed countries. […] Although usually considered part of agriculture, in many places livestock production has grown in the same way as industry, and is no longer directly tied to land or to specific locations.» (FAO, 2006, 4) and that «the livestock sector, along with food and agriculture in general, is undergoing far-reaching change, much of it driven by factors outside the sector. Growing populations and other demographic factors such as age structure and urbanization determine food demand and have driven the intensification of agriculture for centuries. Growing economies and individual incomes have also contributed to growing demand and a shift in diets» (FAO, 2006, 6). Factors such as expanding population - especially in developing nations with increasing urbanization - , economic growth leading to more disposable income, shifts in dietary preference, and growing productivity due to breeding and feeding technologies all together contribute to the intensification of livestock farming. This intensification, while meeting the increasing global demand for meat and other animal products, also exacerbates the environmental impact of the industry.

This dissertation explores the rationale behind implementing a Pigouvian tax[1] on meat, highlighting the potential advantages of such policy: the central argument is that

[1] Tax on an economic activity that produces negative externalities, based on "the polluter pays" principle.

current retail prices of meat do not reflect the negative externalities[2] caused by livestock. The first chapter explores the philosophical and ethical foundation behind animal exploitation, from the origin of environmental ethics to more recent development, notably the Animal liberation movement. The second chapter analyzes the negative externalities related to intensive farming and meat consumption. The third chapter proposes a "meat tax" as a viable strategy to influence consumer behavior, detailing how to calculate the appropriate amount of such tax and recommending optimal ways to allocate the tax revenue.

[2] In economics, externalities (also known as external effects or external economies) refer to the impacts that the activities of an economic unit (such as an individual or a firm) have on the production or welfare of other units, beyond the confines of market transactions.

1. THE ETHICAL FRAMEWORK

1.1 Environmental ethics

The field of environmental ethics is «the discipline in philosophy that studies the moral relationship of human beings to, and also the value and moral status of, the environment and its non-human contents» (Brennan and Lo, 1998, 1), questioning the assumed superiority of the human species *Homo sapiens* to members of other species living on earth – also referred as speciesism[3] -. This dissertation argues for a reevaluation of our ethical framework to recognize the intrinsic value of non-human beings and advocates for a more respectful and compassionate approach to animal welfare. The distinction between instrumental value and intrinsic value has always been of considerable importance in environmental ethics. Those who support the idea that animals only have an instrumental value will say that their value lies exclusively in the subsequent exploitation. In contrast, those favoring meat taxation – and more generally speaking, the supporters of animal welfare - attribute an intrinsic value to the animal's life. This means that animals have value «as ends in themselves regardless of whether they are also useful as means to other ends» (Ivi, 3). Anthropocentrism is another central idea to better understand animal exploitation: well embedded into Western[4] ethical perspective, it assigns intrinsic value only to human beings. The anthropocentric theory could be intended either in a strong or weak sense, the former attributing intrinsic value only to humans, the latter assigning a significantly greater amount of intrinsic value to human beings than to any non-human things, such that the protection of human interests at the expense of non-human things is nearly always justified (Ivi, 3-4). Traces of anthropocentric ideas date back to Aristotle (*Politics, Bk. 1, Ch. 8): «*nature has made all things specifically for the sake of man», assigning to the non-human world a value that is merely instrumental to human ends. Anthropocentric positions often give vague

[3]Speciesism is a term coined by philosopher Richard Ryder in 1970 and popularized by Peter Singer in his book "Animal Liberation" (1975). It refers to the discriminatory practice of attributing different values or rights to being solely on the basis of their species membership.

[4] other cultures and religious beliefs such as Hinduism, Buddhism, Animism and Indigenous cultures do not stand for anthropocentric positions and appeal for the recognition of non-human animals' intrinsic value.

arguments to explain why the cruel treating of animals is wrong, or at least give reasons that are not really convincing from an "intrinsic value" standpoint. Immanuel Kant ("*Duties to Animals And Spirits*", in *Lectures on Ethics*) suggested that, for instance, a person applying cruel behavior towards a dog might indicate that such person's character is desensitized to cruelty towards human. It is clear that in Kant's standpoint cruelty towards animals is instrumentally - and not intrinsically - wrong: the wrongness in such act lies in the fact that cruelty towards animals can further develop in cruelty towards humans. Following the same line of reasoning, «Anthropocentrism often recognizes some non-intrinsic wrongness of anthropogenic (i.e. human-caused) environmental devastation» (Brennan and Lo, 1998, 4). Destroying the environment is wrong only because such destruction might endanger human beings, and not because the environment is a supreme value that has to be protected at all costs. As historian Lynn White (1967) argued in an essay about the historical roots of the environmental crisis, «the main strands[5] of Judeo-Christian thinking had encouraged the overexploitation of nature by maintaining the superiority of humans over all other forms of life on earth, and by depicting all of nature as created for the use of humans» (Brennan and Lo, 2015, 6), offering the original deep-seated drive to unlimited exploitation, which was later fostered by scientific and technological progress. According to White, «the Judeo-Christian idea that humans are created in the image of the transcendent supernatural God, who is radically separated from nature, also by extension radically separates humans themselves from nature» (Ibidem). For instance, the Bible itself is full of ideas promoting human superiority. *Genesis* 1: 27-8 states: «God created man in his own image, in the image of God created he him; male and female created he them. And God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over fish of the sea, and over fowl of the air, and over every living thing that moveth upon the earth». Of similar ideas was Christian philosopher Thomas Aquinas (*Summa Contra Gentiles*, Bk. 3, Pt 2, Ch 112), arguing that non-human animals are «ordered to man's use».

[5] some minor strands appeal for a different relationship between human and nature, such as the views of St. Francis.

An important contribution to support the idea that non-human animals have intrinsic value comes from Australian philosopher Richard Routley. To express his thesis, Routley speculates about a hypothetical situation in which, after a world catastrophe that killed the whole of mankind except for one last survivor, the last man acts to ensure the elimination of all other living non-human beings, destroying the remaining ecosystems. «From the human-chauvinistic (or absolutely anthropocentric) perspective, the last person would do nothing morally wrong, since his or her destructive act in question would not cause any damage to the interest and well-being of humans, who would by then have already disappeared. Nevertheless, Routley points out that there is a clear moral intuition that the imagined last acts would be morally wrong. An explanation for this judgment, he argued, is that those non-human objects in the environment, whose destruction is ensured by the last person or last people, have intrinsic value, a kind of value independent of their usefulness for humans. From his critique, Routley concluded that the main approaches in traditional western moral thinking were unable to allow the recognition that natural things have intrinsic value, and that the tradition required overhaul of a significant kind» (Brennan and Lo, 1998, 9). Around this time, different scientists and authors were already feeling a sense of impeding crisis: among many works of paramount importance the most cited are Rachel Carson's *Silent Spring* (1963), that focused on the effects of pesticides such as DDT, *The Population Bomb* (Ehrlich 1968), where Stanford ecologists Paul and Anne Ehrlich warned that the growth of human population threatened the viability of planet Earth, and the *Limits to growth* study (Meadows et al. 1972), by a group of MIT researchers led by Dennis Meadows. In the commentary, the researchers wrote «We affirm finally that any deliberate attempt to reach a rational and enduring state of equilibrium by planned measures, rather than by chance or catastrophe, must ultimately be founded on a basic change of values and goals at individual, national and world levels. (Meadows et al. 1972, 195). The call for this "basic change of values" in the relationship between human animals and non-human animals reflected the need for the development of environmental ethics as a new sub-discipline of philosophy.

1.2 Further development

Within this context, the problematic treatment of some groups of animals has emerged as a significant area of concern. The book *"Animal liberation*" by Peter Singer, first published in 1975 and republished with updated data in 2023 with the title "*Animal Liberation now"* is considered of significant importance in the field of animal ethics. Singer made an important step further in the popularization of the issue among civil society by exposing the harsh realities of factory farming, Singer sparked a movement that called for the re-evaluation of how society views and treats animals and his arguments against speciesism have influenced both academic discourse and public policy. The author argues that «In general, we are ignorant of the abuse of living creatures that lies behind the food we eat» (Singer, 1975, 153) and «Very few farms were ever as idyllic as that traditional image would have us believe» (ivi, 154). The Australian philosopher draws on the concept of speciesism and argues that the capacity to suffer[6] is the essential characteristic that grants every being any moral consideration: thus the pain and suffering of animals must be deemed morally relevant. The book in question, focusing mainly on animal testing and intensive farming, was the first to openly describe the common practices - most of the times, abuses - that industries put in place. Singer maintains that «During the last fifty years, large corporations and assembly-line methods of production have turned agriculture into agribusiness» (ivi, 155) and this led to big companies gain control over meat production. Singer was the first to break the taboo and write about the hideous conditions in which animals raised for the meat industry are reared and slaughtered.

[6] there are many scientific studies and government committee reports that prove and reinforce the common sense that all animals feel pain. For further readings, see: Stephen Walker, Animal Thoughts (London: Routledge and Kegan Paul, 1983); Donald Griffin, Animal Thinking (Cambridge: Harvard University Press, 1984); Marian Stamp Dawkins, Animal Suffering: The Science of Animal Welfare (London: Chapman and Hall, 1980); Technical Committee to Enquire into the Welfare of Animals Kept under Intensive Livestock Husbandry Systems (Command Paper 2836, 1965), paragraphs 26–28 (London: Her Majesty's Stationery Office).

Singer described in extensive detail the life cycle of the «broiler[7]», what he considers to be the most exploited animal in history. By making constant references to the farming industry magazines and trade journals, the author raised awareness about a plethora of common practices that most people were unaware of: from the description of the "conversion ratio"[8], to the many physical abuses against the animals which are permitted by the law such as interfering with the natural light-dark cycle[9], mutilations[10], and severe overcrowding in unsanitary spaces, leading to impressive aerial levels of ammonia. Another much cited problem is the fast growth rate demanded by the industry: the careful genetic selection brought chickens that had impressive growth rates, so fast that some of the animals would collapse under their own weight and die after prolonged suffering. In 2023 in the US around 5.7% (National Chicken Council, 2023) of broiler flocks died of "acute death syndrome" (ADS) and those who do not succumb to ADS were condemned to lifelong deformities. This condition is the apparent product of the unnatural conditions generated by the industry that expects broilers to multiply their weight 50-60 times in 7 weeks, average lifespan of a meat chicken (Singer, 1975, 165). Singer described also the processing of laying hens: their agony begins in the early stages of life, when «the newly hatched chicks are sorted into males and females by a "chick-puller." Since the male chicks have no commercial value, they are discarded. Some companies gas the little birds, but often they are dumped alive into a plastic sack and allowed to suffocate under the weight of other chicks dumped on top of them. Others are ground up, while still alive, to be turned into feed» (ivi, 170). This

[7] Common breed name used to refer to chicken whose genes were specifically selected for the purpose of meat production, with big breast and fast growth rate.

[8]In the context of intensive farming, the conversion ratio is a key performance indicator. It quantifies the efficiency with which animals convert feed into fresh meat, essentially treating animals as components of a system designed to optimize meat production. The conversion ratio measures the quantity of feed required to produce a specific amount of meat. This ratio varies across different breeds, with broilers often being regarded as the most efficient in terms of meat production.

[9]This is done by keeping the lights of the stables always on at the early stages of life to encourage weight gaining. Later, upon the massive growth expected in the first weeks and subsequent overcrowding of the stable, lights are kept very dim in order to reduce the natural aggressions occurring among the animals.

[10]In industrial farming, the stressful and overcrowded environments often induce some degree of cannibalistic behaviors among various species. To mitigate these behaviors, public health authorities have permitted farmers to employ routine mutilation techniques. Notably, the practice of beak trimming in poultry, where the birds' beaks are partially amputated using a heated blade, is intended to reduce feather-pecking and cannibalism.

process is now illegal in countries such as Germany and France, and in Italy by 2026, but is still legal in the remaining countries (Singer, 2023, 170). Furthermore, in most countries it is still common for laying hens to be reared in “battery”, euphemism used to indicate metal wire cages that do not allow animals to express their natural instincts, such as build nests, stretch their wings, or bathe in sand, causing a great amount of stress. While the European Commission voted for phasing out cages by 2027 in Europe, in the US around 65% of laying hens is still reared in battery (ivi, 178).

Peter Singer's *"Animal Liberation"* not only shed light on the appalling conditions faced by chickens, either reared for meat or eggs, but also provided an in-depth examination of the treatment of other animals reared in agribusiness: among the different atrocities, pigs are subject too teeth clipping and tail docking for the same reason chicken gets their beak cut (ivi, 186-187); veals - subject to the severely stressful practice of being separated from their mother right after birth - are deliberately fed on a diet that causes them anemia in order to have pale meat, which is sold at higher prices (ivi, 195); dairy cows often develop mastitis because of the extreme exploitation, and the use of antibiotics is particularly widespread (ivi, 200); finally, Singer ironically argues that among all animals, cattle have the best standard of life since they roam for about six to eight months before being brought to “feedlots”, facilities where cattle are put in a confined space and fed on grain, corn and other cereals in order to fatten - even though their stomach is not suited for this concentrated diet - for the remaining part of their life. For animals that survive the grueling conditions of intensive farming, the journey to the slaughterhouse represents a final, often inhumane, ordeal. The process of loading and unloading animals can be brutal: chicken are typically captured by workers who might receive inadequate training and are often paid by the result. On bigger animals, workers may use electric prods, sticks, or other devices to force animals into the trucks, causing pain and fear. Injuries are common during this stage due to rough handling. Furthermore, the transport of animals to slaughterhouses involves several hours, sometimes days, of travel under conditions that exacerbate their suffering: overcrowding, lack of food and water, and exposure to extreme temperatures are common.

In addition to the groundbreaking work of Peter Singer, investigative journalism has played a crucial role in exposing the crude realities of factory farming and advancing the cause of animal welfare. Journalists dedicated to uncovering the truth behind industrial farming practices have brought these issues to the forefront of public consciousness. One notable figure in this field is Italian journalist Giulia Innocenzi, whose investigative work has been pivotal in highlighting the inhumane treatment of animals in the industry. Documentaries aired on national broadcasting company RAI such as "*Animali come noi"* (2017); *"Che polli!"* (2023); *"Che porci!"* (2023); *"La scossa"* (2023), *"I monatti"* (2023) and the book *"Tritacarne" (2017)* have provided an unflinching look into the conditions inside factory farms and slaughterhouses, notably those connected to "Made in Italy" products, often granted PDO labels. Through undercover operations and hidden cameras, Innocenzi has documented blatant violations of animal welfare, many times those already reported by Singer in 1975. Innocenzi's last work, docufilm *"Food for profit"* (Innocenzi, Giulia e D'Ambrosi, Pablo, 2024) made a step further in underscoring the significant influence that agribusiness wields in the European Union. With a journey from Bruxelles - headquarter of the European Commission and many lobbying firms - to farms across Europe (Italy, Spain, Germany, Poland), Food for Profit denounces how Europe is channelling hundreds of billions of euros through the Common Agriculture Policy (CAP) from taxpayers into intensive farms operations, at the expense of animal welfare, public health and environmental sustainability. The Common Agricultural Policy (CAP) is the European Union's longest-standing policy, aimed at supporting agricultural production and rural development[11]. Despite reforms that have progressively reduced its share of the EU budget, CAP still comprises 31% of the total EU budget for the 2021-2027 period (European Parliament, 2023). The latest CAP reform, applicable for the years 2023-2027, was crafted to significantly advance the objectives of the European Green

[11] Article 39 TFEU sets out the specific objectives of the CAP:
1. To increase agricultural productivity by promoting technical progress and ensuring the optimum use of the factors of production, in particular labour;
2. To ensure a fair standard of living for farmers;
3. To stabilise markets;
4. To ensure the availability of supplies;
5. To ensure reasonable prices for consumers.

Deal, particularly with regard to the "Farm to Fork" strategy[12]. Innocenzi maintains that this is not enough. The docufilm makes three proposals to counteract the issue of intensive farming: to stop public subsidies to intensive farming operations; a moratorium on the building of new intensive farms; a public assembly of citizens and academic experts to discuss PAC reforms, instead of Members of European Parliament that might be affected by conflict of interest (Innocenzi and D'Ambrosi, 2024.).

[12] The European Union's Farm to Fork Strategy, a central component of the European Green Deal, seeks to create a fair, healthy, and environmentally sustainable food system by transforming the entire food value chain. This comprehensive plan addresses the multifaceted challenges of sustainable food production and consumption by promoting practices that reduce the environmental impact, enhance biodiversity, and mitigate climate change. Key objectives include reducing the use of chemical pesticides and fertilizers, curbing greenhouse gas emissions, and expanding organic farming. Additionally, the strategy aims to reduce food loss and waste by half, ensure food security, and support the resilience and competitiveness of the agricultural sector. Public health is also a priority, with efforts to improve nutrition and food safety while reducing the use of antibiotics in farming.

2. THE SOCIAL COSTS OF MEAT: ENVIRONMENTAL EXTERNALITIES AND PUBLIC HEALTH

The production and consumption of meat, particularly through intensive farming systems, entail substantial social costs that extend far beyond immediate economic transactions. These costs, often externalized and not reflected in the market price of meat, include significant impacts on both the environment and public health. While intensive farming is effective in meeting the growing global demand for animal protein, it contributes to a range of negative externalities that undermine environmental sustainability and pose serious risks to human well-being.

This chapter aims to examine these externalities in detail, highlighting how meat production practices, particularly in intensive agriculture contexts, negatively affect climate change, soil and air pollution, and biodiversity loss. It will then explore the public health implications, focusing on the spread of non-communicable diseases, antimicrobial resistance, and the emergence of novel zoonotic diseases. Through a presentation of the data, this chapter seeks to demonstrate the urgent need to address the social costs of meat production and consumption, both to protect the environment and to safeguard public health globally. In doing so, it underscores the necessity for a rethinking of agricultural and food policies, aimed at making the food system more sustainable and less harmful for future generations.

2.1 Meat and environmental externalities

This part of the dissertation focuses on analyzing the negative environmental externalities arising from intensive farming. Despite Godfray et al. (2018) maintains that «The question of whether producing meat is more or less harmful to the environment than other food types is complex because of the variety of meat production systems, because meat production may or may not compete for resources that could be

used to produce other food types, and because it depends critically on how harm to the environment is measured», recent development of life cycle assessment (LCA) provides models and estimates that are sufficiently accurate for decision making. Even though global efforts to meet the objectives[13] of the Paris Agreement have seen significant intervention and regulation in many sectors - such as fossil fuels, transport, and electricity - negative externalities from intensive farming have not received comparable attention. Intensive farming is responsible for a wide range of negative environmental impacts and such impacts not only compromise natural ecosystems but also have direct implications for public health and the well-being of local communities. Exploring these negative externalities is crucial for understanding the need to integrate more effective mitigation measures in the agricultural and livestock sectors, ensuring that climate policies are truly comprehensive and sustainable.

Funke et al. (2022) note that «there is a growing consensus within the environmental research community that the recent global trajectory of meat production and consumption is unsustainable» and outline that the main environmental externalities arising from livestock farming are (1) climate change; (2) nutrient pollution and air pollution; and (3) biodiversity loss;

2.1.1 Climate change

One of the most significant environmental externalities associated with the livestock sector is its contribution to climate change. The livestock sector is a major emitter of greenhouse gases (GHGs), including methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). These emissions occur at various stages of the livestock production process, from enteric fermentation in ruminants to manure management, feed production, and land-use changes. Meat production is the largest single source of methane emissions worldwide, primarily produced during the digestive process of

[13] The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. (United Nations Framework Convention on Climate Change)

ruminant[14] animals through enteric fermentation, where microbes in the stomach break down food and release methane as a byproduct. Additionally, manure management, especially in systems where manure is stored in anaerobic conditions (such as in lagoons or pits), is a significant source of methane emissions. Methane is a potent greenhouse gas, with a global warming potential 23 times greater than carbon dioxide (CO_2) over a 100-year period (FAO, 2006, xxi). This makes the emissions from livestock particularly concerning, as they represent a substantial share of the agricultural sector's contribution to global greenhouse gas emissions. In addition to methane, livestock farming also generates significant amounts of nitrous oxide, another potent greenhouse gas that is largely emitted from the application of nitrogen-based fertilizers to feed crops and from the breakdown of animal manure. The use of synthetic fertilizers and manure in feed crop production often leads to the release of excess nitrogen into the atmosphere, contributing to the greenhouse effect and ozone depletion. While the livestock sector is not the largest source of carbon dioxide emissions, it does contribute significantly through land-use changes, such as deforestation for pasture and feed crop production. The conversion of forests and other natural ecosystems into agricultural land releases large amounts of stored carbon into the atmosphere. Additionally, the energy-intensive processes involved in feed production, transport, and the operation of intensive farming facilities also contribute to CO_2 emissions.

According to FAO (2023, 4) «Globally, the production of the animal protein […] is associated with a total of 6.2 Gt CO2eq[15] of emissions, constituting approximately 12 percent of the estimated 50 to 52 Gt CO2eq total anthropogenic emissions in 2015. Among the livestock species, cattle are the primary contributors to GHG emissions, producing around 3.8 Gt CO2eq per year and accounting for approximately 62 percent of all livestock emissions. Pigs, chickens, buffaloes and small ruminants contribute to 14, 9, 8 and 7 percent, respectively, of livestock's overall emissions. In terms of

[14] ruminant animals of commercial interest are cattle, sheep and goats.

[15] CO2 equivalent (CO2eq) is a standard unit used to compare the impact of different greenhouse gases on global warming. Since various greenhouse gases have different abilities to trap heat in the atmosphere, CO2eq expresses the impact of these gases in terms of the amount of carbon dioxide (CO2) that would have the same warming effect over a specified period, typically 100 years.

commodities, meat production claims the largest share of emissions at 67 percent, followed by milk at 30 percent and eggs 3 percent».

2.1.2 Nutrient pollution and air pollution

Nutrient pollution occurs when excessive amounts of nutrients[16] contaminate soil, aquifers and nearby water bodies. The primary sources of nutrient pollution in the livestock sector are synthetic fertilizers used in feed crop production and the large quantities of manure produced by animals. These inputs often exceed the absorptive capacity of soils and plants, leading to nutrient runoff. The consequences include soil acidification, eutrophication of aquatic ecosystems[17], and contamination of freshwater resources. Nutrient pollution is one of the leading causes of land degradation: as defined by UNEP (2002), land degradation involves the «reduction of resources potential by one or a combination of processes acting on the land, such as: (i) soil erosion by wind and/or water, (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation». Land degradation is particularly concerning since it reduces land productivity, leading to further expansion of agricultural land into natural habitats, previously untouched. In addition to nutrient pollution, intensive livestock farming contributes to air pollution, particularly through the emission of ammonia (NH_3) and particulate matter from animal waste. Ammonia is a byproduct of manure decomposition and can combine with other pollutants in the atmosphere to form fine particulate matter (PM2.5), which poses significant health risks. Exposure to high levels of PM2.5 is associated with respiratory and cardiovascular diseases, and it represents a major public health concern in areas with

[16] primarily ammonia, nitrogen oxides, nitrates, and organic nitrogen.

[17] in *Food For Profit*, Innocenzi accounted in detail the ecological collapse of Mar Menor, a coastal saltwater lagoon in Murcia, Spain, where the livestock industry has located several intensive farms. The improper treatment of animal waste from nearby farms led to the complete eutrophication of the water.

concentrated livestock operations, causing health issues in agricultural workers and local residents[18].

2.1.3 Biodiversity loss

According to FAO (2019, 18) the third category of environmental externalities, biodiversity loss, refers to «habitat loss driven by human conversion of natural ecosystems to other land uses, mainly for producing commodities for consumption, providing transportation corridors and urbanization». Biodiversity is crucial for the stability, resilience, and productivity of ecosystems. It supports essential functions such as nutrient cycling, water purification, and pollination, which are vital for life on Earth, including human societies. When biodiversity is lost, ecosystems become less resilient, more susceptible to disturbances, and less able to provide essential services. Quantifying biodiversity loss is particularly challenging «due to the intrinsic complexity of biodiversity, scale issues (e.g. context dependency) and the significant challenges associated with reducing biodiversity assessment to a single measure or conservation objective» (ibidem).

The primary driver of biodiversity loss is land-use change: according to FAO (2006, xxi) «the livestock sector is by far the single largest anthropogenic user of land. The total area occupied by grazing is equivalent to 26 percent of the ice-free terrestrial surface of the planet. In addition, the total area dedicated to feed crop production amounts to 33 percent of total arable land. In all, livestock production accounts for 70 percent of all agricultural land and 30 percent of the land surface of the planet». This expansion into natural habitats may lead to deforestation, particularly in biodiverse regions like the Amazon, where 70% of deforested land is now used as pasture (ibidem). The transformation of these habitats results in the loss of plant and animal species that are unable to survive in the altered environment. Another important driver of biodiversity loss are invasive species: the expansion of livestock farming often involves

[18] Innocenzi's work also focused on the impact of intensive farms towards nearby residents. In *Che polli!*, the Italian journalist interviewed people living in the area of Jesi, where one of Italy's leading chicken meat producers operates several intensive farms. Residents reported that ammonia emissions from these farms caused severe respiratory issues and led to a significant worsening of their quality of life.

the introduction of non-native plant species for grazing or as feed crops, which can become invasive. These invasive species can outcompete native flora, leading to a decline in native plant species and the animals that depend on them. Furthermore, the introduction of alien livestock in new environments can pose substantial threats to native ecosystems by preying on indigenous species, competing for resources, introducing diseases, or altering habitats. These disruptions can result in the extinction of native species and the destabilization of entire ecosystems.

2.2 Meat and public health

Meat production and consumption is not only detrimental to the environment: it also poses a significant threat to public health, being closely liked to Non-Communicable Diseases (NCDs), antimicrobial resistance, and zoonotic diseases. As dietary habits evolve, driven by economic growth and urbanization, the social costs associated with meat-heavy diets are becoming more pronounced. As Funke et al. (2018) underlined, «the effects of unhealthy diets on the individual are not an externality because they are a form of self-inflicted harm. Nevertheless, health impacts can affect macroeconomic outcomes. For example, the diet-related health consequences of meat consumption can indirectly lead to productivity losses. In addition, in countries with universal health-care coverage, where costs are collectivized, such risks increase the cost of the public health system».

2.2.1 Non-Communicable Diseases

A significant body of evidence links diets with a high intake of meat to a wide range of NCDs. The International Agency for Research on Cancer (IARC) has classified the consumption of processed meat (both red and white) as a group 1 carcinogen, meaning that there is sufficient scientific evidence to link processed meat consumption to cancer in humans: processed meats are often high in sodium, saturated fats, and preservatives such as nitrates and nitrites, which have been identified as carcinogens. Unprocessed red meat was classified a group 2A carcinogen, meaning that is likely

carcinogenic to humans. Moreover, meta-analyses of epidemiological studies provide moderate to strong evidence that the consumption of red and processed meat is associated with increased risks of coronary heart disease, stroke, and type 2 diabetes (Schwingshackl et al. 2017; Bechthold et al. 2019).

2.2.2 Antimicrobial resistance

The issue of antimicrobial resistance (AMR) refers to the ability of microorganisms such as bacteria, viruses, parasites of fungi to withstand antimicrobial treatments to which they were previously susceptible. The WHO declared AMR as one one leading public health threats for the upcoming years: while a substantial contribution to it comes from the misuse of antimicrobial treatments in humans, another important driver is the widespread use of antibiotics in the livestock industry, particularly in intensive farming systems, where antimicrobials are administered not only to treat infections but also to prevent disease in healthy animals. Such resistant bacteria can be transmitted to humans through various pathways, including the consumption of contaminated meat, direct contact with animals, and environmental routes such as water, soil, and air. Once in the human population, these resistant pathogens can cause infections that are difficult or even impossible to treat with standard antibiotics, leading to longer hospital stays, higher medical costs, and an increased risk of mortality.

2.2.3 Zoonotic diseases

Intensive farming environments are breeding grounds for zoonotic diseases, which are diseases that can be transmitted from animals to humans. The crowded and often unsanitary conditions of factory farms facilitate the spread of pathogens among animals, which can then be transmitted to humans either directly through handling or indirectly through the food supply. Intensive livestock farming also increases the risk of novel zoonotic diseases emerging: the close proximity of large numbers of animals, often genetically similar, provides ideal conditions for viruses to mutate and jump from

animals to humans. One of the most notable examples of this phenomenon is avian influenza. In intensive poultry farms, where thousands of birds are kept in close quarters, the virus can spread rapidly and mutate into highly pathogenic forms. When such a virus jumps from birds to humans, it can cause severe illness and has the potential to spark pandemics. Similarly, the 2009 swine flu (H1N1) pandemic emerged from intensive pig farming operations. The emergence of these diseases often leads to mass culling of livestock upon order of national health authorities, in order to prevent the spread of the virus. These actions, while necessary to contain outbreaks, highlight the severe vulnerabilities within intensive farming systems, both from a public health and animal welfare perspective. Innocenzi provided a comprehensive analysis of the risks associated with zoonotic diseases, notably in her work *"I monatti"*. In this investigation, the journalist, undercover as an Italian entrepreneur, infiltrated one of China's newly constructed skyscraper farms, which houses 600,000 pigs. Chinese authorities claimed that this innovative architecture would offer the highest level of protection against animal diseases. However, various experts expressed concerns regarding the risks associated with concentrating such a large number of animals within a single structure. In another investigation,*"La scossa",* Innocenzi documented the effects of the recent outbreak of African Swine Fever (ASF), a viral disease of pigs and wild boar that causes high mortality in animals but is harmless to humans. Innocenzi denounced how the mass culling were performed: although EU authorities recommend using inert gases for euthanizing animals - considered the most humane method - Innocenzi revealed that in many Italian farms animals were instead culled by electrocution, method permitted only in emergency situations and not for routine use.

3. THE “MEAT TAX”

The environmental and public health externalities associated with meat production have raised interest in policy interventions that can mitigate such negative impacts. The implementation of a “meat tax” has emerged as a potentially effective tool for addressing the economic and social costs embedded in intensive livestock farming. Such tax should be designed to internalize the externalities associated with meat production and consumption, in order to align private consumption with socially optimal outcomes. As maintained by Chloupkova et al. (2018): «a market failure occurs in the case of meat production, where a wide range of negative externalities can be identified […]. These externalities are to be borne not only by the individual itself, but by the whole of society and taxpayers». The concept of using taxes to correct market failures has its origins in the economic theory of Pigouvian taxes, named after the British economist Arthur Cecil Pigou, who also developed the concept of economic externalities. Such specific kind of taxes are designed to equal the external cost of a good or service, thereby incentivizing producers and consumers to reduce activities that generate negative externalities. Historical precedents include taxes on carbon emissions, environmental pollution, tobacco, alcohol, and sugary soft drinks. However, the implementation of a Pigouvian tax on meat is not without challenges, since it involves quantifying different and often interconnected impacts on the environment and public health in order to estimate the external costs. Additional, the tax could be regressive, affecting disproportionately low-income households: to address these concerns, policymakers might consider complementary measures to offset the financial burden of the tax.

This chapter will explore (i) the basic economic theory behind the “meat tax” (ii) the optimal design of the “meat tax” (iii) contrasting ideas (iv) ways to influence consumer behavior.

3.1 Economic theory

Basic microeconomic theory suggest that global meat supply and demand operate as follows (fig. 1): there is a demand curve for meat, D_w, and a private marginal production cost curve, MC_p. The result is a market equilibrium with Q_p produced, at the price of P_p. However, this equilibrium (Q_p, P_p) does not take into account the negative externalities and is not optimal for the overall society. The extra costs imposed on society have to be added to the production cost curve in order to reflect the social costs: by doing so, the negative externalities will be internalized in the cost of meat. Imposing a tax *t* on each unit of meat produced will move the private marginal production cost curve upwards to MC_s, where also negative externalities are considered. This will create a new equilibrium, where the amount produced is Q_s at a P_s price. By doing so, society achieves a "double dividend": (i) meat production decreases from Q_s to P_s and (ii) the total tax revenue will amount to area A (Chloupkova et al., 2018).

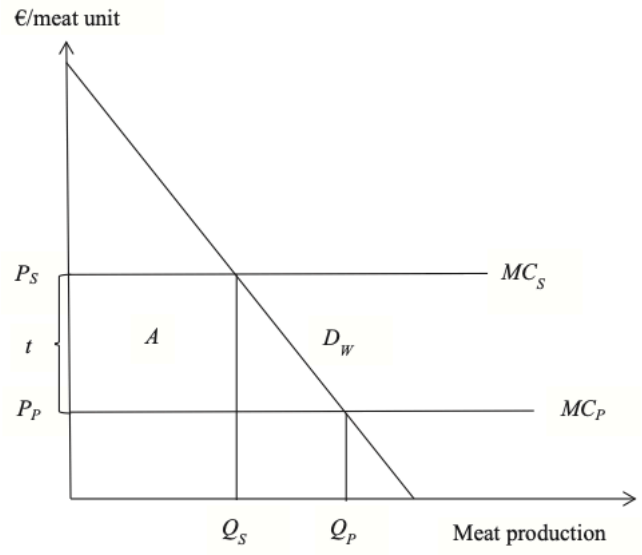

Figure 1. Meat production, negative externalities and taxation

Source: Chloupkova et al., 2018

Furthermore, another important factor for the optimal design of such tax is the price elasticity of demand (PED): it is expressed as a coefficient and it measures how the demanded quantity of a good responds to changes in its price, *ceteris paribus*. Specifically, «The price elasticity of demand is a dimensionless construct referring to the percentage change in purchased quantity or demand with a 1% change in price. It is determined by a multitude of factors: availability of substitutes, household income, consumer preferences, expected duration of price change, and the product's share of a household's income» (Andreyeva et al. 2010). In general, food products are considered essential goods, hence they have a relatively low elasticity of demand: since food is essential for survival, people tend to continue purchasing even if price increase. Effectiveness of a meat tax depends also on the PED: a higher coefficient indicates that a tax is likely to reduce meat consumption more significantly, achieving the intended public health and environmental goals.

- If PED = 0, the demand is considered perfectly inelastic, meaning that changes in price will have no effects on demand.
- If PED < 1, the demand is considered inelastic, meaning that changes in price will have an effect on demand that is less than proportionate: an increase of 10% in price will cause a decrease in demand that is less than 10%.
- If PED = 1, changes in price will have an exactly proportionate effect on demand.
- If PED > 1 the demand is considered elastic, meaning that changes in price will have an effect on demand that is more than proportionate: a increase of 10% in price will cause a decrease in demand that is more than 10%.
- If PED $\rightarrow \infty$, the demand is considered perfectly elastic, meaning that even the slightest change in price will have a huge effect on the demand.

PED for meat, accordingly with other food products, is somewhat inelastic, with coefficients typically falling between 0 and 1. Andreyeva et al. (2010) provided a

systematic review on the PED for 16 major food and beverage categories[19]. PED for foods and nonalcoholic beverages ranged from 0.27 to 0.81, indicating that price interventions might be more effective in certain categories. The categories most responsive to price changes include food away from home (PED = 0.81), soft drinks (PED = 0.79), juice (PED = 0.76). Meat exhibits a similar elasticity: beef (PED = 0.75) and pork (PED = 0.72) are most responsive to price changes, while poultry (PED = 0.68) is slightly less so. Other animal products considered in the study were dairy (PED = 0.65), milk (PED = 0.59), fish (PED = 0.50), cheese (PED = 0.44) and eggs (PED = 0.27). Gallet (2010) provided slightly higher values, concluding similarly that price responsiveness varies across species. Lamb (PED = 1.06), beef (PED = 0.99), and composite meat (PED = 0.85) are characterized by larger elasticity, while pork (PED = 0.91) and poultry (PED = 0.78) exhibit lower values.

These findings suggest that, relatively to other food products, meat has a more elastic demand, meaning that price interventions might be more effective. The degree of responsiveness to price changes across different types of meat varies because of a number of different factors. Premium products tend to have a more elastic demands, since customers are more likely to reduce consumption or switch to cheaper alternatives in response to a higher price. Conversely, cheaper cuts tend to have a less elastic demand since many households rely on such categories for their protein intake.

The availability of substitute goods is also crucial: PED can increase if there are any readily available substitutes, as consumers have more alternatives to choose from. Alternative protein sources are of vegetable, grain, fungal, algal, or insect origin. (Post and Hocquette, 2017, 425). The wide range of substitutes includes both unprocessed foods, such as legumes, and more processed options, like tofu (produced from soy), seitan (produced from wheat gluten), and ultra-processed plant-based products designed to closely mimic the texture and taste of meat or meat products, further expanding the

[19] beef; cereals; cheese; dairy; eggs; fats/oils; fish; food away from home; fruit; juice; milk; pork; poultry; soft drinks; sweets/sugars; vegetables.

range of substitutes. Additionally, novel foods such as cultured meat[20] and insects[21] are under research and development, possibly threatening meat consumption.

3.2 Optimal design of the tax

Globally, meat consumption has steadily increased in last 30 years (fig.2). This growth is driven by a moderate rise in demand from developing economies, alongside a consistently high but stable demand in developed nations, likely influenced by growing awareness of health and environmental issues and the increasing popularity of plant-based diets. Implementing a meat tax could contribute to sustainability goals by supporting the global shift toward plant-based diets, helping to curb rising meat consumption in developing countries and encouraging plant-based alternatives in developed nations. According to Poore and Nemecek (2018) the transformative potential of excluding animal products from current diets include: 76% reduction in

[20] Cultured meat is produced by culturing animal cells *in vitro.* Cells are extracted from the live animal via a biopsy and then grown in a bioreactor, where they receive the necessary nutrients to form muscle tissue that closely resembles conventional meat in texture, flavor, and nutritional profile. The first proof of concept of cultured meat was unveiled in 2013: a burger reputed to have cost more than US$280,000 to develop (Rubio, Xiang, and Kaplan 2020).
Research and development in this field are still evolving, attracting substantive capital with three important main hubs: Silicon Valley in the USA, the Netherlands, and Israel (de Nood, 2020). Singapore became the first country to approve cultured meat for market sale in 2020. Europe lags behind, partly due to its stringent regulatory framework for novel foods: the European Regulation 2015/2283 requires extensive trials and approval from the European Food Safety Authority (EFSA), which has slowed progress. In April 2024 the Dutch startup Meatable became the first in the EU to obtain regulatory approval from the EFSA for a public tasting of their cultured meat. 26 July 2024 French startup Gourmey has applied to EFSA and other regulating authorities worldwide for the acknowledgment of cultured *foie gras.* The evaluation process is expected to take at least 18 months (Politico, 2024)

[21] The use of insects as a source of protein has been common in various cultures for centuries (e.g. Africa, Asia, and Latin America). The global market for edible insects is still in its early stages but rapidly growing: mostly used in the form of flour, insects are being considered as a viable option due to their high protein content and low environmental impact, potentially alleviating the pressure on ecosystems imposed by traditional farming. Even though the status of insects as a novel food has not reached a consensus, in the European Union, from 2021, EFSA has already approved four insect species for human consumption. The research and development of novel food products is still ongoing, partially because of barriers to adoption that are cultural, regulatory, and productive.

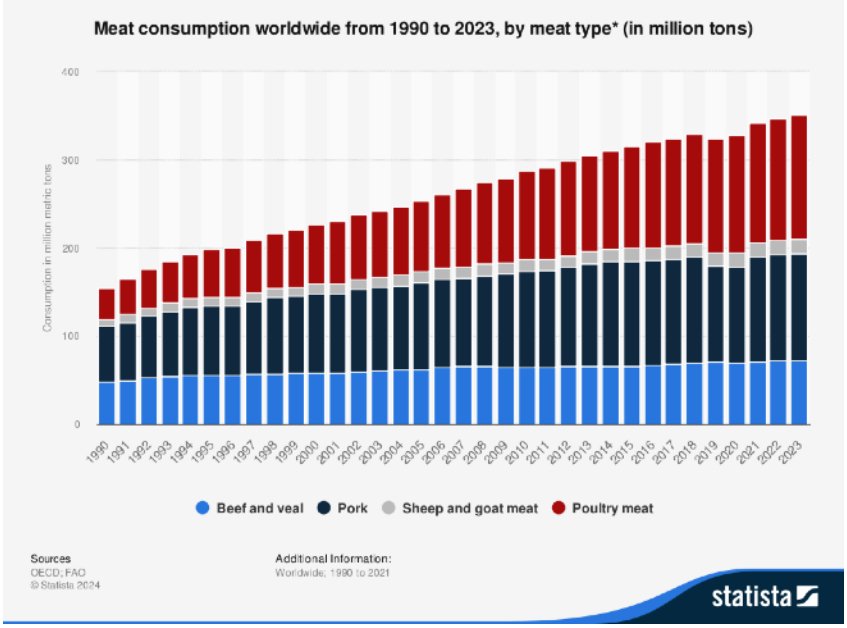

Fig. 2 (Source: Statista, 2023)

food's land use; 49% reduction in greenhouse gas emission; cut acidification and eutrophication in half; and 19% reduction of scarcity-weighted freshwater withdrawals.

In order to optimally design the proposed "meat tax", there is a need to quantify the external costs not reflected in the market price, assessing the cumulative effects of both the environmental consequences and the increased burden on healthcare systems. As maintained by de Graad (2020) «Choosing for a realistic price – in this case of meat – is a matter of moral consciousness. It's not about left or right. It is just that consumers can't organise this themselves. But it can be done with the introduction of a meat tax», emphasizing that while conscious consumerism is important, systemic changes are necessary to tackle the root causes of food-related problems. De Graad (2020) argues that the "invisible hand" of the market currently keeps unsustainable food products artificially cheap, as the external costs are not reflected in their prices. A meat tax, which would raise the price of meat to account for its environmental and social impact, is proposed as a moral and practical solution. De Graad (2020) also cites a study by CE Delft aimed at calculating the "real" price of meat for the Netherlands. Such study covers only environmental-related externalities, excluding health-related costs. The study (fig. 3) finds that retail prices would increase significantly when a real price is adapted for pork (+53%), beef (+40%) and chicken (+26%).

The 'real' price of meat for the Netherlands

	Pork	*Beef*	*Chicken*
Retail price	€7.75	€12.17	€7.00
Climate damage	€1.06	€1.29	€0.62
Environmental damage	€2.81	€2.73	€1.10
Land use (biodiversity)	€0.09	€0.12	€0.05
subsidies	€0.02	€0.42	€0.01
Animal diseases	€0.10	€0.53	€0.03
'external benefits'	€0.00	–€0.20	€0.00
'Real price'	€11.83	€17.06	€8.80
Additional costs as percentage of retail price	53%	40%	26%

Source: CE Delft, de echte prijs van vlees.

fig. 3 (Source: De Graad, 2018)

Funke et al. (2018), provided a global economic evaluation (based on Poore and Nemecek (2018)[22]) of the environmental externalities associated to meat production and consumption. As reported in 2.1, the main environmental externalities are (1) climate change; (2) nutrient pollution and air pollution; and (3) biodiversity loss. The estimate of costs from climate change and nutrient pollution are shown in Fig. 4. Estimates of social costs from air pollution and biodiversity loss are not included because of a lack of data[23]. The review of the empirical evidence indicates a lower bound on total average global environmental external costs of US$ 5,75 - US$ 9,17 per kg for beef (depending on the production of dairy by-products), US$ 3,70 per kg for lamb and mutton, US$ 1,94 per kg for pork and US$ 1,50 per kg for poultry: this is a conservative estimate since biodiversity loss and air pollution are not taken into account.

This evidence suggests that the environmental tax in high-income countries would increase the current retail price by 20-60 percent, depending on the average retail price of different meat types. (Funke et al. 2022, 222-224)

[22] Poore and Nemecek consolidated data on the multiple environmental impacts of ~38,000 farms producing 40 different agricultural goods around the world in a meta-analysis comparing various types of food production systems.

[23] according to Funke et. al. (2018), «a growing body of economics and environmental science research asserts that the economic value of natural ecosystems is immense and that transforming or reducing livestock farming plays an important role in maintaining biodiversity» and «using a model of the optimal expansion of agricultural land, Lanz, Dietz, and Swanson (2018) find that a moratorium on further land conversion is socially optimal based solely on the negative effect of biodiversity loss on agricultural productivity»

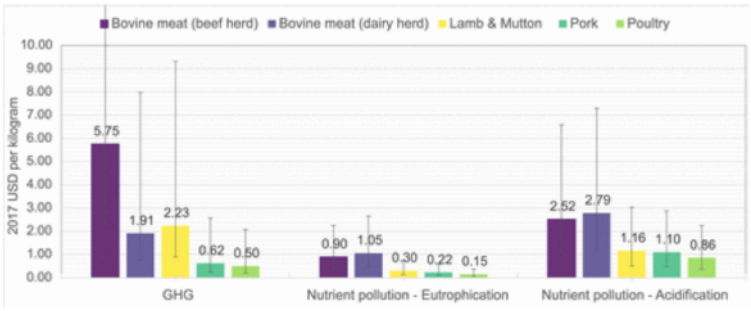

fig. 4

Source: Funke et al. (2018); based on Poore and Nemecek (2018).

In addition to the environmental costs, diet-related health impacts must be integrated into the design of the meat tax. Two approaches are used to estimate the social costs associated with diet-related illnesses. The first approach is the Value of Statistical Life (VSL) which measures the willingness to pay for reductions in mortality risk, thus capturing the broader, privately incurred harms of meat consumption (Fig. 5A): this approach emphasizes the broader societal willingness to avoid premature deaths due to diet-related health issues such as heart disease, diabetes, and cancer, which are closely associated with high levels of red and processed meat consumption. The second approach (Fig. 5B) is the Cost-Of-Illness (COI), that captures the more direct economic impacts, including medical treatment costs, hospitalization, and lost productivity due to sickness and premature death. (Funke et al. 2022, 224-225). According to Funke et al. (2022), «the health-related social costs from high levels of meat consumption are significant, with the value of privately incurred harms from meat consumption (5A) estimated to be one to two orders of magnitude above the economic costs of illness (5B). If the valuation of privately incurred health effects is included, the environmental tax on unprocessed beef would approximately triple».

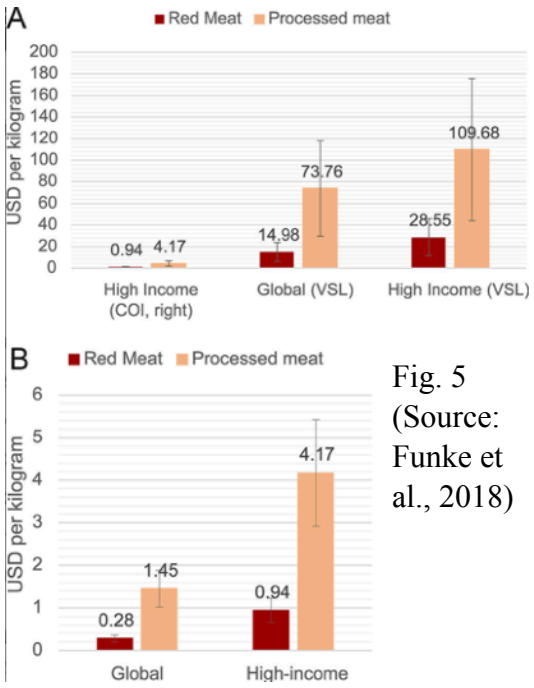

Fig. 5 (Source: Funke et al., 2018)

Despite some key differences, such as geographical focus, variety of externalities considered, and difference in methodology, results of both studies are comparable. Funke et al. (2018) estimate that in high income countries, the environmental tax would raise retail meat prices by 20-60%, price that could be triple once health-related costs are included. CE Delft (2018), although having a narrow geographical scope, included more sources of environmental externalities, resulting in a generally lower estimate. Such difference might be explained by the specific country institutional context.

Another important tool that can be used to both capture new emerging trends and estimate the correct size of such tax are foresight and big data (Chloupkova et al. 2018, 258). Such technology can analyze petabytes of structured data that are produced daily in operational and transactional systems[24]. Furthermore, it is estimated that only 10% of the total information of an organization is structured data: the remaining part is actually unstructured, like freeform text, images, audio, and video coming from web. Chloupkova et al. (2018) maintain that such unstructured data « […] comes from websites, correspondence, contact centre records, social media, blogs, claims, customer complaints and any number of other sources. It is contained in document repositories, emails, PowerPoint presentations, spreadsheets, PDFs, XML documents, SharePoint sites, website interactions, social media sites and texting channels such as SMS and IM. It is everywhere, and it is growing fast».

For example, nowadays many people share pictures of their daily meals on social networks. A lot of cooking websites publish new recipes daily, and most restaurants, cafes, and other forms of collective catering such as canteens, hospitals, and airlines have updated online menus. Big data analysis could help in forecasting trends and understanding better people's relations with meat. In fact, the use of big data does not imply any hypothesis per se, but rather a deep analysis of the data collected in order to find new patterns that are otherwise invisible (ibidem).

[24] Operational and transactional systems are types of information systems that collect, process, and manage data in different business contexts such as order processing, supply chain management, and transaction processing.

3.3 Contrasting ideas

A central debate surrounding the implementation of meat taxation focuses on the possible regressive effect and the allocation of the generated revenue. The primary concern is to mitigate the regressive impact on low income households, as they are likely to be disproportionately affected by the price increase. This could be done by lowering income taxes, lowering VAT on healthy and not polluting foods, or even through subsidies to spend in supermarkets. Secondly, this increase in taxation will likely face strong resistance from stakeholders such as livestock farmers and in order to make this policy politically feasible there is a need to mitigate the negative effects on meat producers. This could be done through highly context-specific policies such as nudging, through economic incentives, switching toward more sustainable agricultural practices, or subsidizing the installation of modern facilities that can cope better with externalities.

3.3.1 Potential regressivity

A frequent concern raised by those who oppose such kind of taxation is that the tax burden will disproportionately fall on low-income households. To support this idea, many scholars cite Engel's law[25]: this is also why foodstuff has a reduced VAT in most countries[26]. Meat taxation is different from other kinds of Pigouvian taxes since consumers can immediately substitute away from the taxed goods without major investments or adverse effects: this means that meat taxes are more likely to have a stronger impact on reducing meat demand, compared to, for example, taxes on fuel[27].

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[25] Engel's law states that the percentage of income allocated for food purchases decreases as a household's income rises, while the percentage spent on other things (such as education and recreation) increases.

[26] In the EU, all countries except Bulgaria, Denmark, Estonia, Latvia and Lithuania have reduced VAT on meat products. In Italy, reduced VAT for foodstuff and other essential products is either 4%, 5% or 10% (depending on the category) while regular VAT is 22%.

[27] Fuel is another good that exhibits a comparatively inelastic demand. Suppose a strong increase in fuel taxes: consumers would have to either buy an electric car (investment) or use a bus that takes double the time (adverse effect).

Moreover, differentiating taxes taking into account the emission intensity of different animals will encourage those who still want to eat meat to shift towards meat types that have lower external costs, thus are less taxed. The impact of such tax will vary considerably based on spending patterns on different meat types: for example, in France, a meat tax based on GHG emission intensity would most affect the three middle quintiles since they spend a larger share of their expenditure on beef than the lowest and highest expenditure quintiles. (Funke et al. 2022, 231).

Klenert et al. (2023) investigated such distributional effects, comparing different meat tax designs and revenue recycling schemes. The authors concluded that the distributional effects of meat taxation on inequality is mild and can be reversed through revenue recycling. As maintained by Klenert et al. (2023), the introduction of a meat tax might have a slightly regressive effect which can be reversed. Klenert's analysis focused on four scenarios of revenue recycling: (i) the tax revenue disappears into the government budget; (ii) tax revenue is returned to customers as lump-sum payments; (iii) the tax revenue is used to lower VAT on fruit and vegetables; and (iv) the tax revenue is used for targeted transfers to the lowest quintile. Klenert et al. (2018) concluded that «transfers targeted to the lowest quintile are, unsurprisingly, highly progressive and reduce inequality far beyond its pre-tax level» and «revenue recycling via reductions in the VAT rate on fruit and vegetables dampens but in many countries does not fully offset the regressive effect of the tax», and that «revenue recycling is the strongest lever to reduce inequality impacts from meat taxation», highlighting the importance of policy measures which have households at its center.

3.3.2 Impact on the industry

Another concern surrounding the introduction of a meat tax is its potential economic impact on the industry. A meat tax could have negative economic consequences for farmers, furthermore affecting various aspects of the meat industry, from processing facilities to the supervision of the supply chain and sales.

The Danish experience provides an important case study. In June 2024, Denmark declared it would become the first country to implement a tax on livestock

CO2 emissions (Reuters, 2024). This follows an earlier initiative from October 2011, when the Danish government introduced a tax on food items that contained more than 2,3% saturated fats to address rising obesity rates and encourage healthier eating habits (Bødker et al 2015). The Danish tax is unique since it does not levy a particular product (sugary drinks, confectionery, etc…) but rather a specific nutrient in food, sometimes naturally occurring and not added during production: this includes products such as butter, milk, cheese, pizza, meat, oil, and processed foods (ibidem). This tax reform was part of a broader reform, ongoing since 2004, aimed at shifting from direct to indirect taxation: the government opted to reduce marginal rates of income tax while increasing other sales taxes such as those on fuel, tobacco, and unhealthy food. However, this policy measure faced numerous challenges and ultimately proved to be ineffective: in fact, in November 2012 was abolished after strong criticism.

The reasons for this failure are many and related to its poor design, implementation issues, unintended economic consequences, and public response. This tax was poorly designed, and having a narrow scope: it targeted only specific high-calorie food items, those rich in saturated fats. The limited focus allowed customers to easily substitute taxed products with untaxed - but still unhealthy - alternatives. Additionally, such measures penalized also the consumption of healthy fats such as olive oil, avocado, nuts, and oily seeds rich in omega-3 and omega-6 fatty acids which are necessary for any diet, especially those plant-based. Moreover, the tax was defined as a “bureaucratic nightmare” for producers and retailers, with a complex structure and varying tax rates depending on the specific fat content and product category: this complexity created an administrative burden, leading to high costs and difficulties in implementing and enforcing the tax. Furthermore, there were implications of economic order: Denmark has a longstanding problem with cross-border shopping because of its high rates of taxation for food, drink, and tobacco[28]. Even though the Danish Ministry of Taxation noted that, due to the relatively short shelf-life of the food products involved, the effect of the tax was “relatively limited”, evidence suggested that customers were doing their shopping in neighboring countries such as Germany and

[28] Denmark has not adopted a reduced VAT rate for food items.

Sweden to take advantage of their lower prices. Lastly, the public and industry response was very negative: many industry associations threatened lawsuits and intensified their lobbying activity. Predictions of welfare losses were made, since the administrative burden would damage Denmark's competitiveness compared to other nations, increasing inflation and border trade. Finally, industry associations tried to cast doubt on evidence that meat is detrimental to one's health. (Bødker et al 2015).

A range of supportive policy measures can be introduce to help producers accept such tax. First, part of the revenues generated from the tax can be used as a subsidy for sustainable farming practices, which would help offset the cost of adjusting their operations and make the transition to a lower-impact production model. Such sustainable farming practices include adopting technologies that reduce anthropogenic emissions and improve animal welfare. Other form of support involve rural communities that rely on farming: such communities could receive targeted investments to diversify their economies. Secondly, the design of the tax should be simple and the implementation gradual, allowing the industry time to adapt without experiencing financial or operational disruptions. Such gradual introduction would also provide businesses the opportunity to make strategic investments such as sustainable farming practices or alternative protein production. Another possible strategy to gain industry support would be to exclude from the tax, at least for the first years, products that are part of cultural heritage such as Protected Designation of Origin (PDO), Protected Geographical Indication (PGI), and Traditional Specialities Guaranteed (TSG). Such exemption would recognize the importance of maintaining cultural traditions and practices. This approach could also encourage the expansion of the range of protected products, which generally must adhere to more strict traditional procedural guidelines. This would require also significant investments in certification authorities to ensure regular auditing[29]. Furthermore, governments should invest in innovation, supporting the existing industries in diversifying production into alternative protein sources. Lastly,

[29] In «Che porci!», Innocenzi documented possible mismanagement in the certification authority supervising Italian PDO Parma ham supply chain. A whistleblower report revealed that the authority prioritized industry demand over regulatory compliance (for example: genetics of pigs, animal welfare standards, sanitary problems) , leading to its suspension by the Ministry of Agriculture. The certification authority was later reinstated.

the Danish attempt proved that having a tax at a national level is quite useless: any measure would have to be holistically thought to address the problem of meat overconsumption but also to avoid any kind of market distortion. In fact, since negative externalities affect the whole world, there is no reason for some countries to try to improve while other countries do nothing at all. Global agreements, similarly to climate agreements, could be developed to encourage countries to adopt consistent meat taxation policies.

3.4 Influencing consumer behavior

Implementing a meat tax alone may not be sufficient to drive the necessary changes in consumer behavior. Godfray et al. (2018) provided a decision-making framework (fig. 6) which emphasizes the intervention of the dual - process theory[30], that considers both the role of conscious and unconscious processing operations.

The role of the conscious, or the reflective decisional system, is particularly targeted by policies such as taxes, but also by complementary strategies such as public awareness campaigns and labeling. For example, public awareness campaign aimed at eradicating the deep-seated beliefs or meat-free days in collective catering could help build public support for a meat tax. Additionally, Front-of-Pack Labels (FoPL) including grading systems or warnings similar to those used for sugar or fat content can have a crucial role in guiding consumer choices. By prominently displaying information about the standards of animal welfare the specific animal was subject to, these labels would increase transparency and enable customers to make informed decisions.

[30] «Dual-process theories propose that judgments and behavior can be understood as the product of two (sets of) qualitatively distinct processes, one being characterized by features of automatic processing and the other by features of controlled processing» (Gawronski et al., 2024)

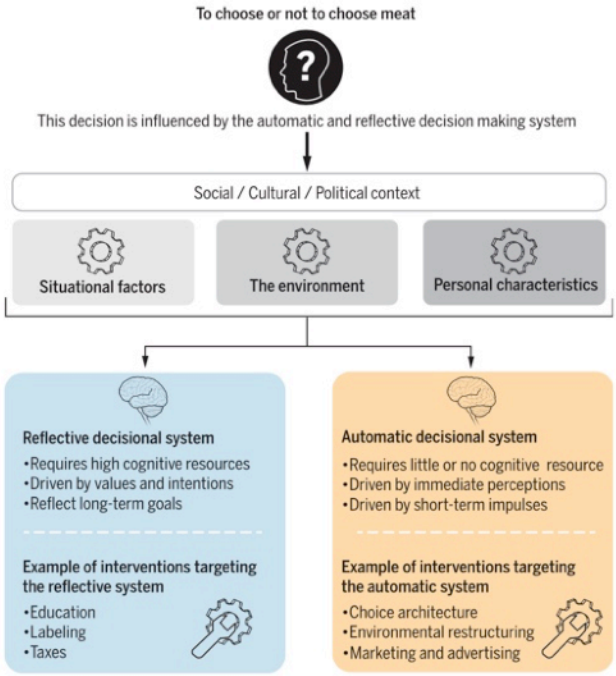

Fig. 6. (Source: Godfray et al. 2018)

The dual-process model of motivation and interventions that target automatic and deliberative decision-making. Examples of (i) situational factors are events, moods, and emotions; (ii) the environment are the layout of products in a shop or the marketing experienced by an individual; and (iii) personal characteristics are factors such as values, beliefs, and traits such as self-restraint or impulsivity (Godfray et al. 2018).

Other forms of FoPL could include warnings or grading systems used to explicit the environmental impact or the detrimental effects of meat products towards health. To support such labelling, certification programs and regular auditing, led by private, governmental, or nongovernmental organizations should be promoted, ensuring the accountability of such certification authorities.

The role of unconscious, or automatic decision system, is targeted by a more subtle form of policies: in this area, nudging[31] can play a crucial role. Making plant-based meals the default option in all forms of public catering such as schools, offices, hospitals can reduce meat consumption: meat would still be available but might require an active choice or additional cost. Similarly, offering plant-based dishes first on menus can influence consumers to choose them more often. Another form of nudging could be creating a price system that visibly shows the real cost of meat, breaking down its environmental and health cost and making the consequences of meat consumption more visible and tangible.

[31] «A nudge, as we will use the term, is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not» (Thaler and Sunstein, 2008)

CONCLUSIONS

FAO report *Livestock's Long Shadow: Environmental Issues and Options* was released in 2006. Since then, growing evidence has underscored the urgency of policy measures to address such challenges. This dissertation supports the adoption of a tax on meat, in order to account for its environmental externalities and health related impacts.

The first chapter of this dissertation examined the ethical and philosophical rationale that lies behind human relationship with non-human animals and justifies current levels of animal exploitation. One key insight is the distinction between instrumental and intrinsic value in the treatment of animals. While many anthropocentric frameworks have traditionally justified the exploitation of animals by attributing them merely instrumental value, the work of philosophers like Richard Routely and Peter Singer argue for the intrinsic worth of animals. Singer, in particular, brought attention to the issue of speciesism and animal suffering, underscoring the real word implications arising from modern industrial practices. Such inhumane conditions described by Singer in the 70s are mostly the same that fifty years later are discovered by investigative journalists like Giulia Innocenzi while assessing the state of Italian meat producers and processors. Furthermore, Innocenzi's work focused on the intense lobbying activity carried out by the industry.

The second chapter focused on the social burden imposed by meat production and consumption. While meeting global demand for animal protein, intensive farming practices inflict substantial harm on the environment and public health. Such costs are not reflected in the market price. Intensive meat production is a major contributor to climate change, nutrient and air pollution, and biodiversity loss. Greenhouse gas emissions accelerate global warming, nutrient runoff from fertilizers and manure degrades land and water, while air pollution affects workers and local communities. Public health risks are equally important. The consumption of meat, particularly red and processed, is liked to non-communicable diseases such as cancer, hearth diseases, and diabetes. The industry misuse of antibiotics fosters antimicrobial resistance, a global

health threat, while crowded and unsanitary rearing conditions increase the risk of zoonotic diseases such as swine and avian flu.

The last chapter focuses on the proposal of a Pigouvian tax on meat as a possible solution to counteract the social costs imposed by meat production and consumption, producing socially optimal outcomes. Precedents of similar tax include those on environmental pollution, tobacco, alcohol, and sugary soft drinks. Initially, the basic economic theory of the meat tax is explored, with particular regard to the role of the tax in producing a "double dividend", which is less meat produced, and substantial tax revenues. Moreover, the price elasticity of meat demand is investigated because of its importance in determining the effectiveness of the tax. Secondly, scientific evidence about a hypothetical magnitude of such tax is presented: the environmental meat tax could increase meat prices by 20 - 60%, potentially tripling with the inclusion of health related costs. The optimal design of a meat tax must carefully balance the need to reflect the true cost of meat with the need to mitigate potential regressive effects on low-income households and avoid detrimental effects on the industry. Evidence suggests that redistributing tax revenues might counter the regressive nature of such tax. Furthermore, the economic impact on the meat industry must be addressed through supportive measures aimed at implementing more sustainable practices and industry diversification into new meat substitutes. The Danish case study highlights the importance of a sensitive approach to avoid market distortions and ensure the policy's effectiveness. Finally, to maximize the effectiveness of a meat tax, it must be complemented by strategies that influence consumer behavior that act on both conscious and unconscious decision systems. Such behavioral approach encompass different strategies: public awareness campaigns, FoPL grading systems to highlight animal welfare standards or environmental impact, and nudging techniques.

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