The true price of meat

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1. Introduction

The price that consumers pay for meat does not include all costs incurred throughout the entire chain from animal feed to the meat on the shelves. For instance, these external costs include environmental damage caused by deforestation in order to clear land for soy cultivation or livestock farming, damage to nature caused by emissions during transport and suffering caused by farming and transporting animals. Furthermore, the meat chain is sometimes subsidized, for example with slaughter premiums, which reduce the consumer price.

The objective of this study is to estimate the ‘true’ price of pork. By ‘true’ we mean the price that would have been paid if there were no subsidies and if the external costs were internalized. We reviewed both conventional meat production and organic meat production. We selected pork due to the homogeneity of the pig farming industry and its relative economic importance in the Netherlands in comparison to the beef industry. This is an exploratory study commissioned by the Nicolaas G. Pierson Foundation.

2. Methods

There are countless ways to produce meat, both organic and conventional. Since it is impossible to map all these ways in an exploratory study, we have chosen an ‘average’ product for this study (one kilogram of pork) and its corresponding characteristic production methods (organic and conventional). We specifically review production methods of products that are offered on the Dutch market. Subsequently, we can map the entire production chain: animal feed production, raising the animals, slaughter, transportation, refrigeration etc.

In this study, we apply the *impact pathway approach* (Friedrich et al., 1998). This method consists of three steps:

1. An inventory of all possible effects that may give rise to externalities;
2. The quantification of these effects;
3. The valuation of these effects.

Practice usually shows that not all effects can be quantified and that not all quantified effects can be monetized. Of course, these will be explicitly mentioned in the presentation of the external costs.

Our study included research into the following effects:

- Climate change
- Animal welfare
- Biodiversity
- Animal disease

In the *impact pathway approach* subsidies are considered to be social costs: therefore, they are included in the ‘social costs’:

Social costs = market price + externalities + subsidies

Here, externalities are costs of social factors rising from unintended side effects of an economic activity. A classic example of an externality is a farmer’s reduced harvest due to the fact that the water he uses for irrigation comes from a river is polluted by upstream factory wastewater discharges. By definition, external costs are not included in the market price of a product. Environmental economists have developed different methods to determine externalities. In order to limit the length of this report, these methods have not been described; a clearly written overview for non-economists in Dutch has been established by the Department for Environment, Nature and Energy in Flanders (Departement Leefmilieu, Natuur en Energie in Vlaanderen; LNE, 2007).

In economic valuation studies such as this one, only values for humans are included. These may be use values (such as recreational values or use of clean water), but also non-use values (such as existence values[1]) (LNE, 2007). Intrinsic values, i.e. values that would have been present if there were no people to appreciate them, are not considered.

The effects and the valuation of these effects in this study, have been calculated based on literature data. We have not performed field studies to quantify effects or to determine the externalities.

1 For instance, knowing that whales exist.

3. Global Warming

3.1 Introduction

In 2006, the FAO calculated that the global meat sector contributes 18% (7.1 Gton every year) to the total emission of carbon dioxide equivalents. Half of this amount is accounted for by methane and nitrous oxide (Steinfield et al., 2006). The contributions of these substances to global warming, are expressed as carbon dioxide equivalents: the emissions are multiplied by the ‘global warming potential’, a factor determined by the IPCC based on the physical characteristics of these greenhouse gasses. The costs of climate change are very difficult to determine, but Stern (2006), for instance, calculated that the cost of extreme weather in developed countries caused by climate change alone, would be 0.5 to 1% of the gross national product. So it is clear that meat consumption significantly contributes to global warming and that this is accompanied by huge external costs: damage to third parties that has not been included in the price.

3.2 Quantification

Kool et al. (2009) focused on the pork industry in four European countries. They investigated the carbon footprint of conventional and organic pork. By carbon footprint they mean the contribution to climate change. The term refers to the ecological footprint: a method that translates the environmental impact of certain activities into a hypothetical number of ‘global hectares’ required to perform that activity. For instance, land required to supply raw materials or to absorb pollution.

Kool et al. (2009) do not calculate global hectares, but limit themselves to a calculation of the emissions of carbon dioxide equivalents. They do so by using life cycle assessment. Kool et al. calculated emissions are a result of the production of inputs (feed crops) up until the slaughterhouse. In addition to cereals, maize, seeds, tapioca and peas, overall pig feed consists of approximately one quarter of by-products: waste products from the food industry. This applies to the Dutch situation in particular; in most other counties, the use of rest streams is lower. The associated CO_2 emissions are allocated based on the prices of the main product (for instance sugar) and the by-product (for instance molasses). If the product costs 20 cents per kilogram for instance, and the by-product costs 5 cents and both products are produced in equal amounts, 80% of the greenhouse emissions resulting from the production are allocated to the main product and 20% to the by-product (ultimately, to the pork). Although there are alternatives (for instance allocation based on relative weight) this economic allocation is a generally accepted allocation method with regard to lifecycle assessment.

Kool et al. model the emissions up to and including the slaughterhouse. Greenhouse gas emissions due to transport and refrigeration between the slaughterhouse and the store have not been included. Based on transport emissions between the farm and the slaughterhouse (about 1% of the total; Kool et al., 2009: p. 42) it is estimated that the emissions up to the store are not much higher than those calculated by Kool et al.

Kool et al. calculate that in the production of 1 kg of fresh conventional pork until it leaves the slaughterhouse, 3.6 (±0.4) kg CO_2-eq. is released. For organic meat this is 4.3 (±0.4) kg CO_2-eq. These calculations do not include the share of land-use change (primarily deforestation). The emissions caused by this are 1.8 en 2.3 kg CO_2-eq. respectively (see Table 3.1). In 2008, 1.3 million ton of pork was produced in the Netherlands (PVE, 2009). Assuming that all pork in the Netherlands is produced in a conventional manner, the total emission due to pork production in the Netherlands in 2008 was 7.0 Tg CO_2-eq. (1Tg=10^{12}g=1 billion kg=1 million tons). In comparison: the total emission in the Netherlands in 2008 was 210 Tg CO_2-eq. And the average emissions per capita were 12.8 *tons* per year (VROM, 2009).

Table 3.1 Emissions caused by the production of 1 kg of fresh pork until it leaves the slaughterhouse in kg CO_2-eq.

	Conventional	**Organic**
Animal feed	1.4	2.3
Other	2.2	2.0
Land use and -change	1.8	2.3
Total	5.4	6.6

3.3 Valuation

Determination of the economic damage of global warming is an extremely complex manner, as the impact varies significantly between locations. Some areas may even benefit from climate change. Plus, the negative effects are more severe when there is even further average temperature rise. Therefore, the expected damage increases as time passes. Tol (2008) performed a meta-analysis of a large number of studies that try to model the social costs of greenhouse gasses (in economic terms: *the marginal* damage costs). He concluded that the average costs are 127$/tC (Tol, 2008; Table 1, Fisher-Tippett) and that there is a chance of 1% that the costs are 1655$/tC. This concerns American dollars at a 1995 rate; if we correct these for inflation[2] to 2008, the respective amounts are 169$/tC and 2203$/tC.

169$ per ton C can be converted to $ per ton CO_2 by multiplying the amount by the ratio of the relative masses of C and CO_2: 12/44. At an exchange rate of 0.68 € (average exchange rate of 2008) per $, the average value of the social costs of CO_2 emissions is 0.031€/kgCO_2. Subsequently, we can calculate the climate related social costs of the production of one kilogram of pork by multiplying the produced CO_2-eq. from Table 3.1 by 0.031€/kgCO_2. The outcomes of this calculation are listed in Table 3.2.

2 Price(2008)=Price(1995) * GDP-Deflator(2008)/(GDP-Deflator(1995)*PPP(1995)); in which GDP-Deflator(1995)=92; GDP-Deflator(2008)=122; PPP(1995)=0.996 (Worldbank, 2010).

Table 3.2 Climate related social costs of 1 kg of fresh pork until it leaves the slaughterhouse in €.

	Conventional	**Organic**
Costs climate change	0.18	0.22

The average consumer price of pork in 2008 was €6.69. If the social costs of climate change would be added to the selling price of conventional pork, the total price would be €6.87; a 2.7% increase.

4. Animal Welfare

4.1 Introduction

Pig welfare in the Dutch situation is largely determined by the type of housing, the use of medicines and specific procedures such as tail docking, teeth grinding or removal and castration without anaesthesia. In addition to information of NGOs such as 'Pigs in Distress' (Varkens in Nood) the conditions of the SKAL Foundation, the Dutch organization that enforces compliance with organic production requirements, provides insight into the current welfare problems in pig farming (Table 4.1).

Table 4.1 Certification conditions by SKAL relevant to pig welfare (source: SKAL, 2010).

- Pigs have no mandatory pasture time. However, pigs should be able to move or have outlets to outdoors. The outlet may be hardened and covered to a maximum of 75%.
- Daylight and natural ventilation should be abundant in the stables. Every animal should have sufficient indoor space to be able to express its natural behaviour. With regard to the indoor area, a required minimum surface applies: for a lactating sow with piglets this is 7.5 m^2 per animal, for piglets between 85 and 110 kg, this is 1.3m^2 per animal.
- Up to half of the total floor area may consist of lath- or lattice structures. The rest of the floor surface should be closed and flat.
- Each animal should have a clean, dry lying area, sprinkled with sufficient dry litter made from natural materials.
- Preventive use of synthetic veterinary medicines and antibiotics is prohibited, as well as the use of growth- or production-enhancing substances and hormones.
- All actions with regard to the animals should be performed with care for the welfare of the animals.
- Procedures such as tail docking and teeth clipping are prohibited.
- Castration of meat-type pigs should be performed under the responsibility of a veterinarian, at the most suitable age, while sedated.
- Securing and tying down animals is prohibited. Only when necessary for the safety or welfare of the animal, SKAL may allow one to tie down or secure individual animals for a limited time. One needs to request an exemption for this.
- When transporting animals, one is not allowed to use common antidepressants and the use of electronic means of coercion is prohibited.

4.2 Quantification

Quantifying animal welfare is not simple. In valuation studies for animal welfare, specific procedures that contribute to animal welfare are often selected, such as replacing a battery cage for chickens with free range housing or a change in transportation or slaughter regime. An alternative method is that we consider pig farming in compliance with the SKAL standards (Table 4.1) as a situation with high animal welfare and common pig farming as a situation with low animal welfare. That is somewhat arbitrary, since common pig farming must to comply with all kinds of animal welfare requirements as well. A practical problem is that the standards for common pig farming are shifting more and more towards the SKAL standards, for instance with regard to the minimum space per pig (LNV, 2004). The difference between both pig farming methods is diminishing. The following section provides an in-depth review of the quantification and the valuation of animal welfare.

4.3 Valuation

The difference in price between organic meat and conventional meat in itself is not a proper measure for the valuation of animal welfare. That is partly because organic meat is not widely available (preventing the market from operating optimally) and partly because the perspective of people that do not buy organic meat, for instance because they are not wealthy enough to do so or because they are vegetarian, is not included in the price. These are the so-called *non-use values.* This is why we depend on *stated preference*-methods to determine the *willingness to pay* (WTP) for animal welfare. WTP is determined by having a large number of people complete a questionnaire with specific questions about what they are willing to do in order to achieve certain objectives.

In literature, various studies can be found that try to determine the WTO for pig welfare using *stated preference* methods. Bennett and Blaney (2002) focus on slaughter practice, exclusively. They are very sceptical about the meaning of the WTP they derived, since the outcome turned out to be very dependent on the amount of information that the participants in the survey received. Nocella et al. (2010) studied the WTP for animal friendly certified products in several European countries. They found that households (2.7 persons) are willing to pay about €10 more for their weekly groceries if the products were to have a certificate for animal welfare (€3.70 per person). However, the article doesn't describe what the weekly budget is, which makes it hard to determine which share pork would have in the €10 referred to. In comparison: the costs of food in the Netherlands are about €35 per person per week (Nibud, 2010).

Burgess et al. (2003) studied the WTP for a doubling of the living space of pigs, improvement of the grids and adding bedding and rooting materials in North Ireland. Their study showed that the individual weekly WTP is £2.10 (about €3 in 2003). If the people of Northern Ireland were to eat about 400 g of pork every week, just like Dutch people (PVE, 2009), this would mean €7.50 (!) per kg of pork.

Chilton et al. (2006) converted the results of Burgess et al. to the WTP per pig and concluded that it is odd that in the study of Burgess et al. the welfare of individual cows and pigs apparently is worth a factor 10 to 60 more than that of chickens. This is inconsistent with previous studies that showed a much smaller difference. Consequently, they draw the conclusion that there might be a methodological problem in the determination of the WTP in the study of Burgess et al.

Meuwissen et al. (2007) calculated that Dutch consumers have a WTP of between €2.90 and €5.90 per kg if that meant that *all* of their concerns with regard to the pig sector would be addressed. The different WTPs apply to different sociological consumer groups.

A general problem of *stated preference* methods is that respondents usually have little knowledge about animal welfare. Therefore, it is often unclear what it is exactly that they are valuing (McInerney, 2004). According to him, the results are only meaningful if they are considered in relation to the existing price difference between conventional and organic meat. McInerney states an increase of 10% or more of the budget for food, a common outcome of animal welfare WTP studies (including the aforementioned), not very realistic against this background.

Consequently, the question is how to determine what the WTP for pig welfare should be. The difference between organic and conventional pork may serve as a proxy, which has two disadvantages. The first is that consumers not only pay the added value of organic meat due to animal welfare, but also because of cultural or environmental values. This would lead to an *over*estimation of the WTP, based on the price difference. The second disadvantage is that the *non-use values* have not been included in the WTP. This leads to *under*estimation of the WTP. With the upper limit of 10% of the budget for food mentioned by McInerney (2004), the upper limit of the WTP for animal welfare is approximately €3.50 per person per week. About half of total meat consumed in the Netherlands is pork: so the maximum WTP is €1.75/0.4 kg = €4.60.

In 2005 the consumer price for conventional pork was €6.38 and for organic meat €8.00 per kg (Blonk et al., 2007): a difference of €1.62 or 25%. If the same percentage applied in 2008, the price difference would be €1.67. De Boer et al. (2007; 2009) studied the motivation of consumers with regard to buying free-range meat. They concluded that an animal-friendly attitude is more closely linked to buying free-range meat than to a measure for the interest that is generally attributed to food (p. 993). Assuming that the decision for buying organic meat is attributed for two-thirds[3] to animal welfare, the WTP for pig welfare as defined by SKAL, is somewhere between €1.10 (2/3 times €1.67) and €4.60. In that case, the 'true' price of conventional pork is between €1.10 and €4.60 higher than the consumer price and that of organic meat between €0 and €3.50 (€4.60 minus €1.10) due to animal welfare (Table 4.2).

Table 4.2 Animal welfare related social costs of 1 kg fresh pork until it leaves the slaughterhouse in €.

	Conventional	**Organic**
Costs animal welfare	1.10 – 4.60	0 – 3.50

3 This seems to be a conservative estimate. In March 2010, the three free-range products sold by Albert Heijn (chops, fillets and shoulder chops) are between 25 and 27% more expensive than their conventional equivalents. Free-range meat is animal friendly, but pig feed was not organically grown. The organic meat sold by Albert Heijn is more expensive than free-range meat (so more than 25% more expensive than conventional meat that Blonk et al. (2007) reported over 2005).

5. Biodiversity

5.1 Introduction

According to the Rio Declaration (CBD, 2010) biodiversity means: ‘the variability of living organisms […] and the ecological systems of which they are a part; this concerns diversity within species (genetic diversity), between species (species wealth) and of ecosystems (ecosystem- or habitat diversity)’. The consequences of a reduction of biodiversity are on one hand the loss of ecosystem functions and on the other hand the decrease in resilience of the ecosystems. Since people are part of ecosystems, ecosystem functions are also services for people (Ott et al., 2008; Costanza et al., 1997). Examples are use functions such as providing clean water and fertile soil, but there are also recreation and information functions.

There are several links between biodiversity and pork consumption, such as:

1. For the cultivation of feed crops such as soy, rain forests are chopped down. These rain forests are nurseries of biodiversity;
2. Emissions of ammonia by livestock farming lead to eutrophication and acidification of nature resulting in a decrease of terrestrial and aquatic biodiversity;
3. In the cultivation of organic feed crops, synthetic pesticides are not used. Partly because the borders of the field are not sprayed with these pesticides, biodiversity is increased in areas that have organic agriculture and horticulture.

Ammonia emissions lead to unintended fertilization of ecosystems, which are not capable of dealing with them and therefore this is considered to be one of the three greatest threats to biodiversity, both (through air) to terrestrial systems and (through runoff water) to aquatic ecosystems (Erisman et al., 2008).

Below we’ll discuss a number of studies quantifying the above relationships.

5.2 Quantification

Kool et al. (2009) indicate that, for conventional pig farming, feed is used that consists of 12.5% soybean meal from South America (p. 73)[4]. Soybean meal is the product that remains after extraction of soybean oil from soy beans. A total amount of 2.7 kg of feed is required to produce 1 kg of meat (Table 4.3) and the proportion of soybean meal in this amount is 0.34 kg. In Brazil, the yield of soy beans per hectare is about 2800kg (Verweij et al., 2009; Table 8.1). For the production of 1 kg of pork, $1.5*10^{-4}$ ha is required, assuming that 80% of the soy is used to create meal or expeller (Kool et al. 2009, Table 2.2). Expeller is the product that remains after mechanical removal (pressing) of the soybean oil. Expeller is used in organic cattle-fodder.

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4 In this table, Blonk et al. mention Argentina, but Argentine soy is often genetically modified and is not imported in the Netherlands. This study assumes that the soy originates from Brazil.

According to the Dutch Emission Registration (2010) the emissions of ammonia by pig farms in 2008 was 30,970 tons. We assumed that the emission per kg of meat is equal for conventional and organic pig farms.

We have not explicitly looked into the agricultural and horticultural surface area used for the production of organic animal feed, since the increase of biodiversity associated with this is very difficult to quantify and value.

5.3 Valuation

The value of biodiversity can be expressed in (Ott et al., 2008):

- The use values and non-use values related to the loss of ecosystem services;
- The values related to the decrease of ecosystem resilience.

Verweij et al. (2009) calculated that WTP for ecosystem services of tropical rainforest is between €485 and €1100 per hectare per year (not including storage of carbon dioxide). In this, they took into account hydrologic services, retention of nutrients, climate regulation, production of wood and other forest products, pollination, recreation, tourism and non-use values. If it is assumed that about 30%[5] of soy is grown in the Amazon region, the WTP for the preservation of the tropical rainforest between €0.30 and €0.56 per kg of conventional pork at a discount rate of 10% and a time span of 20 years. Moreover, according to Kool et al. (2009), organic pig feed also contains soy in the form of expeller (7.5%). When using the same calculation as above, the WTP for organic pork is between €0.24 and €0.44 per kg, in which the assumption of Kool et al. (2009) is followed with regard to the fact that in organic cultivation, the yield is 30% lower than with conventional cultivation (p. 21).

The above costs apply only to the share of soy in the animal feed grown in areas where tropical rain forests used to be. All other effects to the biodiversity have been disregarded.

Ott et al. (2008) calculated the WTP for the ammonia emissions, among other things. They do so based on the restoration costs: the costs required to restore damaged nature, i.e. the costs involved in the restoration of the original ecosystem services in the cheapest way possible. This does not include the non-use values, nor are loss of species and biodiversity. For the Netherlands, they calculate the restoration costs for ammonia emissions at €3.14 per kg (2004). Per kg of meat this comes to €0.14 at a production of 1.306 billion kg carcass weight in 2008, in which the consumption is half of the carcass weight; PVE, 2009).

[5] This is a very rough estimate. The Amazonia States in Brazil supply about a third of the soy production. Between 1990 and 2005, annual growth was 14.1%. A relatively small area of rainforest is chopped down directly for soy production, but soy production is an indirect cause of deforestation, since soybean farmers buy the land from livestock farmers. Subsequently, the livestock farmers develop the rainforest (Verweij et al., 2009).

We can conclude that the external costs for conventional pork related to biodiversity (excluding the effects on climate change) are estimated to be at least €0.44 per kg. This does not include all sorts of effects on biodiversity, such as the production of non-soybean products in the feed. For organic pork, this amount is at least €0.06 per kg lower; potential positive effects on biodiversity have not been included either (Table 5.1).

Table 5.1 Biodiversity related social costs of 1 kg of fresh pork until it leaves the slaughterhouse in €.

	Conventional	**Organic**
Costs biodiversity	>0.44	> ≈0.38

6. Animal Diseases

6.1 Introduction

The social costs of the consumption that are not included in the price of meat include food poisoning on the one hand (usually of microbial origin) and health aspects that are related to the production side on the other hand. Large outbreaks are centrally monitored in the EU (EFSA, 2010). The first aspects will not be discussed here (for instance, see Raney et al., 2009: p. 79). The latter aspects often concern zoonoses. These are animal diseases that can be transmitted to humans as well. Pathogens are usually species-specific, but they continue to change. Thus, new diseases can arise for humans, diseases that were already present in the animal world, such as AIDS, SARS and Q fever or new variants, such as with the flu.

Social costs of zoonoses can be broken down into 1) economic loss in the sector (for instance by culling animals), borne by the industry/industries and the taxpayer, 2) health costs of employees and 3) impact on (global) public health (not necessarily consumers of meat products). The literature is quite diverse and often doesn't provide a detailed description of what has and what has not been included in the estimates. The contribution across a long period of time and a large number of tons of meat produced, is often a low amount per kg of meat. The large amounts are mainly hidden in aspect 3, but they are difficult to quantify. Details about recent outbreaks mainly consist of the economic aspect 1. Aspect 2 is less important financially.

6.2 Quantification

Pigs take a special position in relation to zoonoses because they frequently and easily serve as a conduit for diseases that were previously specific to birds, but that, through pigs (as mammals) are able to adapt to humans as a host.

6.2.1 Influenza

With regard to the influenza virus, the strains that make birds sick have little pathogenic effects on mammals and vice versa. Still, these species-specific viruses have such a large exchange of genetic material that new human influenza viruses arise every year with elements from bird flu and swine flu. In this process, pigs are the intermediaries, not just with regard to fitness, but also because they (in Southeast Asia in particular) exist in increasingly large numbers together with large numbers of poultry and humans (Pilcher, 2004). The consequence of this is that bird flu viruses, swine flu viruses and human influenza will increasingly lead to epidemics among both animals and humans. This is why poultry- and pig farms should be spatially separated, both from each other and from large concentrations of humans in urban areas (Raney et al., 2009: p. 86). In 2003, there was a large bird flu outbreak among poultry in the Gelderse Vallei and Limburg in the Netherlands, which led to the culling of 30 million birds (including pets). Research into the transmission of the disease suggested that vaccination of the poultry or reduction of the density is required to reduce the risk of an epidemic of this size (Stegeman et al., 2004). The direct costs were almost 300 million Euro, but damage due to vacant cages and loss of turnover were estimated to amount to approximately 500 million Euro (Boon, 2006). The number of human victims was limited.

6.2.2 Resistance to Antibiotics

MRSA (methicillin resistant *Staphylococcus aureus*) is often referred to as the 'hospital bacterium' because that is where it is commonly found. However, resistance of bacteria to antibiotics, primarily originates in farms (Johnson et al., 2009), by adding antibiotics to animal feed by default, even if the animals are not sick (because it helps them grow faster) and for therapeutic use. Since 2006, EU regulations prohibit the use as growth accelerator, but in 2007 the sale of antibiotics in the Netherlands for therapeutic use in livestock farming rose to 590 tons (Wentzel, 2008).

A quote (Redactie Resource, 2010): "In comparison to other European countries of which veterinary data are available, the consumption of antibiotics per animal is the highest in the Netherlands. The consumption of antibiotics in Dutch pig- and chicken farming is five times as high as in human healthcare in the Netherlands. The consumption of antibiotics in the dairy industry is equal to human consumption. The consumption is expressed in day dosages for each animal year. In 2007, an average Dutch milk cow received a dosage of antibiotics almost six times a year, meat-type pigs more than 16 times, sows and piglets more than 22 times and table fowls 33 times per year. The consumption of antibiotics table fowls in particular increased significantly between 2004 and 2007: from 19 to 33 day dosages, according to the LEI report 'Antibioticagebruik op melkvee-, varkens- en pluimveebedrijven' (Antibiotic consumption on dairy, pig, and poultry farms) from February 2009. The consumption with regard to meat-type pigs increased as well." The LEI report described is written by Bondt et al. (2009).

6.3 Valuation

Foot-and-mouth disease afflicts cattle, sheep, goats and pigs. There was a major outbreak of this disease in 2001 in the Netherlands, of which the direct cost to the industry have been estimated to be 374 million Euro (Backer et al., 2009: p. 154), and the damage to the tourist industry for instance at 275 million Euro (Backer et al., 2009: p. 32). We have not determined the share of the pig industry in this figure.

The classic swine fever in 1997-98 in the Netherlands was, back then, the largest and most expensive epidemic in the EU, about 11 million pigs were culled (Dijkhuizen, 1999). The direct costs were estimated to be DFL 4.68 billion (€2.76 billion in 2008 after inflation correction), 37% of which was borne by the EU, 10% by the Dutch government, 28% by the farmers and 25% by the related industry (Meuwissen et al., 1999). According to the CBS, 1.7 billion kg (carcass weight) of pork was produced in 1998; so the total amount is 3.22 €/kg meat (the consumption is half the carcass; PVE, 2009). If we assume this to be an average loss for every 10 years over all animal diseases and crises sizes, this means 0.32 €/kg.

The costs of the increasing risk of *human* flu (Gibbs & Soares, 2005) are high, but difficult to assess. For the USA, the economic damage of a pandemic was once estimated to be a 100-200 billion dollars (McLeod et al., 2005). However, this issue primarily concerns the *increase of the risk.* The share of pigs in these costs is even more difficult to isolate, but their central role is evident.

Resistance to antibiotics is a serious and global issue, but monetary valuation and an estimate of the part caused by the Dutch pork production is not simple, which is why we did not attempt it. This issue primarily concerns the *rate of increase with which resistance develops*.

Due to lack of literature and the limited scope of this project, this chapter contains a rough estimate of 0.32 €/kg meat as costs of pig disease in the Netherlands. Since we were unable to quantify and value global issues with regard to resistance to antibiotics and flu epidemics, this likely concerns a conservative estimate. Moreover, the contribution to the last two categories of the organic pig farms will be much smaller, since they use much less antibiotics and work on a smaller scale.

Table 6.1 Animal disease related social costs of 1 kg of fresh pork until it leaves the slaughterhouse in €.

	Conventional	**Organic**
Costs animal disease	>>0.32	> 0.32

7. Subsidies

The pig industry receives subsidies from the government, just like many other industries. A quick survey shows the following schemes (some do not apply to pig farms exclusively):

- Investment arrangement organic pig farms (expired in 2007);
- Investment in integrated sustainable stables (total € 3,5 million, 2010);
- Varkens in zicht / Stap in de stal (Pigs in sight / Get in the stable) (€100.000, 2007 once);
- Arrangement combined air wash systems (€ 5 million in 2008);
- Subsidies for business advice to companies with liquidity problems (LNV);
- Cooperation in innovation projects (LNV);
- Government contribution to the destruction of carcasses (€ 15 million per year until 2010).

Often it is very complex to determine what the effect of subsidies is on the final product. In this case, we must focus on those subsidy flows that probably have the most influence. In 2008, 1.3 billion kilograms of pork was produced (PVE, 2009). Even a subsidy of € 13 million a year for the pig sector, which seems to be a high estimate given the list above, means no more than 2 cents (13 million/1.3 billion = 1 cent divided by 0.5, because the consumption is half of the carcass weight; PVE, 2009) subsidy per kg of meat (at a consumer price of € 6.69).

8. Conclusions and Discussion

In this study, a preliminary attempt has been made to quantify the externalities of pork in the categories climate change, animal welfare, biodiversity and animal disease. Several studies have calculated the specific externalities using various methods. In some cases it concerns the direct social costs, sometimes the costs of damage restoration and in other cases it concerns *stated preference* methods employing surveys. In many studies, not all externalities have been included. Non-use functions in particular, functions that are not related to usefulness, such as existence values and the value attributed to the use that future generations may attribute to it, are ignored by many studies. This leads to an underestimation of the externalities. On the other hand, we, as well as the underlying studies, were forced to make some crude assumptions. Therefore, the uncertainty margin in a number of the amounts mentioned is considerable.

Table 8.1 provides an overview of all external costs listed in this report. The total external costs for conventional pork are estimated to be at least €2.06 per kg for an average consumer price of €6.69 (PVE, 2009), or 31%. In this, animal welfare is the main factor, followed by biodiversity, animal disease and climate change. Subsidies appear to play a negligible role.

The external costs for organic pork are estimated to be at least €0.94. The average consumer price of organic meat in 2005 was 25% higher than that of conventional meat. For 2008 that price would be €8.36 and the external costs at least 11% of the consumer price. Biodiversity, animal disease and climate change are the main factors.

For the estimates of both conventional and organic pork, the non-use functions of animal welfare have not been included in the determination of the external costs. According to some studies, this effect in particular, is supposed to constitute an important proportion of the total external costs.

Table 8.1 External costs and grants of 1 kg fresh pork until it leaves the slaughterhouse in € (price level 2008).

	Conventional	**Organic**
Costs climate change	0.18	0.22
Costs animal welfare	1.10 – 4.60	0 – 3.50
Costs biodiversity	>0.44	> ≈0.38
Costs animal disease	>>0.32	>0.32
Subsidies	<0.02	<0.02
Total	>2.06	>0.94

Although the lower limit of the calculated externalities is somewhat uncertain, the total concerns a conservative estimate (also see Table 8.2). This particularly applies to the aspect animal disease, but animal welfare, biodiversity and to a lesser extent climate change, require further research to gain a better insight into the externalities of pork. The total annual social costs of pigs slaughtered in the Netherlands in 2008 was at least €1.3 billion per year, or about €80 per Dutch citizen. This was calculated by multiplying the total costs from table 8.1 by the production of 2008 divided by 2 (meat production is half of the carcass weight).

*Table 8.2 List of externalities that have **not** been included in the calculations of Table 8.1 (incomplete).*

General	**Climate**	**Animal Welfare**	**Biodiversity**	**Animal Diseases**
-Desiccation	-CO_2 emissions related to refrigeration and transport after slaughterhouse	-Non-use values	- Effects other than those of the soy cultivation in Brazil and the use-values related to ammonia emissions	-Costs related to resistance to antibiotics, and flu
-Water pollution			-Benefits of organic cultivation of feed crops, such as field border management	
-Health damage to livestock farmers and consumers				

A method to internalize the externalities – i.e. including them in the prices – is the introduction of a Pigouvian Tax (Tietenberg, 2006). Such a tax would correct the market failure due to externalities. The average rate of the Pigouvian Tax should be at least €2.06 for conventional pork, that is 31% of the consumer price. At any rate, an increase of the VAT rate from 6% to 19% – proposed by VROM top official Bernard ten Haar for the Study Committee Tax System (Douwes, 2010) – is insufficient with regard to internalizing all external costs.

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