

The Animal Welfare Levy

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Motivation

- Meat consumption generates externalities on farmed animals
 - When we consume meat, it imposes costs on animal welfare that are not accounted for in market prices
- Economic principle
 - Basic economics suggests using taxes to correct for negative externalities, aligning private costs with social costs
- Policy question
 - Should meat be taxed to address its externalities on animal welfare?

Meat tax: Ongoing policy discussions

Is a Dutch meat tax on the cards?

By Jane Byrne
05-Jul-2022 - Last updated on 05-Jul-2022 at 16:03 GMT



Climate change: German MPs want higher meat tax

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True prices
for meat and dairy

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The animal welfare levy

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European Court of Auditors wants animal welfare better reflected in meat prices

The institution says long-distance animal transport is a source of stress and suffering bolstered by a search for profits.

By Mathilde Gérard
Published on April 18, 2023, at 5:25 pm (Paris) · 3 min · Lire en français

Germany eyes new animal welfare levy to help raise standards in livestock farming

By Magdalena Pistorius | EURACTIV.de 22 mars 2021



German agricultural minister, Julia Klöckner, calls for labels on egg products to carry information on laying hens' living conditions. [SHUTTERSTOCK]

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Animal welfare is a stronger determinant of public support for meat taxation than climate change mitigation in Germany

[Grischa Perino](#) & [Henrike Schwickert](#) ✉

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This paper

- Proposes a theoretical basis for implementing an animal welfare levy
- Quantifies this levy

Basic insight

- The levy can be conceived as a Pigouvian fee
 - Captures the cost (or benefit) associated with the birth and life of a farm animal that is produced for meat
- Key notion: Life worth living
 - The purpose of the levy is neither to compensate animals for their suffering, nor to raise money for improving their rearing conditions
 - Instead, it aims to **incentivize or disincentivize the consumption of animals** based on whether their existence entails a life that is deemed worth living or not

Two major difficulties, not discussed in the Pigouvian taxation literature

If animal welfare matters intrinsically:

- 1) Taxing meat affects the **number** of animals produced/consumed, and thus raises a **population ethics** issue
- 2) In practice, it is not clear how to **evaluate the externality on animals** (using humans' WTP does not seem appropriate and using animals' WTP seems elusive)

Related literature

- A large literature in philosophy about animal welfare
 - Bentham (1789), Singer (1975, 2011), Regan (1983) and many others
- Economics is anthropocentric
 - Well known problem (Johansson-Stenman 2018, Carlier and Treich 2020, Fleurbaey and Leppanen 2021)
 - A few exceptions: Blackorby and Donaldson (1992), Espinosa and Treich (2021), Kuruc and McFadden (2022), Eichner and Runkle (2023), Zuber et al. (2024))
- Population ethics
 - Parfit (1984) in philosophy, Blackorby et al. (2005) in economics
- Animal welfare measurement
 - Animal sciences (Broom 2015, Mellor 2016, Weathers et al. 2020, Browning 2022, Fischer 2024)
 - Economics (Wong 2016, Budolfson and Spears 2019, Espinosa 2024)

To begin: A very simple model

Representative consumer's objective: $u(n) - cn$

n : number of animals consumed

$u(n)$: utility of meat consumption, increasing and concave with $u(0) \geq 0$

c : cost to produce an animal

$$\text{FOC: } u'(n_e) = c$$

Non-anthropocentric social objective

Social objective: $U(n) = u(n) - cn + nv$

v : farm animal utility level

Key point: Animal welfare is **directly** included in the social objective (i.e., animals matter intrinsically)

FOC: $u'(n^*) = c - v$

A life (not) worth living

This implies:

- i) Over-consumption of meat: $n_e > n^*$ if $v < 0$ (i.e., life not worth living)
- ii) Under-consumption of meat: $n_e < n^*$ if $v > 0$ (i.e., life worth living)


Case ii) is reminiscent to the “logic of the larder” (Salt 1917)

We do animals a favor by eating them because otherwise they would not exist

Longstanding debate in philosophy

Salt (1917), Hare (1999), Matheny and Chan (2005), McMahan (2008), Singer (2011), Visak (2013)

Optimal animal welfare levy

Consumer problem's FOC: $u'(n(t)) = c + t$ 

Social problem: $\max_t u(n(t)) - cn(t) + n(t)v$

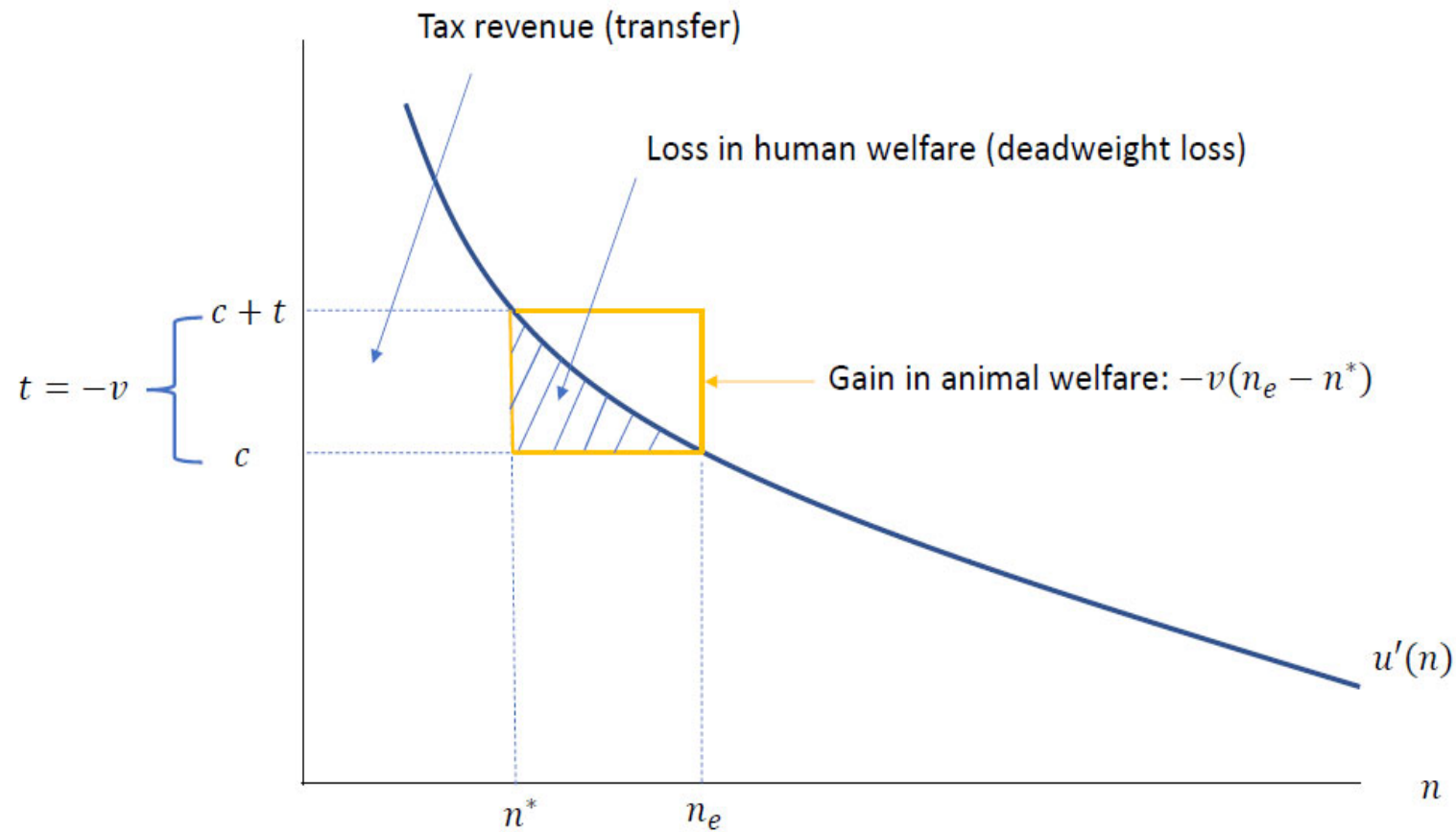
FOC: $u'(n(t)) = c - v \Rightarrow t^* = -v$

Benchmark result: The socially optimal animal welfare levy is: $t^* = -v$

Indeed, similar as a Pigouvian fee: the fee equals the marginal damage (or benefit) and the non-anthropocentric first-best is retrieved

Welfare impacts of the levy

Case: $t^* = -v > 0$ (i.e., life not worth living)



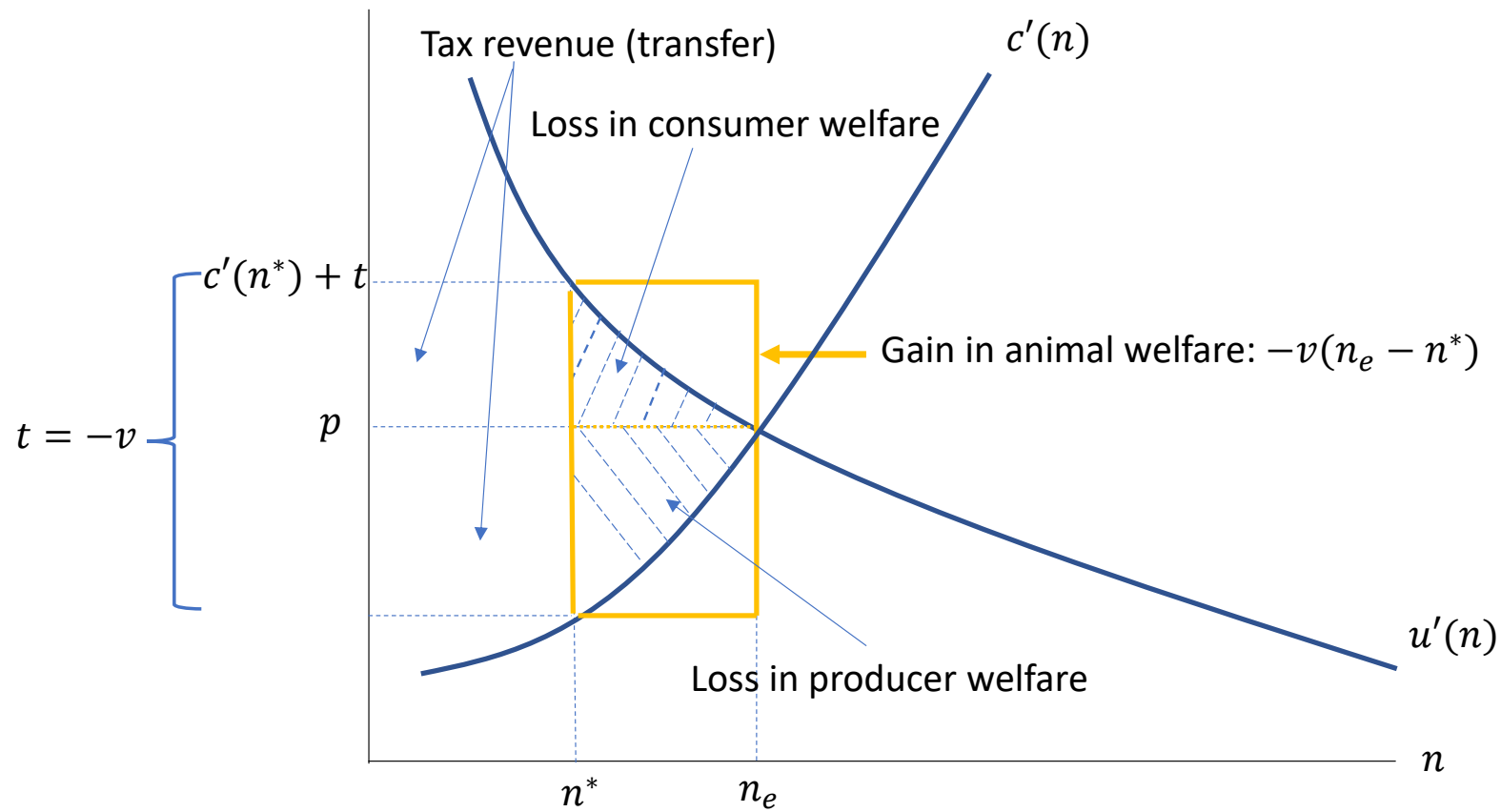
Generalizations

- Nonlinear cost, competitive equilibrium
- Quality choice (animal welfare standard d affecting v)
Result preserved: $t^* = -v(d^*)$ where d^* is the optimal animal welfare standard
- Density effect, $v(n)$
- Several animals (or food products)
- Consumers' pure altruism towards animals
- Accounting for wild animals

$$t = -v - \lambda v_w$$

where v_w is wild animal utility and λ a “technical factor” which captures how the number of wild animals varies with a change in the number of farm animals

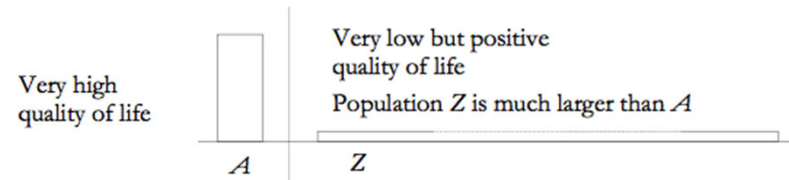
Nonlinear cost



Difficulty #1: Population ethics

- So far, we have assumed total utilitarianism
- But total utilitarianism under variable population raises ethical concerns:

Repugnant conclusion (Parfit 1984)



Procreation asymmetry (McMahan 2009)

Bringing an individual with a positive utility into existence \neq Abstaining from doing so under opposing negative utility

As an alternative: Average utilitarianism

- Social objective: $\bar{U}(n) = \frac{1}{1+n} (u(n) - cn + nv)$

- Lower animal consumption than under total utilitarianism $U(n)$

Proof: Let $\bar{n} = \operatorname{argmax} \bar{U}(n)$ and $n^* = \operatorname{argmax} U(n)$. We have $\frac{U(\bar{n})}{1+\bar{n}} \geq \frac{U(n^*)}{1+n^*}$

implying $\frac{1+n^*}{1+\bar{n}} \geq \frac{U(n^*)}{U(\bar{n})} \geq 1$, thus $n^* \geq \bar{n}$

The levy under average utilitarianism

- We find:
$$\begin{aligned}\bar{t} &= -v + \frac{1}{1+n} (u(n) - cn + nv) \\ &= \frac{1}{1+n} (u(n) - cn - v)\end{aligned}$$

⇒ Always positive when human welfare is greater than animal welfare

Hence, under this plausible case, the levy under average utilitarianism is in fact **always a tax**

- Intuition: A tax permits to reduce the number of individuals with the lowest welfare (i.e., animals), which increases average welfare
- Now, the “threshold value” of v when the tax becomes a subsidy is the human utility level. It is not anymore when life becomes worth living.

Summary of theoretical results

| Setting | Social objective | Animal welfare levy |
|--------------------------------|---------------------------------------|---|
| Total utilitarianism (TU) | $u(n) - cn - nv$ | $t = -v$ |
| Critical-level utilitarianism | $u(n) - cn + n(v - \gamma)$ | $t = -v + \gamma$ |
| Average utilitarianism | $\frac{u(n) - cn + nv}{1+n}$ | $t = -v + \frac{u(n(t)) - cn(t) + n(t)v}{1+n(t)}$ |
| Number-dampened utilitarianism | $\frac{1}{1+n}(u(n) - cn + nv)f(1+n)$ | $t = -v + \left[\frac{1}{1+n(t)} - \frac{f'(1+n(t))}{f(1+n(t))} \right] [u(n(t)) - cn(t) + n(t)v]$ |
| Prioritarianism | $g(u(n) - cn) + ng(v)$ | $t = -\frac{g(v)}{g'(u(n(t)) - cn(t))}$ |
| TU with non-linear cost | $u(n) - c(n) - nv$ | $t = -v$ |
| TU with quality choice | $u(n) - (c + d)n + nv(d)$ | $t = -v(d)$ |
| TU with density effect | $u(n) - cn + nv(n)$ | $t = -[v(n(t)) + n(t)v'(n(t))]$ |
| TU with two animal species | $u(n) - cn + n_1v_1 + n_2v_2$ | $t_1 = -v_1, t_2 = -v_2$ |
| TU with altruism | $u(n) - cn + \alpha nv - nv$ | $t = -v$ |
| TU with wild animals | $u(n) - cn + nv + wv_w$ | $t = -v - \lambda v_w$ |

Difficulty #2: Calibrating the levy

- Benchmark result: $t^* = -v$

Reminder: This is a conservative estimate

- How to calculate v ?

- We build on the QALY approach used in health and on the Five Freedoms approach used in animal sciences

Follows from Wong (2016), Budolfson and Spears (2019) and Espinosa (2024)

- Remark: SWF approach (Adler 2012, 2019) rather than BCA

We don't use animals' WTP

General formula

- Animal utility over lifetime:

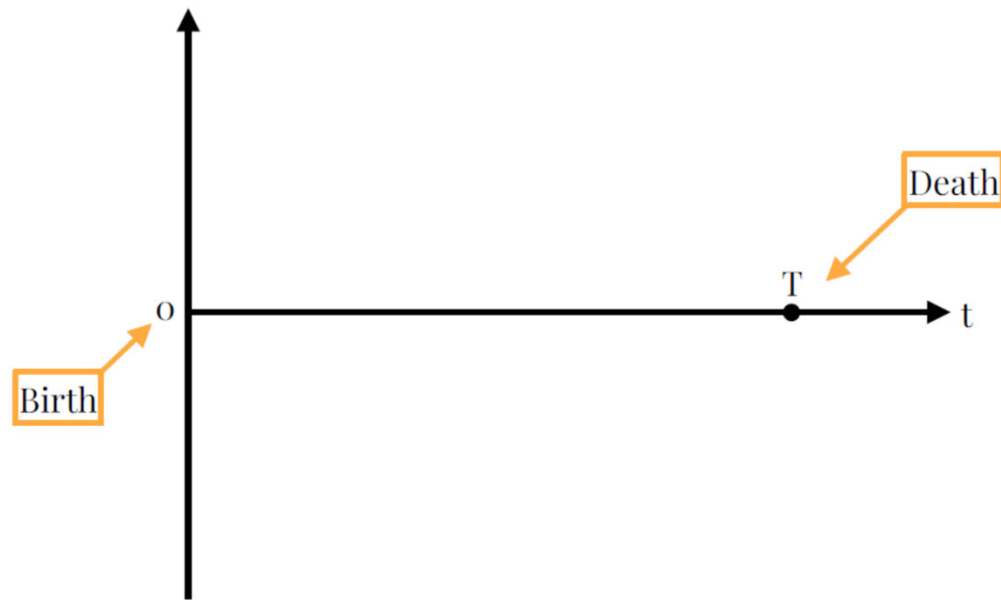
$$v = m\phi_s \int_0^T q(t)dt$$

$q(t)$: **animal welfare score** at a given time t between birth ($t = 0$) and slaughter ($t = T$)

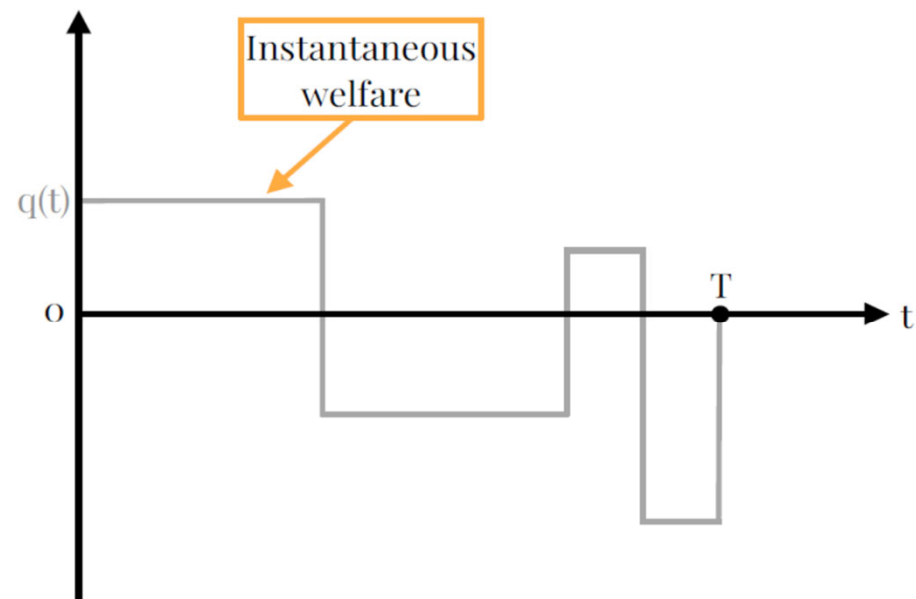
ϕ_s : **utility potential** of species s (permits to make interspecies comparisons)

m : **monetization parameter** (permits to translate utility levels in monetary units)

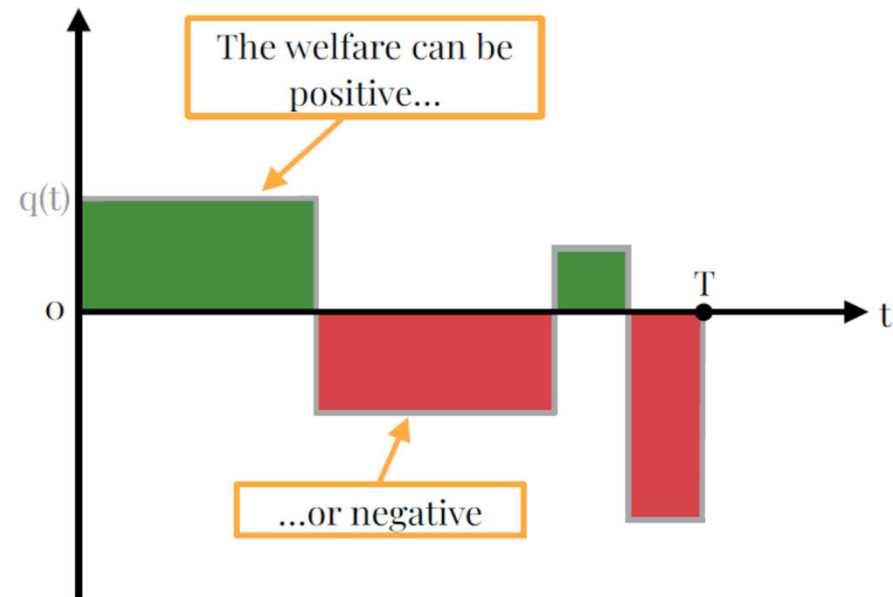
Lifetime utility



Lifetime utility



Lifetime utility



Animal welfare score, $q(t)$

- Similar to the QALY approach (EQ-5D) in health
- Based on the Five Freedoms approach used in animal sciences (Brambell 1965)
- We assess a level of violation for each Freedom
- The score is $q(t) = \frac{W_0 - W(t)}{W_0}$ where $W(t)$ is the **total number of violations** (between 0 and 20)
- No violation ($W(t) = 0$) implies $q(t) = 1$
- The parameter W_0 defines the “threshold” number of violations at which $q(t) = 0$

Five Freedoms (World Organization for animal health):

1. Freedom from hunger, malnutrition and thirst;
2. Freedom from fear and distress;
3. Freedom from heat stress or physical discomfort;
4. Freedom from pain, injury and disease;
5. Freedom to express normal patterns of behavior.

Five levels of violations:

0. No violation
1. Mild violation
2. Moderate violation
3. Severe violation
4. Very severe violation

General formula

- Animal utility over lifetime:

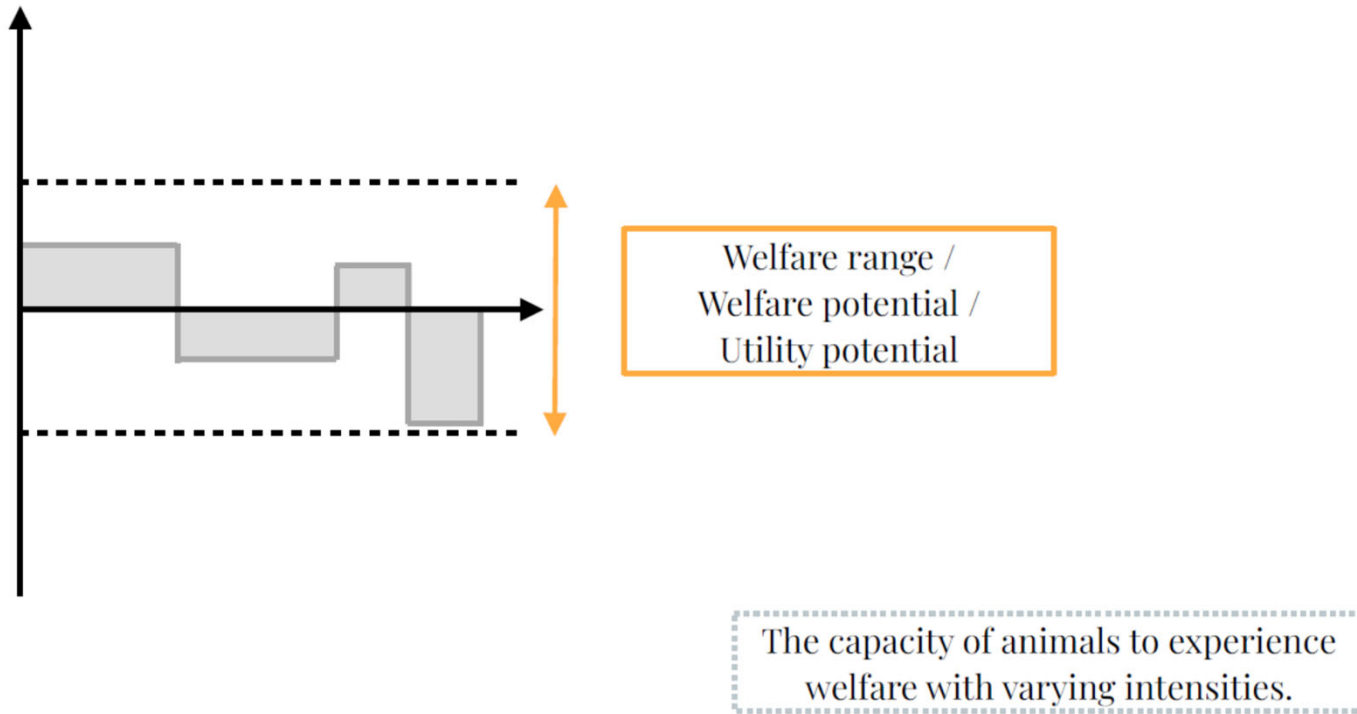
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$q(t)$: **animal welfare score** at a given time t between birth ($t = 0$) and slaughter ($t = T$)

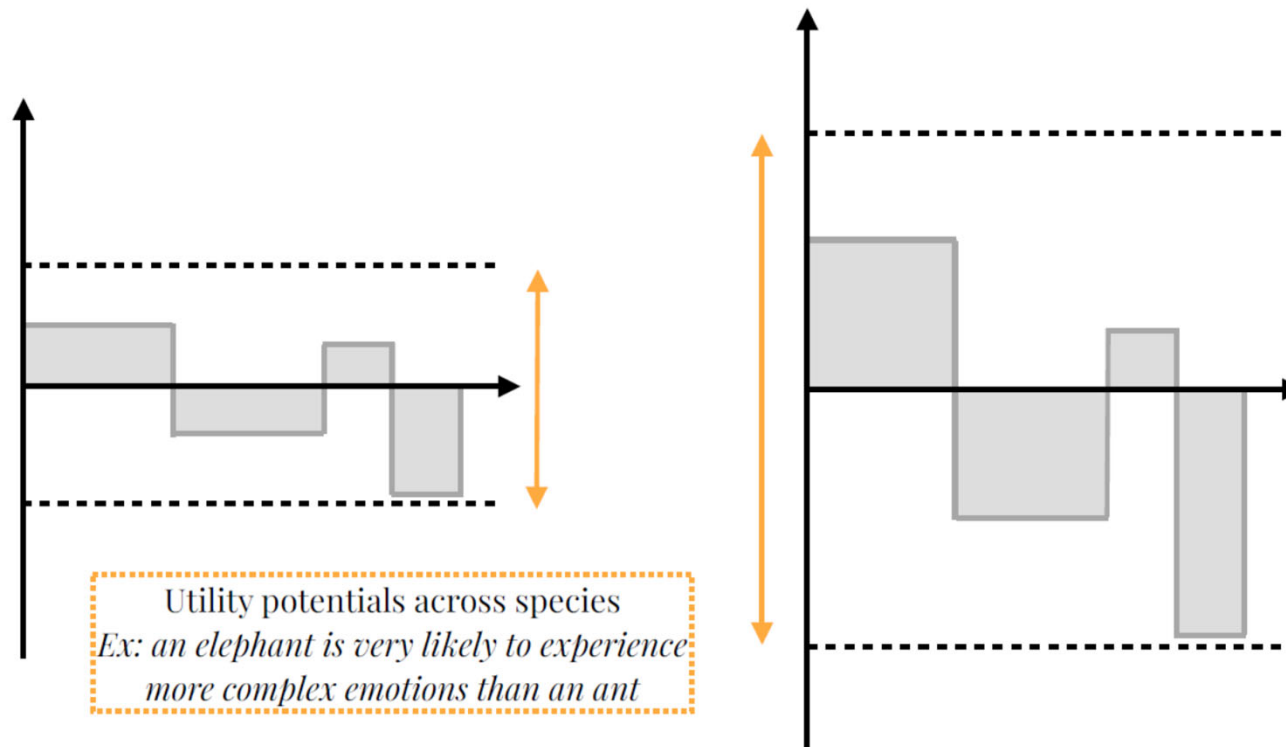
ϕ_s : **utility potential** of species s (permits to make interspecies comparisons)

m : **monetization parameter** (permits to translate utility levels in monetary units)

Comparing lifetime utilities



Comparing lifetime utilities



Utility potential of species s , ϕ_s

- Captures the ability of species s to experience emotions
- A proxy for this ability could be the number of neurons (Budolfson and Spears 2019)
We use cortical/pallial neurons (Herculano-Houzel 2017)
- The formula is $\phi_s = \left(\frac{n_s}{n_h}\right)\varphi$
 - n_s : number of neurons of species s
 - n_h : number of neurons of humans
 - φ : parameter capturing the gain in utility potential from an additional neuron
(we use $\varphi = 1$ in the baseline calibration)

Number of cortical / pallial neurons by species

| Animals | Species | Neurons (10^6) | ϕ_s |
|-------------|--------------------------------|--------------------|----------|
| Humans | Homo sapiens | 24526 | 1 |
| Elephant | African elephant | 5508 | 1/4 |
| Dolphin | Bottlenose dolphin | 2366 | 1/10 |
| Bovine | Bos Taurus | 790 | 1/31 |
| Pig | Wild Boar - Sus scrofa | 554 | 1/44 |
| Dog | Canis familiaris | 528 | 1/46 |
| Hen/chicken | Red Junglefowl - Gallus Gallus | 86 | 1/285 |
| Rat | Rat | 44 | 1/557 |

Source: Jardim (2017), Herculano (2019), Espinosa (2024)

Monetization parameter, m

- We calibrate m using humans as a reference, i.e., $s = h$ and $\phi_s = 1$
- Then m could be interpreted as a monetary value of a QALY/day
Namely, m is the social monetary value of a day in perfect health for a human
- We use $m = 402$ euros (i.e., $\frac{147k}{365}$) (Téhard et al. 2020)
This implies, for instance, that the value of one additional day of the life of a pig with maximal welfare is about 10 euros

Application to chickens in intensive farms (France)



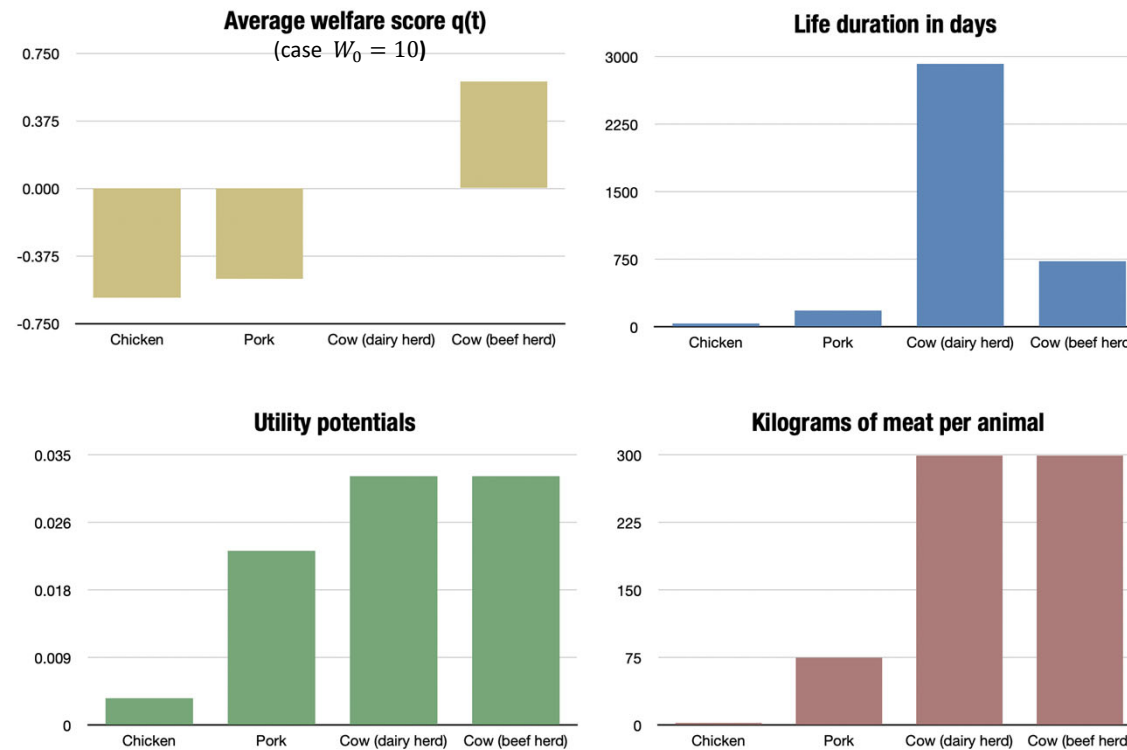
Economic valuation of chickens' utility

| | Farm | Transport | Abattoir |
|---|-----------------|------------------|-----------------|
| Freedom from hunger, malnutrition, and thirst | Mild (1) | Moderate (2) | Moderate (2) |
| Freedom from fear and distress | Severe (3) | Very severe (4) | Very severe (4) |
| Freedom from heat stress or physical discomfort | Very severe (4) | Very severe (4) | Very severe (4) |
| Freedom from pain, injury, and disease | Very severe (4) | Severe (3) | Severe (3) |
| Freedom to express normal patterns of behavior | Very severe (4) | Very severe (4) | Very severe (4) |
| Total number of violation points: W(t) | 16 | 17 | 17 |
| Number of days | 38 | 1 | 1 |
| $v = m\phi \int_0^T \frac{W_0 - W(t)}{W_0} dt$ | If $W_0=7$ | -€72.57 | |
| | If $W_0=10$ | -€33.96 | |

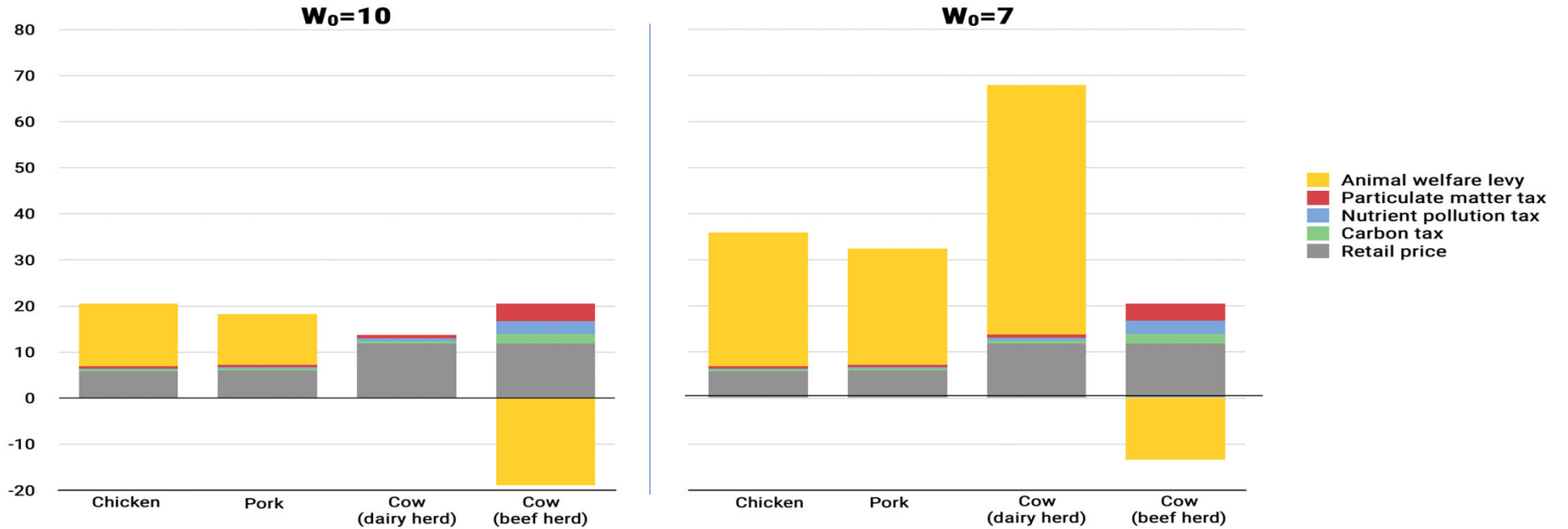
Values per chicken in various production systems

| Production System | Economic valuation of v (in €) | |
|--------------------------|---------------------------------------|-------------------------|
| | W₀=7 | W₀=10 |
| Standard | -72.57 | -33.96 |
| Certified | -82.59 | -33.40 |
| Label Rouge | -68.76 | -13.19 |
| Organic | -52.72 | -1.96 |

Calculations for different animal species



Retail price and externalities of meat products (€/kg of meat)
Total utilitarianism



Note: $\psi=1$, chicken 2.5kg, pork 75kg, cows/beef 300kg

Prices of chicken, pork and beef/dairy cow meat per kg, including environmental taxes and animal welfare levies (for $W_0 = 10$ and $W_0 = 7$)

Robustness

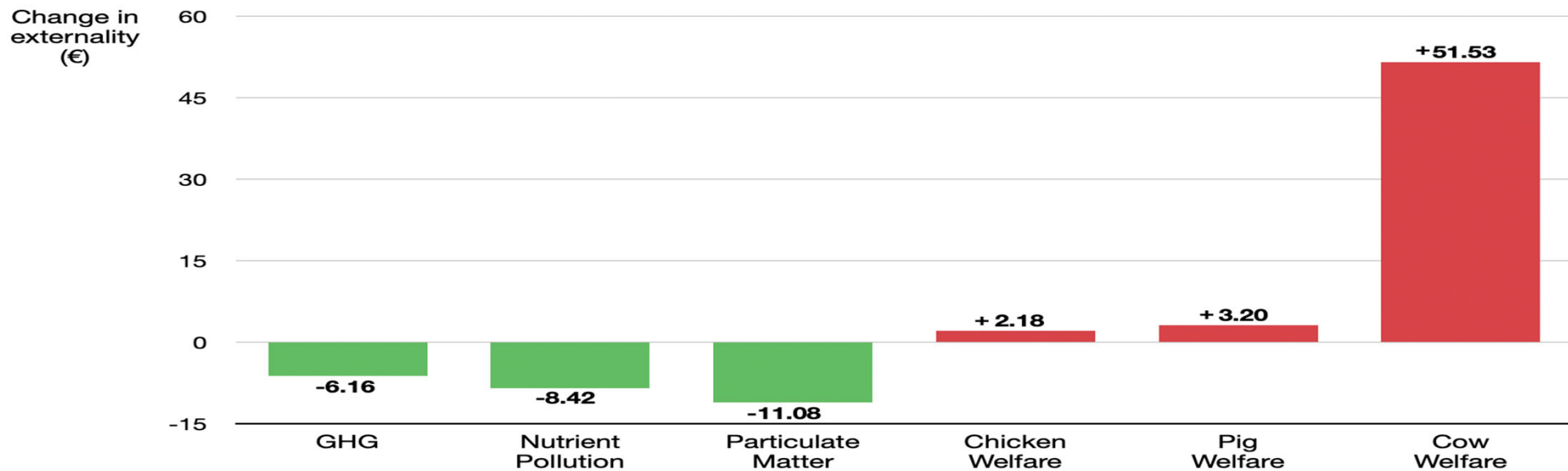
| Threshold W_0 | Utility potential | Tax in Euros per kg of meat | | | |
|-----------------|--------------------------------|-----------------------------|--------|-------------|------------|
| | | Chicken | Pork | Cow (dairy) | Cow (beef) |
| $W_0 = 10$ | Neuron ratio with $\psi = 1$ | 13.58 | 11.07 | 0.06 | -18.86 |
| $W_0 = 10$ | Neuron ratio with $\psi = 0.9$ | 23.92 | 16.17 | 0.09 | -26.58 |
| $W_0 = 10$ | Moral weight | 1432.02 | 268.47 | . | . |
| $W_0 = 7$ | Neuron ratio with $\psi = 1$ | 29.03 | 25.25 | 54.17 | -13.39 |
| $W_0 = 7$ | Neuron ratio with $\psi = 0.9$ | 51.11 | 36.89 | 76.37 | -18.87 |
| $W_0 = 7$ | Moral weight | 3060.16 | 612.63 | . | . |

Table 4: Taxation levels with varying weights on animal welfare

Source: « Moral weights » (Duffy 2022, Fischer 2023): $\phi_s = 0.548$ for pigs, 0.368 for chicken

Impact of a GHG tax on beef

Estimated change in annual externalities per capita following the introduction of a GHG tax on beef meat (in €) with $W_0=10$



Estimated change in annual externalities per capita following the introduction of a GHG tax on beef (in Euros) with $W_0 = 10$

Summary

This paper makes three contributions:

1. It proposes a **theoretical foundation** for applying a tax (or a subsidy) on meat for animal welfare considerations
2. It studies the **population ethics** problem raised by the implementation of such a tax
3. It **calibrates the tax** building on recent developments in animal sciences and economics