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Economic considerations in relation to damaging behaviour and health

GroupHouseNet training school on Relationships between damaging behaviour and health, 7-9 Nov 2016, Belgrad, Serbia

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Session outline

- Introduction - What is economics?
- Some basic principles in economics
  - Acknowledgement: This section is partially based on training materials Topic 4: Costs (Aragrande, Canali and Beaugrand) and Topic 5: Decision-making context (Rich and Niemi) produced within NEAT project (Networking to enhance the use of economics in animal health education, research and policy making in Europe and beyond, http://www.neat-network.eu/) which was co-funded by the Lifelong Learning Programme of the European Union.
- Economic issues related to damaging behaviour
- How to analyse economic impacts and how to utilise results?

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Pre-course reading

- Read preface (pages xi-xvi), Chapter 2 (“What is economics and how it is useful”) and first 12 pages (p. 16-28) of Chapter 3 ”Livestock production economics” from the book Rushton, J. (ed.) 2009. The Economics of Animal Health and Production. CABI international. 384 p. A copy of the book is available on the Internet: http://blogtiengviet.net/media/users/tamthanh27/tailieu/cbaebook/animalhealth.pdf

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Pre-course assignment 1

- Think about tail biting in pigs or feather pecking in hens. Characterize (e.g. by using bullet points) how they in your opinion:
  - Affect input used by a farm which is at the risk of suffering from tail biting in pigs or feather pecking
  - How they affect revenues obtained (output prices, quality, quantity etc.)

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Objectives for this session

- To get an overview of economic implications of tail biting and feather pecking
- To understand basic principles of costing the effects of damaging behaviour
  - We mainly focus on farm-level issues

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Introduction

- People have **endless needs** but only limited resources

  ➔Must allocate resources efficiently

  ➔ Focus on consuming goods which can provide the highest value per resource (e.g. value for money)

- Economics is about how to best use scarce resources
  - Understanding how and why decisions are made and what kind of perspectives are relevant in decision making?
  - Which tradeoffs are made upon choice?
  - How should resources be used?
  - What are the implications of decisions (costs, benefits etc.)

  ➔ Economics can help decision-makers to choose between different options to prevent or control for damaging behavior

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Introduction

- Tail biting and feather pecking are economically important disorders
  - They cause health care costs
  - They cause production losses and reduce animal production and production efficiency
  - They reduce animal welfare which has societal costs
  - Controlling them is costly
  - Controlling them has benefits
- When assessing the costs of damaging behavior or interventions related to them, pay attention to differences between ”disease” vs. ”no disease” cases or ”intervention” vs. ”no intervention” cases. The costs are due to differences between the cases.

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Factors affecting the choice of intervention

- **Preferences and goals** of the **decision-maker**
  - **Trade-offs** may need to be made
  - **Opportunity cost**
  - Decision-making context and situation

- Different stakeholders – different views
  - Who makes the decision?
  - Who receives the benefits?
  - Who pays the costs?
  - How/why these actors **value** different things? What are their goals?
  - Which **options** are there?
  - Which **constraints** are there?

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The profit maximisation problem

Economic actors strive for a goal

Profit maximisation is used to present producers' behavior when they maximize their profit

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Economic actors can have different objectives

- **Maximise health**
- **Minimise costs**, e.g. if only a limited quantity can be produced
- **Maximise profit** (=revenues minus costs)

  Maximising production or health may not maximise profit!
- **Maximise utility**, i.e. happiness that one can get by consuming goods, given their resources (e.g. income) available to get the goods

  Tradeoffs are made because resources are scarce

Different aspect to be considered

- Profit-maximization is often assumed as the goal
- Besides profit, costs and benefits of an intervention may be related to other factors such as

  Improving farming or herd structure

  Improving efficiency or input-output relationship

  Improving economic results (revenues, solvency etc.)

  Making the farm more robust

  Ease of working or operating the farm

Firms operate in the market

- Most people enter business to make profit
- To make profit, a firm must be able to sell its products, while the costs (monetary + non-monetary) of producing the good must be less than the sale price
- Usually we assume that **markets are perfectly competitive**

  There are many buyers and sellers which sell standardized products

  Buyers and sellers know which opportunities there are

  Firms are typically **price takers,** i.e. the price offered in the market is "take it or leave it". If the price is too high, the buyer can go to another seller. No one firm in the market can influence the price of goods sold in the market.

Profit

- Profit = revenue – cost
- The farmer's revenue is determined by the **market prices** (*p)* of inputs and output(s) and his/her **production technology**: $f(x_1, x_2, x_3, \ldots)$, *where*

  $x_1, x_2, x_3, \ldots$ are different inputs into production (labor, feed, capital, etc.)

  $f(x_1, x_2, x_3, \ldots)$ describes how much output (e.g. milk) farmer can produce with certain amount of inputs

  Each of these inputs has a cost associated with them i.e. x_1 costs w_1, x_2 costs w_2, etc.

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Profit maximisation

- Total profit (π) for the farmer is

$$\pi = \underset{x_1, x_2, x_3}{\textbf{maximise}} (P_{output} * f(x_1, x_2, x_3, \ldots) - w_1 x_1 - w_2 x_2 - w_3 x_3)$$

- The costs and the revenues of production increase when production is increased, but in the relevant range the costs per unit of output usually increase more than the revenues per unit of output.

$\Rightarrow$**The law of diminishing returns**: if the amount of one input is increased (while other inputs are held constant), amount of output added per unit of variable input will decrease

- **The profits are maximized where marginal (or additional) revenues equal to marginal (or additional) costs**

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Costs of damaging behaviour

Costs exist if an item is used that has *value* **and** is *scarce*
An item has a value when it contributes to fulfillment of needs

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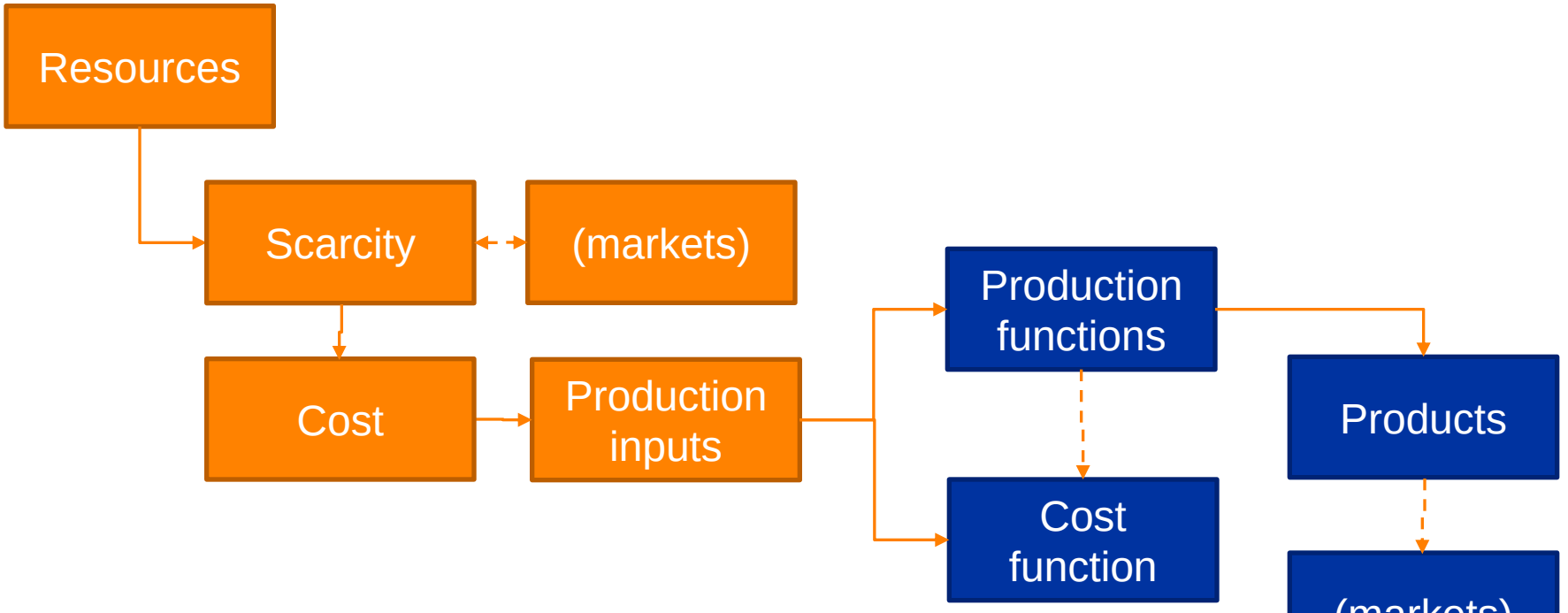
How do resources produce effects (from a farm/firm perspective)



Cost categories

- Direct (e.g. loss of animal value, medication costs)
- Indirect (e.g. business interruptions and other consequential (secondary) effects of the “project”)
- Induced (e.g. multiplier effects)

- Total costs = fixed costs + variable costs
- When the level of production changes…
  - Variable costs (e.g. feed) change
  - Fixed costs (e.g. housing cost) remain the same (e.g. depreciation of house per year can be fixed)
  - Fixed costs can change in steps (quasi-fixed costs)
  - Note: Firm’s perspective
- Costs can be larger than expenditures

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Examples on costs related to damaging behavior (generic)

- Costs of planning intervention
- Purchase of facilities, land or other factors
- Costs of setting up and maintaining a “control programme”
- Medication, vet fees
- Effect on productivity (FCR, ADG, etc.)
- Labor needed to carry out intervention, effect on labor used in the production process
- Depreciation and interest
- Price discounts, value of livestock product
- Externalities
- Administration and transaction costs

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Examples on benefits of controlling to damaging behavior (generic)

- Benefit of an intervention are usually due to lowering disease losses and costs
- Price premiums, increased value of livestock products, potential for value-added
- Less labor needed to take care of animals
- Increased utilization rate of facilities
- Higher output
- Improved productivity (e.g. FCR, ADG, longevity etc.)
- Benefits to humans (monetary and non-monetary)

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Variable costs

- *Variable costs*
  - Variable costs are costs that change depending on variations in the size of the activity: they increase with the increase of production and decrease when production is reduced;
  - Common examples of variable costs are given by the use of inputs entirely consumed in one production cycle; e.g. in pig production variable costs may consist expenses for:

- Feed and inputs needed to produce feed
- Fuel
- Electricity
- Medicines
- Veterinary assistance;
- Hired labour paid per hour, day, or unit of product;
- Rent of machinery
- etc…

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Fixed costs

- *Fixed costs*
  - Fixed costs are costs that do not vary in the short term, even though the business' activity, production volume and sales are
  - NOTE: It may not be necessary to calculate fixed costs if you are analysing the costs of disease in an existing farm. However, when comparing production systems or making changes to housing, these changes must be accounted for.
  - Some common examples of fixed costs are:

- Depreciation of tangible assets (machinery, buildings, tools, office equipment, etc.)
- Amortization of intangible assets (patents, trademarks, etc.);
- Interests paid on loans used to buy assets
- Salaries paid to permanent employees of a company
- Insurance costs for builtdings
- Etc.

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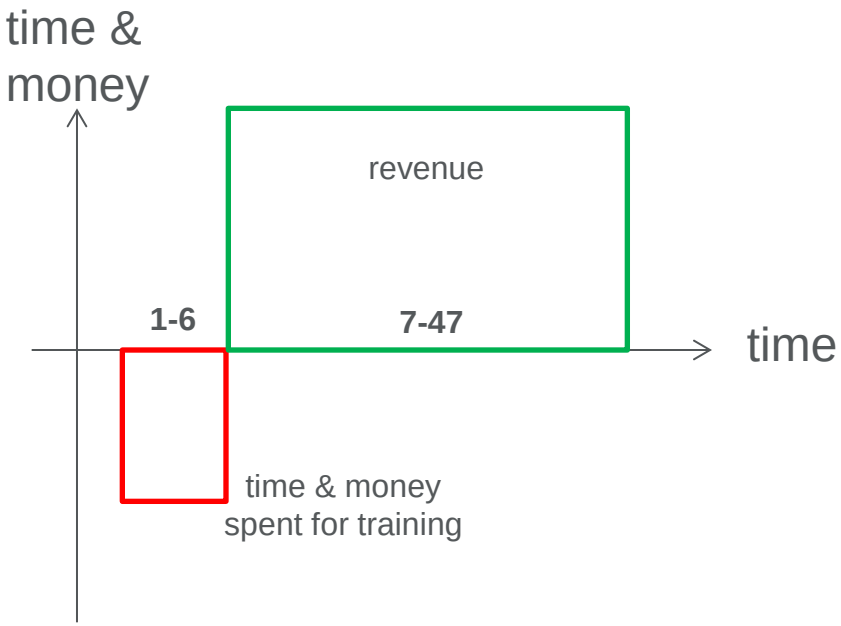
Fixed costs and investments

- An *investment* is time, energy, matter, money **spent once** on expectation of **future benefits**.

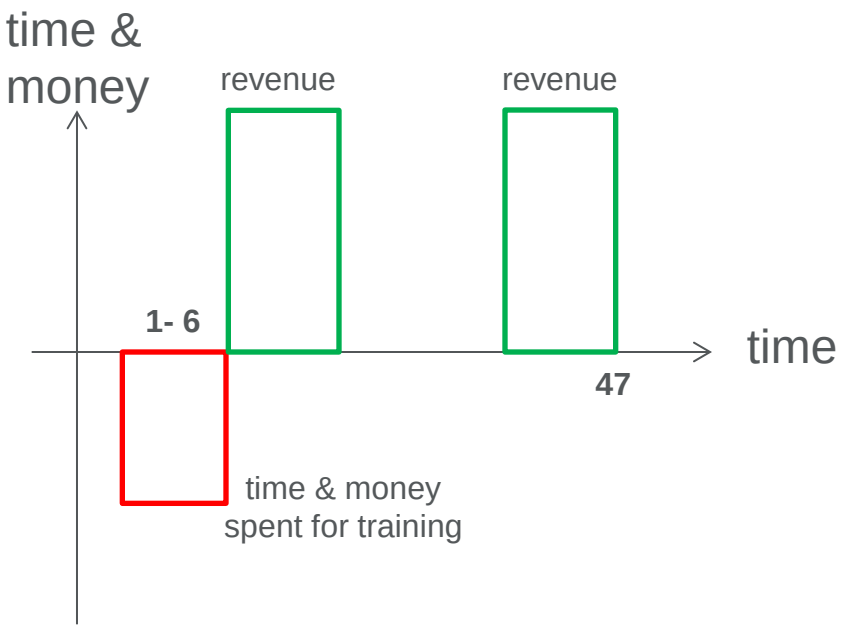
Two examples:
-Your education: You spend money and time to learn. Your hope is that you will have a job with income.

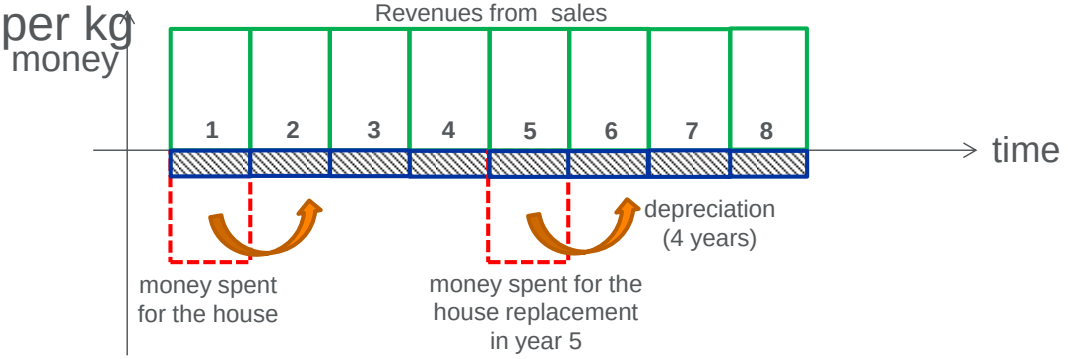
-A farmer builds a poultry house to produce eggs.



Investment and depreciation

- Investment is sunk cost. You cannot get your money and time back..
  - A poultry house maintains its functionality for a number of years, which defines the *useful life period* of the asset. The house loses value gradually because of wearing ➔ Depreciation
  - Housing costs are fixed costs. Even if the birds are suffering from feather pecking and farmer loses income because of that, the costs of housing are virtually unchanged to the farmer (unless resolving the problem requires changes to the house)
  - However, fixed cost per animal or per kg of output may change.





Now we go back to the profit maximization problem

Optimization refers to seeking for a desired objective (minimize, maximise, satisfy a fixed goal) by adjusting a decision variable (such as measures to prevent damaging behavior)

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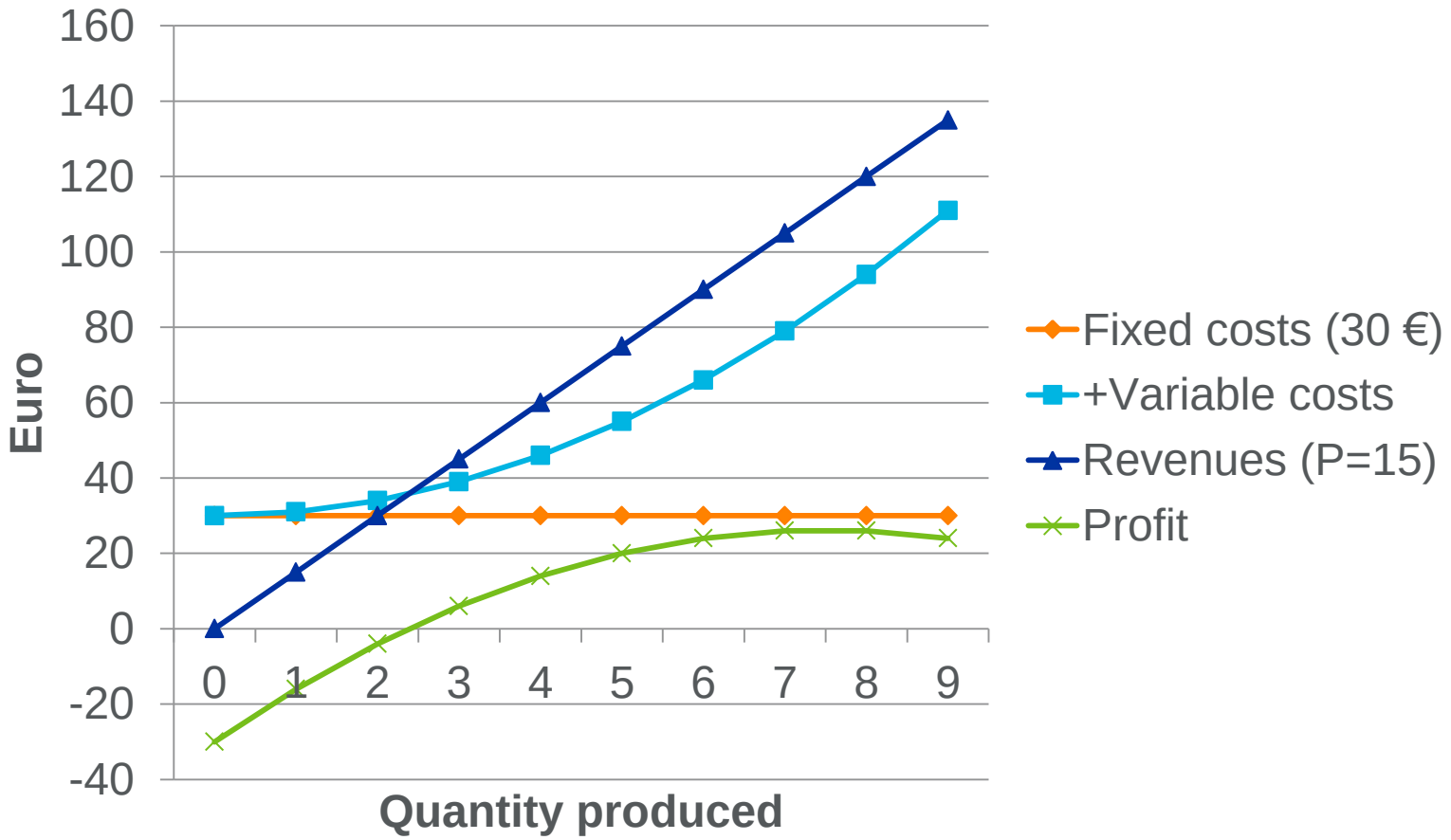
Hypothetical example with prices

Assume that the graph represents prevention damaging behaviour
Reaching zero level can be very costly



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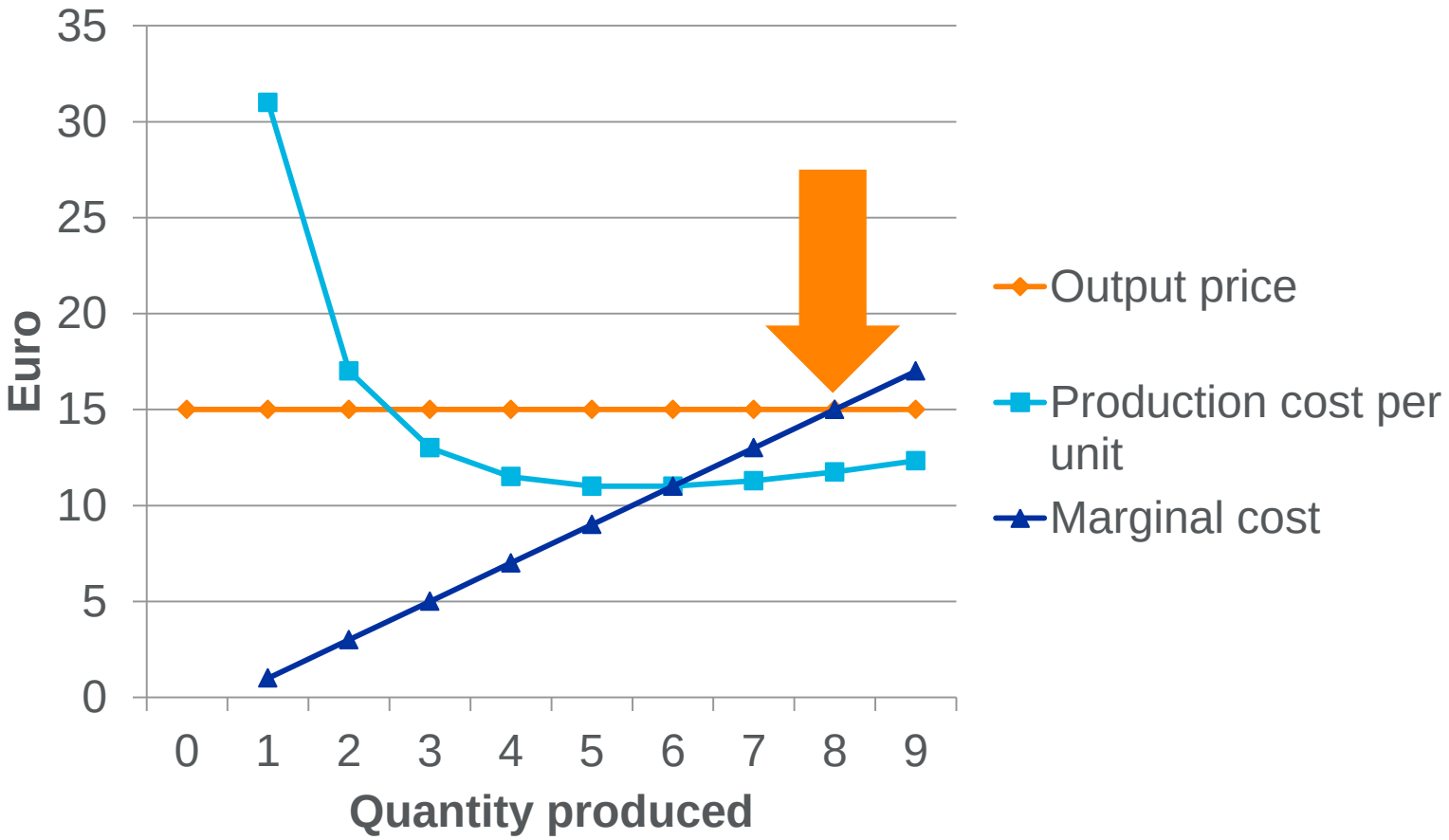
Hypothetical example with prices



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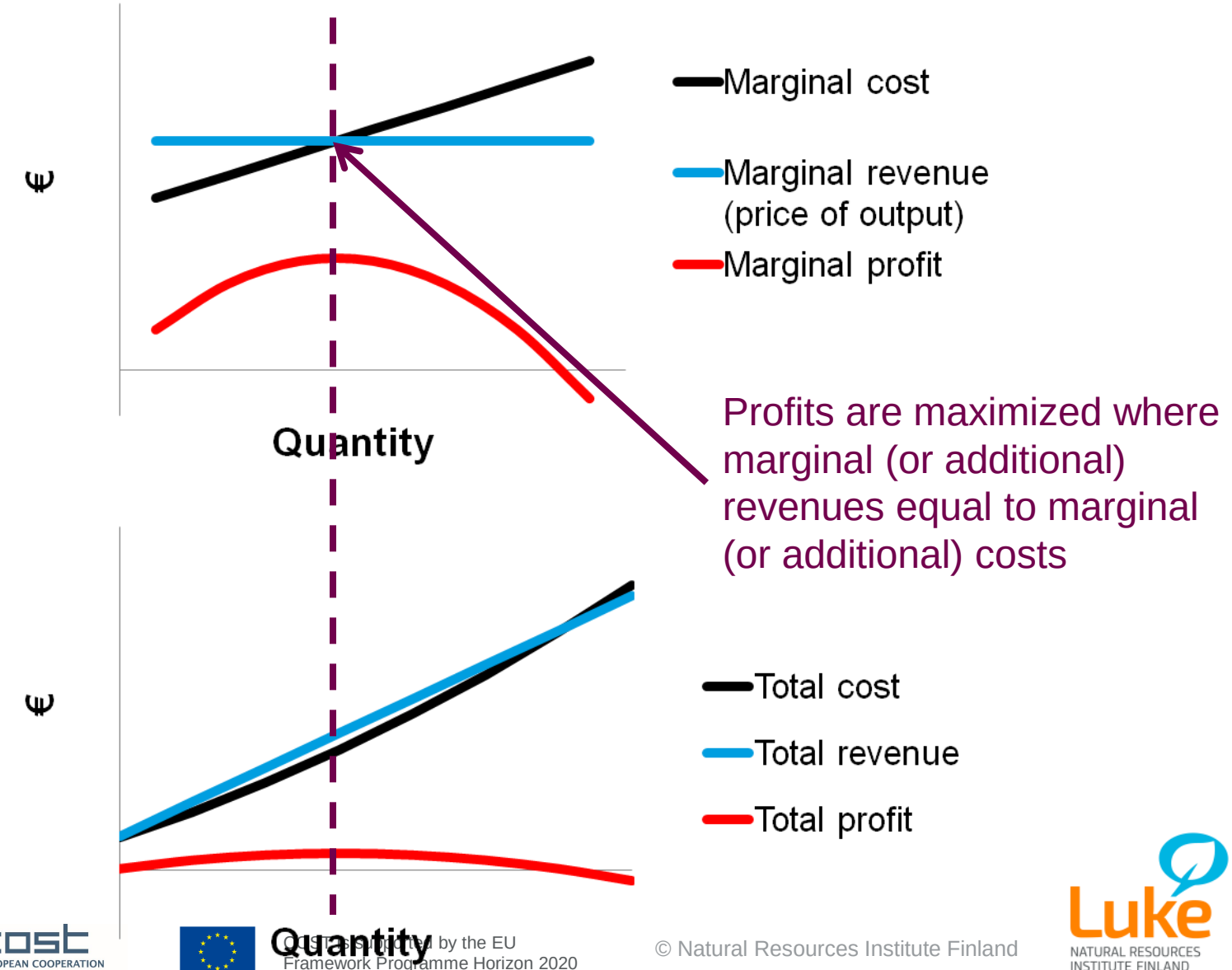
Profit maximisation – illustrative graph



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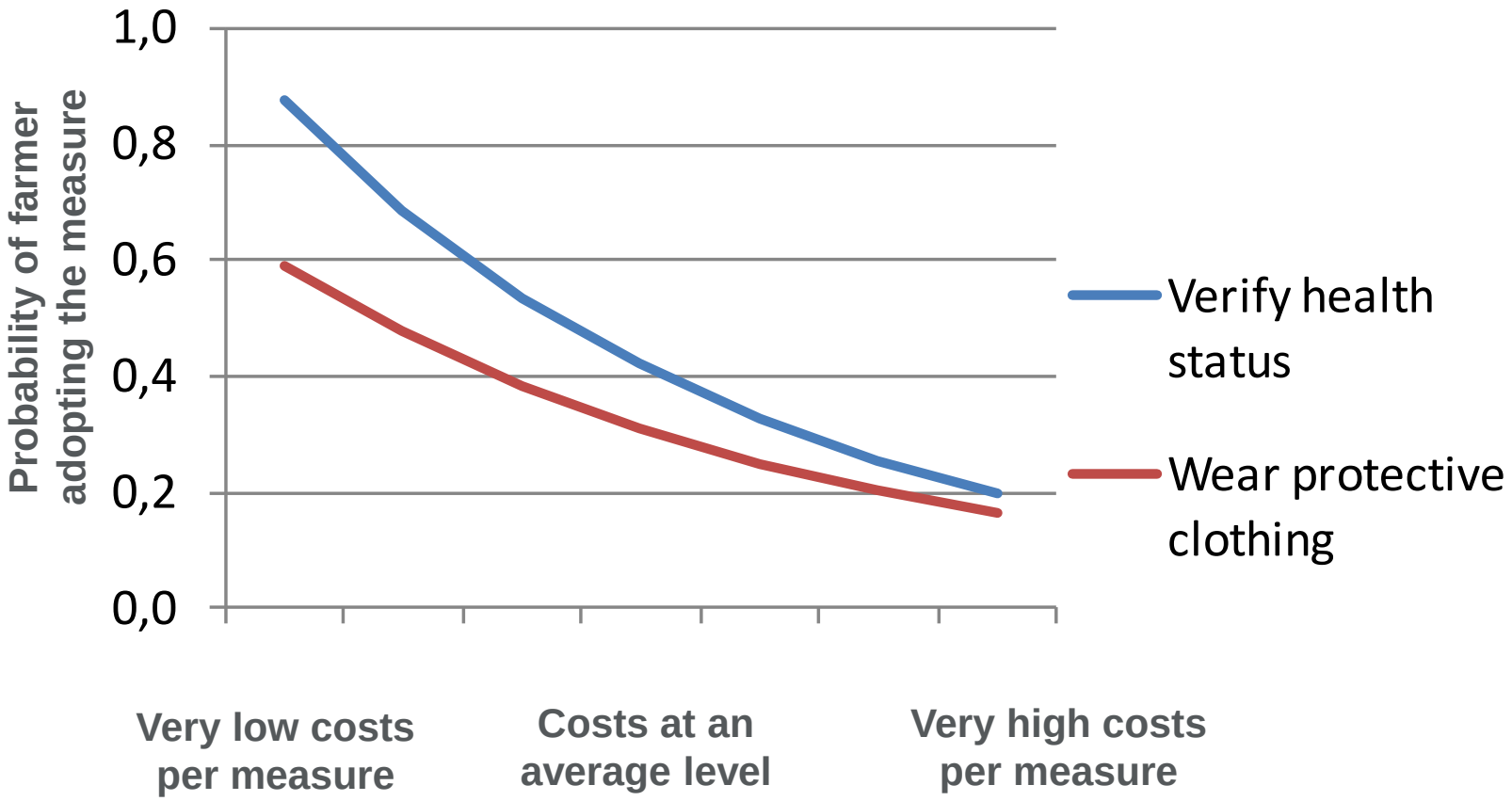
The optimal decision depends on prices

Adoption of two biosecurity measures as example



Based on Niemi *et al*. (2016)

Niemi et al. 2015

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Some steps in intervention analysis

- Determine what is your goal, i.e. which criteria will be used to make the decision regarding interventions
- Assess how interventions affect revenues
- Assess how interventions affect costs
- Assess whether there is risk or uncertainty related to costs, revenues and parameters used
- In the investment literature, Net Present Value it is considered as the best criteria to select between options
  - Budget cash flows for each time period
  - Discount cash flows from future periods to the reference period

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Additional things that may influence decision-making

- Risk and uncertainty: Most people are risk-averse (i.e. uncertainty about the outcome incurs a cost). Whenever there is decreasing marginal utility, there is also risk aversion
- Asymmetric information: Actors are not equally informed about the situation
- Strategic behavior
- Externalities: Individual vs. collective benefits and costs. What is best for you may not be the best for your neighbour.
- Market failures: Public goods, externalities
- Ways to overcome these issues include contracts, insurance, taxes, property rights, etc.

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Costs of tail biting

Data presented in different slides are not always comparable as they may represent different cases

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Costs of tail biting

- Reduced growth
- Increased feed consumption
- Increased mortality
- Extra labour needed
- Less efficiently used pen space
- Increased veterinary treatment costs
- Carcass condemnations
- Preventive measures

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Literature suggests the following

- Overall, the costs of tail biting appear to be about tail biting €2 per produced fattening pig
- Tail biting is a major economic and welfare problem in farmed pigs, estimated to cost only the UK industry £3.51 million in 1999 (Moinard et al., 2003)
- The next slide summarizes cost estimates or parameters used in some studies

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Costs of tail biting as derived from some studies

Study	Cost item	€	Animal type
Telkänranta et al. 2014	Tail biting	0.78	Piglet
Telkänranta et al. 2014	Tail biting	2.31	Pig
Moinard et al. 2003	Tail biting	0.51	Pig
Zonderland 2010	Tail biting	0.61	Piglet, pig
Niemi et al. 2011	Tail biting	3.3	Pig
Zonderland et al. 2010	Tail biting	2.59	Pig
Zonderland et al. 2010	Tail biting	2.32	Pig
D'Eath et al. 2015	Tail biting	0.56	Pig
Guy et al. 2011	Tail biting	52.60	ton pork (38 - 275)
Harley et al. 2012	Carcass condemnations	0.4	Pig
Harley et al. 2012	Entire condemnation	0.31	Pig
Harley et al. 2012	Partial condemnation	0.09	Pig

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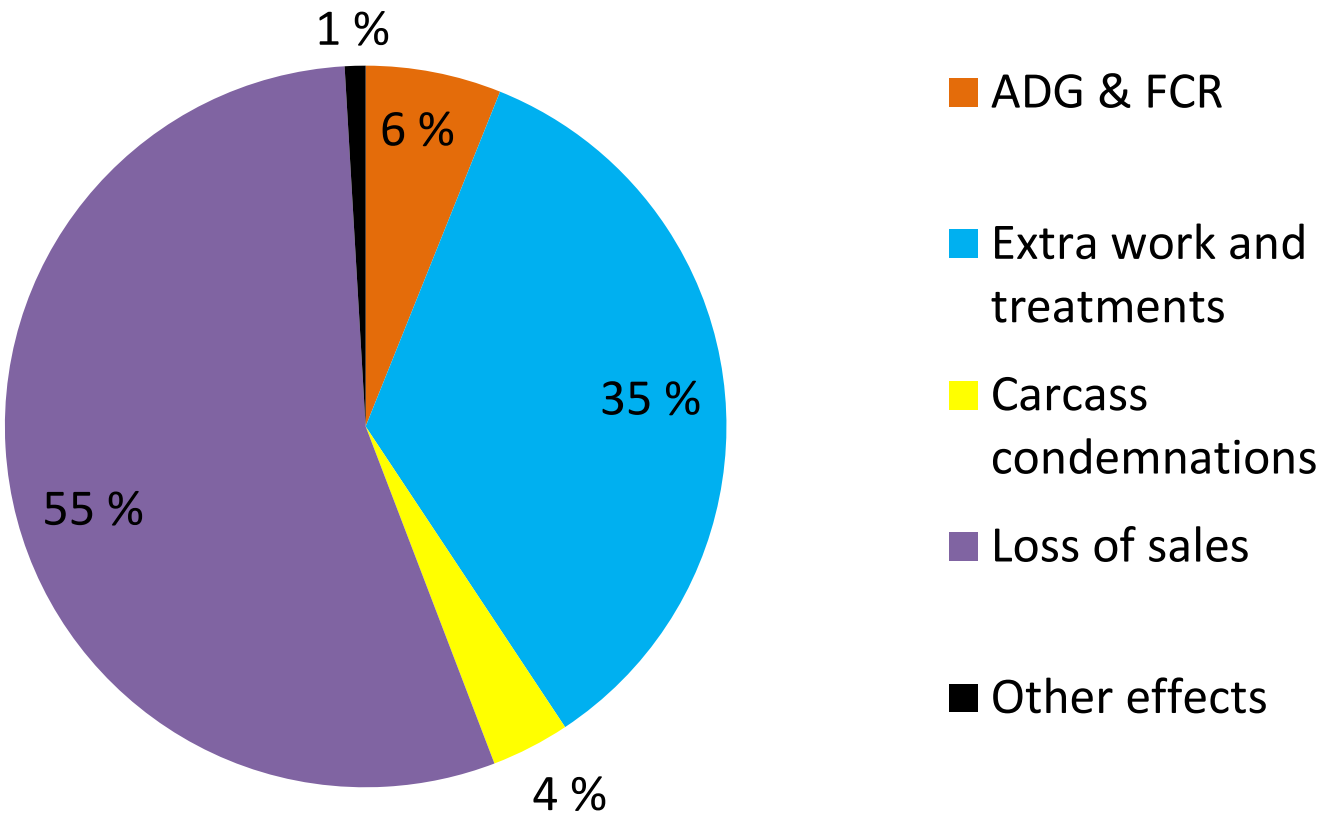
Reasons for economic losses in a Finnish study



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Costs of tail biting in piglets

Source: Zonderland et al. (2011, Table 3)

Weaned piglets	Cost per damaged pig	Cost per 1000 pigs
Reduced growth	0.10	2.12
Material cost per minor damage	3.15	12.60
Enrichments +move of biters, severe cases	6.24	21.90
Regroup animals+group therapy and enrichments, severe cases	4.96	5.71
Loss of sales	17.32	106.35
Loss of sales	20.09	12.92
Total loss per weaned piglet with tail damage		**7.63**
Total loss per 1000 delivered piglets		**162.00**

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Costs of tail biting in fattening pigs

Source: Zonderland et al. (2011, Table 3)

Fattening pigs	Cost per damaged pig	Cost per 1000 pigs
Reduced growth	0.21	4.49
Provision of enrichment materials, minor damage	3.15	12.60
Enrichments +move of biters, severe cases	17.50	60.38
Regroup animals+group therapy and enrichments, severe cases	16.48	18.95
Loss of sales	72.62	33.40
Loss of sales, euthanized pigs	121.03	61.58
Loss of sales, via slaughterhouse	0.14	1.41
Total loss per fattening pig with tail damage		**9.09**
Total loss per 1000 delivered pig		**193.00**
Losses at slaughterhouse		
Total loss per pig with tail damage at **slaughterhouse**		**0.21**
Total loss per 1000 pigs **at slaughterhouse**		**2.19**

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The following estimates are mainly from the Nordic study ”Tail biting and tail docking: Biology, welfare, economics”, where a model was developed to assess the costs of tail biting.

The numbers mainly represent cases studied in Finland.

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Illustration of underlying models

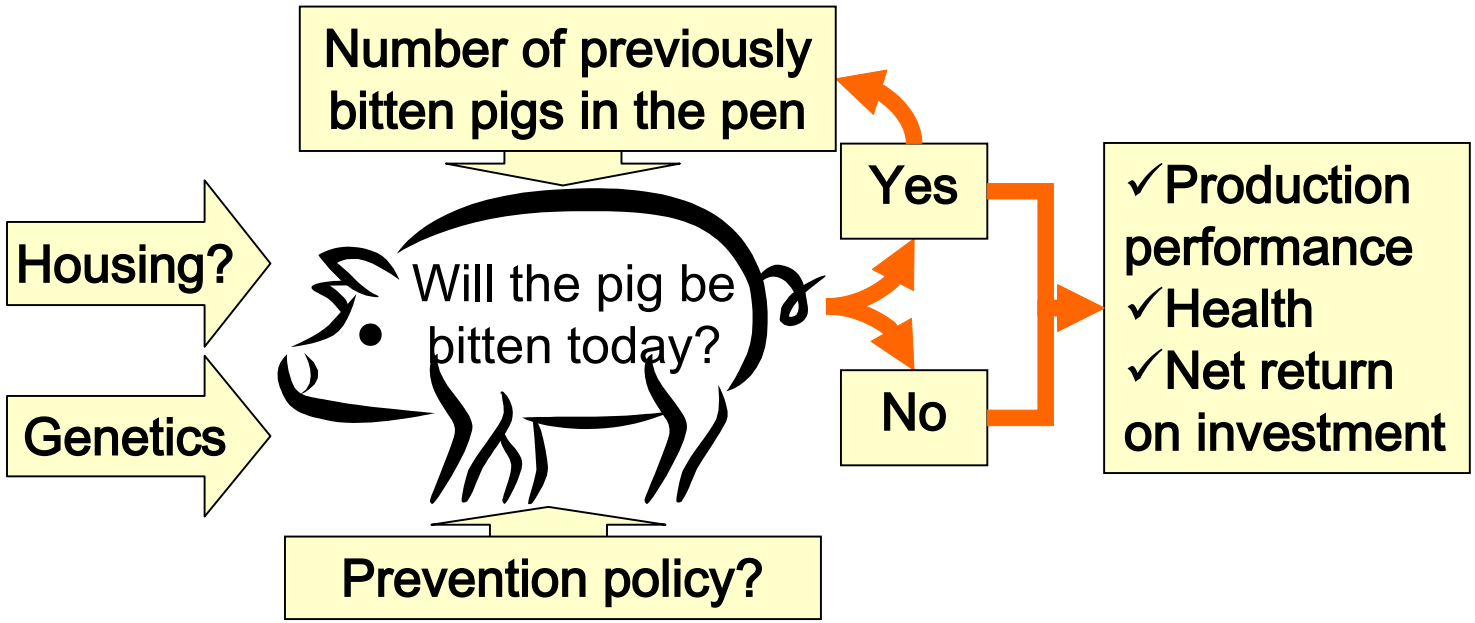

Figure 1. Overview of simulated aspects of risk.

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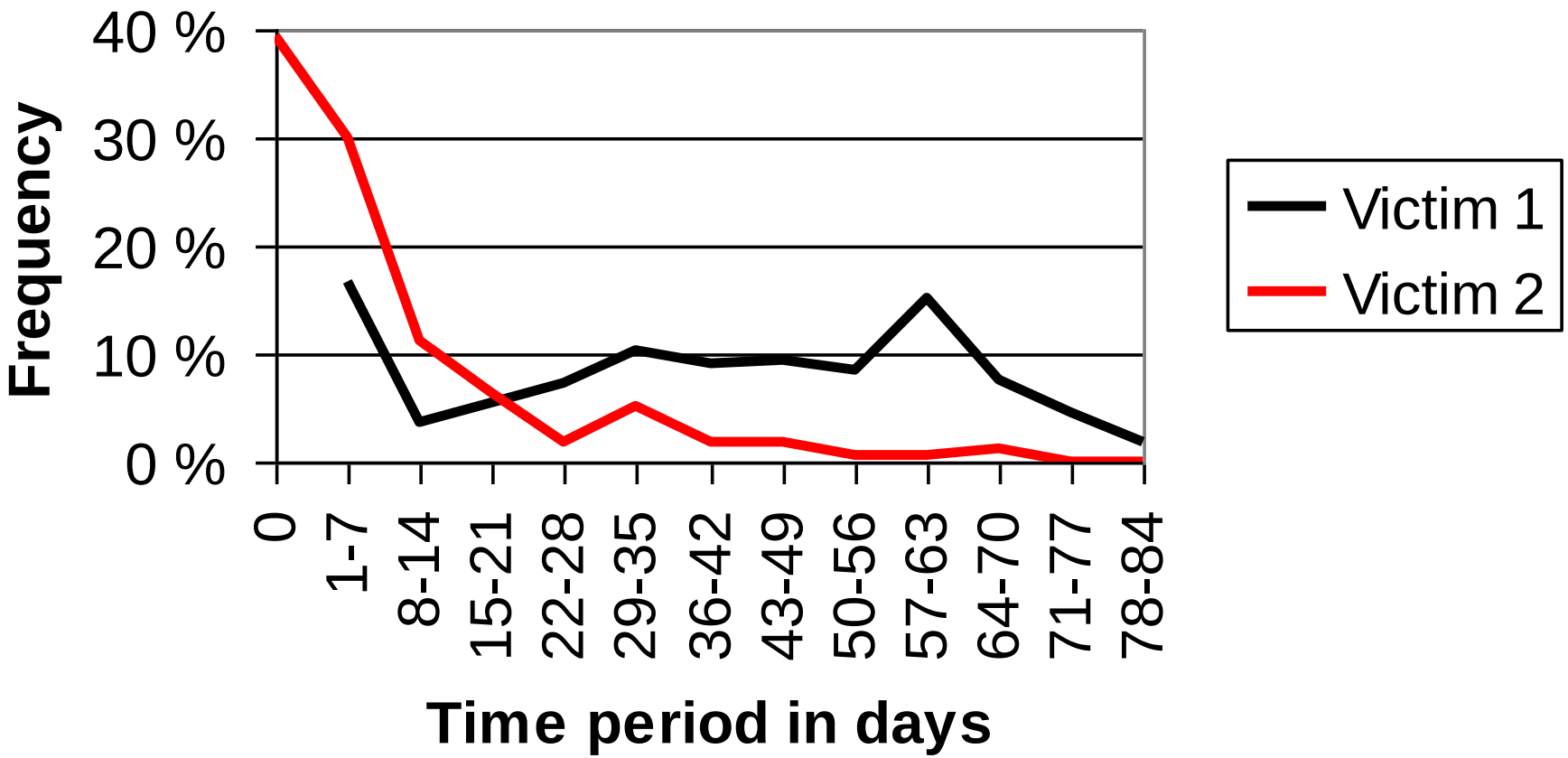
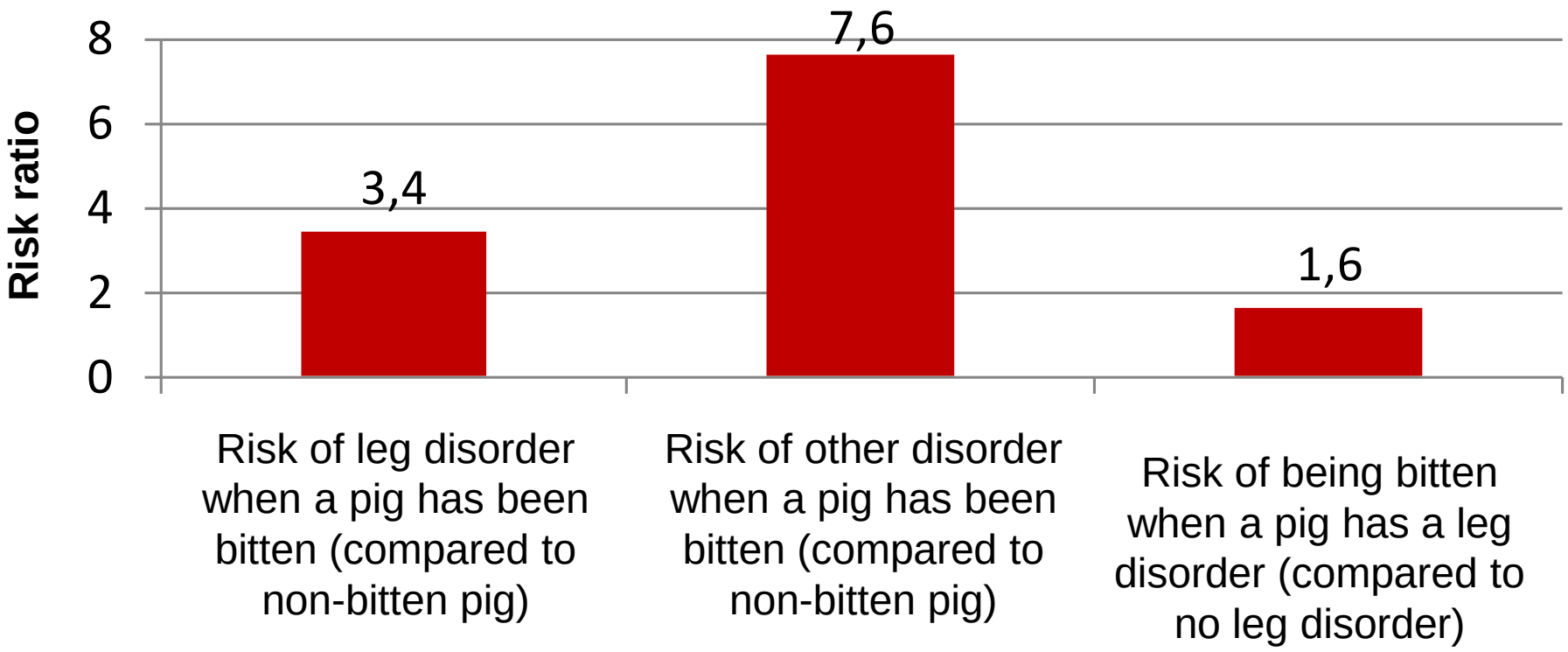
Tail biting can occur like an epidemic

Based on a Nordic study ”Tail biting and tail docking: Biology, welfare, economics”.



(Days after arriving at the farm or days after the first case)

Besides TB, bitten pigs have more other disorders



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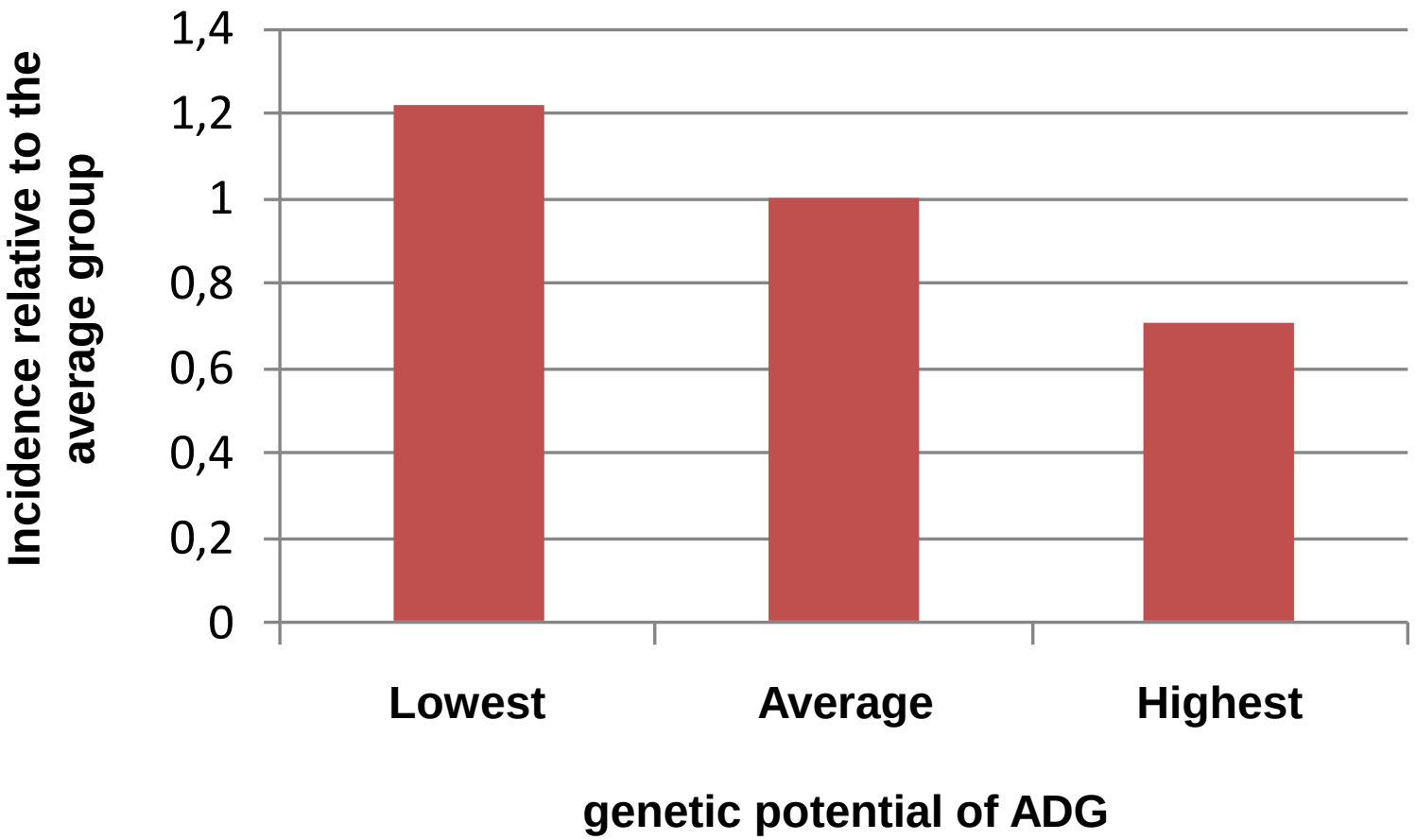
Pigs having poor genetic potential are bitten more frequently



Each group covers about 1/3 of pigs

N=1236-1281 pigs per group

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Impact of TB on average daily gain (g/d)

- Castrated pigs have the largest difference in median ADG between victims and non-victims

Sex	Phenotypic difference[1]	Genetic difference[1]
Boars	11.0 n.s.	9.8 *
Female pigs	38.0 ***	15.0 ***
Castrated pigs	63.5 ***	19.4 ***
All	29.5 ***	13.8 ***

[1] Significance levels (Mann-Whitney U-test), *=P<0.05; ***=P<0.001; n.s.=not significant. Measurements excluding pigs eliminated from the experiment.

Source: Sinisalo et al. 2012

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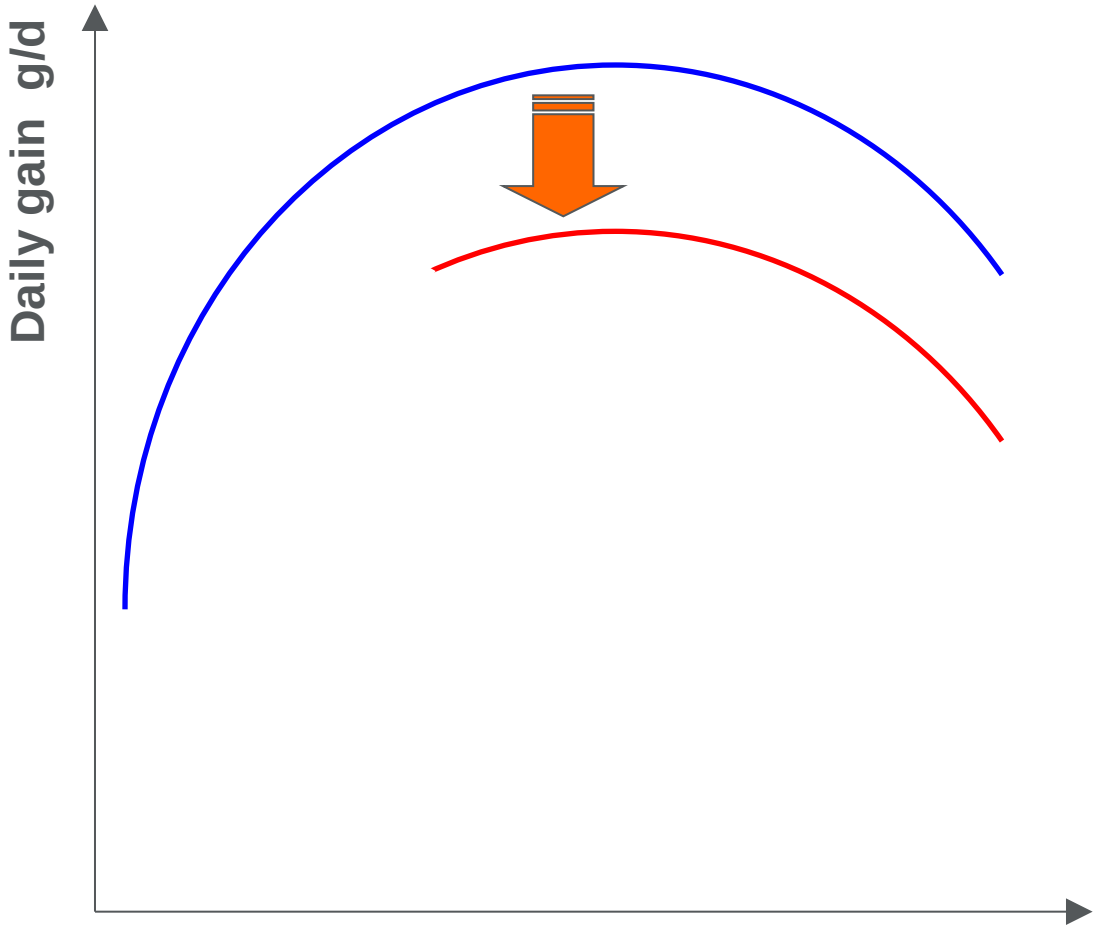
Impact of TB on growth



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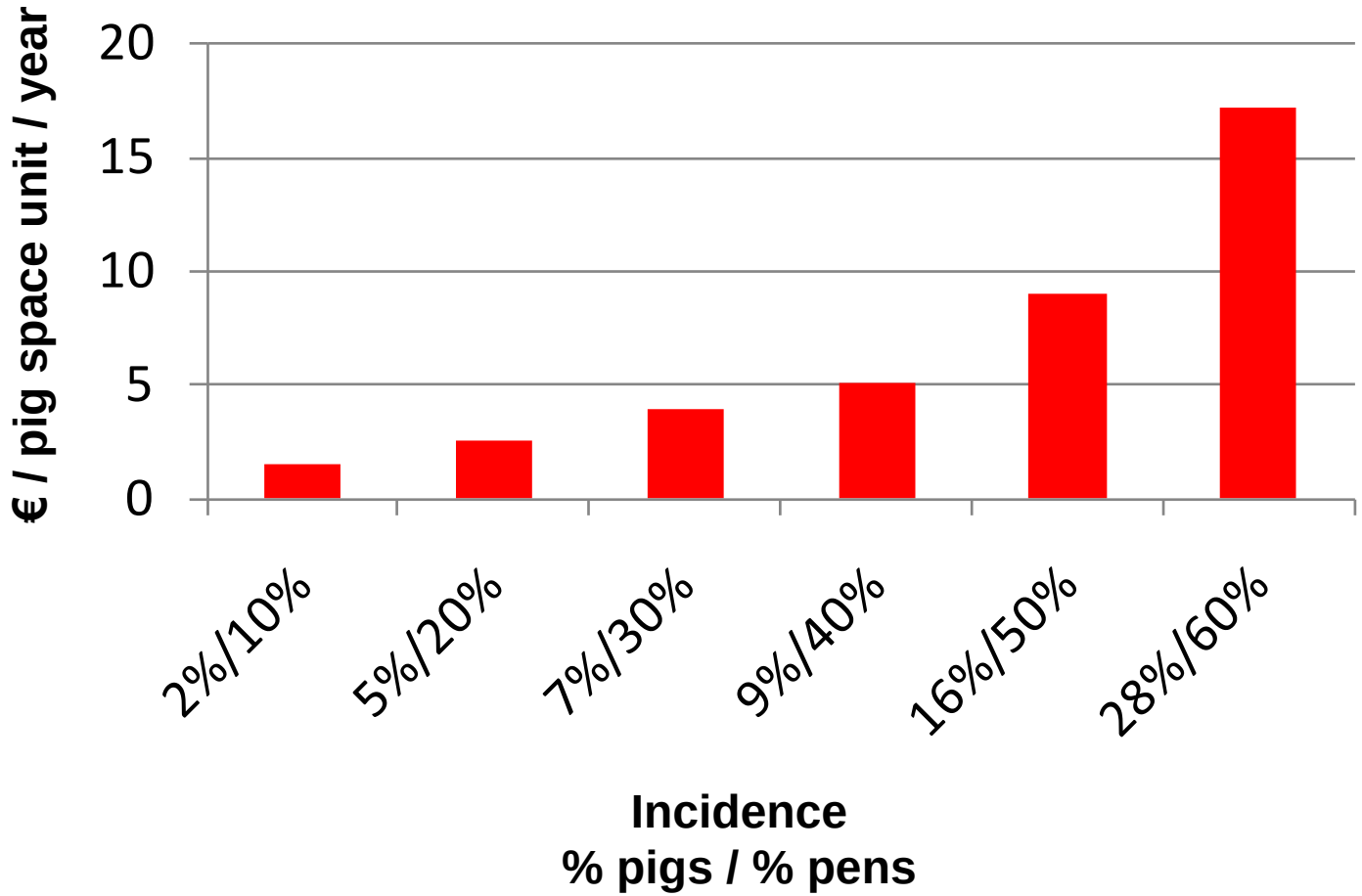
The cost of tail biting by incidence



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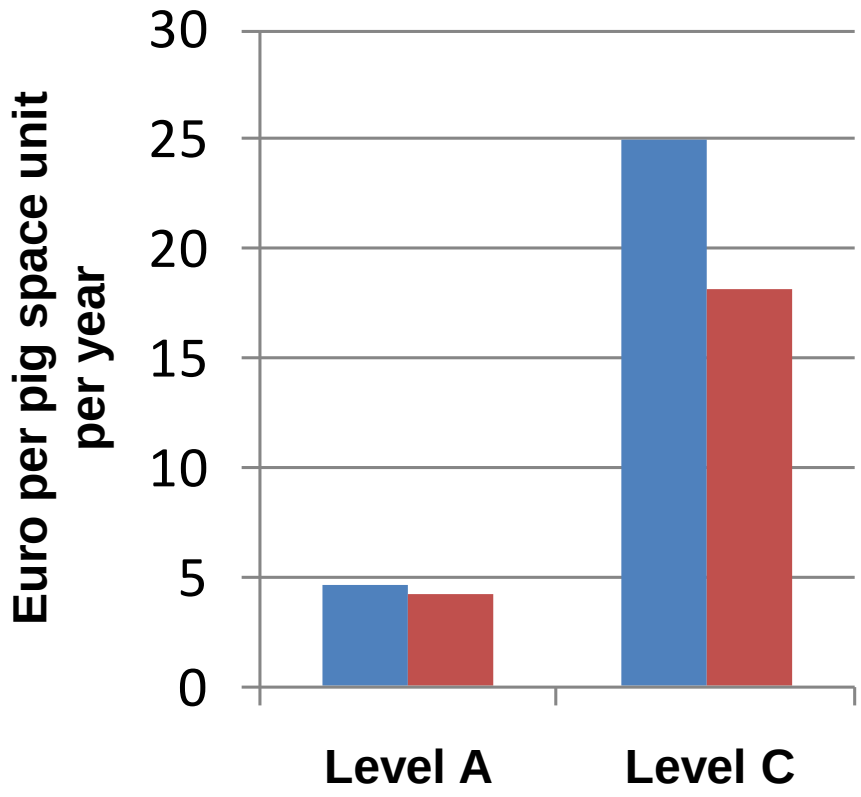
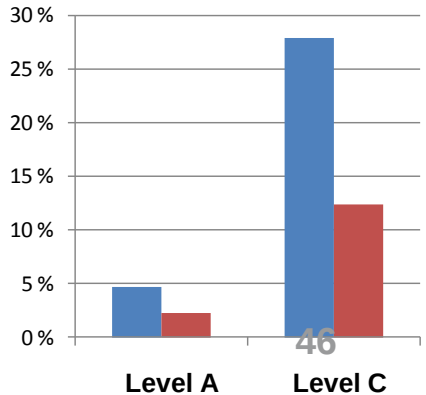
Estimated effect of removing the biter



Cost of TB risk if biter is not removed from the pen

Cost of TB risk in the biter is removed from the pen



Costs of tail biting

- Economic loss due to tail biting are likely to range from €10 to €40 per bitten pig
  - These costs are mainly due to extra work, materials and medication and carcass price discounts
  - Reduced ADG and FCR and the value of condemned meat may present just 10-15% of losses
- For instance in a finishing farm having 1000 fattening pigs the costs can be several thousands of euros per year
- Extra work is need to control for the problem. This may reduce probitability but simultaneously it can increase entrepreneur's income

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Medication costs per bitten pig

- The costs of medicine and vet depend on how the farm and the veterinarian are operating
- Extra work due to medications
- Labour and other costs are incurred if bitten pigs and biters are moved to a hospital pen
- Estimated cost of taking care of the victim was 10.4 €/bitten pig

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Carcass condemnations

- Pigs having a tail damage tend to have more carcass condemnation than non-bitten pigs
  - The effect can vary from zero up to several percents
- In a median case partial carcass condemnations were 3,8 kg/carcass, part of which was likely due to tail biting (Valros et al. 2004)
- Some slaughterhouses apply price discount for a carcass which has been bitten.
  - Although the amount of condemned meat itself can be of minor importance, the loss due to price discount can be substantial!

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Some information on the costs enrichments

- **Finishing pigs:** The cost of using enrichment objects made of fresh wood, which were found to be the best functioning objects in this project, was **1.80 Euros per slaughtered pig.** This includes both material and labour costs.

- **Suckling piglets:** The cost of using sisal ropes, in the way they were tested in this project, was **0.50 Euros per piglet.** This includes both material and labour costs.

- For details and original data, please visit: http://telkanranta.com/economic_profitability.html

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Some information on the costs enrichments

(Telkänranta et al. 2014)

- Rope and newspapers: material and labour costs were €133 (217 pigs)
  - It helped to “save” 49 victims, increased productivity by €119

  → Net cost 11 cents per pig (29 cents per saved tail)

- Fresh wood: material and labour costs were €270 € (152 pigs)
  - It helped to save 36 victims, increased productivity by €230

  → Net cost 26 cents per pig (€1.11 per saved tail)

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The type of housing and space allowance affects housing costs

- Mäki-Mattila (1998):
  - Production costs per kg pigmeat were 3 to 5% higher in a deep-bedding (no slatted floor, wood-based material as bedding) system than in a liquid manure/partly slatted flooring system
  - Production costs per kg pigmeat were 7 to 8% higher in a dry manure than in a liquid manure system
  - The difference was mainly due to labour and fixed costs

- In general, our studies show
  - The use of small amount of straw, if effective, is also cost effective.
  - Daily use of a measure can be profitable only if it is effective enough in reducing TB and the cost of measure per day are minimal

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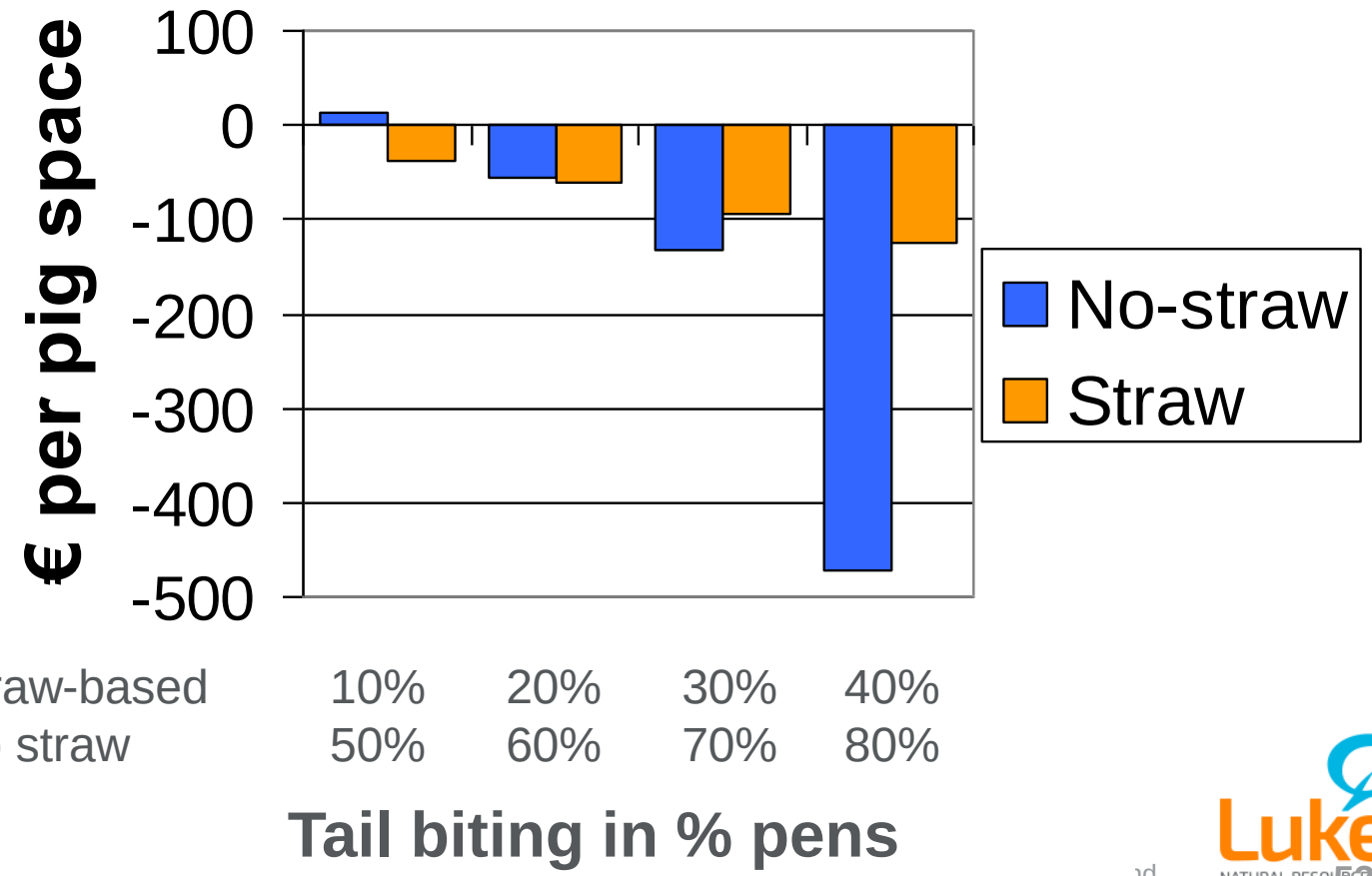
Housing

Return per pig space unit at different levels of tail biting risk (% pens suffering from TB) with straw-based and non-straw (or minimal straw) housing when compared to straw-based pen with no tail biting



Some hypothetical housing scenarios which may reduce tail biting

Option	Description	High	Low
Basic	Production facility with partly slatted flooring and using a minimal amount of straw as enrichment and 0.9 m^2 pen space per pig	0.45 α_1	0.30 α_1
Enriched	As basic but assumed to use of straw as enrichment	0.10	0.07
Solid floor	Straw-based bedding with solid flooring and plenty of straw and 0.9 m^2/pig	0.05	0.03
Extra space	As basic, but assumes the pig has 35% more pen space allowance	0.40	0.27
No mitigation	Optionally can reduce the effort to mitigate tail biting after observing the first biting in the pen (this option can be used in combination with three others)	0.76	0.56

$$\Pr(n_{t,TB}) = \begin{cases} \alpha_1 & \text{if } n_{t,TB} \equiv 0 \\ \alpha_2 + \alpha_3 \ln(n_{t,TB} + 1) & \text{if } n_{t,TB} \geq 1 \end{cases}$$

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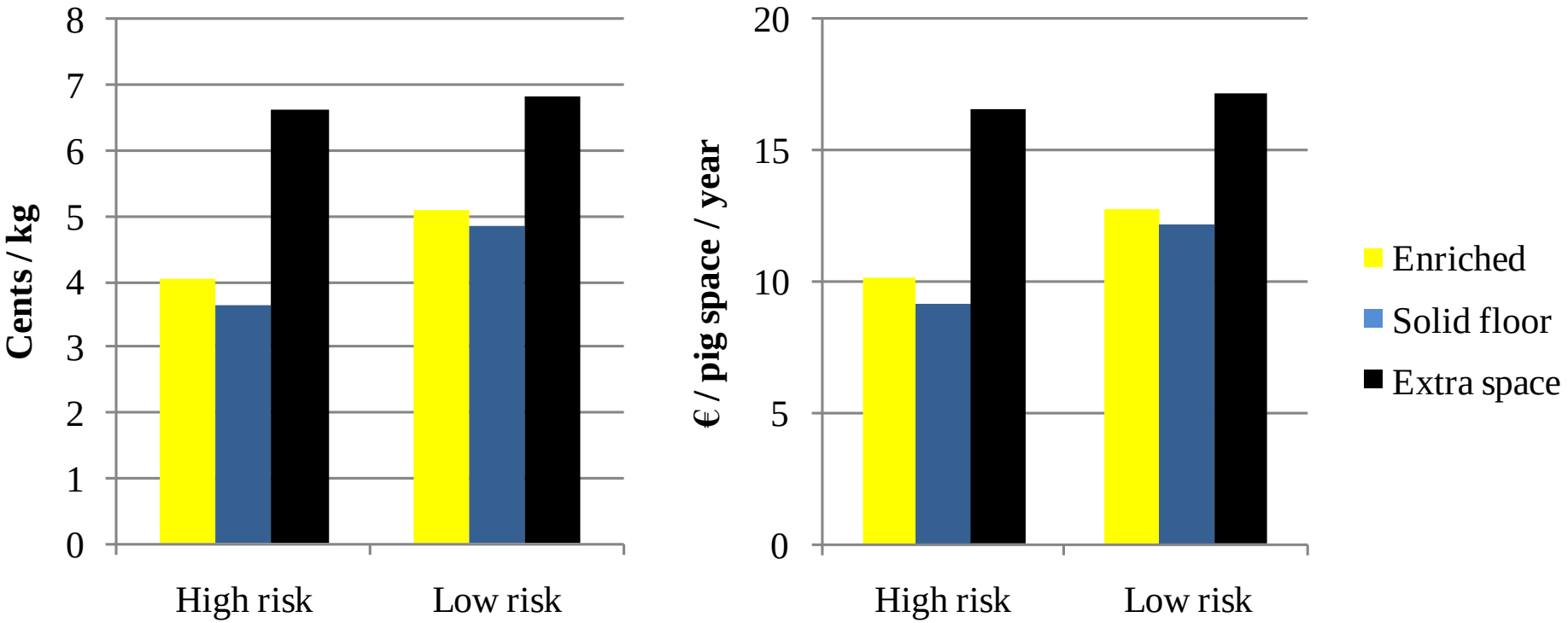
Estimated additional revenue (cents/kg, left; €/pig space/year, right) needed for animal welfare improvements to become profitable the producer



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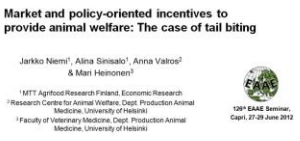
Market and policy-oriented incentives to provide animal welfare: The case of tail biting

Jarkko Niemi[1], Alina Sinisalo[1], Anna Valros[2] & Mari Heinonen[3]

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126th EAAE Seminar, Capri, 27-29 June 2012

Cost scenarios regaring the prevention of tail biting (Niemi et al., 2014)

- 3.5-4 cents price premium per kg pigmeat would be required for a farmer to invest in solig-froom-based housing or to increase the use of enrichments substantiallu
- 6-7 cents price premium would be required for a farmer to increase the pen size by 35%

Tail docking

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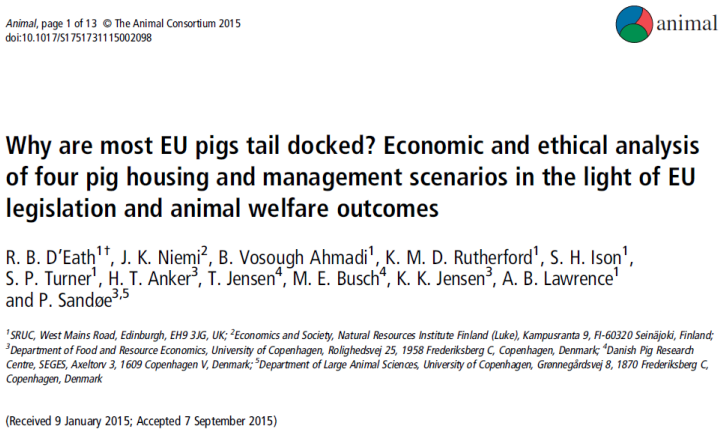
About the study

- The following slides are based on D'Eath et al. (2015).
- The results are applicable to specific condition only due to the assumptions made in the model (e.g. slaughter weigth, TB prevalence, housing)



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animal

Why are most EU pigs tail docked? Economic and ethical analysis of four pig housing and management scenarios in the light of EU legislation and animal welfare outcomes

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The study compared housing and tail docking scenarios

- Tail docking vs. non-docking
- Simulations based on information retrieved from Danish pig production
- Prevalence of TB was based on scenarios

Table 1 *Comparison of cost items of the modelled scenarios in relation to tail biting management practices*

	Standard Docked	Standard Undocked	Enhanced Undocked	Efficient Undocked
	Standard housing with tail docking	Standard housing with no tail docking	Enhanced housing with extra space and straw, no tail docking	More space and straw than Standard, less than Enhanced, no tail docking
Labour cost of tail docking	Yes	No	No	No
Losses due to victims of tail biting outbreaks	Small	Large	Intermediate	Intermediate
Extra variable and fixed costs of reducing tail biting (straw, space)	No	No	Yes	Yes, between standard and enhanced

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Summary of costs and revenues when the costs of tail biting were **not** included in the estimates

Table 2 *Summary of costs and revenues (€/pig produced) for the four finishing pig production scenarios in 2012 used in the model when not taking into account potential differences in tail biting and not taking into account potential costs associated with tail biting*

Monetary values	Standard Docked (€/pig)	Standard Undocked (€/pig)	Enhanced Undocked (€/pig)	Efficient Undocked (€/pig)
Total revenue	123.93	123.93	123.93	123.93
Total variable costs[1],[3]	124.86	124.86	128.87	126.36
Total fixed costs[2],[3]	12.71	12.57	14.46	13.39
Gross margin	− 0.93	− 0.93	− 4.94	− 2.43
Net margin	− 13.64	− 13.50	− 19.40	− 15.82

[1]Variable cost include: weaner cost, feed, vet and medicine, transport and marketing, straw and enrichment materials, water and electricity, carcass condemnation, interest on capital in animals and interest on capital in variable inputs.
[2]Fixed cost include: interest and depreciation of fixed capital, insurance and maintenance and labour (including tail docking labour).
[3]Detailed figures of variable and fixed costs are presented in Table 3.

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Simulation results when the risk and uncertainty associated with TB outbreak was taken into account

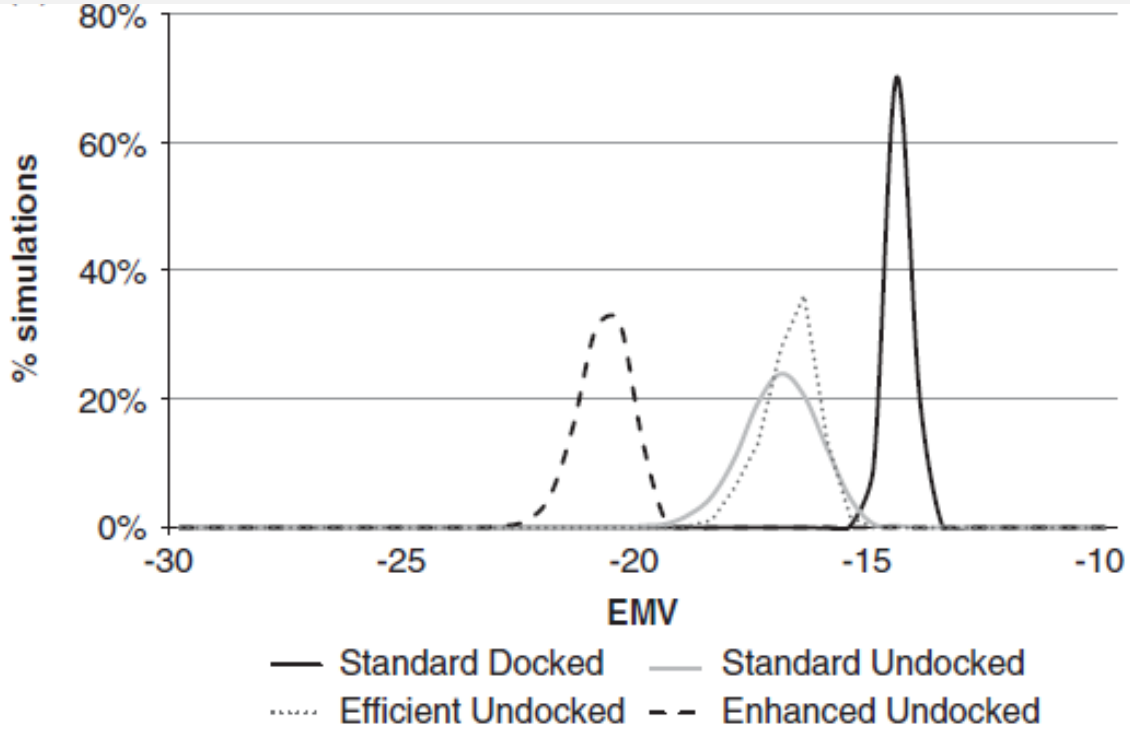
Mean, standard deviation for TB outbreak to occur in a pen as per scenario

Standard Docked (0.846, 0.05) ➔EMV mean -€14.2/pig

Standard Undocked (0.43, 0.1) ➔EMV mean -€16.8/pig

Enhanced Undocked (0.73, 0.1) ➔EMV mean -€20.6/pig

Efficient Undocked (0.73, 0.1) ➔EMV mean -€15.8/pig



and

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Injurious pecking

Costs associated with feather pecking

- Although impacts of injurious pecking on production parameters are known, economic impacts are poorly studied
- Feather pecking can occur in various degrees of severity
- Feather damage is painful and can lead to cannibalism and the bird's death
- Victims have an elevated mortality losses, rendering costs and less revenue from spent hens

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Costs associated with feather pecking II

- Poorer thermal insulation increases heat losses and feed consumption (e.g. about +25% in Glatz, 1998)
- Injured birds may produce less eggs (about 8% in Glatz, 1998)
- The birds are also more susceptible to infections and diseases
- Taking care of birds can require more labor
- Housing can be more costly - improvements in housing can be a preventive measure, thus also prevention costs
- Other costs can increase, for instance medication and veterinary costs

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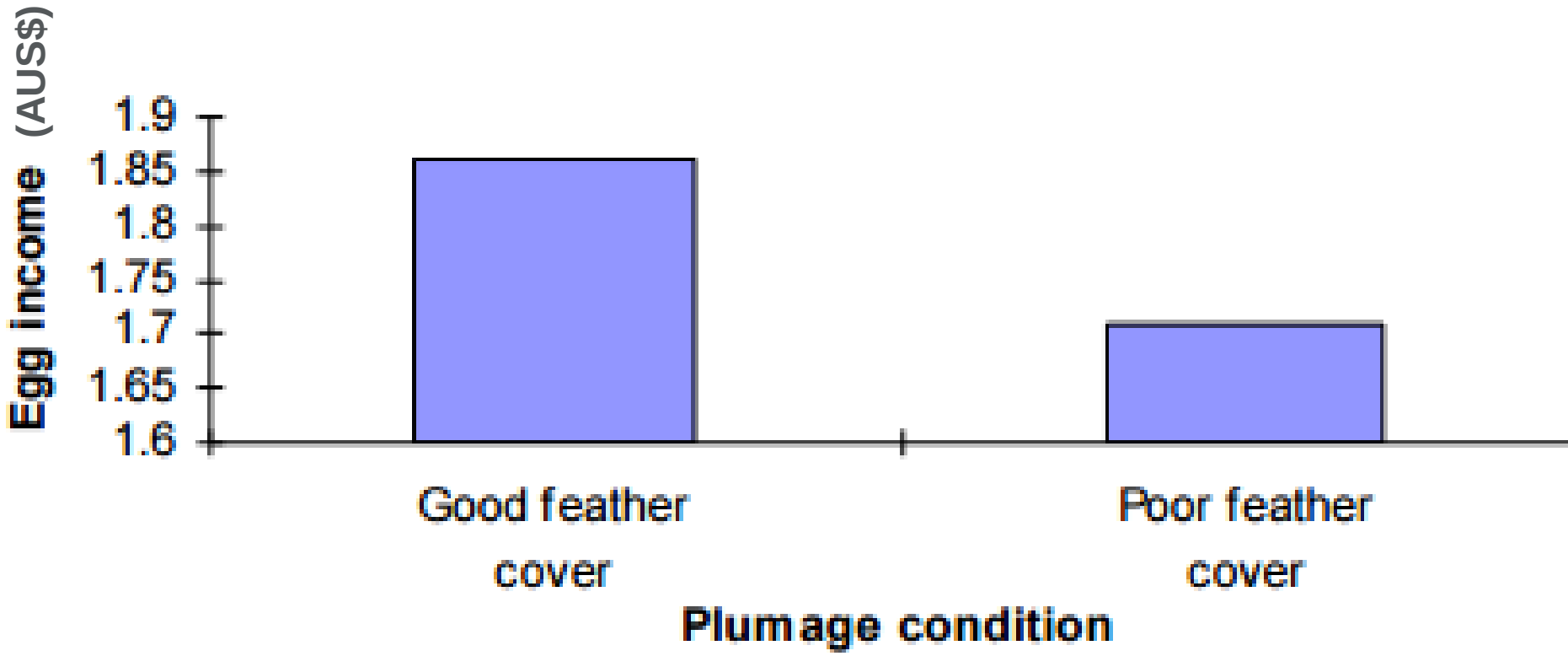
Economic impacts feather cover on egg income

Figure by Glatz (1998)



Source: Glatz (1998)

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Economic impacts according to Glaz (1998)

- If assuming that half of the Australian layer flock has poor feather cover and are subject to environmental temperatures below 20 C for 50% of the time they are housed, then increases in food costs amounts to $6.57m (about €4.6m) annually (+18g/bird/day)
- The loss in egg income is estimated to be 8% over the same period which amounts to $1.50/bird (ie. 8%, about one euro) or $7.5m annually (about €5.2m).
- Total losses to the egg industry in Australia because of poor feather cover could be in excess of $14m annually

➔ Total costs were close to €10 million or about 1.9 € per bird!

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Economic losses due to injurious pecking

- Farms suffering from production diseases can make substantially less profit than disease-free farms.
- However, these losses can often be reduced by a range of interventions.
- The economic benefit of interventions to control production diseases varies greatly according to disease and the particular intervention chosen.
- Severe feather pecking can result in losses within the magnitude of €4 to €7 per bird (Niemi et al. 2015)

Source: www.fp7-prohealth.eu, Niemi et al. (2015)

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The consumer

Utility maximisation

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Some consumers are willing to pay for improved animal welfare

- International meta-analysis suggests that the consumers are willing to pay (WTP) on average about 14% price premium for animal welfare, athough WTP varies by country, definition, product etc. (Lagerkvist & Hess 2010, Cicia & Colantuoni 2010).
  - Obtaining robust WTP requires the use of robust methods. This is also an active field for methodological development.

- Note that not all consumers/citizens are willing to pay the premium
  - For instance, in FInland, some 54% of respondents were willing to pay an extra price premium for increased welfare in pigs (Forsman-Hugg et al. 2009)

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Some key concepts

- **Utility** refers to how much happiness or satisfaction a person gets from consuming a set of goods

  It is an abstract concept: there are no ”utility meters”!

  Utility is a way of representing preferences and tradeoffs

  It allows us to combine the happiness obtained by consuming different goods such as apples and bananas

  To fulfill our needs, we make decisions on which needs are satisified and which are not ($\Rightarrow$ tradeoffs).

- **Opportunity cost** is the value of the second-best alternative that has to be given up to choose the first-best alternative

Preferences

- **Preferences** refer to the ordering of alternatives. For example:

  Do you like more apples than bananas?

  Do you like more red than green apples?

  Do you like more beef than pork?

  Do you like more high-quality pork at €8 per kg than standard pork at €2 per kg?

- Preferences are based on the amount of happiness that a person can get from consuming a good. An example of someone's preferences

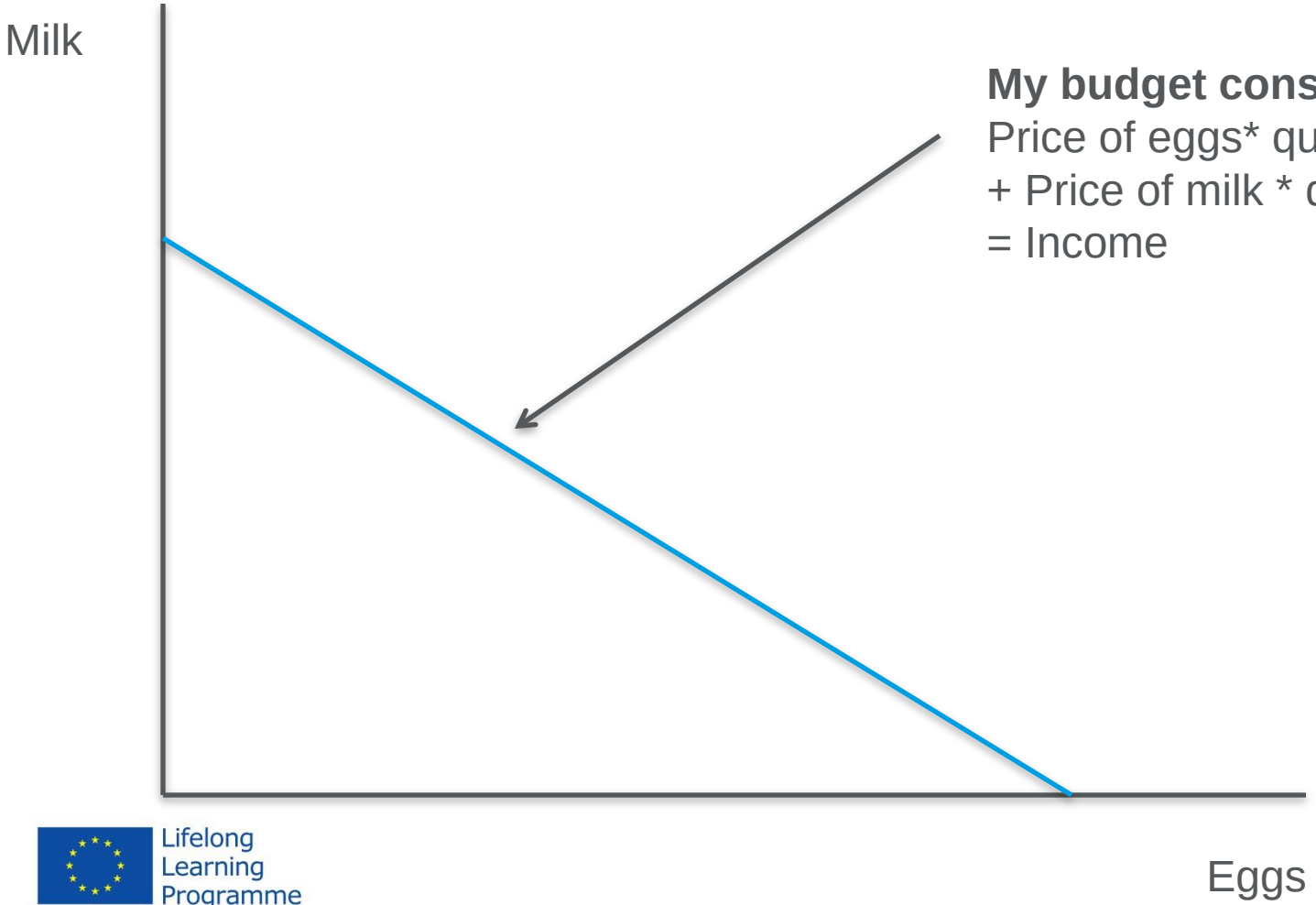
Less happiness **More happiness**

Factors affecting preferences

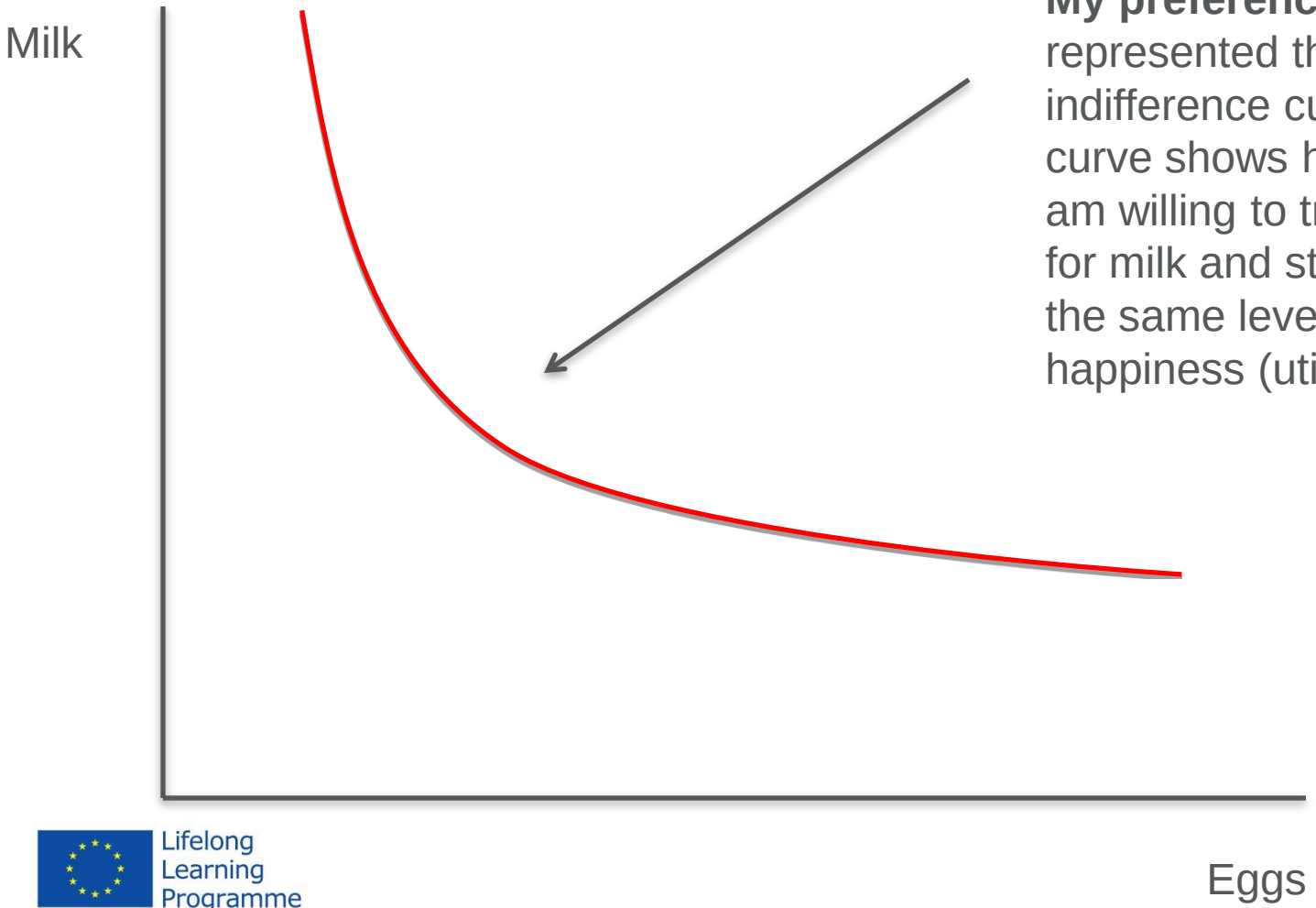
- Tastes
- Cultural factors, religion, norms, habits (e.g. seasonal demand for certain goods)
- Biological factors: e.g. age, gender, physical characteristics
- Social factors: e.g. education, occupation, marital status (e.g. singles and married persons have different needs)
- Other factors

Consumer's perspective

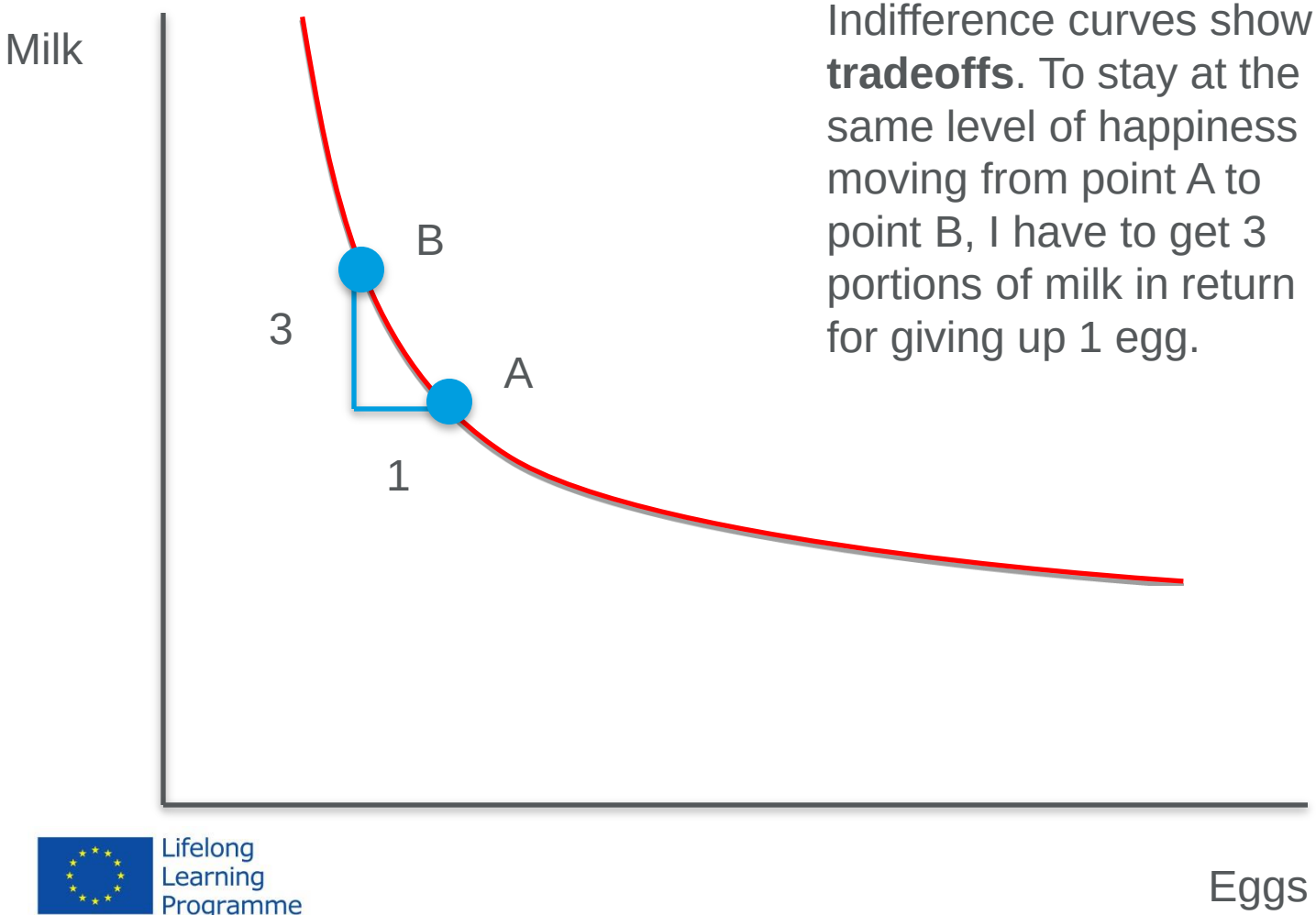
- Consumers consume to get more utility
- Consumption decisions are constrained by the scarcity of resources (e.g. income $\Rightarrow$ the budget constraint)
- Consumption should be increased until the marginal benefit is smaller than the marginal cost
- Diminishing marginal utility means that the extra utility from consuming something falls after a certain point
- Consider an example where you spend all you income on two goods: milk and eggs (the two good could be also products having different attributes, such as food produced by using animal-friendly vs. conventional production practices)



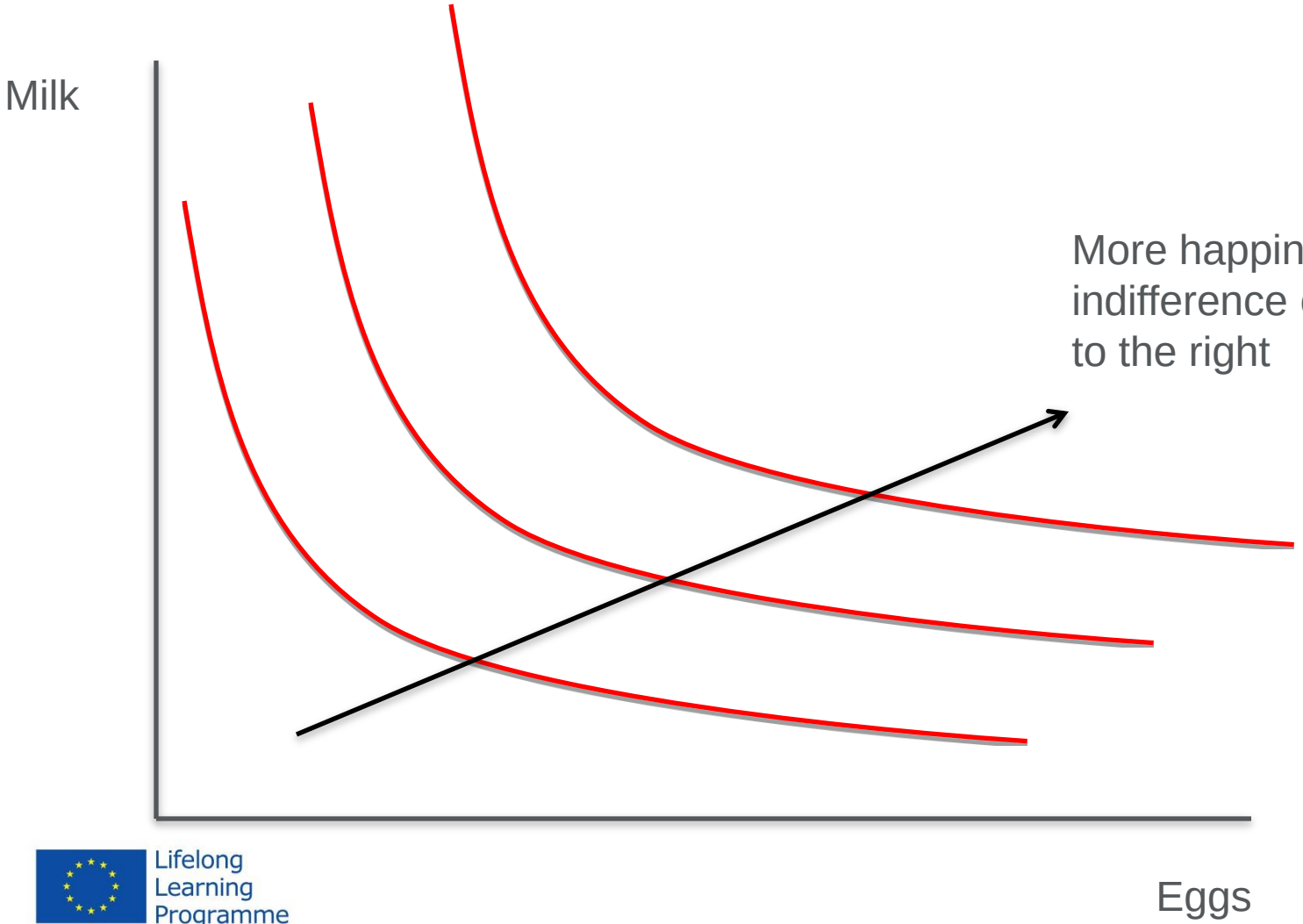
My budget constraint:
Price of eggs* quantity of eggs
+ Price of milk * quantity of milk
= Income

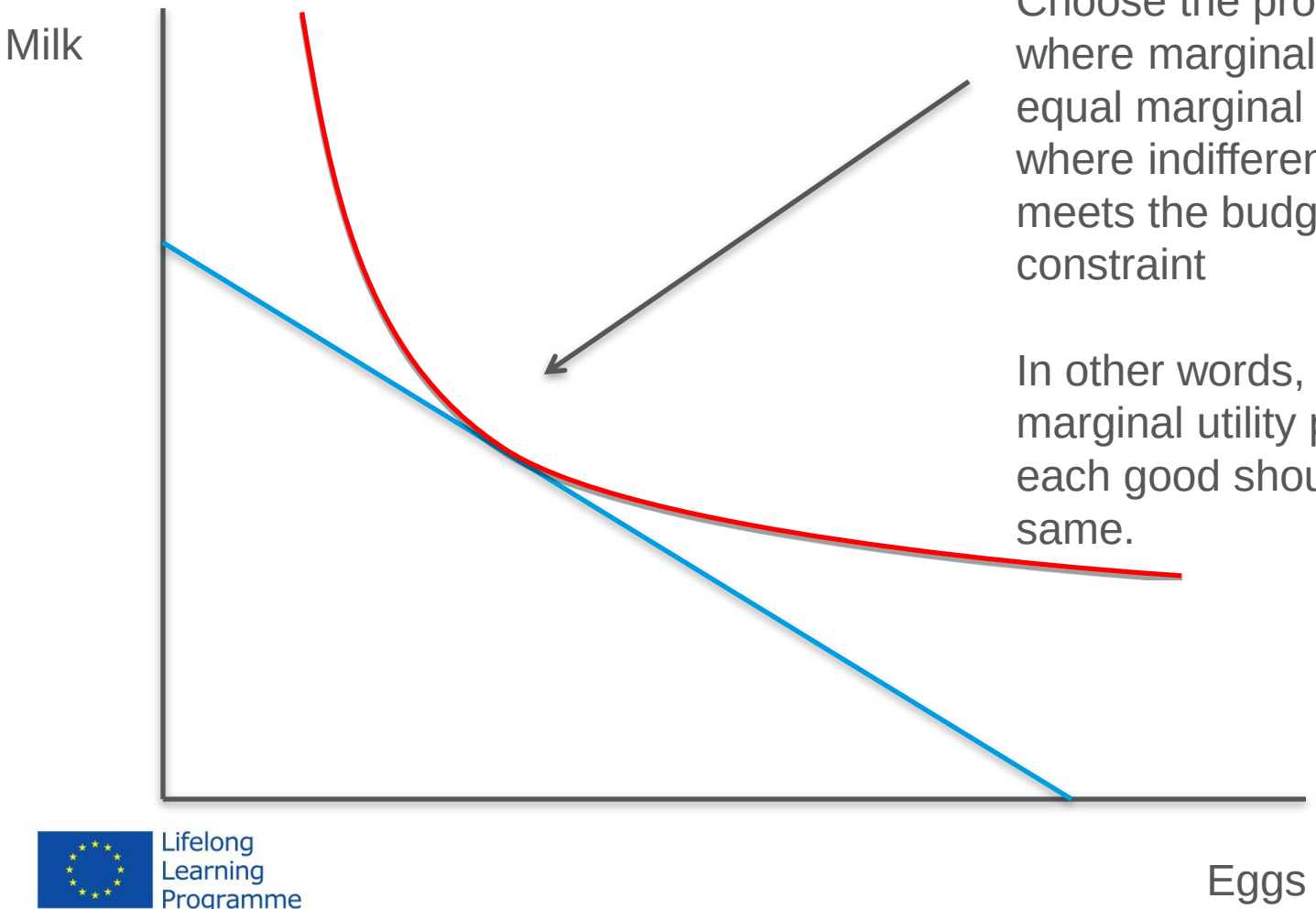


My preferences represented through indifference curves. The curve shows how much I am willing to trade eggs for milk and still remain at the same level of happiness (utility)



Indifference curves show **tradeoffs**. To stay at the same level of happiness moving from point A to point B, I have to get 3 portions of milk in return for giving up 1 egg.


Milk
More happiness (utility) as indifference curves move to the right
Eggs



Choose the product mix where marginal benefits equal marginal cost or where indifference curve meets the budget constraint

In other words, the marginal utility per euro of each good should be the same.

Market-level issues:
Analyzing impacts for a group of stakeholders

Markets can play an important role in some cases

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Does the intervention affect supply, demand, prices?

- If we take all producers and consumers in the economy together, we get supply and demand curves.
- Supply curves show the opportunity cost of supplying to the market

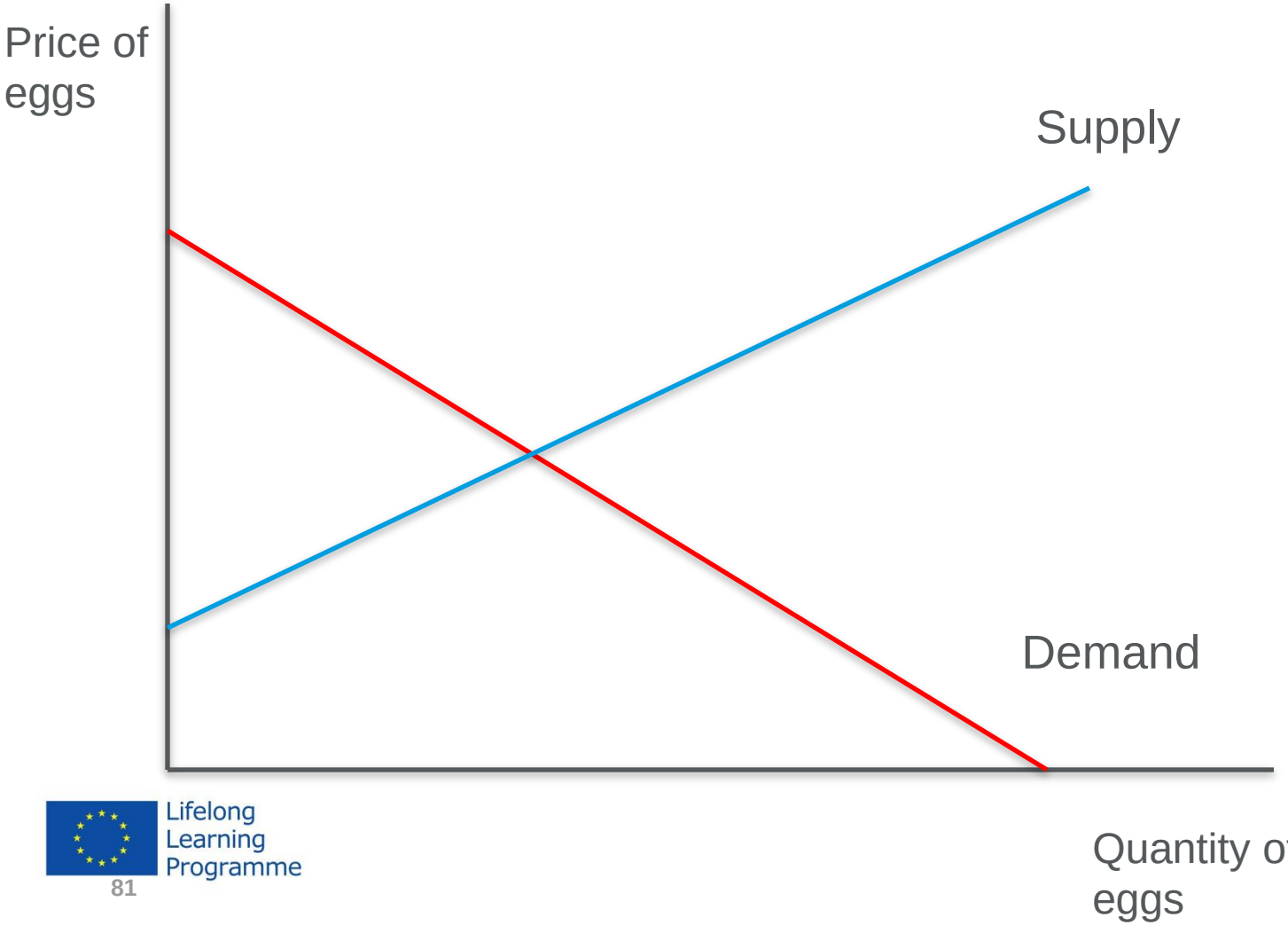
  At higher prices, more people are willing to forgo other activities to supply a good to the market

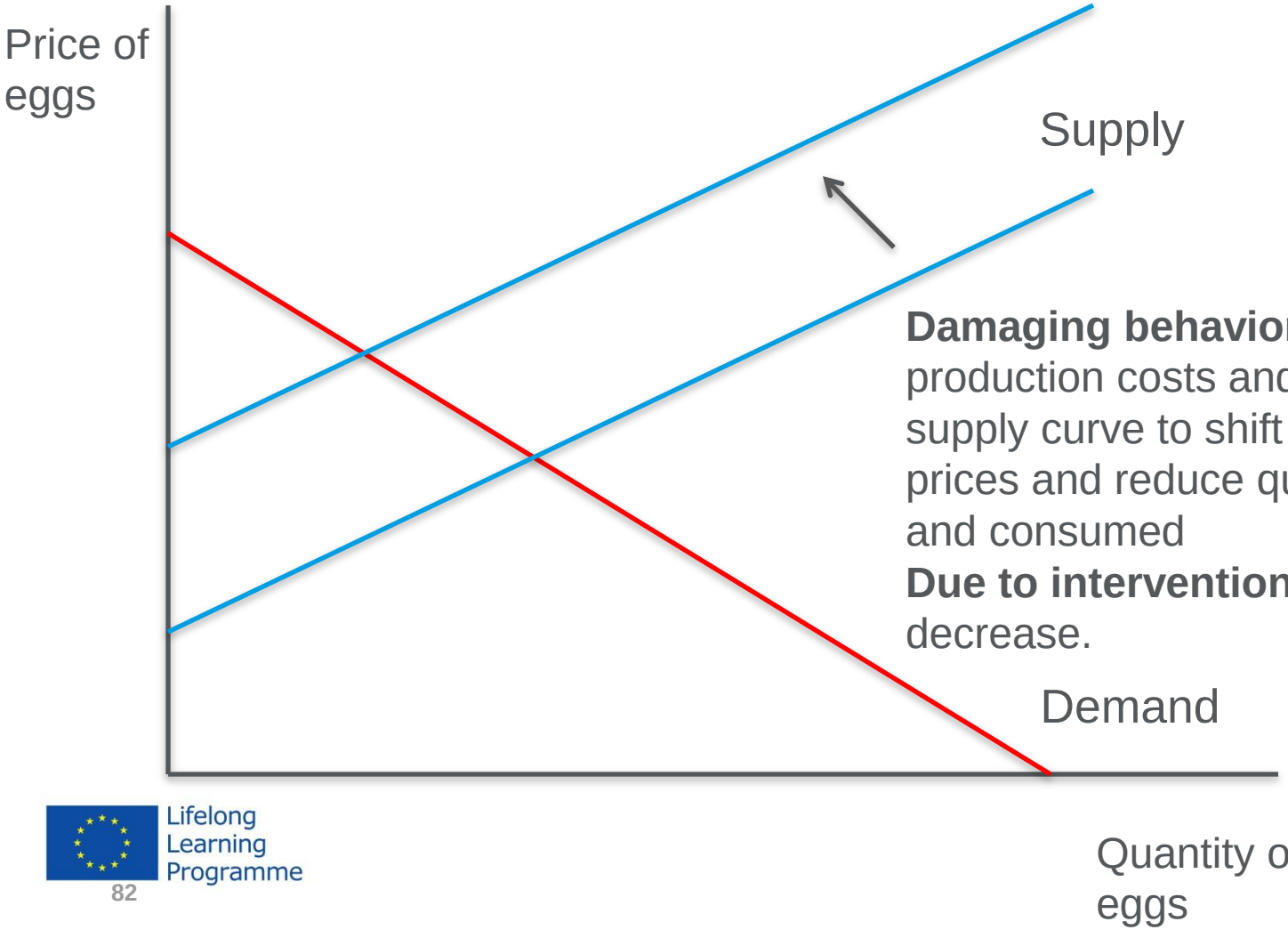
  Supply is determined by production technology, prices etc.

  Disease **can affect the costs and production technology**
- Demand curves show the **willingness to pay for a good**

  At higher prices, only those with a high willingness to pay will buy

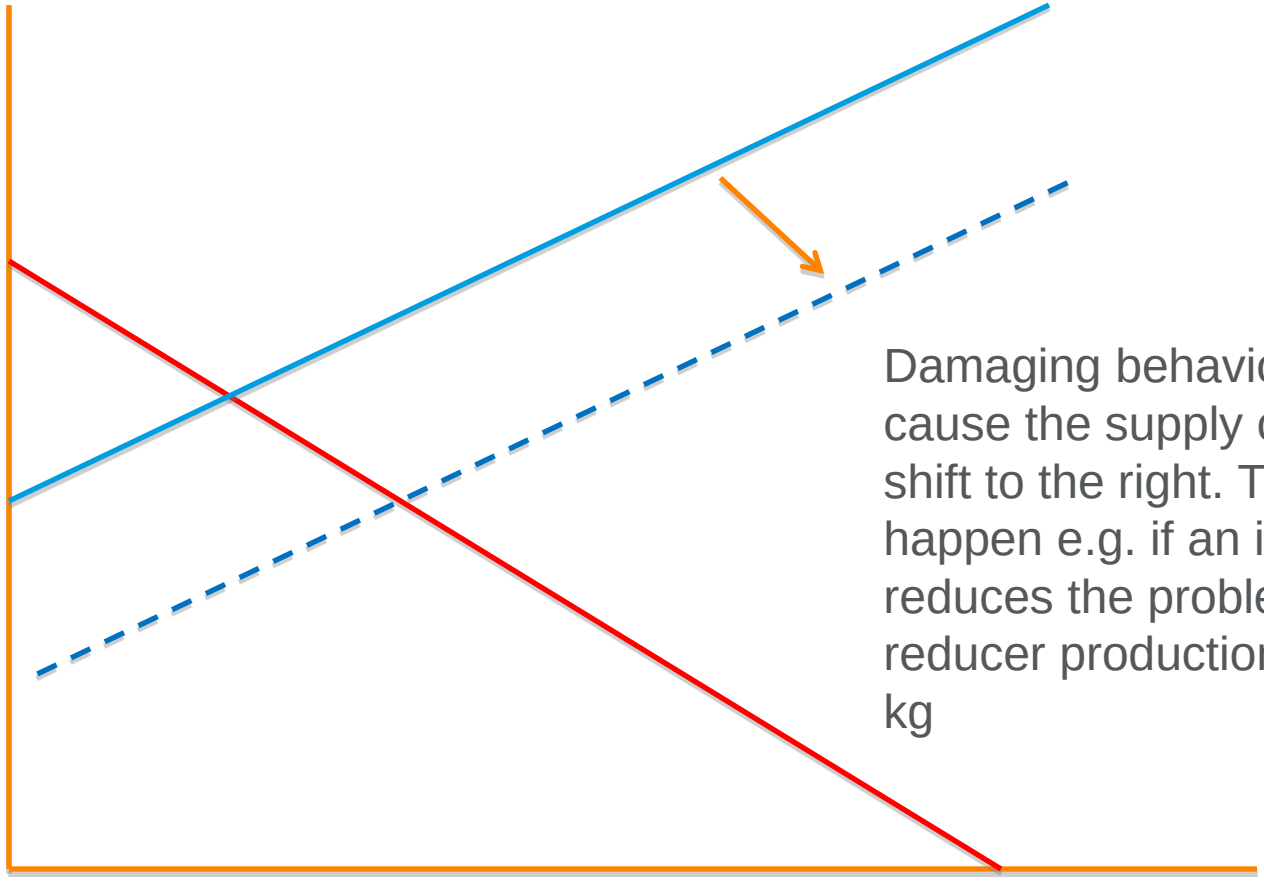
  Demand is determined by income, prices etc.


Price of eggs
Supply
Demand
Quantity of eggs



Damaging behavior can increase production costs and cause the supply curve to shift to the left, raising prices and reduce quantity supplied and consumed

Due to intervention, the costs might decrease.



Damaging behavior can also cause the supply curve to shift to the right. This can happen e.g. if an intervention reduces the problem and reducer production costs per kg

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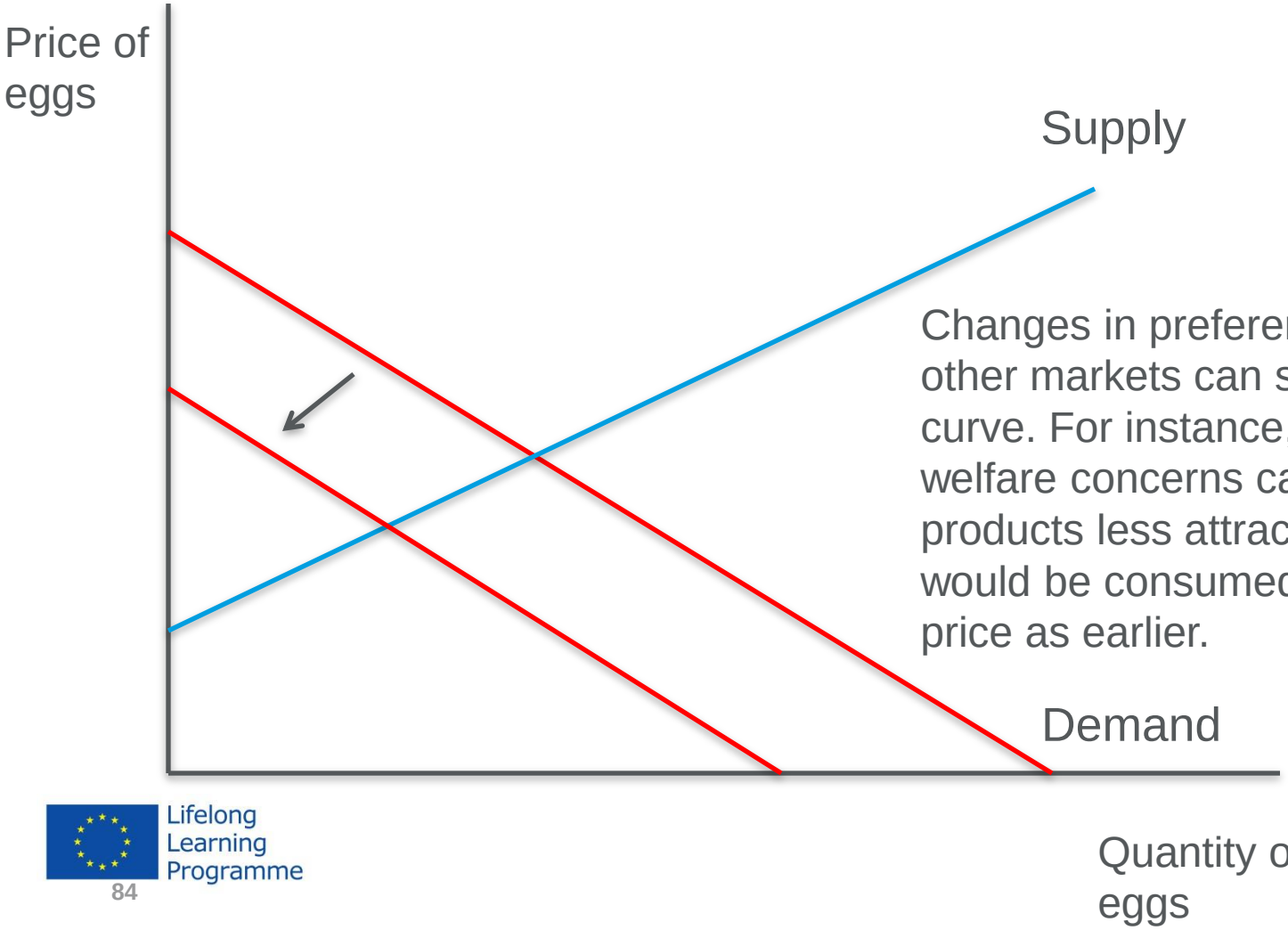

Changes in preferences, income, or other markets can shift the demand curve. For instance, rise of animal welfare concerns can make animal products less attractive. Then less would be consumed at the same price as earlier.

Concluding remarks

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Summary

- Damaging behavior, such as tail biting or feather pecking, can cause substantial economic damages to the livestock producers
  - Literature on economic impacts is, however, scarce
- Economic analysis can inform about the benefits and costs of interventions and preventive measures
- Costs of taking care of the victims, loss of sales and preventive measures can be important cost factors

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Thank you!

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