Is there a Finnish Animal Welfare Kuznets Curve?

CHIARA LOMBARDINI[1], ANNA-KAISA KOSENIUS[1], SOILE KULMALA[2], MARKO LINDROOS[1]

[1]Department of Economics and Management (Environmental Economics), P.O. Box 27, FI-00014 University of Helsinki

[2]Finnish Environment Institute (Marine Research Centre), P.O. Box 140, FI-00251 Helsinki

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1 Introduction

In the environmental economics literature, much research has been done on the relationship between per capita income and various indicators of environmental pressure. Hundreds of papers have explored the so called environmental Kuznets curve (hereafter EKC) hypothesis. According to the EKC hypothesis as per capita income grows environmental degradation first increases and then, as per capita income reaches a threshold level, it starts declining.

First proposed by Grossmann and Krueger (1991, 1995), the hypothesis has been tested for several pollutants and other indicators of environmental degradation such as deforestation, with very mixed results (for a review, of the EKC hypothesis and its testing see e.g. Dinda 2004), the very existence of the notion of EKC has been questioned (see e.g. Caviglia-Harris et al. 2009, Galeotti et al. 2009, Stern 2004). For Finland, the existence of the EKC was tested by Kunnas and Myllyntaus (2007) for the period 1800-2003 for carbon dioxide, sulphur oxide and nitrogen oxides emissions Support for the EKC hypothesis was found for sulphur dioxide emissions and, with some reservations, for nitrogen oxides, but not for carbon dioxide. Hoffren et al. (2001) provide a Decomposition Analysis of Finnish Material Flows for the period 1960-1996, which is suggestive of the existence of a Finnish EKC. Recently, Frank (2008) presented the idea that a relationship similar to the EKC may exist between animal welfare and per capita income: animal welfare firsts deteriorate as per capita GDP increases and then, after per capita GDP has reached a threshold level, improves with further economic growth. He called this relationship the Animal Welfare Kuznets Curve (hereafter AWKC) hypothesis and suggested several reasons of why such a relationship may exist.

This paper contributes to the discussion of animal welfare in economics. So far animal welfare has been mostly examined in economics in studies aimed to estimate the willingness to pay (hereafter WTP) for improvements in animal welfare (see e.g. Baltzer, K. 2004, Bennett & Blamey 2002, Bennett & Larson 1996, Carlsson et al. 2007, Carlucci et al. 2009, Chilton et al. 2006, Lagerkvist et al. 2006, Liljenstolpe 2008, María 2006). Research has also been conducted on the impact of animal welfare regulations on international trade. Cowen (2005) has discussed the treatment of animals as an instance of market failure and Blackorby & Donaldson (1992) discussed the ethics on animal exploitation within the framework of a utilitarian economic model. To the best of our knowledge, little attention has been paid to study the interactions between animal welfare and economic growth, with the exception of Frank (2008). It is to this line of enquiry that our paper wants to contribute.

Our preliminary exploration of Finnish data suggests that per capita income growth in the last 30 years has been associated with a deterioration of the animal welfare of farm animals. This deterioration appears to be driven by dietary changes. Finnish consumption of foods from animal origin, especially meat and dairy products, has grown; beef has been partially substituted by poultry meat, and intensive farming methods have become more diffuse. Our preliminary result holds regardless of whether consumption data or production data are examined. We conclude by discussing whether we might expect a mitigation of such farm animal welfare deterioration in the future and what the sources of such mitigation may be. The possible correlation between the Animal Welfare Kuznets Curve and the Environmental Kuznets Curve is also examined.

2 Measuring animal welfare: consumer-based, production-based and animal-based measures

In order to even discuss the testing of the AWKC hypothesis, we must first define animal welfare and identify some reliable and computable indicators to measure its evolution as per capita income grows.

Defining animal welfare is not an easy task, as consensus on a shared definition of animal welfare is still to come in the scientific community. In this paper, we will try to identify indicators of animal welfare that can both capture the physical and mental states of animals as well as their ability to carry out natural behaviours. In this respect our approach is closest to both the classical stance on animal welfare by the Brambell Committee (1965) as the Five Freedom approach of the Farm Animal Welfare Council (1993). The five freedoms are "*1. Freedom from Hunger and Thirst - by ready access to fresh water and a diet to maintain full health and vigour. 2. Freedom from Discomfort - by providing an appropriate environment including shelter and a comfortable resting area. 3. Freedom from Pain, Injury or Disease - by prevention or rapid diagnosis and treatment. 4. Freedom to Express Normal Behaviour - by providing sufficient space, proper facilities and company of the animal's own kind. 5. Freedom from Fear and Distress - by ensuring conditions and treatment which avoid mental suffering.*" (FAWC 2009)

The consumer-based approach to animal welfare

In the consumer-based approach, animal welfare counts in so far as it affects the well-being of human economic agents. Counting only human preferences is the most usual approach in the economic analysis of animal welfare within the neoclassical tradition (Cowen 2006, 40). Nevertheless, theoretical economic analyses exist in which also the lifetime utility of animals is taken into account (see e.g. Blackorby & Donadson 1992).

The economic value of animal welfare to humans is often estimated using the willingness to pay (hereafter WTP) for improvements in animal welfare. WTP measures can be obtained by using stated preference approaches such as contingent valuation or revealed preferences approaches such as hedonic pricing. The latter, however, can be applied only to products that are already available and that have "*overt" animal welfare attributes* (Bennett et al 2000, 15-16). Maybe for this reason, most studies of the economic value of animal welfare use stated preferences approaches (Baltzer, K. 2004, Bennett & Blamey 2002, 2003, Bennett & Larson 1996, Carlsson et al. 2007, Carlucci et al. 2009, Chilton et al. 2006, Lagerkvist et al. 2006, Liljenstolpe 2008, María 2006, Napolitano et al. 2008, Rolfe 1999, Schnettler et al. 2009, Taylor & Signal 2009) .

Production-based measures

Production-based measures estimate levels of animal welfare on the basis of the production method employed (e.g. free-range vs. battery-cages for egg production) and the number of animals reared under that production method. One problem with production-based measures is that although there is scientific evidence on how various factors under different production methods affect animal welfare, there is no consensus on how to aggregate them into a single indicator of animal welfare. Aggregation poses the greatest challenges, when a production method is not superior to another with respect to all possible factors affecting of animal welfare. This is for instance the case of free-range egg production, which gives chickens more exercise space but less predatory protection. (Hurnik 1990 ref Bennett et al 2000, 25.) Moreover, there can be greatly variability in animal welfare levels under the same production method depending on how well or poorly it is implemented (Bennett et al 2000, 24).

Building upon Frank (2008, 481) and Blackorby and Donadson (1992), we could model the animal welfare impact AWI of the production method m =1,…, M for animal i = 1…n (e.g. poultry, beef, broilers, etc) as

$$AWI = \sum_{m=1}^{M} \sum_{i=1}^{n} \left[(U_{im} - \alpha_i) \cdot w_i \cdot N_i \right] \qquad [2]$$

where

- U_{im} is the utility (= welfare) of animal i under the production method m
- α_i is a benchmark lifetime utility level, in the simplest case the benchmark could be zero, identifying the utility level of the animal, if it were not put into existence.
- w_i is the weight given to animal i, allowing for different weights to different species (cows versus pigs versus fish, etc).
- N_i is the number of animals of type i in the given production method.

As in equation [1] here too animal welfare is assumed to be equally valuable in all periods. Equation [2] allows the estimated utility of the animal to be negative, so that it possible to accommodate situations in which non-existence may be considered superior alternative in terms of animal welfare that to a state of intense suffering brought about by a given production system. Finally, as we model it, this measure is animal centred, the welfare of the animal matters regardless of whether it is part of humans' utility functions or not.

3 A theoretical analysis of the foundations of the Animal Welfare Kuznets Curve Hypothesis

The environmental Kuznets curve (hereafter EKC) first emerged as purely empirical relation between some indicators of environmental degradation, namely air pollutants and per capita GDP (Grossmann and Krueger 1991, 1995). According to the EKC hypothesis in the initial stages of economic growth, environmental quality deteriorates, but then as per capita GDP reaches a critical level, it starts improving. Adopting the same of the EKC for the AWKC, in a multi country time series AWKC could be tested starting from the following relationship:

$$y_{it} = \alpha_i + \gamma_t + \beta_1 x_{it} + \beta_2 x_{it}^2 + \beta_3 x_{it}^3 + u_{it} \qquad [3]$$

where $y = \ln Y$ and $x = \ln X$ and where Y is the measure of animal welfare degradation, X is per capita GDP and i the index for country ($i = 1, \ldots, N$) and t for time ($t = 1, \ldots, T$).

If the statistical analysis of animal welfare and per capita income data suggests that $\beta_2 = \beta_3 = 0$ and β_1 is positive and statistically significant, then the relationship between GDP and animal welfare impact, in per capita terms, is linearly increasing and the AWKC hypothesis is not supported or, alternatively, the data indicates that at the current levels of per capita income we are still in the increasing part of the curve.

If $\beta_3 = 0$ and β_1 is negative and β_2 positive and are both significant, we have the equivalent of "classical" inverted U shaped EKC, with animal welfare first decreasing and then increasing after per capita GDP has overcome a crucial level.

Empirical explanations underlying the Animal Welfare Kuznets Curve Hypothesis

In their literature review article on economic growth and the environment, Copeland and Taylor (2004, 16) identify four main explanations for the EKC empirical relation presented above. These are: (1) sources of growth; (2) income effects; (3) threshold effects; and (4) increasing returns to abatement. In this section, we examine if and how these explanations may apply to the animal welfare Kuznets curve.

The sources of growth explanation, also called composition effect explanation, stems from the observation that economic growth has generally been accompanied by a change in the structure of production from agricultural to industrial production and then to a serviced based economy. In terms of animal welfare, the evolution from agrarian to industrial societies sees almost a total disappearance of the use of as a source of transportation and of power, a phenomena that Frank (2008, 479) interprets as an improvement in animal welfare. On the other hand, the move from subsistence agriculture to factory farming, typical of the change in the production structure from agrarian to industrial, is likely to lead to a decrease in animal welfare. The net effect is likely to be a deterioration of animal welfare, at least for farm animals.

There are several avenues through which **income impacts** animal welfare. Some of these appear to lead to a deterioration of animal welfare while others to an improvement. The overall effect is theoretically ambiguous. As per capita income grows, the demand of normal and luxury goods increases. Thus the overall demand for factory farmed meat, dairy products, fish, and furs increases, leading to a greater number of animals slaughtered which could be interpreted as indicating a decrease in animal welfare. However, also the demand for the more expensive animal welfare friendlier organic products increases, with potentially positive effects on animal welfare. The recent shift in consumption from red meat to poultry, which is often said to have been motivated by health considerations, has increased the number of farmed animals and the increase has happened for broilers, arguably the farm animals in the direst living conditions today. As income grows the demand for animal welfare may become stronger due to changes in attitudes and increases in altruistic behaviour. Frank (2008, 478-480) suggests that higher income may make people more altruistic and caring for animal welfare as part of the self-actualization process related to higher-level needs (Maslow 1968).

As pointed out by Copeland and Taylor (2004, 19), the **threshold effect** is related to but distinct from the income effect explanation. In the case of animal welfare, the main difference is that the threshold effects explanation predicts inactivity in animal welfare policy below a critical level of per capita income, while the income effect predicts small, incremental steps toward more stringent animal welfare policies as income grows.

According to Frank (2008, 481) there is some evidence of positive **returns to scale** in the technological alternatives to the use of laboratory animals. One could also expect positive returns to scale to preferences and institutional factors related to a meatless diet as dietary preferences are often guided by habit, by the preferences of one's social network and by social norms. (Frank 2008, 481, see also Frank 2007.) Increasing returns in intensive farming however may contribute to a deterioration of animal welfare. Olson and Vu (2009) find that larger farm size is consistently associated with greater technical efficiency. Taking into account that larger farm size is usually related to more intensive farming methods, this may not suggest a positive impact on animal welfare.

4 Economic activities with a significant direct impact on animal welfare

In this section we try to identify which economic activities have the greatest impact on animal welfare as an avenue to the selection of key indicators of animal welfare development in Finland. For the

purpose of this paper, an activity is defined to have a direct impact on animal welfare, when the animal (e.g. pet), its parts (e.g. meat, leather) or its products (eggs, milk & other dairies) are used as a commodity.

Analytically, the animal welfare pressure generated in a country by different economic sectors, could be modelled extending the EKC literature (see e.g. Bagliani et. al 2008, 651) as

$$A = \sum_{j=1}^{n} Y(\frac{Y_j}{Y})(\frac{A_j}{Y_j}) \qquad [4]$$

where Y is GDP, Y_j is sectoral GDP, A_j is the negative impact in terms of animal welfare due to sector j, so that $\frac{Y_j}{Y}$ is the share of the GDP in sector j over total GDP, and $\frac{A_j}{Y_j}$ is the jth sector's animal welfare impact intensity. The number of animals employed in sector j could be used to approximate A_j as a rough indicator to identify key activities crucial in terms of animal welfare.

The decomposition in equation 4 refers to production data: the animal welfare pressure depends on the impact on animal welfare of domestic production activities. In the EKC literature, in addition to tests of the EKC based on production data, also consumption data have been used (see e.g. Bagliani et al. 2008).

When applied to animal welfare, the use of consumption data would imply a different decomposition, namely:

$$A_c = \sum_{j=1}^{n} Y(\frac{C_j}{Y})(\frac{A_j}{C_j}) \qquad \textbf{[5]}$$

where Y is per capita GDP, C_j is consumption per capita of good j, A_j is the negative impact in terms of animal welfare due to per capita consumption of good j, so that $\frac{C_j}{Y}$ is the share of per capita income devoted to the consumption of good j, and $\frac{A_j}{C_j}$ is the animal welfare impact intensity of the consumption of good j. The use of consumption data assigns to each country the animal welfare pressure generated in order to produce the goods and services consumed by its population, regardless of where production takes place. In the paper, we include both production and consumption data in order to avoid misinterpretations which may be due to "animal welfare leakages". Animal welfare leakages occur when production moves abroad in response to stricter domestic standards of animal care.

5 The evolution of the welfare of farm animals Finland

In this paper, we look at evidence of a Finnish AWKC restricting our attention to production and consumption activities with a direct impact on animal welfare. More specifically we examine the production and consumption of food from animal origin with a focus on eggs, meat, and dairy products. We choose to restrict to these activities as they involve large number of animals. In Finland in 2008, there were approximately 1 399 500 pigs, 3 259 000 egg laying hens, 915 341 bovines (TIKE 2009c).

5.1 Meat consumption and production

Up until now, empirical evidence suggests that as per capita income grows so does per capita consumption of meat (e.g. York & Hill Gossard 2004). Disregarding for the moment the difference in animal welfare associated to different meat production system, let us assume that the utility of being a farm animal is negative due to the intensive rearing systems used in the majority of production units. Let also assume that not being born a farm animal would give zero utility and that all animals have equal weight w_i . Then, according to equation [2], an increase in meat consumption would decreases animal welfare. An analogous conclusion could be made, given the above assumptions, for an increase in the consumption of milk and other dairy products and of eggs.

Finnish data shows that the consumption of meat and dairy products increased while eggs registered a decrease in consumption. Figure 1 plots the levels of per capita GDP and meat consumption for the years 1975-2006. We find that beef consumption has declined from 24.2 kg/per capita to 18.9 kg/per capita, pork consumption has increased from 26,6, kg per capita to 34.2 kg/per capita while poultry meat consumption has more than tripled passing firm 2.4 kg/per capita in 1975 to 7.8 kg per capita in 2006. Thus the aggregate meat consumption has increased from 53.2 kg/per capita in 1975 to 68.4 Kg/per capita in 2006.

Vinnari (2008, see also Vinnari & Tapio 2009 and Vinnari et al. 2009) suggests that this increasing trend in meat consumption in Finland will continue. Based on thirty nine Finnish experts' opinions, he estimated an average probable per capita consumption of 75 kg with a median of also 75 kg in 2030 in Finland, suggesting an increase of about 6.6 kg per capita from the 2006 level of 68.4 kg.

Figure 2 shows that the increase in meat consumption was also accompanied by an increase in domestic production measured as the number of farm animals slaughtered. Given the overall increase as well as the change in the composition of meat consumption from red meat to poultry, an increasing number of animals have had to be slaughtered to support the increasing meat consumption of Finnish households. Moreover, considering that animal welfare levels tend to be lowest for broilers and highest for cattle, we can conclude that both greater consumption of meat in general and substitution toward poultry are suggestive of a deterioration of animal welfare levels.

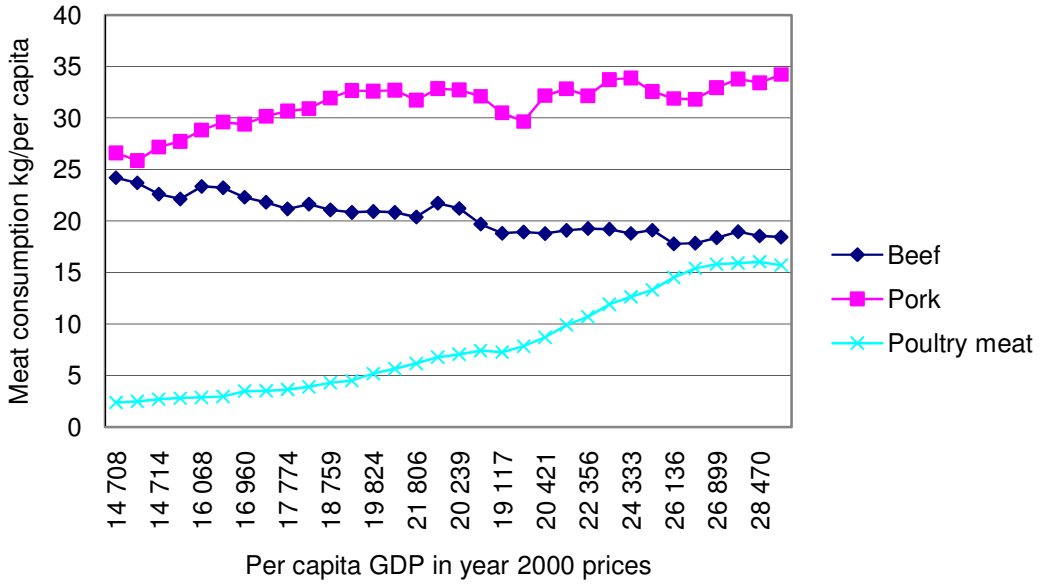

Figure 1 Meat consumption kg/per capita and GDP/per capita (year 2000 prices) in Finland 1975-2008
Sources: Meat consumption statistics from the Yearbook of Farm Statistics 2007 (2007, 171); Per capita GDP statistics in year 2000 prices: own elaboration from Statistics Finland (2009a, 2009b)

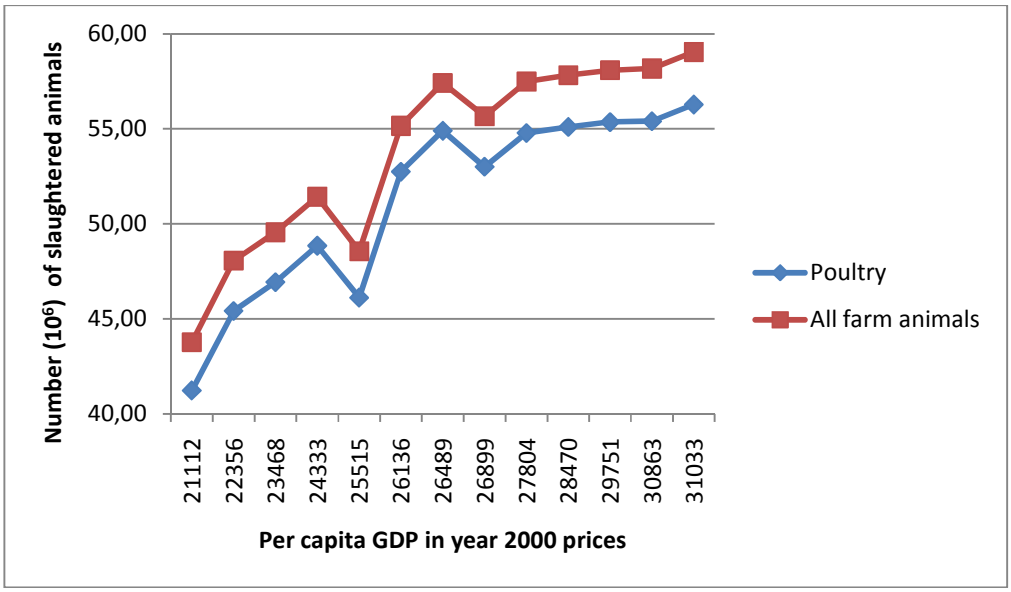

Figure 2 Farm animal slaughtering in Finland 1996-2008 and per capita GDP.
Sources: Number of farm animals slaughtered (includes bovines, pigs, sheep, lamb, & horses) TIKE (2009); Per capita GDP statistics in year 2000 prices: own elaborations from Statistics Finland (2009a, 2009b).

In interpreting the data above, we have made the strong assumption that all farm animals experience negative utility, assuming de facto no significant difference in animal welfare between different management systems or sectors. It could be argued, however, that management systems, which adopt sufficiently high animal care standards, can provide farm animals with welfare levels that would make it preferable being reared as farm animals as opposed to not being put into existence. In Finland at

present, there is no separate animal welfare labelling to help identify animal friendlier production practices. However, the organic label as an animal welfare component in that it ensures higher standards of animal care compared to the minimum levels established by EU and domestic norms. Support to the AWKC hypothesis could come from an increase in organic meat production, great enough to offset the decrease in welfare due to the increase in meat produced under intensive farming.

5.2 Consumption and production of dairy products

While there is a clear increasing trend in the consumption of meat, the overall development of per capita consumption of dairy products is at a first inspection less clear. Milk and butter consumption has decreased between 1975 and 2006 but cheese consumption has increased as shown in figure 3.

According to Viinisalo et al. (2008, 10) milk consumption has decreased between 1966 and 2006 but this decrease has been compensated by the increase in the consumption of cheese (measured by the amount of milk needed in cheese production). Moreover, the consumption of yogurts, which came to the Finnish, markets in the sixties, tripled from 1971 to 2006. Thus, on the bases of Viinisalo et al (2008), one could make the educated guess that the overall consumption of dairy products also increased. Once again, this general increase in the consumption of dairy products could be interpreted as a sign of animal welfare deterioration.

Organic poultry can be thought to have higher levels of welfare as they are given greater possibilities to species-specific behaviour. However, ensuring poultry high welfare status under organic management systems is challenging. Preliminary studies by Holma et al. (2005) and Virtala et al. (2005) that involved 20 out of 23 commercial organic layer farms (amounting to over 80% of all commercial Finnish organic farms in the year 2003), suggest that these challenges are especially great in Finland. This is due to two main factors. First, welfare levels in organic poultry depend crucially on good stockmanship and sufficient levels of experience in free range systems. In Finland, however, experience is still limited as free range egg production is still relatively uncommon (Virtala et al. 2005, 119). Second, Finland's climatic conditions limit permanent outdoor access that, according to the current EU Regulation, should be ensured for one third of the birds' life (KTTK 2005 ref. Virtala et al. 2005, 123). Although the EU Regulation allows, as a temporary measure, reduced outdoor access due to climatic conditions, in order to ensure the higher animal welfare associated to the organic standard one should find other solutions to ensure access to natural behaviour such as winter gardens and verandas (Virtala et al. 2005, 123).

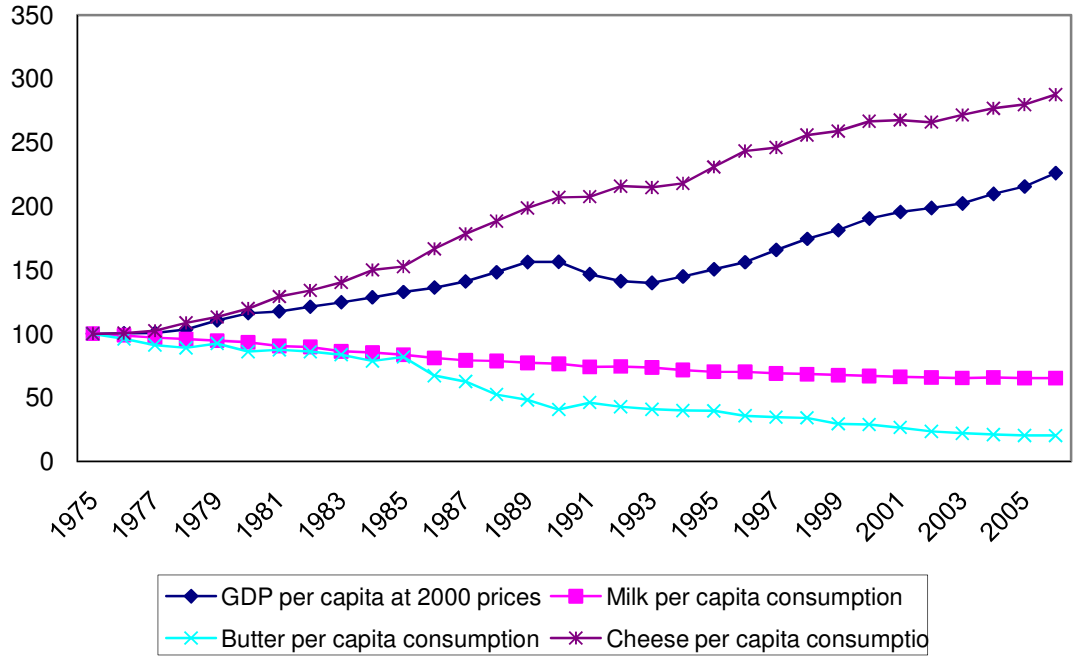

Figure 3 Indexed dairy products consumption and per capita GDP (year 2000 prices) in Finland 1975-2006, 100 =1975. **Sources:** Milk, butter, and cheese consumption statistics from the Yearbook of Farm Statistics 2007 (2007, 171); per capita GDP statistics in year 2000 prices: own elaboration from Statistics Finland (2009a, 2009b).

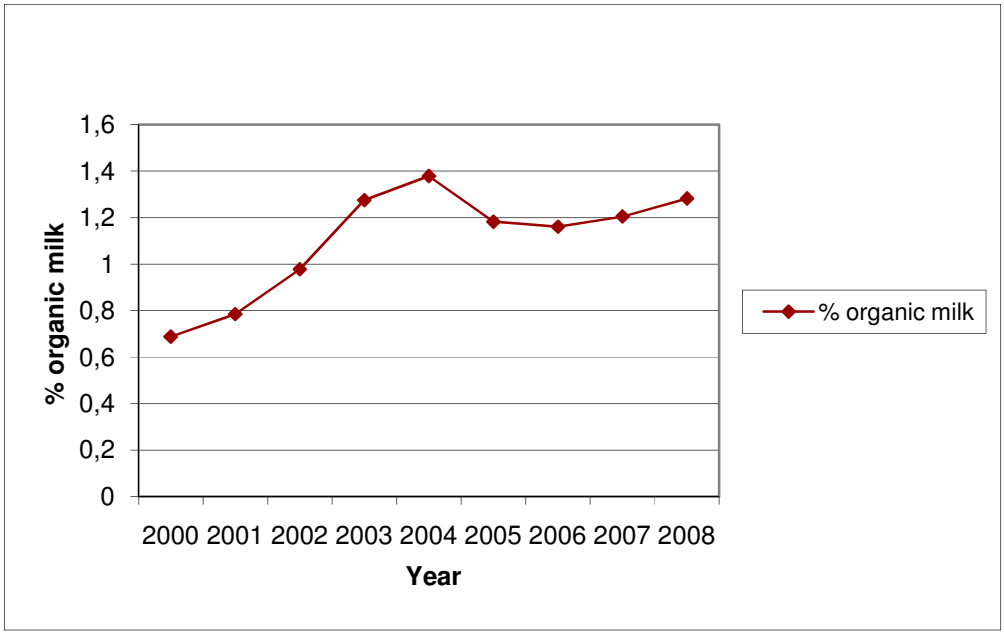

Figure 4 % of organic milk production over total Finnish milk production 2000-2008
Source: TIKE (2009b)

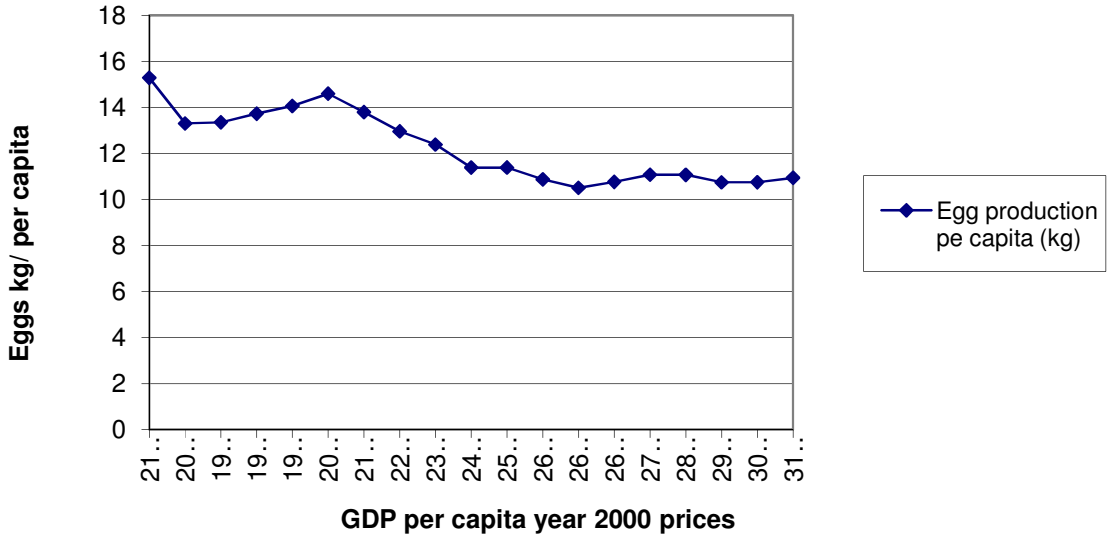

Figure 5 Egg consumption kg/per capita and GDP/per capita in Finland 1975-2006
Sources: Egg consumption statistics from the Yearbook of Farm Statistics 2007 (2007, 171); per capita GDP statistics in year 2000 prices: own elaboration from Statistics Finland (2009a, 2009b).

6 Discussion and conclusions

Using data on the consumption and production of meat, eggs and dairy products as well as the share of organic products, we explored the evolution of the animal welfare of farm animals in Finland in the last thirty years. This preliminary analysis was meant help study the tenability of the AWKC hypothesis using Finland as a case study. In addition, we discussed the possible theoretical foundations of the AWKC hypothesis. Our analysis suggests that per capita income growth seems to have been associated with a deterioration of the welfare of farm animals. This deterioration appears to be driven by dietary changes: Finnish consumption of foods from animal origin, especially meat and dairy products, has grown; beef has been partially substituted by poultry.

Our preliminary results should be taken with great caution. They are driven by the strong assumption that the level of utility of an animal raised in the conventional farm sector, thus excluding organic production, is negative compared to a zero utility of not being put into existence. Moreover, the time horizon of the data is limited, especially for the data regarding the production of organic milk, eggs and meat. More generally, one should be very careful when studying the links between economic growth and animal welfare. These links can be extremely complex and ambiguous, as hopefully we have been able to show in our analysis of the possible theoretical underpinnings of the AWKC hypothesis.

Our analysis was restricted to the study of the welfare of farm animals. We disregarded important activities such as aquaculture, fish farming, fishing, hunting, recreational activities involving animals, and the use of animals in research and education. We leave the analysis of the relationships between animal welfare and economic growth in these areas to future papers.

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