ANIMAL WELFARE: ENDS AND MEANS

By

ROGER CRYAN

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Dedication

This work is dedicated to my daughter, Elli, and my wife, Rene, without either of whom it likely would not have been completed.

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I also acknowledge the lack of cooperation from others whose vertebral fortitude was inadequate to participation in such "daring" work.

TABLE OF CONTENTS

Abstract of Dissertation Presented to the Graduate School
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By

Roger Cryan

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Chairman: Dr. Thomas Spreen
Major Department: Department of Food and Resource Economics

The social side of the animal welfare debate has been inadequately informed by

economic science. This work examines the philosophical debate over animal welfare and

proposes an alternative approach. It examines the prospects of the animal welfare/rights

movement in the context of public choice theory. An economic theory of animal welfare

is developed. Finally, a case study is used to demonstrate one methodology for

estimating the direct human costs of animal welfare restrictions.

CHAPTER 1
INTRODUCTION

Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses. - Lionel Robbins, 1935, p.16

A December 1995 Associated Press poll highlights the changing attitudes of the American people toward animals. In addition to the growth of existing majorities opposed to "indiscriminate" animal testing and killing animals for fur, new majorities now consider sport hunting to be "always wrong" and agree with the idea that "an animal's right to live free of suffering should be just as important as a person's right to live free of suffering." (Gainesville Sun, December 3, 1995, p. 3A) Such an expressed public philosophy has significant implications for both the producers and consumers of farm animals. If these views continue to become more common among a population alienated from the production of its food, government animal welfare policies could change the way of life of millions of American producers and consumers of animal products.

Since the relationship of means to ends is the subject of economic science, agricultural economists are behooved to consider the animal welfare ends desired by both the 'movement' and the public, and, in turn, to evaluate the rational means to those ends, whatever they may be.

The aims of the animal welfare and animal rights movement have been closely associated with the academic philosophical debate over animals' status in human society. These aims are examined in this work to discern any purposive and consistent ends that they might contain.

Whether, when, and how public sentiment will be translated into direct government action will have economic implications for agriculture and the consuming public. Inevitably, the perceived benefits of animal welfare measures will be weighed, however imperfectly, against human costs. To that end, specific economic impacts should be investigated, so that any restrictive measures taken on behalf of animals may be based upon a balanced prior consideration. This research proposes one theoretical basis for the economic consideration of animal welfare, based upon productivity as a measure of welfare. Further, it attempts to establish one methodology for such economic consideration through an examination of the impact of hypothetical animal welfare restrictions on contract broiler production in the state of Maryland.

Problem Statement

The upsurge of popular concern for animal welfare and of animal rights activism has led a wide variety of groups to make a wider variety of demands on agriculture. These demands have progressively included curbs on particularly intensive forms of animal production, a ban on all animal products and animal agriculture, and, finally, legal protection for animals comparable with that provided humans. The ultimate success of these groups, if that success results in effective constraints upon agricultural practices,

would have considerable economic consequences for those engaged in the production of animals and animal products.

In many ways the debate over farm animal welfare lacks a substantive philosophical context. Concern for animals generally has been expressed, even by professional philosophers, in emotional terms on intuitive premises. A sound philosophical foundation for this conversation is needed to frame the policy questions and define our real concerns about animals.

A substantive economic context is still more sorely lacking. Economic science takes human values as given and demands of the "rational" economic agent only that his preferences are "consistent" and "purposive". (Robbins 1935, pp. 90-93) Once the aims of a philosophy have been translated into such a consistent and purposive expression of desired ends, economic analysis allows useful evaluation of the required means.

However, society must decide among ends and means, as a whole and as individuals, on the basis of available information. The role of economics and social science is to inform the decision, not to make it. Once the consistent and purposive ends pursued by our society with regard to animals have been clearly identified, an economic context can be developed to evaluate means to those decided ends. This research is an economist's attempt to begin both the identification of ends and the evaluation of means, with respect to the issue of animal welfare.

Research Objectives

Animal welfare, for the most part, has been examined superficially by social scientists familiar with agriculture (Guithier and Van Buer 1991; Simpson and Rollin 1984). If it is one role of agricultural economics to assess the interaction of the farm sector with society at large, the field can have a useful place in the now disjointed debate over the status of farm animals, from which the agricultural establishment has been largely excluded (or from which it has excluded itself), despite its enormous stake in the outcome.

A discussion of this issue and the suggestion of an economic methodology to explore the human costs of the pursuit of welfare for animals are the purposes of this research.

The philosophical discussion upon which much of the animal welfare debate has been based is explored. This burgeoning literature is re-examined and a new basis for the consideration of the status of animals is suggested which makes clear the soundness of weighing animal welfare in light of its cost to humans.

The animal welfare movement is described. Its potential for success and a practical definition of the animal welfare issue are considered in the context of public choice theory and the political processes involved. Constitutional issues suggest the means by which an animal welfare agenda could most easily be translated into law, and demographic considerations may indicate jurisdictions in which such laws would be most likely.

An economic theory of animal welfare is developed, based upon the ordering of animal welfare by productivity per animal. A neo-classical production framework is used to consider the theoretical impact of welfare restrictions on "welfare", production, and profitability.

A case study is used to demonstrate a methodology for the analysis of the farm-level impacts of hypothetical but plausible animal welfare restrictions on broiler producers in the state of Maryland. After a review of broiler production, and Maryland's industry in particular, a representative farm is modelled to estimate the firm-level economic impact over time of potential animal welfare restrictions. Such results are used to draw conclusions regarding impacts on supply and profitability, as well as the multiplied effect on the local and state economies of changes in industry sales.

CHAPTER 2
PHILOSOPHICAL CONTEXT: DEFINING ENDS

Then God blessed Noah and his sons, saying to them, "Be fruitful and increase in number and fill the earth. The fear and dread of you will fall upon all the beasts of the earth and all the birds of the air, upon every creature that moves along the ground, and upon all the fish of the sea; they are given into your hands. Everything that lives and moves will be food for you. Just as I have given you the green plants, I now give you everything. - Genesis 9:1-3

Animal agriculture traditionally has been based upon an acceptance of the priority of human interests within the natural world, including the belief that human interests should rule human actions. Another, increasingly common, view of the role of animals in human society would place the 'intrinsic' interests of animals, and even plants and natural systems, on a comparable footing with human interests, leading its advocates to an ethical conclusion that man must yield some part of his interest to the rest of the natural world. Effecting such an ethic would have considerable human costs, and begs innumerable questions about methods and results.

From a philosophical standpoint, the animal welfare issue is both fascinating and useful, since it demands a fundamental consideration of the ends of morality. Man's moral relationship to animal can only be clarified in the context of man's moral relationship to man.[1] The current conventional philosophical arguments for animal

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[1] The author begs that the reader excuse the politically incorrect but traditional use of 'man' when referring generally to the human race as a preferable alternative to the

welfare and animal rights start from a weakly defined position with an under-developed foundation.

The Academic Mainstream

More importantly for this research, defining the philosophies driving the demands of the animal welfare and rights movement is vital to framing the economic question; without understanding the ends pursued, one cannot adequately evaluate the means necessary to those ends.

The most influential writers on the topic have been Peter Singer, who demands improved conditions for farm and other animals on the basis of 'equal consideration' in an utilitarian system, and Tom Regan, who argues that animals are entitled to rights which are comparable or identical to those of humans. These two writers have largely set the philosophical terms of the broader debate about animals' moral status in human society; this can be seen in the extensive critical literature devoted to the slight difference between the routes each takes to reach the same practical conclusions. (Thompson and Curtis 1994)

Peter Singer argues that animals are entitled to equal consideration with humans on the basis of their physical capacity to suffer and the lack of an intrinsic distinction between humans and animals. This argument for our equal consideration of animals rests upon three premises. First, suffering is intrinsically evil; second, animal suffering is morally indistinguishable from our own; and third, because suffering is evil, human

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tiresome repetition of such phrases as 'man and woman' or 'human beings.'

society is obliged to minimize it in all forms. If one accepts these premises as defining necessary human ends, it is indeed a trivial conclusion that human society must give consideration to the pain and pleasure of animals equal with that given to the pain and pleasure of humans. (Singer 1989, 1990) Because they are taken as given by Dr. Singer, each of these three premises must be questioned.

The first and third are the bases for utilitarian philosophies generally. Utilitarians hold that society should maximize the sum of happiness across individuals. This requires the feasibility of interpersonal comparisons of utility and denies the individual's unique qualifications to pursue his own ends. That such comparisons have no scientific legitimacy is a tenet of economic science. (Robbins 1935; Hicks 1946; Gardner 1995, p.19) The valuations necessary for a utilitarian balancing of ends would therefore be so arbitrary as to deny the efficiency of liberty without effecting a scientifically justifiable 'utility' maximization. This is rather more a conclusion of economic science than an argument of philosophy, but serves both purposes.

This standard criticism of utilitarianism as an economic philosophy becomes clearer when applied to Dr. Singer's formulation of measurable comparability of utility among species. In fact, he believes that society can determine the amount of pain or pleasure a particular practice causes a farm animal, directly compare that to the pain or pleasure which thereby accrues to humans, and dictate whether that practice shall continue. (Singer 1989) The pursuit of such a weighted utility objective by an utilitarian state depends upon the arbitrary criteria by which that state measures the individual happiness of each man and each beast. On the basis of what others claim will produce

the greatest happiness for non-human animals, man is denied the opportunity to pursue his own interest. Utilitarianism cannot provide an objective basis for social order among men; and it certainly cannot among species.

Dr. Singer's second premise links man's interest to that of animals by denying any fundamental intrinsic difference between men and animals that could provide any moral basis for disregarding the interests of animals. (Singer 1990, p.237)[2] In effect, he adopts the position of eighteenth century utilitarian philosopher Jeremy Bentham that the basis for utilitarian consideration "is not, Can they reason? nor, Can they talk? but, Can they suffer?"(p.7) That is, he identifies all suffering and decides on that basis that animals are entitled to equal consideration with humans. Human unwillingness to grant that consideration is therefore a form of bigotry Dr. Singer calls, after Richard Ryder, 'speciesism.'(Singer 1989; Ryder 1972)

Like Dr. Singer, Tom Regan (1982) denies man's right to make a moral distinction between humans and animals based on the absence of an intrinsic difference between humans and animals, further arguing that animals are entitled to whatever legal and human rights that they are capable of enjoying. Dr. Regan asserts each animal's right to pursue its own interests as the subject of a life on the basis of its ability to 'value' those interests, an assertion for which he draws explicitly from Dr. Singer's arguments for animals' capacity to suffer. This leads to his claim for animals' equal consideration and independent legal standing in human society.

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[2] In this, Dr. Singer is 'lifting himself by his boot straps', since his rejection of traditional moral theory relies upon that theory for its foundation.

He differs from Dr. Singer in denying, based on criticisms of utilitarian theory similar to those above, that each human's obligation is to maximize the aggregate utility of all creatures. He questions the necessarily centralized utilitarian program and finds it lacking. The authoritarian control demanded by any system of direct utilitarianism would be susceptible to the abuses which arise from all arbitrary authority. "Indeed, I believe that only if we postulate human rights can we provide a theory that adequately guards humans against the abuses that utilitarianism might permit." (Regan, p.90) This statement, by acknowledging that the origin and justification for a system of rights lies in its functional, rather than intrinsic, properties, provides the basis, not only for his refutation of Dr. Singer's animal utilitarianism, but also for a refutation of Dr. Regan's animal rights theory, which is based upon the 'inherent' value of all feeling animals and their interests. (1982, p.71)

If the Regan approach is more theoretically coherent in light of the impossibility of interpersonal or interspecial utility comparison and allocation, it still finds itself on the slippery slope of attempting to define the line 'below' which species do not possess some or all rights. Dr. Regan's theory requires that the same judgement be made upon some non-human species which he calls immoral when passed upon all non-human species; a rights framework must fall apart unless a line is drawn between those beings which do have rights and those that do not.

Dr. Regan neither questions nor defends the fundamental basis of the morality which, he believes, demands that we consider animal's rights the same as our own, but takes it on faith. He begins with the unsupported belief that animals are entitled to

equality with humans, and "postulates" a theory of animal rights to support this belief, in the same way that a theory of human rights has been postulated to support the more consistent ends of human protection from arbitrary authority. (Regan 1982, p. 90)

Libertarian political philosopher Robert Nozick has argued that animals must have equal consideration on the basis of a similar and similarly presupposed moral theory, according to which he finds no 'moral' basis for differentiating man from other species. He makes an analogy to human enslavement by 'superior' space aliens in support of his argument: if we would consider such an enslavement 'immoral,' we should so consider our enslavement of animals. This argument, however, appeals to our self-interest; we would perceive a violation of our well-being in an alien enslavement rather than an immoral act. This concern for our own well-being, in fact, must be an important consideration, if not the original basis for any moral theory, just as it provides the basis for economic science.

Professor Nozick recognizes the gap left in his work (and the work of Drs. Singer and Regan) by the absence of an explanation for his moral theory. "The completely accurate statement of the moral background, including the precise statement of the moral theory and its underlying basis, would require a full-scale presentation and is a task for another time.... That task is so crucial, the gap left without its accomplishment so yawning, that it is only a minor comfort to note that we here are following the respectable tradition of Locke, who does not provide anything remotely resembling a satisfactory explanation of the status and basis of the law of nature in his *Second*

Treatise." (p. 9)[3] Nevertheless, like Drs. Singer and Regan, he puts his philosophical cart before the horse and 'postulates' a journey. That he admits the gap does, however, lead to a more profitable line of reasoning.

Professors Regan, Singer, and Nozick define animals as morally indistinguishable from men, but can only define morality itself on an intuitive basis. They rest what they claim to be a rational, even a scientific, framework upon a traditional foundation which they then deny. They fail to define consistent and purposive ends when they presuppose a moral theory without the benefit of a rational explanation (or divine inspiration), and this failure makes the pursuit of their ends inconsistent and, so, infeasible. Indeed, biological science has generated a consistent and feasible philosophical ordering, grounded in evolution.

Many animal advocates cite the work of Charles Darwin as knocking out the foundations of 'speciesism.' (Singer 1990, pp.209-212) Professor Darwin did, indeed, redefine man's self-image by demonstrating his close natural relation to the other species; but perhaps more relevant to our inquiry is his theory of man's moral development.

The acceptance of evolution has led to the collapse of the 'intrinsic value' basis of man's self-centered world-view; but Professor Darwin himself begat a new theory of morality based upon evolution that defines even more clearly the functional separation of man from other species. In *The Descent of Man*, Professor Darwin presented a theory of man's morality as the product of evolution. Man's 'moral sense' was promoted "through

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[3] John Locke did, however, have the comfortable support of a Biblical moral theory that few in his time dared openly question.

natural selection: for those communities, which included the greatest number of the most sympathetic members would flourish best and rear the greatest number of offspring." (p.82) The seeds of a new ethical philosophy were planted when he suggests that "it would be advisable, if found practible,...to take as the test of morality, the general good or welfare of the community, rather than the general happiness; but this definition would perhaps require some limitation on account of political ethics."(p. 98) Thus, he recognizes that good and evil can be seen strictly as what is good or bad for the physical survival of the community, including both selfish and selfless acts.[4]

This is key to the Darwinian revolution in moral philosophy. A rethinking of basic moral theory by such philosophers as Thomas Huxley, Herbert Spencer, Friedrich Nietzsche, and William Graham Sumner (who coined the term 'social Darwinist') denied traditional morality for its lack of a rational foundation, and was based instead in man's brute origins. (Mencken 1908, Sumner 1885, Spencer 1879, Huxley 1911) Human morality, according to this view, is only justified and can only persist insofar as it promotes some basic, generally physical, 'good' of the human species.

Modern socio-biology uses the theory of genetic selection, based upon the assertion "that the fundamental unit of selection, and therefore of self-interest, is not the species, or the group, nor even, strictly, the individual. It is the gene, the unit of heredity." (Dawkins 1989, p. 11) Richard Dawkins, though "not advocating a morality based on evolution", does a very good job of describing such a morality. (p. 2) One

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[4] Nevertheless, man's morality is limited and "his actions are largely determined by the expressed wishes and judgement of his fellow-man, and unfortunately still oftener, by his own strong, selfish desires." (p.86)

implication of our being 'bred' by the survival of individual genes is that we are more accurately seen as 'vehicles' for the selection of genes than the direct subjects of evolution. Another implication, more to the point here, is that such Darwinian concepts as 'group selection' and behavior bred for the good of the species as a whole are qualified, and individuals' bald self-interest is tempered only by traits and behavior beneficial to genetically close relatives and, significantly, by more subtle self-interest of the kind which typifies much human interaction. (Dawkins 1989)

Natural law, then, if it can be said to exist, are only those positive physical circumstances which drive man's struggle for existence, the 'law of the jungle.' Under this law, there is no right and wrong, except what is good and bad for the species (or the relevant gene). Such human institutions as government, morality, law, and markets evolve and survive in order to serve human purposes. If they do not, they cannot be reasonably defended and they cannot survive in evolutionary competition with institutions which do. Here is a concrete end, defined functionally and functionally sustainable.

Morality toward animals, according to Professor Darwin, is essentially a stochastic by-product of a functional sympathy toward a growing circle of humans. "Sympathy beyond the confines of man, that is humanity to the lower animals, seems to be one of the latest moral acquisitions.... This virtue, one of the noblest with which man is endowed, seems to arise incidentally from our sympathies becoming more and more tender and more widely diffused, until they are extended to all sentient beings."(p.101) The rationality of this sympathy, Professor Darwin's sentiments about its nobility aside, may be judged by the standard he suggested earlier, that of 'the general good of the

community.' Since morality is based on man's historical competition with other species, there exists no rationally definable 'natural' basis for the inclusion of animals a priori and for their own sake.

Rational morality, to meet its human ends, must be concerned with functional, not 'intrinsic' values. Human institutions are valued for their functions and depend upon the reciprocity implicit in the social contract; the inclusion of all humans in this contract ("government of the people, by the people, and for the people") serves a functional human purpose.

The inclusion of animals on a comparable basis, on the other hand, will not serve the same purpose, since animals cannot be expected to reciprocate morally. In order to be functionally sustainable, evolutionarily or socially, the degree of animals' inclusion in human society must based on some human purpose. Jan Narveson (1989) argues on this basis for the exclusion of animals from the social contract. At least as important is the other half of the argument, that all humans must be included in the social contract in order to guarantee against the arbitrary exclusion of any. It is the clear line between our own species and the rest that provides the only consistent functional definition of full members of society. To use Dr. Regan's word, a system of rights must be postulated extending to all humans and only humans in order to provide a moral theory that will functionally guarantee human interests. The clear and natural boundary between man and all other species is the only solid footing on the slippery slope of exclusion. It is functionally necessary to make that distinction, for the good of the human species; and the good of the species, according to Professor Darwin, is the mandate of nature.

Morality is a practical tool. Collectively, humans are moral because morality has promoted human interests. This means that we can and should protect animals if we prefer to do so, but only because it is what we, as a species or as individuals, prefer. This is not to argue against animal welfare measures; it is simply to say that the sovereignty of man is an established fact, and that man may and will, in his own interest and according to the laws of nature, do whatsoever he decides is in his own perceived interest, as does every other species in its own way.

Animal Welfare and Human Ends

In fact, man serves his own purpose by promoting the welfare of animals in many ways.

The 'management ethic' offers the most rational positive argument for animal and environmental protection, but does not justify rights or equal consideration for animals. (Singer 1990) The preservation of the ecosystem as part of such an ethic provides direct benefits to animals which have indirect benefits to humans.

A certain degree of animal welfare coincides also with profitable farming, although profit maximization clearly does not produce animal welfare maximization, as will be shown in a later section of this work.

Aesthetic values also seem to have a large role in our moral sentiments toward animals. We view the extermination of rats differently from the death of a baby seal largely because their aesthetic impacts upon us are very different. On this basis the protection of aesthetically 'valuable' animals becomes a consumption good. The priorities

we place on such goods are the product of unscientific human preferences and can only be measured by the ways in which we reveal those preferences as a society.

Most would argue that a certain kindness to animals is necessary and necessarily enforced in order to prevent the moral degradation we feel is attendant to cruelty for its own sake. This is, again, a consumption choice, based on human ends. We might even decide that the granting of such rights as are advocated by Drs. Singer and Regan is necessary to the moral evolution of mankind; but if we do, it should be with the understanding that we do it in our own perceived interest.

Animal welfare, then, may be an intermediate input to human welfare. It also may be a direct human consumption good, like mountain vistas or flowers in the city parks. As such it must be weighed against other goods, including milk and eggs, fishing and hunting, meat, or fur. Restrictions on each of these goods for the sake of animal welfare will have a direct cost in human satisfaction. This is the fundamental trade-off upon which public policy regarding animals must be based.

This chapter is not written to condemn animals; it is merely an attempt to reconsider animals' place in human society in the context of man's natural history, and so to clarify the ends of animal welfare measures. The only rational (i.e. purposive and consistent) basis for man's protection of animals is the direct and indirect benefits he derives. *Homo sapiens* has thrived through its use of animals for food, protection, clothing, traction, and transport. The health of his physical environment depends in large measure upon the survival of many other species in a balance so complicated that man's poor understanding of it suggests caution in its care. Clearly, there are many arguments

for animal protection for man's own sake; but these must be valued for what they are to man, and not for what they are to other species.

In this context, it is appropriate to consider the benefits we wish to bestow upon animals in light of the costs to human society. It is an indirect recognition of the practical truth of this that many animal welfare appeals emphasize the slightness of the sacrifice they claim is necessary to provide animals with welfare. (Singer 1990; Regan 1982; PETA 1995) Since such material factors are, ultimately, the criteria upon which we will make these decisions, we should be more fully informed regarding them.

CHAPTER 3
POLITICAL CONTEXT: DEFINING THE MARKET

*Democracy is the theory that the common people know what they want,
and deserve to get it good and hard.* - *H.L. Mencken, 1949 p.622*

Our increasingly urbanized and suburbanized society provides fertile ground for appeals to the anthropomorphic sentiment many feel toward such "animals" as Mickey Mouse, Bugs Bunny, Lassie, and such "edible" characters developed to sell related animal products as the tuna fish that wants to taste good, Elsie the Borden Dairy Cow, and even the bull on the glue bottle or the cow on the box of gelatine.

The practical result of the animal welfare debate will be decided in public forums by any of a variety of voting rules, including legislative choice, direct voting, and boycott. These decisions will be made in the context of awareness raised by various animal welfare and rights groups, and will be informed by philosophy and, hopefully, economics. While the agricultural community tends to view animal welfare activists as outside the political mainstream, many single-issue groups have come to dominate the debate with respect to their issue[1] and, as the beforementioned AP poll indicates, a

[1] For example, the promoters of Prohibition in the 1910's and the opponents of gun control in recent years.

growing majority of Americans seem willing to accept greater restrictions on their or, more particularly, on others' use of animals.[2]

The Movement

The "movement" for improved treatment of animals is generally divided between the 'welfarists' and 'rightists', along lines defined by Drs. Singer and Regan and is more or less radical in its demands than these philosophers. The largest group on what may be called the extreme end of the animal advocacy spectrum is People for the Ethical Treatment of Animals (PETA), which attracts nearly $11 million in annual support and spending as much as $13 million yearly for a program which relies heavily on Dr. Regan's rights approach. (PETA 1996) The organization promotes vegetarianism and condemns all animal farming. They attract attention to their position by such means as the strategic placement of people dressed as animals protesting for their lives. During a recent American tour by the Pope, for example, a pair of PETA supporters dressed as a cow and a nun made the most visible protest in New York and Baltimore. (*City Paper*, Oct. 12, 1995) Their position on animal agriculture is made clear in their on-line 'Factsheet,'

> *...the factory farming system of modern agriculture strives to produce the most meat, milk, and eggs as quickly and cheaply as possible, and in the smallest amount of space possible.... Factory farming is an extremely cruel method of raising animals, but because it is profitable, it will only increase. One way to stop the abuses of factory farming is to support legislation that abolishes battery cages, veal crates, and intensive-confinement systems. But the best way to save animals*

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[2] This willingness to restrict the behavior of others is, of course, a hallmark of moral legislation.

from the misery of factory farming is to stop buying and eating meat, milk, and eggs. Vegetarianism and veganism mean eating for life: yours and theirs.
-People for the Ethical Treatment of Animals

This appeal has attracted the support of such visible celebrities as the B-52's musical group, singers Chrissie Hynde and k.d. lang, actors Elliott Gould and Winona Ryder, and cartoonist Berke Breathed, among others. (Thomas 1990) Such support attracts attention, if nothing else.

Other organizations concern themselves exclusively with the welfare of farm animals. The Human Farming Association claims 90,000 members and has an annual budget of over $1 million, derived almost entirely from direct contributions. Their activities focus primarily on their "National Veal Boycott," but also oppose the use of bovine growth hormones in milk production, the use of anti-biotics in farm animals, or any type of confinement animal production which might be described as "factory farming." (Human Farming Association 1995)

The Farm Animal Reform Movement (F.A.R.M.), originators of the "Great American Meatout," have designated Ghandi's birthday, October 2, as "World Farm Animals Day" in order "to memorialize the suffering and destruction of billions of innocent, feeling farm animals. The world-wide observances feature exhibits, memorial services, marches, vigils, and civil disobedience." This groups has an annual budget of over $125,000, used for the promotion of a meatless diet, including the distribution of materials for use in the public schools. The group also uses veal as a focal point, expanding its message to discourage the use of all farm animal products. (F.A.R.M. 1996)

Finally, United Poultry Concerns, dedicated to the "effort to establish more humane treatment of poultry and a healthier lifestyle," collected over $80,000 in 1995. Among their activities were protesting a Honda ad depicting a chicken unable to cross the road fast enough to avoid a speedy Prelude; placing 25 large paid advertisements in Washington's subway system decrying chickens' exclusion from legal animal welfare protection; holding a vegetarian Thanksgiving dinner in Frederick, Maryland, to publicize the alternative to turkey; picketing the annual Maryland Gamefowl Breeders Association Crabfeast to protest cockfighting; distributing 10,000 brochures against the ostrich and emu trade; conducting mourning vigils for chickens; and providing poultry-friendly teaching materials to science teachers. (United Poultry Concerns 1996)

In addition, many groups promoting a 'soft' animal welfare message in their fund-raising, emphasizing protections for dogs and cats and curbs on use of lab animals for cosmetics testing, in fact promote vegetarianism, 'veganism' and severe restrictions on animal agriculture in their other activities.

For example, the Humane Society of the United States has, since 1993, conducted a "public-education initiative to heighten awareness of the impact our food choices have on humans, animals, and the Earth." The Society "discourages people from buying food produced by factory farms where animals are raised in completed confinement.... The campaign promotes the 'three R's': *refining* the food you eat by purchasing only organic, and humanely and sustainably obtainable products; *reducing* the consumption of animal products; and *replacing* animal products with grains, beans, vegetables, and fruits." (H.S.U.S. 1997) In a 1990 address, President John A. Hoyt of the H.S.U.S. explicitly

supported a campaign "targeting Frank Perdue, the symbol of the poultry industry... We will relentlessly pressure Perdue to develop, promote, and implement systems that are responsive to the birds behavioral and physical needs.... We have no doubt that the Perdue campaign... will place farm animal welfare on the national agenda." (Hoyt 1990)

The H.S.U.S. has a staff of 115 in Washington and around the country. (Hoyt 1990) Their 1996 revenues were over $48 million. (HSUS 1996) In 1990, the Society published a "Close-Up Report" on confinement agriculture. The report's conclusion called for "humane sustainable agriculture" which "eschews intensive-confinement factory systems,...rejects dependence upon antibiotics, hormones, genetically engineered animals, pesticides, herbicides, and synthetic fertilizers," in order "to promote healthful and humane conditions for farm animals." (HSUS 1990) In addition, the Society conducts an annual National Farm Animal Awareness Week. (HSUS 1997.)

Even traditional Societies for the Prevention of Cruelty to Animals, seen by most Americans as mainstream and moderate, will almost inevitably come to be dominated, as has the Humane Society of the United States, by the passionate and committed people who have provided such vitality to the 'radical' animal rights groups.

Public Opinion

These organized groups dedicated to animal welfare represent several regions on one end of a conceptual spectrum of views toward animal welfare. Their work influences the distribution of the general population on this spectrum, and this distribution defines the public choice regarding the status of animals in our democratic society.

Some of the positions along such a spectrum may be represented by the following characterizations, beginning with the most animal-centered and ending with the most human-centered:

Equal rights for animals.

Equal consideration of animal welfare.

Comparable rights for animals.

Comparable consideration of animal welfare.

Some consideration of animal welfare, all animals.

Some consideration of animal welfare, some animals.

Animals as means to human ends only.

There is considerable overlap among these broadly characterized philosophies, but they may be ordered, as above, in a single dimension according to the sacrifices each expects man to make for the sake of animals' well-being.

An Associated Press poll conducted November 10 through 14, 1995, may adequately reflect American opinion of animal welfare and rights on more than one level. The results are given below[3]:

> Some people say an animal's right to live free of suffering should be just as important as a person's right to live free of suffering. Would you say you...
> 38%   Agree strongly
> 29%   Agree somewhat
> 18%   Disagree somewhat

[3] Attributed to Associated Press. "Source: AP national telephone poll of 1,004 adults taken Nov. 10-14 by ICR Survey Research Group of Media, Pa., part of AUS Consultant. Results have a margin of sampling error of 3 percentage points, plus or minus. Sum may not total 100 percent because of rounding. "Don't know" omitted."

12%   Disagree strongly

Do you think there are circumstances where it's perfectly OK to kill an animal for its fur or do you think it's...

59%   ...always wrong

36%   ...OK, in some circumstances

Do you think there are circumstances where it's perfectly OK to hunt an animal for sport or do you think it's...

51%   ...always wrong

47%   ...OK, in some circumstances

Do you think the use of animals to test cosmetics is...

46%   ...never right

21%   ...seldom right

29%   ...right under some circumstances

2%   ...always right

Do you think the use of animals to test medical treatments is...

14%   ...never right

15%   ...seldom right

62%   ...right under some circumstances

8%   ...always right

How often do you eat meat, poultry, or fish?

2%   Never

6%   Rarely

21%   Occasionally

71%   Frequently

(Foster 1995)

The economist (and the philosopher) might note with particular interest the answers to the first and last inquiries as an example of the contrast between stated and expressed intentions. The abstract response differs greatly from the concrete. Similarly, the expression of a public issue as a question of abstract principle, on the one hand, or as a specific balancing between costs and benefits, on the other, will greatly affect the issue's outcome.[4]

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[4] Other polls have been commissioned by such groups as the American Farm Bureau Federation, the American Veterinary Association, and the Animal Industries Foundation. An attempt was made to acquire and examine the results of these polls for the final dissertation, but communication with each of these groups revealed an inability or

Assuming the respondents to the Associated Press poll cited above to be both truthful and representative of the American electorate, the median voter eats meat, poultry or fish frequently; thinks that it is always wrong to kill an animal for its fur; thinks that animal testing of medical treatments are right under some circumstances, but that animal testing of cosmetics is seldom right; believes that hunting is always wrong; and agrees somewhat with the proposition that "an animal's right to live free of suffering should be just as important as a person's right to live free of suffering." (Foster 1995)

These results are consistent with a concern for animals, conditioned by self-interest. The median poll respondent depicted offers animals one absolute protection, from hunting; however, in 1994 only 5.9% of Americans bought hunting licenses, indicating that the median respondent held no personal interest in hunting.[5] (U.S. Fish and Wildlife Service statistic cited in Foster 1995)

Whatever arguments may be brought to bear for or against animal welfare or rights considerations, in our democratic society it has already become an issue by the voice of a vocal minority and an apparently accepting majority, and will become more important.

Democratic Processes

By its nature, the polity of a democratic society can impose any restriction or bestow any right on any person, place, or thing which the political process chooses and

unwillingness to provide these results.

[5] See footnote number 6.

which does not make the polity untenable. The only constraints are the process and, in the longer term, the sustainability of the outcome.

In this country the process is defined in part by the federal constitution. This constitution restricts the authority of government to deprive owners of property, and so long as animals are considered to be property strictly, there exists protection from very restrictive legislation. However, once animals are defined as more than property, the last constitutional objection is gone, and the choice becomes purely political; there is nothing, then, necessarily unconstitutional about animal welfare or rights legislation.

The legal history of animal welfare legislation in the United States dates to "The Body of Liberties" enacted by the Massachusetts Bay Colony in 1641 which stated, "No man shall exercise any Tiranny or Crueltie towards any bruite Creature which are usuallie kept for man's use." (Animal Welfare Institute, p.1)

Many modern anti-cruelty laws may be read as forbidding many of the standard practices to which animal activists object.[6] The law in the state of Maryland, with which the case study for this research is concerned, reads as follows:

27:59. Cruelty to animals a misdemeanor.

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[6] The Florida statute, which is typical of state anti-cruelty laws, reads as follows: *828.12. Cruelty to Animals. Whoever unnecessarily overloads, overdrives, tortures, torments, deprives of necessary sustenance or shelter, or unnecessarily or cruelly beats, mutilates, or kills any animal, or causes the same to be done, or carries in or upon any vehicle, or otherwise, any animal in a cruel or inhuman manner, is guilty of a misdemeanor of the first degree, punishable...by a fine of not more than $5,000, [imprisonment not exceeding 1 year, or both.(Florida Statute 775.082)]* (p.18, Animal Welfare Institute)

Any person who (1) overdrives, overloads, deprives of necessary sustenance, tortures, torments, cruelly beats, mutilates or cruelly kills; or (2) causes, procures or authorizes these acts; or (3) having the charge or custody of an animal, either as owner or otherwise, inflicts unnecessary suffering or pain upon the animal, or unnecessarily fails to provide the animal with nutritious food in sufficient quantity, necessary veterinary care, proper drink, air, space, shelter or protection from the weather; or (4) uses or permits to be used any bird, fowl, or cock for the purpose of fighting with any other animal, which is commonly known as cockfighting, is guilty of a misdemeanor punishable by a fine not exceeding $1,000 or by imprisonment not to exceed 90 days, or both...
27:62 *Definitions*

The words 'torture,' 'torment,' and 'cruelty' mean every act, omission, or neglect whereby unnecessary or unjustifiable physical pain or suffering is caused or permitted, and the word 'animal' means every living creature except man. (Maryland Statutes, cited in Animals and Their Legal Rights, p.26)

This is representative of the vagueness of state anti-cruelty laws, which generally leave the definition of cruelty so open to interpretation that any judge of a certain mind could find against any farmer that he felt was causing 'unnecessary or unjustifiable physical pain or suffering.' A Maryland broiler producer with, say, 100,000 birds could, in theory, face over 24,000 years of 90 day sentences or $100,000,000 in fines for one offending management practice.

Neither should the intent of the legislators at the time these laws were originally passed be counted upon to protect traditional practices; modern judicial interpretation makes great allowances for changing community standards in the literal interpretation of old statutes. 'Unnecessary or unjustifiable physical pain' might be interpreted in light of such public views as were expressed in the poll referred to in the introduction of this work; and new community standards may define as 'unnecessarily painful' any practice, however essential to modern production or rooted in ageworn tradition, which causes any pain, or even discomfort, to the animals involved.

Further, the provisions for 'proper drink, air, space,' etc., leave those production parameters particularly subject to state jurisprudence. In addition, the definition of "animals" to include "all living creatures" is broader than that in the dictionary, which would itself define rats, cockroaches, and amoebas as "animals."

In short, the status quo of production agriculture does not have institutional inertia on its side. Changing community standards regarding the status of animals need not be acted upon legislatively to effect a change; they need only be recognized by, and incorporated into the opinions of, individual judges.

Current law in many states is so open to interpretation as to require action merely to preserve the status quo. This legal ambiguity, the growing anthropomorphic sentiments of urban and suburban citizens, and the dominance of the audible debate by one side are each significant; taken together they suggest a wide variety of possibilities for the future of animals in human society.

In 1988, voters in Massachusetts were asked to pass judgement upon a ballot initiative, the ballot summary of which read in full:

> *The proposed law would require the Commissioner of the Department of Food and Agriculture to issue regulations to ensure that farm animals are maintained in good health and that cruel or inhumane practices are not used in the raising, handling or transportation of farm animals.*
>
> *The Commissioner would issue regulations, effective within four years after passage of the proposed law, about the surgical procedures used on farm animals, the transportation and slaughter of farm animals, and the diet and housing of those animals. The Director of the Division of Animal Health could issue exemption permits for a period of time up to one year and one half to any farmer.*
>
> *Under the proposed measure, an unpaid Scientific Advisory Board on Farm Animal Welfare comprised of veterinarians and animal scientist would also be established within the Department of Food and Agriculture.*

The Board wold examine animal agricultural practices, issue for publication certain reports on farm practices, and make non-binding recommendations to the Commissioner about specific regulations. If appropriated by the legislature, the Board may allocate an annual sum of not more than ten cents per Massachusetts citizen to assist farmers in adopting methods which are consistent with the purposes of this law.

The Director of the Division of Animal Health would be responsible for enforcing regulations issued as a result of this proposed law. Persons who violate the new law would be punished by a fine of up to $1,000.

Among the provisions of this law not mentioned in the Attorney General's "fair and concise summary" were directives to the Commissioner to "(e)nsure sufficient and appropriate ventilation, flooring, bedding, space, and temperature control to maintain the health and *comfort* of each farm animal" (emphasis added) and to ensure "healthful" and "nourishing" diets "to maintain optimum health and well-being of each animal." In addition, any construction or modification of an animal housing structure costing over $10,000 would have to be reviewed by the Scientific Advisory Board, four of whose five members would be appointed by the Governor only after being "nominated by at least two nonprofit humane organizations constituted for the primary purpose of preventing cruelty to animals and incorporated in Massachusetts." Finally, for purposes of enforcement, the law would allow that "Any person residing in or incorporated in Massachusetts may commence a civil suit in Superior Court on his own behalf to compel the commissioner or director to perform any duty which is required" by this law. (Mass. House Bill No. 4002)

That nearly 30% of voters supported this bill after a 2-150 defeat in the Massachusetts House of Representatives and a 0-34 defeat in the state Senate, and after a well-financed campaign by the Massachusetts Farm Bureau, suggests, again, that animal

welfare and animal rights must be addressed by the agricultural establishment in a serious manner. (Department of Food and Agriculture) In Europe, Union recommendations and individual country laws call for increasingly restrictive measures on behalf of animal welfare. (See Animal Welfare Institute 1990.)

Animal Welfare: A Public Choice

It may be inferred from the comparison of legislator's animal welfare votes with those of the public that the ballot initiative holds out the greatest hope for the animal welfare movement. This is borne out by public choice analysis.[7]

Voting in legislatures is defined by vote trading, essentially a market for votes in which votes are exchanged among legislators so that the issues most important to their own constituents turn in their favor. Though commonly seen as unethical, vote trading effects a theoretical Pareto improvement whereby each legislator's constituency, taken as a whole, gains support for that issue which matters most to it. (Mueller 1989)

Much larger numbers of people materially depend upon animal agriculture than are self-defined "animal activists". A balancing of relative interests would, then, seem to favor the farmer, whose living is at stake, over the marginally interested majority. Furthermore, many legislators, elected in geographically defined districts, are specifically

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[7] "The subject matter of public choice is the same as that of political science... The methodology of public choice is that of economics, however. The basic behavioral postulate of public choice, as for economics, is that man is an egotistic, rational, utility maximizer." (Mueller 1989, p.1) In other words, the political agent is purposive and consistent.

dependent upon farm constituencies, which are more geographically specific than the dispersed supporters of animal welfare measures.

In contrast, isolated single issue votes by the general public favor the majority above all, regardless of relative interest in the issue's outcome. According to an important theorem of public choice theory,

If x is a single-dimensional issue, and all voters have single-peaked preferences defined over x, then x_m, the median position, cannot lose under majority rule." (Mueller 1989, p. 66)

This theorem is demonstrated in Figure 2, also from Mueller (1989). Each "hill" represents the preference of one voter for a provided quantity of some public good (x) measured along the horizontal axis. The assumption of single-peaked preferences means only that each voter has a single maximum preference for x (or for the x relative to its direct costs, or opportunity costs in other public goods forgone), and that his preference ordering falls monotonically as x is further from that peak. The position of the median voter, represented by x_m, cannot lose under majority rule because half the other voters will always favor it over a smaller x, half will always favor it over a larger x, and the median voter will always favor it, giving x_m a majority against any alternative.
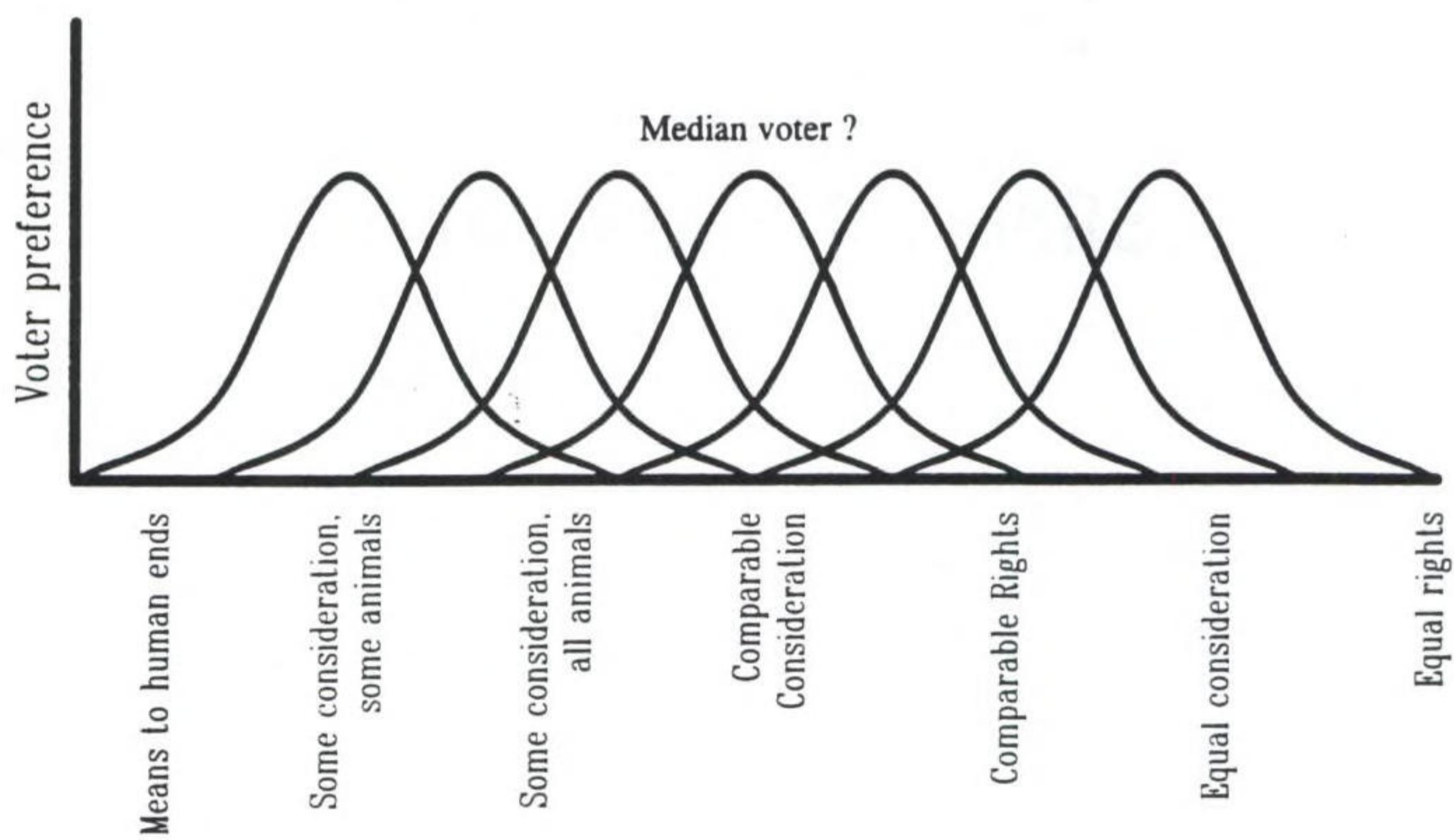
Applied to the animal welfare issue, the framers of a ballot initiative would wish to define the most extreme position which will win a bare majority, so that in practical

Figure 1. Voter preferences on a single-dimensional issue
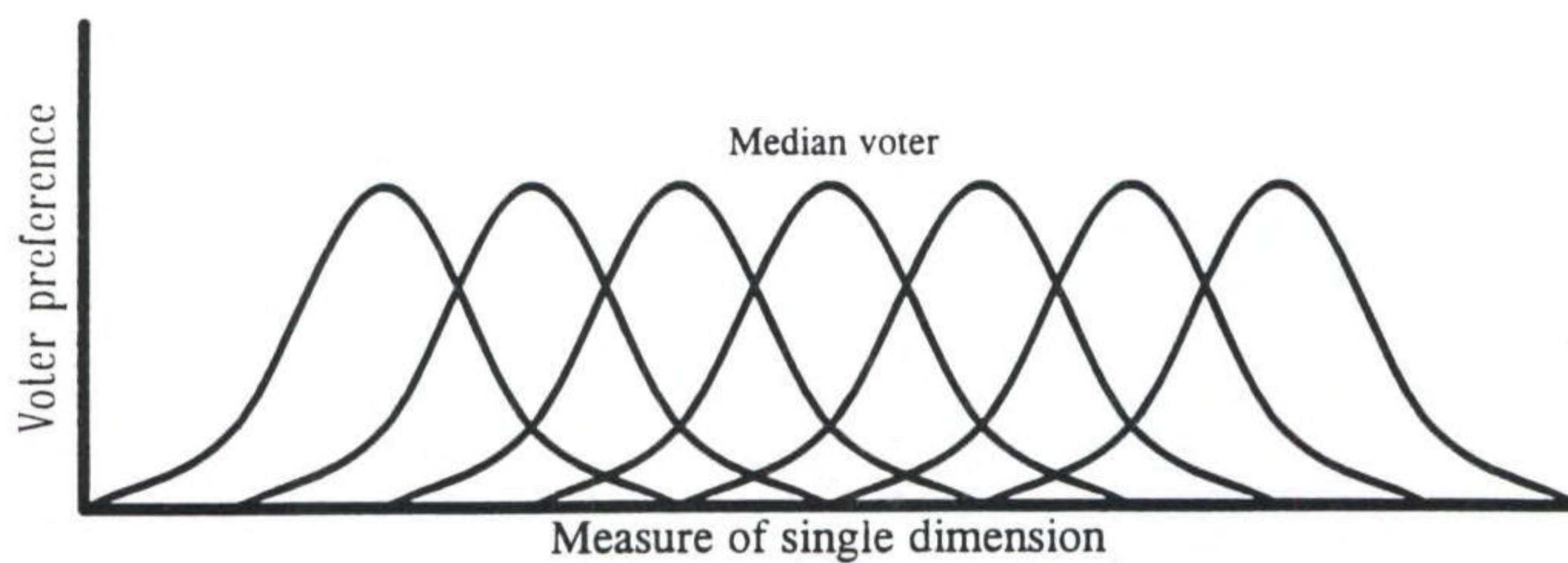
From Mueller (1989)

Figure 2. Voter preferences on animal welfare.

terms as well, the median voter along the animal rights/welfare/use spectrum will define the degree to which the welfare or rights of animals will be protected.

The representation of voters along the animal welfare spectrum represented in Figure 3 is consistent with the polls discussed above. The median voter has been defined above as concerned about animals' welfare, but not at any cost. We can only assume such a median voter to be a rational economic agent, whose choice will depend upon a weighing of all its known costs and benefits. This voter will, presumably and consistently with economic theory, be willing to bear some personal costs for the sake of animals and the satisfaction received from their improved welfare; but for the trade-off to be efficient, it must be understood. Therefore, analysis of costs and benefits associated with projects for the welfare of animals is not only justified, but would seem to be demanded.

Finally, the bounded rationality of such economic agents tends toward a fuzzy perception of self-interest. Even if corrected over time, this could, in the case of inadequately considered animal welfare measures, cause expensive disruptions to animal agriculture, to the detriment of producers and consumers. Again, foreknowledge has a value which must be recognized.

CHAPTER 4
WELFARE, RIGHTS, AND THE BROILER INDUSTRY

"It takes a tough man to make a tender chicken." - Frank Perdue

Concerns for the welfare of commercial poultry, particularly broilers, are less confounded with such issues as aesthetics or human health and safety than are concerns for other commercial farm animals. Chickens are not cute. They do not graze, thereby adding charm to rural views. It is generally difficult to identify with chickens, except in a relatively abstract and philosophical way. Human safety concerns are related much more to processing practices than to the conditions in which the birds lived. The health concerns attendant to meat-eating, commonly raised by animal advocates, are least for chicken among farm animals.

It is for these reasons, among others, that the broiler industry is chosen for the case study in this research. The estimated costs of regulation on behalf of animals may be counted directly as the human cost of animal welfare. To a large extent we are not indirectly promoting our own physical well-being by pursuing better conditions or higher standing for broiler chickens, so that we may directly relate the pursuit of animal welfare, as an end, to human economic goods forgone, as a means to that end.

The Maryland Broiler Industry

The application of modern mass production techniques to the broiler industry since the 1950's and 1960's makes that industry a particularly useful case study in the consideration of animal welfare. Almost inevitably, this industrialization represents the future of commercial livestock production in the United States, as may be suggested by more recent changes in hog and beef production. Other animal sectors are still in a transition to what will more closely resemble the broiler industry.

According to one argument, the capital intensity of modern meat production, by reducing the need for land, along with improvements in transportation of feedstuffs, should lead increasingly to the efficient location of pork, beef, and other animal production facilities nearer to urban centers. (Abdalla 1995) This has the potential to put animal farms within the jurisdiction of animal-concerned constituencies.

However, the natural economic efficiencies of this movement are often outweighed by the poor image such modern facilities seem to have in the eyes of urban and suburban populations with respect to other aspects of the "factory farm." These difficulties are generally associated with odor, unsightliness (in contrast to the "picture book" farms of old or of imagination), and the risks of surface and groundwater pollution associated with the large volumes of animal waste necessarily processed in large animal operations. Of course, animal welfare is another of these concerns.

As such public perceptions lead to the redefinition of property rights, broiler and other livestock industries will face increasing scrutiny. Proximity to cities and suburbs

and sites in urban states will become a political, and so economic, liability. (Abdalla and Shaffer 1997)

Table 1. Broilers: Production and price, 1934-94[1]

	Production, Thousands		Price per Pound[2]	
Year	Birds	Pounds	Cents	1994 Dollars
1934	34,030	96,594	19.3	2.14
1944	274,149	817,605	28.8	2.43
1954	1,047,798	3,236,248	23.1	1.27
1964	2,161,172	7,521,269	14.2	.68
1974	2,992,820	11,320,396	21.5	.65
1984	4,283,020	17,861,023	33.7	.48
1994	7,017,540	32,528,500	35.0	.35

1/ Marketing year December 1-November 30.
2/ Liveweight equivalent price.
3/ 1994 is preliminary.
Sources: Poultry: Production and Value, Annual Summary, National Agricultural Statistics Service, USDA. CPI: Bureau of Labor Statistics, U.S. Department of Labor.

In many ways the Maryland broiler industry is ahead of other meat industries. Its growth has been associated in part with its proximity to the large markets of the Northeast. It resides in a primarily urban and suburban state and so is subject to state regulation by a state government answering to an urban and suburban constituency. Because its move into such a "neighborhood" pre-dates many of the present concerns for animal pollution and the calls for collective action against animal production, the Maryland broiler industry offers a lesson on such conflict between the direct economic

benefits of location and public perceptions about the "factory farm," perceptions which will define collective public action.

In 1995, the broilers produced 63% of producer revenues in the $18.6 billion U.S. poultry sector, including eggs, turkey, and other meat-type chickens. (NASS 1996) As can be seen in Table 1, there has been enormous growth in the broiler industry since its modest beginnings. Large reductions in cost of production, and so in price, have fed the demand which has made such growth possible.

Table 2. Top broiler firms: market share and number of plants, selected years 1/

Year	Percentage of total U.S. slaughter			Number of slaughter plants operated		
	4 largest firms	8 largest firms	20 largest firms	4 largest firms	8 largest firms	20 largest firms
1960	12	18	32	21	31	52
1964	18	28	44	36	51	80
1968	18	29	47	31	48	84
1972	17	29	43	25	47	80
1976	18	31	55	26	47	91
1980	23	39	66	34	60	104
1984	34	51	73	41	68	105
1987	38	55	78	50	77	116

1/ Includes only those firms slaughtering broilers under Federal inspection.
Source: Lasley 1988.

There has been a steady trend since 1959 toward industrial concentration in the sector, with a few large integrated companies controlling larger and larger shares of production, in order to take advantage of economies of scale in processing and marketing. (See Table 2.) These companies control all aspects of production and processing directly or indirectly. Indirect control of the 'growing out' of broilers is maintained by the contract under which independent operators produce the grown bird. These large integrators typically hatch eggs from purchased breeding stock, and harvest, process, and market the grown birds. The integrators provide the growers with nearly all inputs to production, including feed, chicks, veterinary services, and production advice. The growers own only the broiler houses (often built to integrator specification) and equipment, and provide the labor, management, and capital-related expenses. (Knoeber and Thurman 1995, Lasley et al. 1988)

These large integrated processors have returns to scale and size so great that there is no effective market for live broilers. "Due to integration in the industry, there is no farm-level broiler price, so the USDA constructs a farm-level equivalent price by subtracting estimated processing and marketing costs from observed retail prices." (Knoeber and Thurman 1995, p.492.) The four largest integrators in 1990 controlled 41.2% of production nationally. (Knoeber and Thurman 1995)

The grower operation is concerned with the growth of the birds from the setting of a flock of integrator provided chicks to their catching, after seven weeks of growth, of four-pound birds, ready for slaughter and processing.

The closed, intensive nature of broiler production, and the careful control of the birds themselves, lead to less direct and less extensive conflict between production and human habitat, so that the issue of broiler welfare, when it is raised, is less to be confounded with the 'not in my backyard' concerns described above, which have plagued many new and established dairy, pork, and even egg operations. Since broilers are less aesthetically pleasing and less prone to personification than most mammals, the issue of their welfare is more specifically about the nature of human responsibilities to other species. For these reasons, the broiler industry is a useful case study for examining the ends and means of animal welfare.

Maryland, as an increasingly urban and suburban state with a large animal production industry, may be seen as a relatively likely area for the success of the animal welfare lobby. The state's ballot initiative process would allow a small committed group to place an animal welfare bill on the ballot. A large urban population in both Baltimore and the 'edge cities' around the District of Columbia, with limited exposure to production agriculture, are more likely to support such an initiative. In such a vote the passion of faint-heartedness of each vote has no bearing on the outcome; if the median voter is only barely convinced to vote "for the animals," his vote counts is weighed the same as all the rest.

The geographic isolation of broiler production from those centers also might weaken its appeal and potential ability to mount a campaign in opposition. The broiler industry is a large part of Maryland's rural economy, especially in those eight counties

where production is concentrated; a large impact upon production would have a large general impact upon those counties.

Table 3. Broilers: Production, Price, and Value by State and Total, 1995 [1,2]

State	1,000 Birds	1,000 Pounds	Price/Lb.[3]	Value of Production ($1,000)
AL	900,000	4,230,000	.340	1,438,200
AR	1,107,300	4,982,900	.355	1,768,930
CA	235,800	1,179,000	.325	383,175
DE	263,100	1,394,400	.340	474,096
GA	1,070,000	5,136,000	.345	1,771,920
MD	295,700	1,360,200	.340	462,468
MS	644,000	2,962,400	.335	992,404
NC	670,100	3,417,500	.340	1,161,950
TX	395,200	1,746,800	.370	646,316
VA	260,100	1,196,500	.335	400,828
FL	139,800	615,100	.355	218,361
US[4]	7,325,670	34,222,000	.344	11,762,222

[1]December 1, 1994, through November 30, 1995.
[2]Broiler production including other domestic meat-type breeds.
[3]Liveweight equivalent prices, derived from ready-to-cook (RTC) prices using the following formulas: (RTC price minus processing cost) X (dressing percentage) = liveweight equivalent price.
[4]Excludes States producing less than 500,000 birds.
Source: "Poultry Production and Value Summary", Released May 2, 1996, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, U.S. Department of Agriculture.

In 1995, Maryland's 690,000 tons of broiler production ranked seventh among the United States. (See Table 3.) This $462 million industry has an enormous impact on Maryland's eight Eastern Shore counties, which form her part of the larger Delmarva (Delaware-Maryland-Virginia) peninsula. This value of production is equal to more than 8% of personal income in these counties, which in 1992 produced 99.7% of the state's 257,209,663 broilers and other meat-type chickens, and contained all but six of the state's 1070 farms selling over 2,000 birds. The other Delmarva states, Delaware and Virginia, produce another 1.3 million tons of broilers, and contain the other two thirds of a $1.3 billion regional industry. (U.S. Dept. of Commerce; See Table 4.)

The mean annual sales per Eastern Shore farm is about 240,770 birds. (U.S. Dept. of Commerce) The median bird is produced on a farm producing 200,000 to 500,000 annually, and the median farm produces just over 200,000 birds. Poultry and poultry products accounted for 63% of 1992 sales of livestock and poultry products and 42% of all agricultural sales in Maryland. (p 10, U.S. Dept. of Commerce)

Potential Restrictions

The most extreme and most unlikely restriction upon the broiler industry in the state of Maryland would be a ban on all animal agriculture. This could be simply evaluated as the loss of animal-based agricultural economic activity and the complete depreciation of all unmovable and unadaptable capital in the sector. Beyond such a ban, there is a large range of restrictions upon production practices desired by more or less of the animal welfare community.

It has already been shown that the Maryland animal cruelty statute is so broadly written as to allow severe restrictions on all animal agriculture, if a small minority of judges and bureaucrats were to so interpret it. As animal welfare becomes more widely debated, the state's attitude toward animals and their keepers will necessarily be redefined and refined.

Restrictions could include bans on de-beaking and toe-trimming, both seen as detrimental to animal welfare by animal advocates and as vital to the health of the birds by growers. Any production system employing such restrictions would necessarily be significantly different from current practices, or would, at the least, require study by poultry scientists to determine their impacts upon production.

The requirement of a specific amount of floor space per animal is a common demand from animal advocates of all animal production industries. In addition, as a continuously variable input to existing production systems it has been studied in the poultry science literature, and the results of these studies may be applied to an economic consideration. This restriction will be examined in more detail in Chapters 5 and 6.

Table 4. Maryland Broiler Production and Farms by Size

County	All Farms	Birds Sold	1 - 1,999	2,000- 59,999	60,000- 99,999	100,000- 199,999	200,000- 499,999	500,000 or more	1993Pers. Inc. ($1,000)	1995 Population
Caroline	152	35,549,391	0	10	17	51	63	11	425,678	29,072
Dorchester	79	19,672,412	0	3	9	11	51	5	518,868	30,170
Kent	9	2,156,824	0	0	1	3	4	1	381,664	18,736
Queen Anne's	30	8,599,198	0	0	1	7	21	1	776,523	36,992
Somerset	187	48,523,355	0	22	17	53	75	20	327,719	24,431
Talbot	28	8,014,902	0	1	0	7	15	5	881,380	32,405
Wicomico	322	76,497,668	0	27	57	90	119	29	1,413,816	79,256
Worcester	258	57,407,806	1	15	46	81	98	17	816,561	39,946
Eastern Shore	1,065	256,421,556	1	78	148	303	446	89	5,542,209	291,008
All other cos.	44	788,107	38	2	1	2	1	0	112,995,479	4,751,430
Maryland	1,109	257,209,663	39	80	149	305	447	89	118,537,688	5,042,438

Source: U.S. Department of Commerce, 1994.

CHAPTER 5
AN ECONOMIC THEORY OF ANIMAL WELFARE: DEFINING MEANS

"Rabbits for sale:
Bunnies
Breeders
Fryers"
- sign seen on State Route 24 outside Waldo, Florida

Using an imperfect but uniquely scientific index of animal welfare ordering, an integrated theory of production and welfare can be developed in the neo-classical framework to formally express a relationship between animal welfare and economic production.

Defining Welfare

Framing such an economic theory of animal welfare depends upon developing a definition of animal welfare which is consistent with observable data and which is relevant to the economic decisions of animal production.

A large and growing animal and poultry science literature explores the relationship between farming practice and various indices of animal well-being. Three of these indices which have been widely studied are animal preferences and behavior, physiological stress, and productivity.

In Europe most recent scientific research on animal well-being has focussed upon preferences and other behavioral criteria. The absence of "natural" patterns of behavior,

stereotypic behavior ("persistent, highly repetitive behaviors without obvious purpose"), and "vacuum" behavior (behavior inappropriate to the relatively barren environment of a production facility, such as birds "dust-bathing" on a concrete floor) are all seen as indicating "mental suffering" on the part of the animal. Duncan and Petherick have been cited as suggesting that "animal welfare is dependent solely on the mental, psychological, and cognitive needs of the animals concerned."(Craig and Swanson 1994, p.927) This may have intuitive appeal to the economist who defines human welfare as the fulfillment of purposive and consistent preferences.

At first sight the economist may also be attracted to the preference ordering approach to animal welfare which is now gaining support in the animal sciences. The choices animals make among freely 'offered' multiple alternatives are recorded as a revealed preference ordering. The technique is further advanced by throwing up obstacles to the animals' choice of one option over another; this is supposed to suggest a 'price', or willingness to pay, on the part of the animal. (Duncan 1992)

The same economist will, presumably, recognize on closer examination that the significance of such results is based upon an assumption that animals, like *homo economicus*, are purposive and consistent in their preferences, and that their cognitive abilities allow them to efficiently determine means to their preferred ends. Even the proponents of this approach recognize that animals often choose what is contrary to their physical well-being, especially farm animals whose artificial selection or artificial environment are not compatible with the assumption of instinctive self-interest. In these cases, where physical well-being is not promoted by the animal's preferred alternative,

these supporters of the preference approach will define the inconsistency as an exception to their general rule, and acknowledge that the health promoting alternative represents a higher level of welfare. (Duncan 1992)

Since the 1960's, many researchers have attempted to define the overall well-being of animals by the presence or absence of physiological 'stress', as measured by a specific bio-chemical response. The long-held assumption that all stressors produce identical physiological responses in the higher animals (i.e. stimulation of the pituitary and adrenal cortex) has now been abandoned. There are, in fact, no physiological responses that are consistently correlated with all stressors, so that stressors must ultimately be defined as those factors which produce long-term negative impacts on physical well-being. (Hill 1983) In addition, significant observation effects related to the handling of animals for measurement purposes can seriously confound results. (Craig and Adams 1983) As with behavior and preferences, those supporting the use of physiological indicators of stress to measure overall well-being define as exceptions to their general rule those cases in which physical well-being is not consistent with the measured level of their indicators. (Hill 1983) In addition, some stress, especially early in life, has been shown to advance long-term welfare by promoting adaptations which allow the animal to better cope with other, later stressors. (Craig and Swanson 1994) In the absence of a consistent physiological response, the concept of stress as a measure of well-being is tautological, as well-being simply becomes the absence of stress.

The most consistent, measurable, and scientifically legitimate indicator of animal well-being is the productivity of the animal. Since productivity, measured by mortality,

reproduction, and weight gain, indicates much about the health of the animal, and since physical well-being is consistently defined as a necessary basis for overall well-being, a scientific approach to animal welfare may be effectively based upon identifying productivity with welfare (Macindoe 1987).[1]

Several criticisms are made against productivity as a measure of welfare.[2] First are the objections to average productivity, which fails to account for welfare differences among animals within a group. (Hill 1983) However, among animals of homogeneous age, breeding, and physical characteristics, such as typifies production agriculture, these differences should be minimal. (Craig and Adams 1983) In addition, the lack of a definitive weighting of reproduction, mortality, and weight gain (and milk production, for milking animals) leads critics to represent productivity measurements as potentially contradictory. (Hill 1983) This is true to some degree, but may be countered by pointing out the correlations among rates of reproduction, longevity, and growth within most species. Where such correlations do not exist this criticism warrants consideration, if only in a context of weaker alternative measures.

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[1] Productivity may be an even more appropriate index of animal well-being in light of the "social Darwinist" philosophy outlined above; the definition of well-being by those outcomes which would tend to represent evolutionary success may be the best measure of "the general good or welfare of the community", or alternatively, the best measure of the success of the genetic vehicle.

[2] Another concern may be the presumably negative impact on welfare from such practices which attempt, over the lifetime of the animal, to alter the nature of the animal product, such as the swelling of duck livers and the whitening of veal. This may be examined as a matter of animal health. Most animal productivity measures, however, are consistent with animal health.

The field of economic history, in fact, has adopted physical height as the best index of the former well-being of the mute dead. Graves are now robbed in the name of economic science, bones are measured, and the deceased are returned, confident that their feet and inches have revealed what their mouths never will, namely their welfare relative to their shorter ancestor or taller descendent. (Steckel 1995) If these economists can evaluate welfare from the bones of the dead and make comparisons across vast genetic, geographic, and chronological diversity, then we can certainly find value in such an index among genetically homogenous broilers in the same building at the same time, with the only difference the conditions of their captivity.

Another, more common, criticism of productivity as a measure of animal welfare comes from critics' confusion of animal productivity with profitability. (Craig and Adams 1983; Curtis 1988) The relationship between profitability and productivity, and their different implications for animal well-being, is our next consideration.

Welfare and Production

For those animals for which the identity of measurable welfare with measurable health, and so with per animal productivity, has been established, an economic evaluation of welfare can easily be conceived in the context of microeconomic production theory.

The theory of the firm provides a framework for considering animal welfare in relation to human costs. The relationship between cost and welfare can be established theoretically under both welfare and profit maximization.

Consider a strictly concave production function,

(1) $$y = f(x_b, x_h, x_f, x_l),$$

where

(2) $$f_i > 0$$

(3) $$f_{ii} < 0$$

(4) $$f_{ii}f_{jj} - f^2_{ij} > 0,$$

for $i,j = b,h,f,l$, and where y is liveweight broiler production, x_b is the number of chicks set in the flock, and the x_h, x_f, and x_l are housing, feed, and labor inputs, respectively. This production function and its impact upon per animal welfare, as we have defined it, may be analyzed in the contexts of maximization of that welfare, of farm-level profit maximization - the aim of the grower, and of per unit cost minimization - the aim of the corporate integrator.

Welfare Maximization

Taking productivity per bird as a monotonically increasing function of welfare, as is consistent with our definition of productivity as an index of welfare ordering, welfare maximization takes the form of the following optimization:

(5) $$\text{Max } (y/x_b) = f(x_b, x_h, x_f, x_l)/x_b,$$

for which first order conditions

(6) $$\delta(y/x_b)/\delta x_b = (x_b f_b - f)/x_b^2 = 0$$

(7) $$\delta(y/x_b)/\delta x_h = f_h/x_b = 0$$

(8) $$\delta(y/x_b)/\delta x_f = f_f/x_b = 0$$

(9) $$\delta(y/x_b)/\delta x_l = f_l/x_b = 0$$

solve to

(10) $$f_b = f/x_b$$

(11) $$f_h = f_f = f_l = 0.$$

That is, the marginal product of additional birds is equal to the average product per bird, and the housing, feed, and labor inputs are used until their marginal product is null. This optimum can be achieved if it is assumed that the per-bird productivity returns to the non-bird inputs diminish to zero (or, more practically, become statistically indistinguishable from zero)[3]. The cost of production will be $x^*_b r_b + x^*_h r_h + x^*_f r_f + x^*_l r_l$, where x^*_i is the welfare-maximizing level of input i, and r_i is the given price of input i.

Such an optimization, of course, is both theoretically and practically inconsistent with profitable farming, as has been confusedly pointed out by most critics of animal productivity as a index of animal welfare. It does, however, offer a useful starting point for considering the relationship between welfare and profitability.

Firm Profit Maximization

The production firm described in standard economic theory faces a production technology, such as that stated above, and a set of market input and output prices, and maximizes firm profits;

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[3] It should be further understood that the productivity of animal welfare can only reasonably be seen as indicative of ordinal utility, and that attempts to compare different increments of utility/growth along the production function or to compare the welfare of two significantly different chickens would be unscientific and irrelevant to economic analysis.

(12) $\qquad$ Profit $= f(x_b, x_h, x_f, x_l)p - x_b r_b - x_h r_h - x_f r_f - x_l r_l.$

Profit maximization is defined by the first order conditions

(13) $\qquad$ $\delta(\text{Profit})/\delta x_i = f_i p - r_i = 0,$

which solve to

(14) $\qquad$ $f_i = r_i/p,$

for all $i = b, h, f, l.$

Farm-level profit maximization, then, approaches welfare maximization, as defined by equations (10) and (11), as the cost of chicks set approaches one hundred percent of total cost of production, which is again defined by $x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l$, where x_i^* is now the firm profit-maximizing level of input i, and r_i remains the given price of input i. This condition obviously differs greatly from the current cost structure of broiler production, (see Chapter 6, Table 3,) but the extent to which the profit maximizing welfare outcome differs from that of welfare maximization depends upon the curvature of the production function. One significant implication of this is that the assessment of a head tax on farm animals, in place of taxes on other inputs to animal agriculture, would alter profit maximization (and cost minimization, based on results presented below,) outcomes in favor of animal welfare.

Constrained Firm Profit Maximization

Consider the constraint of such a firm by a floor space requirement, as has been discussed above among potential restrictions, which fixes a minimum ratio (k) of housing inputs (x_h) to chicks set (x_b),

(15) $$x_h/x_b > \text{or} = k.$$

Assuming the constraint to be binding, we may describe it as an equality in the producer's optimization,

(16) $$\text{Profit} = f(x_b, x_h, x_f, x_l)p - x_b r_b - x_h r_h - x_f r_f - x_l r_l.$$

$$\text{s.t. } x_h - kx_b = 0,$$

an optimization whose Lagrangian is

(17) $$L = f(x_b, x_h, x_f, x_l)p - x_b r_b - x_h r_h - x_f r_f - x_l r_l + m(x_h - kx_b).$$

The first order conditions for this Lagrangian solve to

(18) $$f_b = (r_b + mk)/p$$

(19) $$f_h = (r_h - m)/p$$

(20) $$f_l = r_l/p$$

(21) $$f_f = r_f/p.$$

This constraint, then, has the same positive impact upon welfare as the combination of an addition to the input price of chicks (r_b) equal to the shadow price of the constraint (m) times the constrained bird per housing unit ratio (k) and a reduction of m from the input price for housing (r_h) equal to m; that is, given a production function, the animal welfare effect is directly related to the cost of the constraint, defined by the Lagrangian m.

This establishes a direct functional relationship between human welfare, as measured by the market in dollars and cents, and animal welfare, measured by productivity as a chosen proxy for physical well-being. This "welfare" relationship, expressed by the outcomes of a constraint of the production function, can be considered in the context of other human optimizations of animal production processes.

Contract Broiler Optimization

In contrast to the classical profit-maximizing farm, the typical broiler growout operation is defined by the terms of the grower's contract with the integrator. As indicated above, the modern integrated poultry processing firm is large in scale and maintains a high degree of control over the production decisions of its contract growers, primarily through this contract, which is written by the integrator to provide incentives to per-unit cost minimization. Before considering the grower, then, it is important to define the objective of the integrator.

The large scale of operation of the integrated poultry firms makes per-unit cost minimization their logical economic aim at the level of the broiler house, the duplicability of which essentially eliminates scale effects for the integrator in the growout stage of broiler production. The integrators' decisions are oriented to cost minimization, and that mandate is imposed upon the grower by the terms of his contract and by the lack of a market for independent broiler production. So much, in fact, is production integrated with processing that there no longer exists a meaningful market price for live broilers; U.S.D.A. price estimates are based upon the 'ready-to-cook' price less estimates of processing costs. (Footnote 3; Chapter 4, Table 3; Knoeber and Thurman 1995)

The integrator's objective may be stated as the minimization of the price of the live broiler input to the processing operation. The unconstrained dual of per-unit cost minimization is per-unit profit maximization, i.e.,

(22)
$$\text{Max Prof}/y = p - rx/y$$

$$= \text{Min} (-p + rx/y)$$

$$= -p + \text{Min } rx/y,$$

where p is a exogenous. This last term will be a more convenient expression of the optimization under discussion.

Consider the per unit cost minimization/ profit maximization objective, subject to given prices (p, r_b, r_h, r_f, r_l),

(23) $\text{Max Prof}/y = \{p(f(x_b, x_h, x_f, x_l) - x_b r_b - x_h r_h - x_f r_f - x_l r_l\}/f(x_b, x_h, x_f, x_l),$

whose first order conditions solve to

(24) $f_b = r_b/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$

(25) $f_h = r_h/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$

(26) $f_f = r_f/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$

(27) $f_l = r_l/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$

Similarly to profit maximization, cost minimization approaches an animal welfare maximizing outcome, (i.e., equations (24-27) approach the conditions expressed in equations (10) and (11),) as $x_b^* r_b$ approaches one hundred percent of the cost of production.

Alternatively, (24-27) may be expressed as

(28) $(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f = r_b/f_b = r_h/f_h = r_f/f_f = r_l/f_l.$

The last four terms of this equation are, of course, a standard result for cost minimization and profit maximization; with the first term, the equation also produces a scale solution (if one exists) for unit-cost minimization/per unit profit maximization at the broiler house level.

The grower contract is the vehicle for the translation of integrator unit-cost minimization into grower profit maximization. These contracts typically set the grower's price (p_g), presumably at something estimated by the integrator at or near the minimum cost of production. The broiler houses are built to contract specifications, effectively establishing a duplicable, but not continuously variable, x_h for the grower operation. The number and quality of chicks set for each growout (x_b) is determined and provided by the integrator. In addition, growers obtain feed exclusively from the integrators, who thereby establish its quality and its effective price (r_f). In addition, the veterinary services and technical assistance must direct, to some degree, the grower's production practices. The high degree of market concentration in the broiler processing industry must also be significant in defining a condition of monopsonistic competition among integrators, limiting the alternatives of growers unhappy with the terms of their contract, almost certainly to an extent that allows integrators to set a bare break-even (cost-minimizing) price for live broilers, accounting for no profits beyond the market value of the grower's labor and the opportunity cost of capital.

Broiler contracts are generally based on "tournament pricing", under which growers are paid more per unit as their costs per unit are lower than other "competing" growers in a given period of time. The dominance of this pricing scheme in broilers particularly has been attributed to the high market concentration in the processing sector; this offers the large numbers of growers relative to processors which is favorable to effective tournament pricing (Barry et al. 1992).

The contract performance of growers is measured by a 'settlement cost', based upon a formula:

(28) $$sc_g = (x_b r_b + x_f r_f)/y,$$

where sc_g is the individual grower's settlement cost (Knoeber and Thurman 1995). Under these terms, r_b and r_f are established by the integrators. The price paid the grower (p_g) is a base price (p_0) plus (or minus) the amount which the grower's settlement cost is less than (or greater than) the average settlement cost (sc_a) among contracted growers during a limited time period:

(29) $$p_g = p_0 + (sc_a - ((x_b r_b + x_f r_f)/y))$$

This determines the grower's profit function,

(30) $$Profit = f(x_b,x_h,x_f,x_l)(p_0 + (sc_a - (x_b r_b + x_f r_f)/f(x_b,x_h,x_f,x_l))) - x_f r_f - x_l r_l.$$

This reduces to an apparently standard profit maximization

(31) $$Max\ Profit = f(x_b,x_h,x_f,x_l)(p_0 + sc_a) - x_b r_b - x_f r_f - x_f r_f - x_l r_l,$$

except that x_b, x_h, r_b, r_f, and p_0 are explicitly determined by the integrator. With x_b and x_h fixed, the first order conditions solve to

(32) $$f_f(x_b,x_h,x_f,x_l) = r_f/(p_0 + sc_a)$$

(33) $$f_l(x_b,x_h,x_f,x_l) = r_l/(p_0 + sc_a)$$

More importantly, the integrator defines, on average, ($p_0 + sc_a$), which is effectively the grower's output price; if the integrator has adequate cost information, this price may be set equal to an average minimum unit cost, leaving the grower no economic choice for profit maximization but an approximation to unit-cost minimization. Such contracts shift broiler price risk onto the integrator, but impose a large degree of cost

minimization per unit of production upon the grower through integrator-determined inputs and prices.

It is clear, then, that the integrator is the defining decision maker in the production process, and that it will be more useful to treat broiler production as subject to unit-cost minimization.

<u>Constrained Contract Broiler Optimization</u>

Consider, then, the effective imposition of the same per-bird housing requirement upon per unit cost minimization, fixing a minimum ratio (k) of housing inputs to birds (x_h/x_b). The integrator's constrained optimization, again assuming the constraint is binding, is

(34) $\text{Max(Prof/y)} = \{p(f(x_b,x_h,x_f,x_l) - x_b r_b - x_h r_h - x_f r_f - x_l r_l\}/f(x_b,x_h,x_f,x_l),$

$$\text{s.t. } x_h - kx_b = 0.$$

The Lagrangian function for this optimization is

(35) $$L = \{pf - x_b r_b - x_h r_h - x_f r_f - x_l r_l\}/f - m(x_h - kx_b),$$

where m is the Lagrangian multiplier. First order conditions solve to

(36) $$f_b = (r_b - mkf)/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$$

(37) $$f_h = (r_h + mf)/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$$

(38) $$f_f = r_f/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f]$$

(39) $$f_l = r_l/[(x_b^* r_b + x_h^* r_h + x_f^* r_f + x_l^* r_l)/f].$$

This also may be expressed as

(40) $(x_b r_b + x_h r_h + x_f r_f + x_l r_l)/f = (r_b - mkf)/f_b = (r_h + mf)/f_h = r_f/f_f = r_l/f_l.$

If m is positive, the constraint is effective. If it is negative, it is not and the producer optimization is effectively unconstrained.

Compare this with the unconstrained producer optimization,

(28) $$(x_b r_b + x_h r_h + x_f r_f + x_l r_l)/f = r_b/f_b = r_h/f_h = r_f/f_f = r_l/f_l.$$

Given a well-behaved production function and assuming no scale effect, an effective restriction (one for which m is positive) will reduce the output per housing input. The effect on the feed and labor inputs is ambiguous. Most significant to this research, cost per unit is increased by a magnitude defined by m on the one hand, and output per bird is increased on the other, achieving in some measure an increase in welfare according to our index.

It is the weighing of this increment of animal welfare against the corresponding increase in direct and indirect human costs that represents the fundamental trade-offs which must be decided upon as animal welfare takes a prominent place in public discourse. In Chapter 6 this trade-off is quantified by means consistent with the theory drawn above.

CHAPTER 6
EVALUATING MEANS: MARYLAND BROILERS

A case study will demonstrate a method of evaluating the human costs of restricting agriculture on behalf of animals and, to some extent, of putting those costs in the context of effects on animal welfare. Hypothetical restrictions on Maryland broiler production are considered and experimental poultry science data are used to incorporate alternative production relationships both in economic terms and in terms of impacts on the birds. The results are presented only as an example of the type of information which may profitably inform policy decisions affecting economic production and animal welfare.

Another study examining the effect of a mandatory lower housing density in broiler production was done by Simpson and Rollin (1984). This was a static comparison of costs for a standard practice and a doubling of floor space, assuming no effect on animal productivity and not evaluating impacts on animal welfare. Based upon a 1981 budget for an 18,000 bird broiler house in Central Georgia, the authors estimated a 27% increase in cost per pound of broiler production on the basis of assumed increases in costs for the building, litter, fuel, and power. That study doubled floor space per bird by doubling the size of the broiler house; the present study will consider instead the impacts on existing operations.

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Data

A firm budget for a representative Maryland broiler operation was compiled using

data from published sources, especially a broiler cost and returns budget for 1992 by the

U.S.D.A.'s Economic Research Service and Delmarva broiler budgets estimated at the

University of Delaware (ERS 1993; Gempesaw et al. 1994; Gempesaw et al. 1992;

Gempesaw and Bhargava 1990; Gempesaw et al. 1989.)

Table 5. Effects of broiler density on body weight and feed conversion

Density	Body weight (g.)	Feed Conversion
	(Std. dev.)	(Std. dev.)
0.05	1895	2.25
	(226.7)	(0.085)
0.07	2001	2.20
	(261.9)	(0.065)
0.09	2064	2.22
	(230.6)	(0.060)
0.11	2055	2.33
	(293.5)	(0.139)

Source: Cravener, T.L., et al. "Broiler Production Under Varying Population
Densities," in Poultry Science 1992, 71:427-433.

Data from poultry science research were used to represent the relationship between

housing density, on the one hand, and body weight and feed efficiency, on the other hand

(Cravener et al. 1992). The experimental results after seven weeks of four different

population densities are incorporated into the model. The feed efficiency results are

consistent with numbers reported by USDA and the Delaware researchers, and were incorporated directly into the model; the experimental body weight numbers differed somewhat from the Delaware numbers, so they were normalized to be consistent with reported average body weights.

Another significant element of both the welfare and production outcomes addressed by the Cravener study cited above is mortality. Clearly, changes in mortality will influence the volume of production. It will also have an impact on welfare which would confound an analysis of animal welfare based upon productivity. It is fortunate for the simplicity of interpretation of the following analysis that Dr. Cravener and his colleagues found no statistically significant impact on mortality associated with the variations in density which their study examined.

Although such experimental data must be used with caution, they nevertheless form a useful basis for developing analysis incorporating production relationships which vary with density.

Model

The model itself begins with a baseline simulation of costs on a representative Maryland broiler operation, based upon the budget data described above. With facility size assumed to be fixed, impacts on cost from changes in broiler density are estimated. Fixed costs are assumed fixed and most variable costs are changed in proportion to the number of birds set in the house, given each density level.

The grower's variable expenses include costs which vary in proportion to the number of flocks set, and costs which vary in proportion to the number of birds set. Costs for fuel and electricity and litter are assumed to vary with the number of flocks set, which we further assume to be 6 per house per year. Expenses for hired labor, operating loan interest, and an "other production costs" category including insecticides, disinfectants, rodent control, light bulbs, and other utilities, are taken to be variable with the number of birds set.

The grower's fixed expenses are constant per house. These are the interest payments on the fixed investment in the house and equipment, the payment to land, repairs and maintenance, and taxes.

The integrator's costs are all variable. The cost of chicks, medication and vaccination, catch and haul, condemnations, and field services are all taken as variable with the number of birds set. This consistency of cost per bird from setting to hauling is based upon the experimental evidence that the effect on the rate of mortality from the variations in density that we consider here is not statistically significant; this means that the number of birds caught and hauled will be in constant proportion to the number of birds set.

The integrator's feed cost varies with both the number of birds set and the average amount of feed consumed by each bird. This average consumption is a function in turn of the feed conversion ratio and the average weight. The feed cost, then, at each density was calculated as feed efficiency times body weight times the price given by the 1992 USDA study (16.28 cents per pound). Each of the other relationships is made explicit

in the tables below showing the model's results. This is the non-linear element of the cost analysis.

Analysis is based upon unit cost minimization. The original intention for this work was to model the profitability of the contract grower over time, but this presented several problems, especially a theoretical inconsistency.[1] First and as discussed earlier, the grower does not face a given set of prices; regulatory constraints on his production are likely to result in new contract terms, dictated by the integrator and aimed at unit cost minimization under the new conditions. Second, the contractual nature of broiler production, by eliminating the discovery of an effective farm level market price, makes the necessarily dependent estimation of profits speculative at best and meaningless at worst. Third, the broiler house is a duplicable unit of production which, in many senses, eliminates economies of scale at the levels of both the contract grower and the integrator.

Analysis of unit cost neatly answered both the theoretical and the practical needs of this study. It is consistent with the present theoretical framework, it is a simpler and, consequently, more flexible analytical approach, and it does not depend upon an unknown or non-existent farm-level market price for finished broilers.

The model, as presented, is static. The addition of a stochastic element was considered but, again, the contractual nature of the grower's "market" complicates this application. Looked at from the farm level (ignoring for the moment inconsistencies with our theoretical conclusions), the grower contract eliminates much of the grower's risk and

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[1] For such animal industries as continue to consist of traditional firm profit maximizers, such as beef, dairy, or, until recent years, pork, a profit maximization approach would be appropriate.

otherwise complicates analysis. Considered at the level of the integrator, stochasticity in the individual broiler house becomes negligible as the number of integrator-contracted houses grows very large; unit cost minimization is the aim, over many grower contracts and in the long run.

Constraints

Space per bird was established in Chapter 4 as the restriction to be considered. This is expressed in the model by holding the size of the houses constant and varying the number of birds. This is reasonable for an analysis of impacts upon existing operations.

Based on the cost relationships and the experimental production data described above, total and per kilogram costs are calculated for a number of birds per house corresponding to the experimental densities, demonstrating the potential effect of each density on unit cost and, by implication from per bird productivity, on welfare.

Results

The model and the model's results are presented in Tables 6, 7, and 8.

Table 6 shows in more detail the parameters of the model. As noted above, these are a composite of the numbers presented in several studies, as are the cost of production numbers. The current, or baseline, density of 0.0744 square meters per bird is based on this composite baseline and is presented for comparison. Its production parameters are not directly comparable to the experimental results, so the experimental body weights and feed efficiency results were normalized for consistency with the baseline; this

inconsistency is to be expected, since the actual production baseline results were not observed under the same experimental conditions as the four experimental densities. This normalization to the baseline scenario is necessary to estimate changes in commercial production costs to be expected from the imposition of the experimental densities.

TABLE 6. Cost of Production Simulation - Production Parameters

	.05 m²	.07 m²	Current Density	.09 m²	.11 m²
Density, m²/bird	0.05	0.07	0.0744	0.09	0.11
House area, m²	1859	1859	1859	1859	1859
Fixed investment, $/m²	74	74	74	74	74
Birds/house (1,000)	37.19	26.56	25.00	20.66	16.90
Houses	3	3	3	3	3
Land, acres	10	10	10	10	10
Flocks/year	6	6	6	6	6
Avg. mortality, %	3.5	3.5	3.5	3.5	3.5
Feed efficiency ratio	2.25	2.20	2.00	2.22	2.33
" , (normalized)	2.07	2.02	2.00	2.04	2.15
Avg. bird weight, g	1895	2001	2180	2064	2055
" ,g (normalized)	2045.1	2159.5	2180.0	2227.5	2217.8
Long-term int. rate, %	8	8	8	8	8
Operating loan rate, %	6	6	6	6	6
Prod'n/house/year, kg	440,319	332,107	315,555	266,438	217,044

Table 7 contains estimated total production costs per house per year. Fixed costs are, of course, unchanged. Fuel and electricity and litter are unchanged, as they vary by only with the number of flocks set and that is assumed fixed at six.

TABLE 7. Cost of Production Simulation - Total Annual Costs per House

	.05 m²	.07 m²	Current Density	.09 m²	.11 m²
GROWER - VARIABLE COSTS PER HOUSE PER YEAR:					
Fuel & Electricity	4,248	4,248	4,248	4,248	4,248
Litter	900	900	900	900	900
Hired Labor (1¢/bird)	2,153	1,538	1,448	1,196	979
Operating loan interest	281	201	189	156	128
Other production costs	2,374	1,696	1,596	1,319	1,079
TOTAL	9,956	8,582	8,380	7,819	7,333
GROWER - FIXED COSTS PER HOUSE PER YEAR:					
Land payments	143	143	143	143	143
Interest on facility	11,047	11,047	11,047	11,047	11,047
Repairs/maintenance	717	717	717	717	717
Taxes	287	287	287	287	287
TOTAL	12,195	12,195	12,195	12,195	12,195
INTEGRATOR - COSTS PER HOUSE PER YEAR:					
Feed ($0.17908/kg)	163,224	120,137	113,019	97,336	83,567
Chicks ($0.018/bird)	38,755	27,682	26,055	21,530	17,616
Medicine, Vaccination ($0.024/bird)	5,167	3,691	3,474	2,871	2,349
Catch & Haul ($0.06/bird)	12,918	9,227	8,685	7,177	5,872
Condemnations ($0.0168/bird)	3,617	2,584	2,432	2,010	1,644
Field Services ($0.024/bird)	5,167	3,691	3,474	2,871	2,349
TOTAL	228,849	167,012	157,139	133,794	113,396
TOTAL COSTS	251,000	187,789	177,714	153,808	132,924
CHANGE IN TOTAL	73,286	10,075	0	(23,906)	(44,790)

Hired labor, operating loan interest, and "other" grower production expenses vary directly with the number of birds defined by each density. Costs of chicks, medicine and vaccination, catch and haul, condemnations, and field services, among integrator costs also vary directly with the number of birds defined by each density. Each of these costs is a linear function of the number of birds, which is in turn an inverse function of the specified densities.

The integrator's feed cost, in contrast, is equal to the number of birds set times the survival rate times the average finished bird weight times the average feed conversion ratio times the (given) price of feed per kilogram. It is this cost into which the experimental data of Dr. Cravener and colleagues enters.

Table 8 shows the same costs per kilogram of finished liveweight broiler. (See Table 6.) Total production in kilograms is the number of birds set times the survival rate times the average finished body weight. This is the denominator for the unit costs presented in this table and the other way in which the Cravener data enters the analysis.

Density has two effects on unit costs. Unit costs are increased as lower density causes fixed and quasi-fixed input costs to be spread over fewer birds; unit costs are first decreased then increased again as lower density has first a positive, then a negative effect on both feed efficiency (which falls again after .07 square meters) and average body weight (which falls after .09 square meters.)

The results indicate that unit cost is lowest at .07 square meters per bird, among the four experimental densities. Again, that this is close to the observed density of .0744 helps to validate both the experimental results and the model as a whole.

TABLE 8. Cost of Production Simulation - Costs per Kilogram

	.05 m²	.07 m²	Current Density	.09 m²	.11 m²
VARIABLE GROWER COSTS:					
Fuel & Electricity	0.0096	0.128	0.0135	0.0159	0.0196
Litter	0.0020	0.0027	0.0029	0.0034	0.0041
Hired Labor	0.0049	0.0046	0.0046	0.0045	0.0045
Operating loan interest	0.0006	0.0006	0.0006	0.0006	0.0006
Other production costs	0.0054	0.0051	0.0051	0.0049	0.0050
TOTAL	0.0226	0.0258	0.0266	0.0293	0.0338
FIXED GROWER COSTS:					
Land payments	0.0003	0.0004	0.0005	0.0005	0.0007
Interest on facility	0.0251	0.0333	0.0350	0.0415	0.0509
Repairs/maintenance	0.0016	0.0022	0.0023	0.0027	0.0033
Taxes	0.0007	0.0009	0.0009	0.0011	0.0013
TOTAL	0.0277	0.0367	0.0386	0.0458	0.0562
INTEGRATOR COSTS:					
Feed	0.3707	0.3617	0.3582	0.3653	0.3850
Chicks	0.0880	0.0834	0.0826	0.0808	0.0812
Medicine and Vaccinations	0.0117	0.0111	0.0110	0.0108	0.0108
Catch and Haul	0.0293	0.0278	0.0275	0.0269	0.0271
Condemnations	0.0082	0.0078	0.0077	0.0075	0.0076
Field Services	0.0117	0.0111	0.0110	0.0108	0.0108
TOTAL	0.5197	0.5029	0.4980	0.5022	0.5225
TOTAL UNIT COST	0.5700	0.5654	0.5632	0.5773	0.6124
CHANGE IN UNIT COST	0.0069	0.0023	0.0000	0.0141	0.0493

Grower Impacts

The Delaware researchers cited above treat production across the Delmarva peninsula as identical, presumably because it is a relatively small area with similar resource endowments across each of the three states' portions. Given this assumption, new investment in Maryland broiler houses will cease if minimum housing densities in that state were to be fixed at .09 or .11 square meters per bird, or any other level significantly above the cost minimizing density which is, presumedly, the current density of .074. This is a trivial result (assuming, also, that the land occupied by the grower operation is valued by the market for its value to some other, less productive, use.)

The model estimates the increase in total and per unit production costs to be expected from a space constraint upon production. Obviously, those densities so high as to raise unit costs will not be applied, as they serve the purpose of neither the grower nor the animal welfarist.

Depreciation or abandonment of existing facilities, on the other hand, will depend upon the specific costs associated with each density. Again given competition from unconstrained and otherwise identical producers in neighboring states, all increases in the unit cost of production will be capitalized into the value of existing facilities. Facilities will be abandoned when their value in broiler production becomes negative.

Within the present cost minimization analysis and given the existence of the opportunity to duplicate the baseline scenario in Delaware or Virginia, depreciation of a Maryland facility may be calculated from these cost of production numbers.

If, as we have assumed, the broiler house facility is duplicable, then like any intermediate input in a competitive market, its cost of replacement which is equal to its use value over time, or the present value of its stream of marginal products, which we may approximate as

(41) $$V_h = VMP_h / r$$

or put another way,

(42) $$VMP_h = k * r$$

where VMP_h is the annual value of marginal product of the broiler house, k is the cost of replacement, and r is the future discount rate. In this case the long-term interest rate is an appropriate future discount rate, since it represents the opportunity cost of the capital sunk into the facility.

An effective animal welfare constraint on cost-minimizing production will have a dual effect on the value of the facilities marginal product. The first component is a unit cost of production effect, which depreciates the facility by making its production process less efficient; the second component is a production effect, which reduces the value of the facility by limiting the number of inputs (birds set) to the production process and, so, limiting the volume of production. The reduced present value of annual product plus the present value of the reduction of annual product, is embedded in the economic value of the facility (assuming no other use value) and can be expressed as

(43) $$D = ((c_w - c_0) - (c_0 (y_w - y_0))) / r$$

where D is depreciation, c_0 is the baseline long-run cost of production (which also serves effectively as the value of production, given the zero profits we may assume of the

grower), c_w is welfare-constrained cost of production (including the original, sunk cost of the facility), y_0 is baseline production, y_w is the welfare constrained production, and r is the future discount rate.

The depreciation of a $138,089 facility under each density requirement is presented in Table 9. At the 6% long-term interest rate assumed in the model, this facility will lose 45.3% of its value under a .09 square meters per bird restriction. At .11 a total loss of economic value is suffered.

TABLE 9. Depreciation of $139,089 Fixed Investment, by density

	.05 m²	.07 m²	Current Density	.09 m²	.11 m²
Increase in variable costs:	$73,286	$10,075	$0	($23,906)	($44,790)
Original cost/kg	$0.563	$0.563	$0.563	$0.563	$0.563
Change in annual prod., kg	124,764	16,552	0	(49,117)	(98,511)
Depreciation, fixed investment:					
At 8%, $	$37,765	$9,413	$0	$46,946	$133,620
At 8%, %	27.3%	6.8%	0.0%	34.0%	96.8%
At 6%, $	$50,354	$12,550	$0	$62,594	$178,160
At 6%, %	36.5%	9.1%	0.0%	45.3%	129.0%
At 4%, $	$75,531	$18,825	$0	$93,891	$267,240
At 4%, %	54.7%	13.6%	0.0%	68.0%	193.5%

The impact of such depreciation on the facility's economic life depends upon its natural economic depreciation. Whenever age and technical obsolescence pushed the house's value of marginal product below zero, production would cease.

The impacts upon Maryland's broiler sector in the aggregate could be substantial. Assuming the model to be representative of Maryland broiler production, the fixed investment for the state's 690,000 tons of production in 1995 was about $278,000,000. The depreciation calculated from the model's results would translate into depreciation of $101.5 million at .05 square meters per bird, $125.9 million at .09, and $278 million (or 100% of investment) at .11.

This means that a restriction of .11 square meters per bird would make production uneconomic, even considering fixed investment as sunk cost. A .09 square meter restriction would cause production to cease as each facility's economic depreciation reached 54.7% of original investment; that is, when the value of its marginal product falls below 45.3% of its initial value. In the short term, production would be directly reduced from 690,000 to 582,600 tons at .09 square meters per bird due specifically to the reduced capacity of the facilities; and, of course, at .11 production would fall to zero.

Regional Economic Impacts

Assuming the baseline unit cost of production as a unit value, a loss in the value of output delivered to final demand can be calculated and used to estimate impacts on the Eastern Shore economy, using final-demand multipliers calculated by the Bureau of Economic Analysis. These multipliers are the output of the Bureau's Regional Input-Output Modeling System, or RIMS II. They are based on the 1987 Benchmark National Input-Output Table and 1992 regional data. This means that the basic framework analysis for the interaction of industries is based on 1987 numbers, and that the numbers input for Maryland's Eastern Shore were for 1992. (Department of Commerce 1997)

The initial value of 690,000 tons of liveweight broilers, at our estimated baseline cost of production of $0.563, is $1,709,268. This is the value by which delivery to final demand is reduced under a .11 square meters constraint. The estimated short-run production of 582,000 tons at .09 square meters, valued at the same cost of production (since the national supply is assumed to be infinitely elastic at that price) is worth $1,441,730,400, a loss of $267,537,600 to delivery to final demand.

In Table 10, output, earnings, and employment coefficients are used to estimate the multiplied impact upon the Eastern Shore resulting from the loss of delivery to final demand associated with each effective constraint.

Table 10. Regional Economic Impacts of Constraints on Eastern Shore Broiler Production

	Multiplier	.09 square meter	.11 square meter
Loss of production, tons		108,000	690,000
Loss of delivery to final demand		$267,537,600	$1,709,268,000
Multiplied output effect	2.4233	$648,323,870	$4,142,069,100
Multiplied earnings effect	0.5206	$139,280,070	$889,844,920
Multiplied employment effect	28.8423	7716	49,299

The output multiplier is "the total dollar change in output that occurs in all industries for each additional dollar of output delivered to final demand" by the poultry and eggs sector in Maryland's Eastern Shore. The earnings multiplier is "the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand" by the sector. The employment multiplier is the

number of jobs in the region directly and indirectly associated with each million dollars of additional output delivered to final demand by that sector.

According to these estimates, household earnings directly and indirectly dependent on the broiler industry are equal to 16% of personal income in the eight counties of Caroline, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico, and Worcester. (Department of Commerce; see Table 4.) Even the loss of household earnings associated with the .09 square meter constraint is equal to 2.5% of the region's household earnings. These are the human costs of animal welfare on the Eastern Shore.

It is to be expected that the impact of a single state's restriction of broiler production would produce, at most, a short-term consumer impact, under the assumption that neighboring states face conditions which would differ only by the absence of housing restrictions, and that these states would increase supply to make up for the potential Maryland shortfall. In the case of Maryland, this is a reasonable assumption. The budgets drawn for Delmarva broiler production at the University of Delaware make neither cost distinctions nor other distinctions among Maryland, Delaware, and Virginia. (Gempesaw et al. 1989, 1990, 1992, 1994; Bacon et al. 1994). In a oligopsonistic market, such as contract broiler production, the integrator can impose almost all of the costs of facility depreciation related to animal welfare upon the grower. Aside from costs associated with the short-run decline in production capacity, there should be no consumer impact.

Animal Welfare Impacts

These enumerated economic impacts upon humans resulting from animal welfare restrictions demonstrate one side of the trade-off between human and animal welfare. The other side, the impact upon chickens raised in broiler production, is more than the direct impact of conditions changed by mandate.

In the short-run, an index of improved animal welfare can be inferred from the increase in per animal weight. As discussed above, the animal welfare maximizing outcome would be appear to be achieved at a density of .09 square meters per bird. The magnitude of this welfare improvement over any other density can not be determined; only a welfare ordering can be drawn from the work of Dr. Cravener et al.

Table 11. Inferred Welfare Ordering, by Density, Assuming Equal Bird Numbers[2]

Square meters per bird	Man: Cost (order)	Chicken: Body weight (order)
.05	$0.5700 (2)	1895 (4)
.07	$0.5654 (1)	2001 (3)
.09	$0.5773 (3)	2064 (1)
.11	$0.6124 (4)	2055 (2)

However, as Maryland's industry declines as a result of production constraints, the number of birds benefitting from the new conditions will decline as well, as they are shifted to unconstrained production facilities in neighboring states. In the long run the impact upon animal welfare of any state law in isolation will be negligible if it makes

[2] If we were negotiating with chickens for one of these arrangements, only .07 and .09 square meters per bird would be in the Edgeworth core, since neither .05 or .11 would be Pareto optimal among these choices.

production uneconomic. This means, then, that a .11 square meter restriction would have no impact on the welfare of broiler chickens, since birds grown in other states instead of Maryland would be raised at the baseline density.

Additional Considerations

The interaction between states' animal welfare restrictions on competing state industries opens up an new set of considerations to be addressed as a problem in game theory. Each state's choice of outcomes would be conditioned by each competing state's decision. For example, the severe restriction of broiler production by both Maryland and Virginia would, by shifting production to Delaware, greatly increase Delaware's economic stake in the industry. On the other hand, Delaware's decision would also have a much greater potential impact on welfare once the other states had closed the door to existing production methods.

Unlike most other conflicts between animal agriculture and the general population, such as over odor, noise, or, especially, water quality, animal welfare issues are not, in principle, a "not in my back yard" concern. One should not expect an animal welfarist to be satisfied if all the "factory farms" move out of state.

Therefore, if the supporters of such a local measure as a state broiler space requirement wished to maximize the "welfare" of a large number of birds, they would most rationally promote a restriction that achieved some balance between individual bird "welfare" and production profitability, suggesting that a local scale for collective animal welfare action is conducive to a balanced, perhaps negotiated, compromise. By contrast,

national regulation could adopt the extensive "command and control" approach so popular with the promoters of ever more collective action. There would be no check on such regulation except the very diluted check of voter (and contributor) dissatisfaction.

Support for that alternative, Federal regulation, must overcome the considerable resistance of agriculture's disproportionate representation in the U.S. Senate, a body whose traditional role is, after all, to give a place to caution in the development of government. Only Federal regulation, with effective protection for "animal-friendly" production, would eliminate the state versus state game aspect of the policy decision, leading, however, to international games of "chicken," if you will.

CHAPTER 7
CONCLUSIONS

A man may well bring a horse to the water,
But he cannot make him drinke without he will.
- John Heywood (1497-1580)
(Bartlett 1938)

This work was an attempt to trace the animal welfare debate from philosophical premises, through social and political processes, to economic conclusions.

Philosophy

The desire to find an "intrinsic" basis for universal human rights led some philosophers to observe that not all men are superior to all animals and that some animals, therefore, are "intrinsically" entitled to the same rights and considerations as man. Some argued further that if some animals are entitled to such rights, all must be. It is this thinking which has largely framed the terms of the debate over animals' place in human society.

"Intrinsic" definitions must be subjective. They invite such abuses as the Soviet use of mental asylums to deny the rights of political opponents or, alternatively, the arbitrary inclusion of the lowest animals which can be (subjectively) judged as the "intrinsic" equal of the most debilitated human.

Rights, and all morality, must be defined in functional terms. The clear and undeniably objective definition of the human species from other species can functionally define rights-holders so that, on the one hand, all humans may be confident of their place and, on the other, the social contract is not extended to other species who cannot be reasonably expected to contribute by their voluntary participation. No system of rights is sustainable which does not work, so workability must be a priority in discussing systems of rights.

It should be understood, therefore, that the sustainability of any system of protections for animals must be grounded in whatever human ends are served by those protections. If we protect animals, it is, quite reasonably, because we derive short and long-term benefits from doing so; if we do not, it is, just as reasonably, because we find that the costs outweigh those benefits. For this reason economic analyses of the human costs associated with animal protections are not only justified, but must be the basis for any informed decision on animal welfare.

Social and Political Processes

Public choice theory, by applying economic methods to political processes, offers useful analyses of those processes. A brief consideration of demographic and constitutional issues in this work leads to a conclusion about the type of jurisdiction which is most likely to implement pioneering animal welfare measures. Such a jurisdiction contains a committed animal welfare movement depending upon a constitutional arrangement which allows the weak preference of an urban and suburban majority to

decide the issue against the large stake of an agricultural minority. Maryland is such a jurisdiction, so her Eastern Shore broiler industry could be a subject of such pioneering measures. For this reason, and because the contract-oriented structure of the broiler industry appears to represent the future of other animal industries, economic analysis of the effects of such measures in this context can both meet a more or less immediate purpose and demonstrate a methodology for considering animal welfare in other animal industries.

Economic Theory

An economic theory of animal welfare has been lacking; this work proposes one such theory. It is a tenet of economic theory that welfare cannot be directly compared among individuals; this holds, presumably, for animals as well as humans. However, just as economic historians have settled on the size of human remains as a proxy for human welfare across time and place, so may we settle upon per animal productivity as a proxy for the well-being of animals, certainly within a homogeneous genetic stock and under similar conditions. High productivity is closely correlated with a general state of good health, to which all definitions of animal welfare defer, but which is not itself easily quantifiable. It is also important to recall that any such measure of welfare can only be a relative index, and not an absolute measure, of each animal's (or each person's) welfare. To the extent that we choose to aggregate welfare across animals, we are assuming them to be identical. This is not an unreasonable assumption in many animal production contexts.

Per animal productivity is only one among several rough indices of animals' physical well-being. It is at least as good as the rest, and has the analytical benefit that it may be integrated into the framework of economic production analysis. In this framework we can make direct comparisons of production systems in terms of both the per-animal productivity and the unit cost of animal output.

Results and Suggestions for Further Research

The results of the quantitative analysis in this work bear out the theoretical conclusions. There is some trade-off between animal welfare and human costs, although their optima may be closer together than is believed. The methods of this quantitative analysis can, with little difficulty be adapted to analysis of any animal welfare measure whose impact on the production function is understood. Application to a profit-maximizing firm in other meat production industries is more complicated, but is standard to production economics, with only the innovation of observing per animal productivity as an index of welfare.

Additional thought must be given to the changes in animal genetics. As breeding and new genetic technologies take each animal farther from the genetic composition defined by evolution, body weight and reproductive success require closer examination as measures of welfare in an evolutionary context. The reshaping of animals by man does, after all, complicate this analysis.

Conclusions

The scientific economist, if he has done his job well, may lead his audience to understand their choices among the uses of scarce resources. However, just as the mare will not be watered except by her own choice, so that audience needs the economist to get out of their way when he is done and let them decide for themselves.

This work, aspiring to a properly scientific economics, will not attempt to reach a conclusion on the subjective choice at the heart of the work, the choice of a role for animals in human society. This research has attempted to frame a human choice in rational terms, so that it might be made with open eyes. This framing, however, bears some brief comment.

The philosophies driving and defining much of the popular debate on animal welfare do not have a rational basis. Humanity should not continue to accept unquestioned premises as the basis for so important a moral development. If a more rational course has been defined by the recycling within these pages of old and forgotten considerations of man and nature, so much the better.

Nevertheless, however rational such a course may be, those who do not choose to follow it can not simply be ignored. If their numbers are large enough, they must be considered in the calculus of collective action; this is pragmatism. Those who would bury their heads in the sand, hoping such a movement as animal welfarism will go away on its own may find themselves particularly exposed.

With regard to economic science, animal welfare may be seen as a great exposer of weak methodology and weaker assumptions. The assumptions made by many

regarding the interpersonal comparability of human welfare are even more clearly shown to be untenable in the light of its perfect analogy to comparisons among members of different species. If, similarly, the presentation of this analogy helps to discredit the demonstrably flawed elements of welfare economics as generally practiced, so much the better.

Finally, if this work successfully encourages a more sober balancing of what man has to gain and what he has to lose from offering more to the animals with whom he shares the planet, so much the better.

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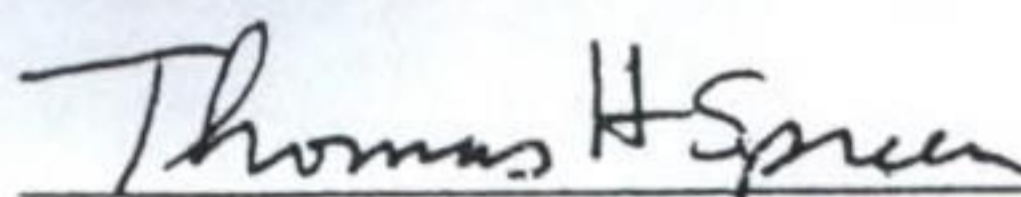
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BIOGRAPHICAL SKETCH

Roger Cryan was raised by his parents, Martin and Meike Cryan, in Grahamsville, N.Y. He received a Bachelor of Arts in International Studies from The Johns Hopkins University in 1987. A long graduate career at the University of Florida has been punctuated by work for the Cities of Waldo and Gainesville, Florida, the Volunteer Center of Alachua County, and the World Bank. His current position with the Atlanta Milk Market Administrator will, he hopes, lead to bigger and better things.
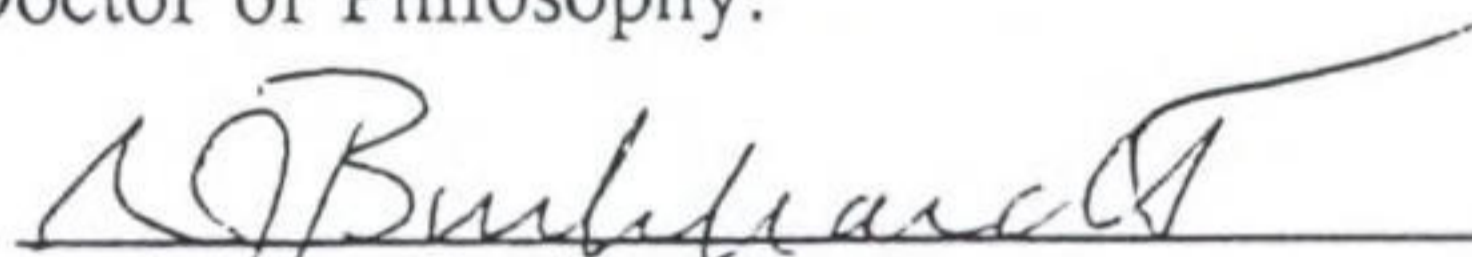
The two most important events in his life have been his wedding to Regina Pana on June 2, 1992, and the birth of his daughter, Elli Pana Cryan, on September 2, 1996.

I certify that I have ready this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
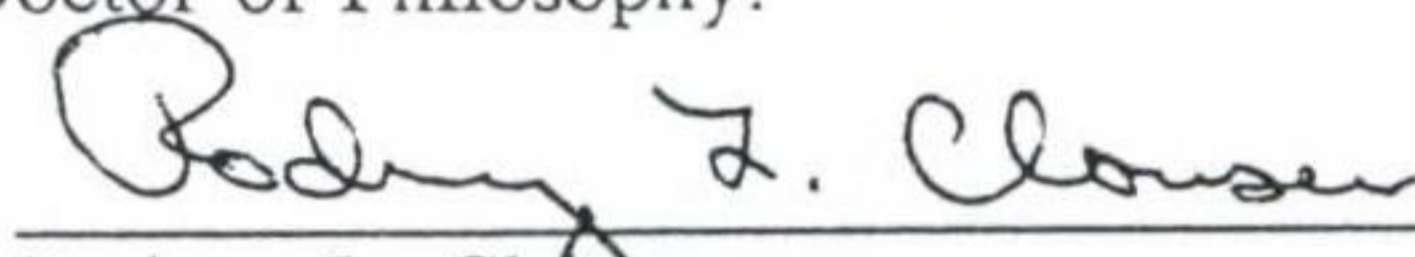
Thomas Spreen, Chair
Professor of Food and Resource Economics

I certify that I have ready this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

R. Jeffrey Burkhardt
Professor of Food and Resource Economics

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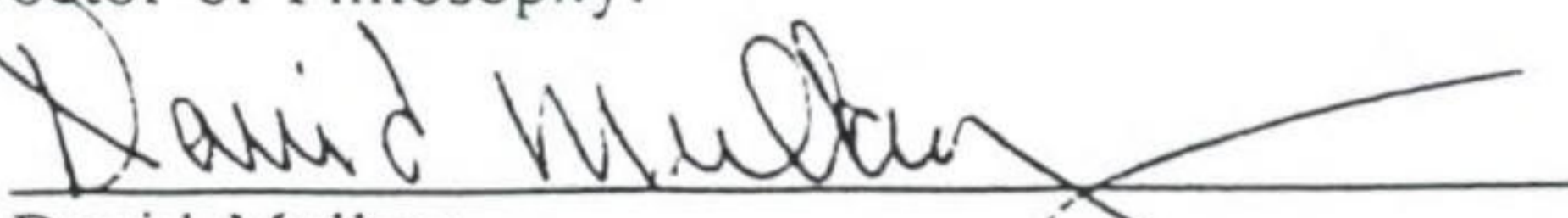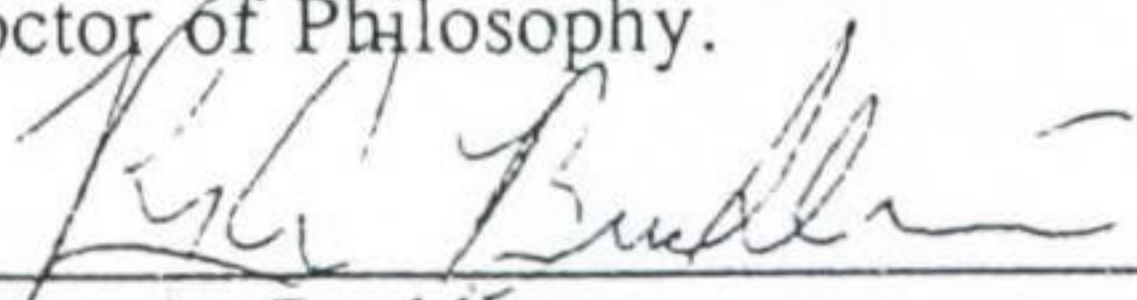
Rodney L. Clouser
Professor of Food and Resource Economics

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John Holt
Professor of Food and Resource Economics

I certify that I have ready this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

David Mulkey
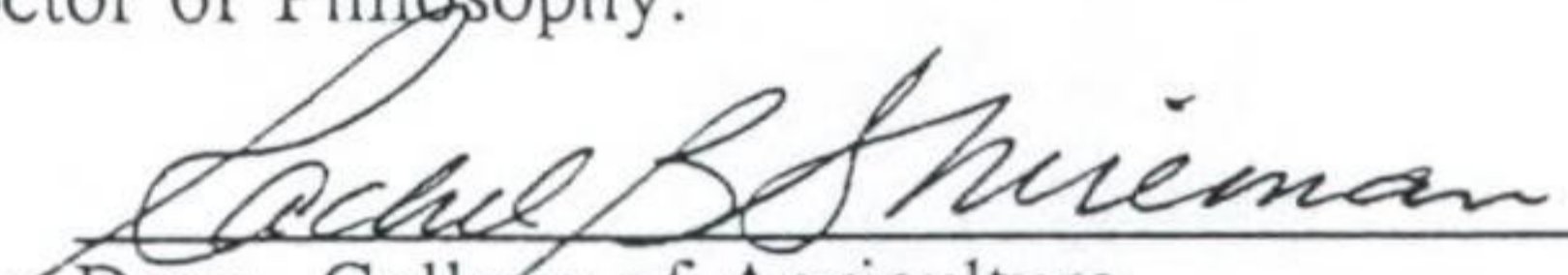Professor of Food and Resource Economics

I certify that I have ready this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Ray A. Bucklin
Professor of Agricultural and Biological Engineering

This dissertation was submitted to the Graduate Faculty of the College of Agriculture and the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1997

Dean, College of Agriculture

Dean, Graduate School