

How can economists help to improve animal welfare?

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Abstract

To-date, the dominant approach to improving farm animal welfare has consisted of a combination of voluntary improvements undertaken by farmers and the tightening of legal requirements. However, history suggests that there is a limit to the improvements capable of being secured by this approach. In this paper, it is argued that economic principles can and should have an important role when new, market-driven and other approaches are set up to improve farm animal welfare. The paper focuses on two ways in which economic principles can improve analyses of animal welfare. The first is by helping to define priorities as to which aspects of animal welfare should be promoted. Here, economic approaches can be used to capture and synthesise the perspectives of all the stakeholders, including the animals, in a transparent and systematic way. The second way is by helping to ensure that incentives are set up in the right way. Where the benefits and costs of improving animal welfare are initially distributed unevenly across stakeholders so that a socially desirable situation will not develop automatically, or be implemented, suitable economic principles may help to create incentives which correct this situation. Thus, if society is to achieve its goal of improving animal welfare, scholars from different disciplines should collaborate in identifying animal needs, assessing stakeholder preferences, making priorities transparent and providing incentives that make solutions realistically attainable.

Keywords: animal welfare, economics, incentives, priorities, stakeholders, transparency

Introduction

For many people the word ‘economics’ will have a somewhat sinister sound when it appears in discussions of animal welfare. Most likely, a negative message such as ‘it is too costly to increase farm animal welfare’ will be expected. However, our message is a positive one. In the present paper, we suggest that economics can help improve animal welfare by making prioritisation of welfare issues transparent and setting up efficient incentive schemes.

Since the late 1960s, farm animal welfare has been on the political agenda, particularly in the Northern part of Europe. The main tool used to protect animal welfare has been legislation — with laws being implemented first at the national level and now increasingly within the European Union (EU) framework (Bennett 1997; Fraser 2008). Research in the field has been dominated by technical and natural science approaches designed to investigate the needs of animals and how these needs are catered for by different production systems. For decades, research results have been adopted gradually by farmers, either in response to legislation (which tightens the minimum requirements for keeping farm animals) or voluntarily (because some of the suggested changes might improve profitability or could be imple-

mented without imposing significant extra costs, or because somewhere along the supply chain someone can see a market opportunity for special ‘welfare-friendly’ products). However, lately, it has become clear there is a limit regarding the extent to which it is possible to improve animal welfare through a combination of voluntary improvements and the tightening of the law. There are a number of reasons for this.

One reason is that the relatively low-cost, or possibly cost-free, or even profitable, welfare improvements have to a large extent been implemented, because these are the easiest for different stakeholders to agree on. Examples may include bans on the tethering of dairy cows, bans on tethered sows, and the requirement of light programmes allowing broilers a certain minimum of hours in darkness. Many of the things which might further improve animal welfare — such as reducing stocking density, securing better resting areas, phasing out of close confinement systems, or providing outdoor access — might increase costs. At the same time, the growing trade in animal products across nations and regions, and the resulting increase in the intensity of price competition, is making it more difficult to use national and wider, regional legisla-

tion, such as EU law, to implement costly changes (Hobbs *et al* 2002; Grethe 2007). As is often said, the effect of tightening local animal welfare legislation may be merely that local animal production becomes less competitive; any connected rise in imports might cancel out the improvements on animal welfare secured at the regional level. Furthermore, there may be problems concerning varying compliance with and enforcement of animal welfare legislation. Thus, a recent evaluation of the EU policy on animal welfare legislation, commissioned by the European Commission, concluded that EU animal welfare legislation has improved the welfare of many of Europe's farm and experimental animals, but that more could be achieved with stronger and more consistent enforcement of existing rules across countries (Rayment *et al* 2010).

At the same time, current levels of farm animal welfare are perceived as insufficient by large segments of the population in many European countries (Eurobarometer 2007). When people are asked to state their opinion as citizens they tend to indicate that decisions concerning animal welfare require public intervention and cannot be trusted to the market place. In their role as consumers, people seem to believe that, in practice, they have little choice because the availability of animal welfare-friendly products is very limited and they do not have sufficient information. As a reaction to these trends, recent policy papers from the EU have stressed the potential for more market-driven approaches (Commission of the European Communities 2009). In particular, the Commission points to the lack of reliable information on animal welfare as an obvious barrier. Another barrier is, of course, high price premiums.

Thus, there seems to be widespread agreement that in order to improve farm animal welfare it is necessary to introduce new, market-driven and other approaches to change the behaviour of the stakeholders. We will argue that economic principles can and should have an important role in the development of these new measures, and we want in particular to focus on two ways in which economists can provide valuable input.

The *first* kind of input, which is explored in the next section of the paper, is that economists can help to define priorities and determine which aspects or elements of animal welfare should be promoted. Even on farms operating specifically to improve welfare standards, there will invariably be limited resources available for improving animal welfare; it will rarely be possible to realise all of the potential improvements fully. Therefore, it is necessary to define priorities. We shall argue that the economic principles help to ensure that the perspectives of all the stakeholders, including the animals, are dealt with in a transparent and systematic way.

The *second* input, explored in the section of the paper after next, is that economists can help to ensure that incentives are set up in the right way. Where the benefits and costs of improving animal welfare are initially distributed unevenly across stakeholders so that a socially desirable situation will not develop automatically, or be implemented, basic economic principles may help to set up incentives which

correct this situation. So, for example, we argue that in order to develop successful market-driven approaches to the improvement of animal welfare it is important to give farmers the right kinds of price incentives to implement the kinds of change which will both benefit animal welfare and satisfy consumer expectations.

Making priorities transparent

People make decisions that affect farm animal welfare in many different situations. Farmers might change their production systems; a committee might be drafting new legislation on animal production; food producers and retailers may develop their own labels for animal products with a focus on farm animal welfare; an NGO may set up information campaigns to raise consumer awareness of the welfare impacts of animal production. In each of these situations, the improvement of farm animal welfare involves human decisions and priorities. It is therefore important to be able and willing to set priorities in a systematic and transparent way — and this is where economic principles can be helpful. One level of priority-setting concerns the allocation of limited resources to animal welfare in competition with other concerns. A second level of priority-setting concerns the relative importance of different activities or attributes that are relevant to animal welfare. Such considerations lie at the heart of the economic disciplines.

The term 'economics' derives from the ancient Greek *oikonomia*, meaning 'household management'. A slightly more recent formulation of the economic discipline is offered by Samuelson (1948) as:

the study of how societies use scarce resources to produce valuable commodities and distribute them among different people.

(NB The term 'resources', includes technical, natural and human resources).

A common approach in economics is to consider animal welfare as a good desired by humans along with a long range of other goods. In that case, resources allocated to maintain animal welfare need to be co-ordinated (directly or indirectly) with resources allocated to the provision of other goods in a way resulting in the highest overall social welfare. An alternative approach is to regard animal welfare as an intrinsic value — ie something possessing value independently of the pleasure that human individuals derive from it. An important consequence of the intrinsic value approach is that the level of animal welfare that a society aims for should not only be determined by the way individual consumers trade-off animal welfare with other desirable goods. Parallel discussions are found in studies assessing the value of nature (as is made clear by twin papers by Johansson-Stenman [2006a,b]). However, ultimately, regardless of whether the values of animal welfare and nature are seen as intrinsic or as traded off with other traits desired in a consumption situation, they need to be balanced and prioritised against other traits — not necessarily at the individual level (the level of the consumer, producer or animal), and not necessarily in monetary terms, but always at a societal level.

Neo-classical consumer demand theory is based on preference utilitarianism, and in particular its underlying ethical norm that society should aim to achieve the greatest preference satisfaction for the greatest number of people and thereby maximise total utility. The most influential classical expositors of the utilitarian norm are considered to be Jeremy Bentham (1748–1832) and John Stuart Mill (1806–1873). The term ‘utility’ is used today, by Bentham’s and Mill’s neoclassical followers, as a measure of relative preference satisfaction.

Hence, in a neo-classical setting, consumers are assumed to choose a bundle of goods and services in order to maximise their utility given their resource constraints. A consumer’s choice depends on the prices of different goods and services as well as how much the consumer likes the different goods and services. The strength of preferences for two different goods can be expressed in terms of how much of a given good a consumer is willing to give up to obtain an additional unit of another good: this is called the marginal rate of substitution. If one of the goods is money, the marginal rate of substitution can be expressed as the consumer’s willingness to pay. It has been observed that the marginal utility of a good often decreases the more of the good the decision-maker already owns (decreasing marginal utility), and that more is preferred to less (non-satiation). These observations are indeed often treated as underlying assumptions in economic analyses of human behaviour. Of course, the assumptions do not capture the full complexity of consumer preferences for all types of goods, but it is commonly accepted that they provide a good starting point for describing rational consumer behaviour.

The idea of placing relative values on various aspects of what contributes to utility, and of then relating these aspects to each other, deploys economic principles in a way that is very useful in relation to animal welfare.

An obvious question to be addressed in an economic analysis of animal welfare would be how to prioritise different welfare-improving activities in order to obtain the largest increase in animal welfare within a budget. As input to such an analysis, we would need animal welfare scientists to provide suitable measures of animal welfare. We would also need to identify what the priorities are for all affected animals and humans. These issues will be addressed in turn below.

What matters to the animals?

In order to identify animal preferences, researchers try to measure how animals react to various environments or treatments. Examples include studies of the in-pen behaviour of growing pigs when they are provided with differing amounts straw (Day *et al* 2002) or straw of different lengths (Day *et al* 2008). Another example is Telezhenko *et al* (2007), who analysed dairy cows’ preferences for rubber mats versus slatted concrete walkways. Interestingly, techniques that were originally developed to reveal consumer preferences have increasingly been employed to analyse animal motivation and demand for various production facilities, activities, and so on (Dawkins

1983). In short, the techniques involve placing an animal in a situation where it has to choose between different alternatives. By changing the effort that the animal has to make in order to obtain one alternative rather than others, it is possible to assess the relative strength of the revealed preferences. For example, Pedersen *et al* (2005) investigated the comparative strength of pigs’ preferences for four types of rooting material by observing the persistence of the pigs’ willingness to attempt to gain access to the differing materials. Certainly, there are limits to the type of trade-off that an animal can meaningfully be ‘asked’ to make. For example, placing an animal in a situation in which it is required to trade-off being free from pain against being free to graze in the fields would not provide meaningful estimates of animal preferences for these two attributes. A critical overview of the method of assessing animal demand functions by observing the animals’ reactions to the increasingly costly performance of several behaviours is provided by Jensen *et al* (2004).

Thus, trading off different aspects of animal welfare against each other is of key importance. Today, animal welfare scientists are increasingly becoming aware of the importance *both* of assessing animal responses that reflect their welfare states *and* of prioritising across these. Economic principles then have a particular role in helping welfare researchers to decide how to prioritise different aspects of animal welfare in ways that reflect the animals’ ‘interests’ viewed as a whole.

In the Welfare Quality® project, 12 criteria were formulated to assess the welfare of production animals; for each criterion different measures and related scores were defined. Part of the goal of the project was to be able to translate and combine the many measures taken on a farm into a single numerical score capable of expressing, in a generally comparable way, the welfare level on each farm. To do this it was necessary to assign relative weights to the different scores — for example, to decide, for a certain species of farm animal, the relative seriousness of prolonged thirst as compared with lack of comfort around resting. It was also necessary to decide the relative weights of different values within the same score. Thus, it was necessary to determine how much severe dehydration weighs in comparison with mild dehydration. To achieve this, experts were asked to assign relative weights to criteria, scores and levels of values as part of the process of reducing the evaluation to a one-dimensional score. Finally, it was illustrated how the score was used to place farms and slaughterhouses into one of the four categories: excellent welfare; enhanced welfare; acceptable welfare; and not classified. To some, this approach will probably seem alarmingly subjective. However, the available alternatives for this way of constructing aggregated one-dimensional scores — including, for example, the simple addition of a large number of score values — might well turn out to be (i) even more subjective, and (ii) grounded in an underlying ethics that is much less transparent. Veissier *et al* (2011) set out the ethical choices that underwrote and informed the

process of reducing the different elements of a comprehensive animal welfare assessment to a single score. For example, it has to be decided to what extent one kind of welfare problem can be compensated for by excellence in another aspect of animal welfare — thus, to give just one kind of case, whether a barren environment can be offset by a low incidence of disease, or *vice versa*. Similarly, it must be decided whether serious suffering in some animals is genuinely compensated for by low levels of suffering in others. As they note, and as is also pointed out by Sandøe and Jensen (2011), there are still unanswered methodological questions about how to compare and aggregate welfare across animals and across welfare criteria.

Such problems are not confined to animal welfare. In a broadly similar way, economists and natural scientists have struggled with the complex, multifaceted concept of sustainability, seeking to derive indices at the national level that capture the economic, environmental and social aspects of sustainable development in a single index. Bohringer and Jochem (2007) recently identified three key steps in composite index formation: normalisation, weighting and aggregation. They found that composite indices of sustainability in common use failed to follow these steps satisfactorily, and that this failure resulted in indices that were useless, and possibly misleading, when used to develop policy advice. One way of alleviating these problems at farm level is to rank systems, farms or other decision-making units against a benchmark of best-production practice. This avoids the difficulties involved in establishing a quantifiable composite measure of sustainability that requires weights to be specified for each component. For example, Reig-Martinez *et al* (2011) used Data Envelopment Analysis (DEA) to combine 12 indicators of sustainability in the ranking of a sample of 163 farms in Spain. From this exercise they were able to establish relationships that would aid the development of policies to improve sustainability. They found that economic and environmental sustainability indicators were positively correlated, but that social indicators were not. Certain characteristics of farms and farmers also had a positive influence on sustainability. It would be possible to include practices that are good for animal welfare in the indicators of sustainability used to rank farms. A method that comes close to doing this has been published by Barnes *et al* (2011). They adopted the same approach as Reig-Martinez *et al* (2011) to rank a sample of 80 British dairy farms according to technical efficiency. They found that farms with low rates of lameness had significantly higher technical efficiencies. This suggests that policies to reduce lameness in dairy cows might lead to more efficient resource use, and hence to economic and environmental benefits that will contribute to the wider drive towards sustainable food production.

Traditionally, neo-classical economists have taken little interest in addressing animal welfare from the animal's point of view. Instead, an anthropocentric approach in which animal welfare matters only to the extent that humans care about it has dominated economic analyses (McInerney

2004; Johansson-Stenman 2006a). However, there are signs of change. Over the last decade, the question of how animal preferences can be included more directly in economic analyses has been discussed with increasing interest; some economists have queried the assumption that purely anthropocentric preferences are adequate for economic analysis. Johansson-Stenman (2006a) addressed the issue by posing the following question in a consumer survey:

Society can reduce through different, most often costly, measures, animals' as well as humans' suffering. In order to be able to prioritize, we need to know how great a weight society should put on reducing suffering in an animal (such as a cow), compared with reducing an equal amount of suffering in a human being. Which of the following statements is most in accordance with your opinion regarding the weight that should be given to animal suffering in public decisions?

He found that 13.2% of the respondents stated that animal suffering should be taken into account to a certain extent in public decisions even when no human beings suffer from the fact that the animals suffer, although with a much lower weight than human suffering; 30.3% of the respondents stated that animal suffering should be taken into account to a fairly high degree in public decisions but with a somewhat lower weight than human suffering; and 49.3% of the respondents stated that animal suffering should be taken into account to a similar degree as human suffering in public decisions even when no human beings suffer from the fact that the animals suffer. Hence, a significant proportion of the Swedish population stated that animal welfare should count in its own right in social welfare studies. Furthermore, Norwood and Lusk (2011) propose a framework for formulating a non-speciesist utility function that is conceptually able to embrace not only our human private valuation and our altruistic preferences for animal welfare but also the animals' own preferences. It is to be hoped that these contributions to the animal welfare debate mark the beginning of a new era of economic literature, one in which animal preferences will be taken seriously in their own right.

What matters to human stakeholders?

As indicated above, improving our understanding of animal preferences and animal welfare is indeed an important step towards implementing regulation that really improves animal welfare. However, since we, as humans, ultimately decide what living conditions should be provided for farm animals, it is equally important to obtain a more detailed understanding of what matters to human stakeholders in relation to animal welfare. Discussion of the interface between science and society in relation to animal welfare includes McInerney (2004), Norwood and Lusk (2011), and Ohl and van der Staay (2012). In this connection, it is necessary to describe exactly how animal welfare is to be prioritised relative to other desirable goods, and how different ways of improving animal welfare are to be prioritised.

In a situation of consumption, animal welfare will be considered as a product quality that is related to the production process — just as environmental impact, fair trade issues, and so on, are related to the production process.

Animal welfare considerations might affect the meat-purchasing behaviour of some consumers. An examination of the market shares of animal welfare products suggests that this group of consumers is a rather small part of the population. Although market shares for products with a special animal welfare label, including products with another quality label such as an organic certificate that comes with animal welfare assurances, have been increasing rapidly in some countries over the last decade, their market shares remain low — at least, in the case of meat, where market shares in Denmark are about 5% (compared to more than 30% in the case of eggs and milk) (Christensen *et al* 2009a).

However, there are some basic problems with using market behaviour as the only measure of human preferences for animal welfare. The first is that animal welfare is not a visible product attribute. In other words, animal welfare is a *credence* good: lack of information typically makes it difficult for consumers to identify and producers to signal the level of animal welfare of a particular product (McInerney 2004; Roe & Sheldon 2007).

The second problem is that many people care for the welfare of all farm animals — not only the welfare of the animals they consume themselves. In economic terms, animal welfare constitutes an *externality*, because one person's actions unintentionally affect other people's utility — as is described, in slightly different terms, in Baumol and Oates (1993), Bennett (1997), McInerney (2004), and Carlsson *et al* (2007). Furthermore, as one consumer's enjoyment at knowing that animal welfare is acceptable does not affect other consumers' opportunity to enjoy the same knowledge — and it is not even possible to exclude other consumers from enjoying it — such welfare is characterised as a public good externality. Hence, animal welfare triggers private values as well as public good values. Typical examples of public goods include clean air and street-lighting (McInerney 2004). It has also been argued that animal welfare should be treated as a *merit* good (McInerney 2004; Mann 2005; Fearing & Matheny 2007). The notion of a merit good can be traced to Musgrave (1957) where it was used to describe merits, or needs, that must be supplied by the government in excess of aggregate consumer demand because market-driven supply alone would be inadequate. Hence, in the background here there is likely to be some form of paternalism where governments know what is best for their citizens. Typical examples of merit goods include children's vaccination programmes and publicly owned schools, because all members of society benefit indirectly from the provision of these goods, including those who are not directly consumers of them (Fearing & Matheny 2007). That animal welfare is a private good as well as a public good externality, and even a merit good, implies that animal welfare markets cannot serve as the only means of securing animal welfare.

In order to quantify the economic values that consumers and citizens associate with animal welfare, survey-based stated-preference methods, involving asking people to state their

preferences for goods whose values are not adequately reflected in market prices, have increasingly been used. For example, Lagerkvist *et al* (2006) estimated that Swedish consumers were willing to pay a price premium on a pork chop of 21% if immunocastration was used, rather than surgical castration, as a means of improving the boars' welfare. They also found, though, that the willingness to pay for pork chops from a surgically castrated pig was around 21% higher than for an uncastrated boar. Clearly, in the latter case, consumers were more concerned about meat taste than animal welfare. Moran and McVittie (2008) estimated that British households on average were willing to pay additional taxes of £7.50 per year for EU legislation that would improve conditions for laying hens. Carlsson *et al* (2007) estimated the mean price premium that Swedish citizens were willing to pay for improving conditions for laying hens by banning battery eggs to be 54%, while the mean price premium they were willing to pay for buying free-range eggs when battery eggs were still allowed was estimated at 20%. Despite the large difference between these two estimates, they were found not to be significantly different, since there was substantial standard deviation in the parameters. (Free-range eggs in Sweden at that time were sold at price premiums of around 7%). Denver and Christensen (2011) have estimated the value different consumer groups place on dairy cows being allowed to graze in the summer, and a recent comprehensive review is provided by Lagerkvist and Hess (2011). In addition, to shed light upon human preferences, this discipline has opened new methodological and ethical challenges focusing on the question how to interpret differences between stated and observed behaviour (see, among others, Johansson-Stenman & Svedsäter 2011). Again, the best argument for social scientists applying the methods they do is the absence of more precise measures of preferences.

So far, we have focused on the role of relative benefits of animal welfare in guiding human decisions. However, the costs of different initiatives to improve animal welfare, and in particular the relative costs, also need to be estimated if we are to identify the best methods of securing improved animal welfare.

A specific case will now be presented and discussed in order to illustrate the ways in which assessments of animal welfare, human concerns about animal welfare, and costs, can be combined rationally in an effort to identify the right priorities when it comes to finding a solution to an animal welfare problem. The case concerns the welfare of dairy cows in Denmark.

Improving welfare for dairy cows

A committee was set up by the Danish Government in 2007 to draft new Danish legislation on the welfare of dairy cattle. The committee consisted of representatives from the Danish Veterinary Association, the Animal Protection Council, the Knowledge Centre for Agriculture — Dairy and Cattle Farming, the Danish Agriculture and Food Council, the Animal Ethics Council, the Ministry of Justice, and the Ministry of Food, Agriculture and Fisheries and its remit described a number of areas relating to housing and

Table 1 Costs associated with improved housing and mandatory access to pasture for dairy cows.

	5-year transition	15-year transition
Improved housing (average additional costs in DKK per cow per year)	1,425	963
Average additional costs (in %)	5.6	2.8
Mandatory access to pasture (average additional costs in DKK per cow per year)	1,602	1,082
Average additional costs (in %)	4.3	2.9

Source: Lund *et al* (2009) for Tables 1 and 2. Note that additional costs are associated with keeping the same number of cows given the suggested improvements in housing and mandatory grazing. The base line is that 36% of the cows are let out to grass. Milk yield per cow is assumed to be reduced by 3% if grazing is made mandatory. Estimations are based on the average of ten different types of dairy farms.

management where a change in the rules could be considered. In a public debate on the work of the committee the issue of whether summer grazing for dairy cattle should be required by law played an important role — partly as the result of a campaign run by the Animal Protection Council which is the main animal welfare organisation in Denmark.

The committee unanimously recommended legislation imposing a number of minimum requirements on the housing and handling of dairy cattle (Justitsministeriet 2009). These include minimum requirements for size of cubicles, quality of flooring, the availability and use of calving boxes and the availability of special boxes for sick animals. The committee also considered carefully the possibility of legislation requiring farmers to give dairy cattle access to pasture during the summer, but it was not able to agree on a single recommendation: the majority of members on the committee, including the independent experts and representatives from Danish agriculture, ended up recommending that summer grazing should not be required by law. A minority consisting of the member representing the animal welfare organisation disagreed and recommended that the legal requirement be imposed.

The recommendations made were based partly on scientific findings regarding the welfare consequences for the animals. There was agreement that summer grazing is an advantage for small- and medium-sized farms, particularly when indoor conditions are not optimal. However, the majority of the committee argued, firstly, that with growing farm sizes the expected positive effects of summer grazing were diminishing; and, secondly, that new and better requirements on the indoor housing of dairy cattle also eroded any advantages of summer grazing.

Economic considerations were certainly also part of the discussion. Lund *et al* (2009) calculated the costs of improving indoor conditions and requiring 0.3 hectare grass

access for Danish dairy cows. They worked with two possible time schedules, of five and 15 years, for when the changes needed to be implemented (see Table 1).

The first interesting result is that a five-year time schedule will cost the farmers nearly twice as much as the 15-year alternative. The main explanation for this huge difference is that 75% of the additional costs of the new requirements are connected with investments. To improve indoor conditions one needs to invest in buildings, and if the required grazing land is to be accessible it is necessary to fund new paths, fences and tunnels under roads. Against this background, and in connection with most of its suggestions, the committee recommended a 15-year time schedule. The other significant result is that even with a long time schedule it is costly to both improve indoor facilities and secure grass access. With a 15-year time schedule the requirements on improved housing and the handling of dairy cattle will impose additional costs of nearly 3% on the farmers on average; approximately the same level of costs will arise if farmers are required to put their cattle on pasture. From this, it can be seen, firstly, that the suggested changes will not occur unless either legislation is imposed or consumers are willing to pay a sufficient price premium for products produced in line with the suggested changes; and, secondly, that national legislation in this area may affect the competitiveness of the sector.

In light of this it should be clear that when suggestions are made about ways to improve animal welfare, whether through legislation or by other means, priorities are called for. Economists have tools for setting such priorities in a structured and systematic way through an evaluation of cost-effectiveness, cost utility or cost-benefit analysis. However, we call for caution when using such approaches, because they might obscure the need to examine the underlying assumptions which, inevitably, must be made when setting up such comparisons. These assumptions must be made in a transparent way so that they are up for discussion.

One potentially controversial assumption that was made in the study of welfare conditions for dairy cows concerns the scope of the analysis. Thus, a recent study by Lawrence and Stott (2011) indicates that, even on large farms with good indoor facilities, there might be a reduction in the incidence of lameness among dairy cows that are allowed to graze. Barnes *et al* (2011) found that low rates of lameness increased technical efficiencies. These relations between lameness and production systems were not included in the decisions concerning revision of the Danish legislation on dairy cows. And, it remains an open question the extent to which this omission affected the conclusions that were drawn.

From a lay person's viewpoint the priorities might have looked different from those the committee put forward. At any rate, surveys seem to indicate that lay people associate great welfare improvements with provision of pasture to dairy cattle. Hence, it is likely that there would have been greater popular support for a legal requirement to offer access to grass than there was for the improvement of indoor housing. Indeed, the ordinary person's stated interest in, and willingness to pay for, milk from cows that are

allowed to graze (Denver & Christensen 2011). This result suggests that it might be possible to introduce additional price premiums for milk from grazing cows — something that might not, to the same extent, be the case for improvements to indoor facilities.

The dairy cow case highlights the multi-dimensional nature of animal welfare. It also highlights the importance of making choices that are informed by the priorities of different stakeholders — and of estimating costs. Setting clear priorities on the basis of transparent assumptions opens up ethical and political discussions of the merits of the various options. To this end, the case illustrates the way in which economic principles could be used to highlight the trade-offs at stake and the priorities that need to be set.

Setting up incentives to make solutions real

Even the best assessment of priorities — in other words, one that takes into account the preferences of all stakeholders, including the animals, and considers the costs — will not in itself guarantee that suitably prioritised improvements of animal welfare occur. Whether a particular improvement regarding animal welfare is actually made depends on the incentives there are for people in charge to make it happen. Therefore, another important use of economic principles is to look at incentives and, if necessary, adjust them so as to facilitate the highest priorities.

In some cases it may be in the interest of farmers to improve animal welfare (Lawrence & Stott 2009). Thus, to the extent that animal welfare improves productivity, the farmer has a direct economic incentive to raise animal welfare standards. Animal welfare improvements falling into this general category typically involve securing basic conditions such as having sufficient amounts of water and feed, avoiding very stressful situations, and securing at least a minimum level of care during the transport and handling of animals in the slaughtering process (see Fraser 2008).

Less straightforward welfare improvements have also been found to deliver a direct economic benefit. For example, the removal of sick pigs and their isolation from the main herd in suitable hospital accommodation has been shown to deliver direct economic benefits because it reduces mortality among pigs (Dansk Svineproduktion 2007). These are so-called win-win situations. If such net-benefits are not realised simply, for example, because farmers lack information, or because time horizons are too short, or because there is insufficient focus on the potential economic benefits of improving animal welfare, it is likely that better or more timely information might provide sufficient incentives. A study by Graversen *et al* (2008) indicates that the prevention of shoulder wounds in sows is another example of a win-win situation since the costs and benefits of welfare improvements here can be expected to balance each other (see Table 2).

In win-win situations, as mentioned above, in principle very little is required to improve animal welfare. From an economic point of view, a welfare improvement that provides financial gains to the farmer is a sign of the existing allocation of production-related resources being

Table 2 Costs associated with the prevention of shoulder wounds in sows.

	Costs (DKK)
Monitoring of shoulder wounds on-farm	6–7.2 million per year
Setting up action plan	7.2 million per year
Public on-farm control	0.1–0.2 million per year
Improved control at slaughter	5–6 million per year
Total costs	18.3–20.6 million per year
DKK per sow	17–20
Gain in productivity (smaller number of sows taken out) (DKK per sow)	19

Source: Graversen *et al* (2008).

inefficient and should, of course, be improved. However, as the case of shoulder wounds illustrates, in practice this may not be simply due to differences in management styles. To be more specific, even though shoulder wounds can be prevented without loss of profit for the average farmer, large variations in farm-level costs imply that some farmers gain additional profits of reducing incidences of shoulder wounds while other farmers might experience direct losses if they sought to reduce the incidence of shoulder wounds on their farms. In actual fact, in Denmark, in addition to previous information campaigns, it has been necessary to set up specific legislation to limit the prevalence of shoulder wounds in sows. What follows from the analysis is that such legislation should not be viewed as an extra cost for farmers on average and that legislation would not erode the competitiveness of the pig industry as a whole.

In animal production, there is often not a win-win situation where efficient production and animal welfare go hand-in-hand. Here, welfare improvements will not come by themselves even though the improvements would be beneficial from a societal point of view. In such situations, economic principles can be used to clarify and direct the provision of incentives. We offer an illustrative case involving loose-farrowing sows.

Improving welfare for sows

Many animal welfare scientists, farmers and citizens agree that sows should be allowed freedom of movement — not only during their gestation period, but also during farrowing and lactation. Unfortunately, independent estimates presented by Lund *et al* (2010) and Guy *et al* (2011) have shown that additional costs are associated with allowing sows freedom of movement during the farrowing and lactation periods. However, focusing on the optimisation of production systems, and also applying the most recently developed understanding of how to increase piglet survival rates in response to extra space, extra substrate and modified pen heating, Ahmadi *et al* (2011) suggest that the costs can be significantly reduced and even turned into a win-win situation.

Nevertheless, despite agreement over the virtues of this welfare improvement, it has not yet been widely implemented. Information provision is certainly not an adequate tool to make it happen, because the relevant costs are incurred by the pig sector while the benefits are mainly experienced by animals and citizens. The problem is how to give producers incentives that make it worth their while to allow their sows freedom of movement during gestation, farrowing and lactation.

Following Ahmadi *et al* (2011) it may be argued that incentives involving information and possibly the education of farmers might prove sufficient to encourage farmers to allow sows to move freely in all three periods in question. However, following the more pessimistic scenario depicted by Lund *et al* (2010) and Guy *et al* (2011), where the producers face considerable additional costs, additional incentives appear to be needed.

One response would be to subsidise production where sows are free to move in all three periods. However, this is likely to be considered as a hidden trade barrier by the EU and WHO, and as a consequence prohibited.

Alternatively, product labelling showing that sows that have been allowed to move freely during these three important periods of their lives might move some consumers to support that type of production through their purchasing choices. The potential of this solution is supported by Lagerkvist *et al* (2006) and Liljenstolpe (2008), who found a willingness to pay for loose-housed sows among Swedish consumers. A study of American consumers also indicated a willingness to pay 20% extra for pig meat from sows without the use of gestation crates (Tonsor & Wolf 2011). At the same time, the authors highlight the challenges of mandatory labelling, especially in terms of the additional costs that must be carried by someone, and the potential erosion of consumer choice. It is likely that relying on labels to fund loose-housed sows will result in a small niche market capturing a segment of consumers with high willingness to pay.

Over the last few decades retailers have become powerful players in the food-production chain — both as buyers and as sellers. Today, five or six international retail chains account for nearly 80% of the everyday necessities that are bought in Europe (Christensen *et al* 2009b). As buyers, some of the larger retail chains might indeed have the market power to place animal welfare on the agenda by requiring their sub-contractors to secure a certain level of animal welfare and thereby branding themselves as animal-friendly companies. This has already been seen with McDonalds in the USA (who require that no eggs are from hens kept in conventional cages) and in the retail store Marks & Spencer in the UK (who require farm-level traceability of all animal products and that specific standards of their own are followed). Clearly, retailers have an interest in satisfying consumer demand — but equally they have an interest in maximising their own profits, and this might entail having an interest in branding themselves as a responsible, conscientious business.

There are some clear tendencies towards retailers choosing fewer and bigger suppliers. In this trend, product assortment is becoming more limited and security and stability of supply is evolving into a quality parameter in itself. As a consequence, niche products are less attractive for retailers unless they can be used either as unique private labels or to brand individual supermarket chains for their customers. Here, there is a significant potential to improve animal welfare (Christensen *et al* 2009b). Also Matheny and Leahy (2007) stress that retailers have a considerable influence over production methods, are vulnerable to consumer pressure, and are immune to trade agreements.

The goal of having sows kept loose throughout their lives is likely to be viewed by the main stakeholders as a high priority among possible animal welfare improvements. To attain this goal it will be necessary to set up incentives for farmers, because such production systems could be more costly than the systems mostly now being used. The incentive could either be a price premium, which is likely to be paid by the consumer of special welfare-friendly products, or the pork producers' way to access a special quality market run by specific retailers. Alternatively, if the public pressure on the policy-makers is great enough, the incentives might even be formulated as legal requirements as it is seen in the ban of battery eggs in all EU countries from January 2012 (ie in 1999, the European Union Council Directive 1999/74/EC banned the conventional battery cage in the EU from 2012).

These examples illustrate usefully the importance of identifying the preferences of the various stakeholders, including the animals! Only with such identification can incentive structures that move the production in the desired direction in a cost-efficient way be designed.

Animal welfare implications

As we see it, economists can contribute to the animal welfare debate in two ways. On the one hand, economics is an analytical discipline concerned with rational behaviour and the efficient use of resources — and it is obvious that, in the presence of limited resources, the identification of activities that contribute most to increased animal welfare will have a positive effect on animal welfare.

On the other hand, and at the same time, using the economic principles can raise the level of discussion, avoiding a limited focus on individuals' interests in specific topics and asking instead how these individuals, and society as a whole, should prioritise and trade-off various goals when resources are limited.

Conclusion

The term economic *principles* has deliberately been used instead of economic *science*. We have done so because the main message is not that economists should single-handedly deal with animal welfare issues. Rather, we want to emphasise the need for inter-disciplinary collaboration in the pursuit of appropriate animal welfare measures. This collaboration should bring forward methods to identify animal needs, to assess stakeholder preferences, to make

priorities transparent, and to provide incentives which will ensure that solutions are realistically attainable.

We suggest that economists, and other social scientists, can make an important contribution to the improvement of farm animal welfare for the following reasons:

- Social scientists can contribute constructively by highlighting the importance of understanding potential differences in perceptions of animal welfare. Such differences constitute a condition of (not an obstacle to) determining the social goals of animal welfare, and that discussion is in the hands of social scientists.
- Economics can enable structured and transparent discussion of priorities (including the priorities of the animals). Economics can provide a holistic approach to the identification of goals based on an efficient use of scarce resource. Key, in this respect, is the need to set priorities.
- The discipline of economics can help us to devise intelligent ways of setting up incentives which foster improved farm animal welfare. The key step is to (re)distribute benefits and costs so that it becomes financially attractive to farmers and others in food production to improve animal welfare.

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References

- Ahmadi BV, Stott AW, Baxter EM, Lawrence AB and Edwards SA** 2011 Animal welfare and economic optimisation of farrowing systems. *Animal Welfare* 20: 57-67
- Barnes AP, Rutherford KMD, Langford FM and Haskell MJ** 2011 The effect of lameness prevalence on technical efficiency at the dairy farm level: An adjusted data envelopment analysis approach. *Journal of Dairy Science* 94: 5449-5457. <http://dx.doi.org/10.3168/jds.2011-4262>
- Baumol WJ and Oates WE** 1993 *The Theory of Environmental Policy, Second Edition*. Cambridge University Press: Cambridge, UK
- Bennett RM** 1997 Farm animal welfare and food policy. *Food Policy* 22: 281-288. [http://dx.doi.org/10.1016/S0306-9192\(97\)00019-5](http://dx.doi.org/10.1016/S0306-9192(97)00019-5)
- Bohringer C and Jochem PEP** 2007 Measuring the immeasurable: a survey of sustainability indices. *Ecological Economics* 63: 1-8. <http://dx.doi.org/10.1016/j.ecolecon.2007.03.008>
- Carlsson F, Frykblom P and Lagerkvist CJ** 2007 Farm animal welfare — testing for market failure. *Journal of Agricultural and Applied Economics* 39: 61-73
- Christensen T, Denver S, Jensen JD, Rosenquist H, Wingstrand A, Aabo S and Ifversen B** 2009a *Consumptions patterns and consumer risks – an overview of the Danish markets for pork, chicken, and eggs and the consumer risk associated with Salmonella and Campylobacter*. Report 202, Institute of Food and Resource Economics, University of Copenhagen, Denmark. http://www.foi.life.ku.dk/Publikationer/FOI_serier/~media/Foi/docs/Publikationer/Rapporter/Nummererede%20rapporter/2009/Rap_09_202.ashx. (Accessed 26 Jan 2012)
- Christensen T, Jensen JD, Hansen HO and Sandøe P** 2009b *Hvordan kan økonomer bidrage til forståelsen af dyrevelfærd? Landbrugets økonomi 2009* pp 87-109. Institute of Food and Resource Economics, University of Copenhagen, Denmark. [Title translation: How can economists contribute to the conception of animal welfare?]. http://www.foi.life.ku.dk/Publikationer/FOI_serier/~media/Foi/docs/Publikationer/Rapporter/Landbrugets_Okonomi/2009.pdf.ashx. (Accessed 27 Jan 2012)
- Commission of the European Communities** 2009 *Options for animal welfare labelling and the establishment of a European Network of Reference Centres for the protection and welfare of animals*. COM (2009) 584 final. Commission of the European Communities: Brussels, Belgium. http://ec.europa.eu/food/animal/welfare/farm/options_animal_welfare_labelling_report_en.pdf. (Accessed 26 Jan 2012)
- Dansk Svineproduktion** 2007 *Fakta om lovpligtige sygestier*. <http://arkiv.dansksvineproduktion.dk/index.aspx?id=3167f77c-ba35-41e3-85f8-686ff2eded09>. (Accessed 27 Jan 2012). [Title translation: Facts about compulsory sick pens]
- Dawkins MS** 1983 Battery hens name their price: consumer demand theory and the measurement of ethological 'needs'. *Animal Behaviour* 31: 1195-1205
- Day JEL, Burfoot A, Docking CM, Whittaker X, Spooler HAM and Edwards SA** 2002 The effects of prior experience of straw and the level of straw provision on the behaviour of growing pigs. *Applied Animal Behaviour Science* 76: 189-202
- Day JEL, van de Weerd HA, Edwards SA** 2008 The effect of varying lengths of straw bedding on the behaviour of growing pigs. *Applied Animal Behaviour Science* 109: 249-260
- Denver S and Christensen T** 2011 Hvordan opfatter forbrugeren økologi? In: Tveit G and Sandøe P (eds) *Økologiske fødevarer: hvor bevæger forbrugerne sig hen?* pp 49-61. Center for Bioetik og Risikovurdering: Frederiksberg, Denmark. [Title translation: How does the consumer perceive organics? Organic food: what are the consumer trends?]
- Eurobarometer** 2007 Attitudes of EU citizens towards Animal Welfare. *Special Eurobarometer* 270. http://ec.europa.eu/public_opinion/archives/ebs/ebs_270_en.pdf. (Accessed 26 Jan 2012)
- Fearing J and Matheny G** 2007 The role of economics in achieving welfare gains for animals. In: Salem DJ and Rowan AN (eds) *The State of the Animals IV* pp 159-173. Humane Society Press: Washington DC, USA
- Fraser D** 2008 Toward a global perspective on farm animal welfare. *Applied Animal Behaviour Science* 113: 330-339
- Graversen JT, Lund M and Gylling M** 2008 *Arbejdsgruppen vedrørende skuldersår hos søer : økonomiske beregninger for arbejdsgruppen*. Institute of Food and Resource Economics, University of Copenhagen, Denmark. [Title translation: Economic calculations for the working group on shoulder wounds on sows]
- Grethe H** 2007 High animal welfare standards in the EU and international trade: How to prevent potential 'low animal welfare havens'? *Food Policy* 32: 315-333. <http://dx.doi.org/10.1016/j.foodpol.2006.06.001>
- Guy JH, Cain P, Baxter EM, Seddon Y and Edwards SA** 2012 Economic evaluation of high welfare indoor farrowing systems for pigs. *Animal Welfare* 21(S1): 19-24. <http://dx.doi.org/10.7120/096272812X13345905673520>

- Hobbs AL, Hobbs JE, Isaac GE and Kerr WA** 2002 Ethics, domestic food policy and trade law: assessing the EU animal welfare proposal to the WTO. *Food Policy* 27: 437-454. [http://dx.doi.org/10.1016/S0306-9192\(02\)00048-9](http://dx.doi.org/10.1016/S0306-9192(02)00048-9)
- Jensen MB, Pedersen LJ and Ladewig J** 2004 The use of demand functions to assess behavioural priorities in farm animals. *Animal Welfare* 3: 27-32
- Johansson-Stenman J** 2006a *Should Animal Welfare Count? Working papers in Economics* 197. Department of Economics, School of Business, Economics and Law, Göteborg University, Sweden. <http://gupea.ub.gu.se/bitstream/2077/2725/1/gunwpe0197update.pdf>. (Accessed 26 Jan 2012)
- Johansson-Stenman J** 2006b *Cost-Benefit Rules when Nature Counts. Working papers in Economics* 198. Department of Economics, School of Business, Economics and Law, Göteborg University, Sweden. <http://gupea.ub.gu.se/bitstream/2077/2724/1/gunwpe0198update.pdf>. (Accessed 26 Jan 2012)
- Johansson-Stenman O and Svedsäter H** 2011 *Self-Image and Valuation of Moral Goods: Stated versus Real Willingness to Pay. Working Papers in Economics* 484. Göteborg University, Department of Economics, Sweden. <http://ideas.repec.org/p/hhs/gunwpe/0484.html>. (Accessed 27 Jan 2012)
- Justitsministeriet** 2009 *Arbejdsgrupperapport om hold af malkekvaeg*. http://www.justitsministeriet.dk/fileadmin/downloads/Pressemeddelelser2008/Rapport_om_hold_af_malkekvaeg_all.pdf. (Accessed 27 Jan 2012). [Title translation: Report from a working group on the keeping of dairy cows]
- Lagerkvist CJ, Carlsson F and Viske D** 2006 Swedish consumer preferences for animal welfare and biotech: a choice experiment. *AgBioForum* 9: 51-58
- Lagerkvist CJ and Hess S** 2011 A meta-analysis of consumer willingness to pay for farm animal welfare. *European Review of Agricultural Economics* 38: 55-78. <http://dx.doi.org/10.1093/erae/jbq043>
- Lawrence A and Stott A** 2009 *Profiting from animal welfare: an animal-based perspective*. The Oxford Farming Conference 2009. http://www.fao.org/fileadmin/user_upload/animalwelfare/lawrence%2009.pdf. (Accessed 27 Jan 2012)
- Lawrence A and Stott A** 2011 Economics & animal welfare: can combining these 'dismal' sciences help improve animals' lives? *Fourth Boehringer Ingelheim Expert Forum on Farm Animal Well-Being* pp 63-67. 27 May 2011, Seville, Spain. http://www.farmanimalwell-being.eu/files/article_16.pdf. (Accessed 27 Jan 2012)
- Liljenstolpe C** 2008 *Consumer valuation studies and structural modelling of the pig industry: a focus on animal welfare*. Doctoral Thesis, Acta Universitatis Agriculturae Sueciae, Sweden
- Lund M, Christensen J and Lawson LG** 2009 Økonomiske konsekvenser af nye krav til husdyrvelfærd i kvægbruget. *Tidsskrift for Landøkonomi* 195: 137-145. [Title translation: Economic consequences of new welfare requirements in cattle farming]
- Lund M, Otto L and Jacobsen B** 2010 *Økonomiske analyser for Justitsministeriets arbejdsgruppe for hold af svin*. FOI Udredning 2010/19. Commissioned work of the Institute of Food and Resource Economics, University of Copenhagen, Denmark. [Title translation: Economic analyses for the pig-keeping working group of the Danish Ministry of Justice]. http://www.foi.life.ku.dk/Publikationer/FOI_serier/~media/Foi/docs/Publikationer/Udredninger/2010/FOI_udredning_2010_19.ashx. (Accessed 27 Jan 2012)
- Mann S** 2005 On institutionalizing animal welfare. In: Riley AP (ed) *New Developments in Food Policy, Control and Research* pp 133-147. Nova Science Publishers: Hauppauge, NY, USA
- Matheny G and Leahy C** 2007 Farm-animal welfare, legislation, and trade. *Law and Contemporary Problems* 70: 325-358
- McInerney J** 2004 *Animal Welfare, Economics and Policy*. Report on a study undertaken for the Farm & Animal Health Economics Division of Defra. Defra: London, UK
- Moran D and McVittie A** 2008 Estimation of the value the public places on regulations to improve broiler welfare. *Animal Welfare* 17: 43-52
- Musgrave RA** 1957 A multiple theory of budget determination. *FinanzArchiv New Series* 25: 33-43
- Norwood FB and Lusk JL** 2011 *Compassion by the Pound: The Economics of Farm Animal Welfare*. Oxford University Press: Oxford, UK
- Ohi F and van der Staay FJ** 2012 Animal welfare: at the interface between science and society. *Veterinary Journal* 192: 13-19. <http://dx.doi.org/10.1016/j.tvjl.2011.05.019>
- Pedersen LJ, Holm L, Jensen MB and Jørgensen E** 2005 The strength of pigs' preferences for different rooting materials measured using concurrent schedules of reinforcement. *Applied Animal Behaviour Science* 94: 31-48. <http://dx.doi.org/10.1016/j.applanim.2004.11.023>
- Rayment M, Asthana P, van de Weerd H, Gittins J, Talling J and Jarvis A** 2010 *Evaluation of the EU Policy on Animal Welfare and Possible Policy Options for the Future: Final Report*. GHK Consulting in association with ADAS UK. Food Policy Evaluation Consortium: London, UK. <http://www.eupaw.eu/docs/Final%20Report%20-%20EUPAW%20Evaluation.pdf>. (Accessed 26 Jan 2012)
- Reig-Martinez E, Gomez-Limon JA and Picazo-Tadeo AJ** 2011 Ranking farms with a composite indicator of sustainability. *Agricultural Economics* 42: 561-575
- Roe B and Sheldon I** 2007 Credence good labeling: the efficiency and distributional implications of several policy approaches. *American Journal of Agricultural Economics* 89: 1020-1033. <http://dx.doi.org/10.1111/j.1467-8276.2007.01024.x>
- Samuelson PA** 1948 *Economics*. McGraw-Hill: New York, USA.
- Sandøe P and Jensen KK** 2011 The idea of animal welfare: developments and tensions. *ICVAE, First International Conference on Veterinary and Animal Ethics* pp 11-17. ICVAE: London, UK
- Telezhenko E, Lidfors L and Bergsten C** 2007 Dairy cow preferences for soft or hard flooring when standing or walking. *Journal of Dairy Science* 90: 3716-3724. <http://dx.doi.org/10.3168/jds.2006-876>
- Tonsor GT and Wolf CA** 2011 On mandatory labeling of animal welfare attributes. *Food Policy* 36: 430-437
- Veissier I, Jensen KK, Botreau R and Sandøe P** 2011 Highlighting ethical decisions underlying the scoring of animal welfare in the Welfare Quality[®] scheme. *Animal Welfare* 20: 89-101