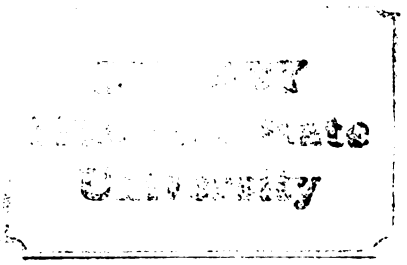

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A CROSS-NATIONAL COMPARISON OF FOOD SAFETY STANDARDS FOR MEAT AND MEAT PRODUCTS

By

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ABSTRACT

A CROSS-NATIONAL COMPARISON OF FOOD SAFETY STANDARDS FOR MEAT AND MEAT PRODUCTS

By

Helena A. Van Oijen

During the last three decades world-wide concern about the effects on human health of residues of toxic substances in food has increased. Consequently, the control of perceived risks did become increasingly the subject of national regulatory action.

However, food safety regulations differ across nations, which may have implications for the safety and supply of food and may create obstacles for international trade.

This study begins the process of gaining systematic knowledge on cross-national food safety standards by focusing on one important food item -- meat and meat products. Cross-national similarities and differences in the safety standards for the use and residues of a variety of potentially toxic substances found in meat and meat products are described. The variables used to examine some potential explanations of the observations include: standard of living, importance of meat trade and level of meat consumption. Also, the international efforts in harmonizing food safety standards are discussed.

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Introduction

I.1 Background and Problem Situation

Ever since antiquity problems regarding the supply of food have plagued human beings. Human dependency upon often exogenous conditions which determine the supply of food is reflected in the occurrence of cycles of famine and feast over time. This dependency has been weakened in recent times by a series of technological advancements in agriculture.

Although this technological progress has solved problems of how to increase production and improve processing, it has also created new concerns about the quality of foods. At a time when the food supply is, for the most part, safer than ever before due to improved preservation techniques such as refrigeration and canning, food safety actually has become a rather debated issue [Chou, 1979, Ch.2].

Concerns about food safety during the last three decades have resulted from a combination of factors. The benefits of technological advancements in the food system became increasingly subject to reassessment as diet and health were more and more linked. Uncertainty about the

impact of pesticides, animal drugs, and food additives generated questions about the wholesomeness of foods and their effects on health. Moreover, the short time span in which numerous new processes and products were introduced created a lag between their use, on the one hand, and knowledge about their impacts on health and the environment, on the other hand.

Research showing acute and chronic toxicity of certain substances present in the food chain contributed to the awareness that these substances are not necessarily riskless. Although limited intake of these substances in general does not lead to acute poisoning, the regular intake of small quantities may cause chronic poisoning, the symptoms of which manifest themselves gradually or long after the intake has taken place. Scientific developments in the area of toxicology made it possible to detect increasingly smaller quantities of chemical residues in food. This led to further research on the health effects of low-level, long-term exposure to toxic substances.

A perceived need to deal with these potential "social bads" led to new institutional arrangements in many countries aimed at managing risks to health and the environment. Concern has increased first and foremost in the more affluent nations. These nations can afford to focus on quality-of-life issues, having to worry less about the quantity of the food supply. However, consciousness

about the quality of food is present in countries with lower standards of living as well. Food safety legislation is not a luxury good but a basic need for ensuring the wholesomeness of food.

The protection of human beings from health hazards related to food appears to be a universal social good. The formulation and implementation of food safety legislation and dissemination of information on food safety issues can be considered as a particular type of public good provision. Markets are unlikely to bring about the optimum safety level of the food supply. Producers, processors, and manufacturers of food items do not have perfect knowledge of the potential negative externalities generated by their use of certain chemical substances, nor are consumers perfectly informed on the safety of their food. High information costs to producers, processors, manufacturers, distributors and consumers, as well as the relatively high level of risks involved, are important justifications for public involvement.

Although this rationale for public action seems to be universally applicable, regulatory devices to ensure wholesome food--in the sense of being microbiologically sound, hygienic and devoid of unappetizing constituents and toxic substances--may differ from country to country. These differences have potential implications for the safety of food, the supply of food, and international trade flows.

I.2 Objectives of the Study

In this study we examine food safety regulations across nations for meat and meat products. Legislation on meat safety covers a variety of issues including the protection of livestock from contagious diseases and the protection of consumers from health hazards. The latter form of safety regulations will be addressed in this study. Of this range of safety problems, we concentrate on potential health hazards which are connected with toxic residues in meat and meat products. The toxic residues we examine include:

-- animal drugs administered to promote growth and to treat or prevent diseases.

-- pesticides applied to animals to control insects or internal parasites, and pesticides applied to crops used for feed, grazing areas, buildings, and feed storage areas.

-- environmental contaminants ingested with drinking water, animal feed or even in the air that animals breathe.

-- substances added to meat and meat products during the processing stage to improve taste, retain moisture, and preserve colour.

We know that the public response to safety problems differs across nations. But there is little systematic information on differences and similarities in the food

safety regulations of nations, why these patterns obtain, and their potential consequences. This study begins the process of gaining systematic knowledge on cross-national food safety standards by focusing on regulations on the use of a variety of potentially toxic substances in meat production and/or their residues in meat and meat products. Once insight into the cross-national pattern of safety regulations is obtained, we will examine some potential explanations of observed similarities and differences among countries' safety standards.

It is not the intention of the researcher to focus on the public health and trade implications of the food safety regulations of certain countries in particular. Nor is it attempted to compile an up-to-date compendium of international food safety standards for meat and meat products. The assessment of the problems and alternatives that international organizations such as the Food and Agriculture Organization (F.A.O.) and World Health Organization (W.H.O.) are dealing with in attempting to minimize human health hazards, as well as to facilitate economic transactions, form the underlying orientation of this study. It is within this context that the process of obtaining systematic information on cross-national food safety standards, the analysis of differences and similarities between countries and the tentative explanation

and interpretation of obtained patterns has to be positioned.

I.3 Organization of the Study

This study is structured as follows. Chapter II describes the methodology that was chosen. In that Chapter, the dependent and independent variables are specified and combined in the form of hypotheses. The findings of the cross-national comparison of safety standards for each substance we examine are presented in Chapters III through VII. Enforcement of the safety regulations is addressed in Chapter VIII. Chapter IX discusses the attempts of international organizations to harmonize food safety regulations in order to reduce potential hazards to human health and to facilitate international trade. The last Chapter summarizes our findings and explores their implications for international concern about food safety, public health, and international trade.

Chapter II

Methodology of the Study

II.1 Introduction

Research processes are usually described less extensively than the actual research output. It is in the process, however, that the important steps that contribute to the outlook of the final output are taken. In the case of this particular thesis project, we went through the usual stages of narrowing down the scope of the study. Once circumscribed, plans of research were adjusted in the actual research process when informational obstacles were met. The development in the thinking about the ultimate thesis topic reflected the need to keep the task manageable. While preliminary plans of study focused on the exploration of safety regulations as non-tariff barriers to international trade in meat and meat products, redefinition of the objectives of study lead to the present topic of cross-national comparison of food safety standards for meat and meat products.

II.2 Specification of Relevant Variables

The dependent variables in this study are the safety standards of different nations on a variety of potentially toxic substances found in meat and meat products. Substances were chosen in each of the primary categories of residues which correspond to different reasons for or causes of residues. These categories include three types of residues associated with meat production (growth promotion, disease prevention and food preservation) and two types of residues associated with unintentional contamination of meat. The resulting list of categories for which safety standards are collected are:

--growth promotors/hormones

--antibiotics

--food additives

--pesticide residues

--heavy metals.

The selection of particular substances within these categories was determined by the availability of information on their legislation. While in some cases we cover the safety regulations in an entire category, in other cases distinctions are made between substances within a category. In the presentation of the findings of the cross-national comparison -- which is organized such that each chapter reflects a particular category of substances -- it is

explained which specific substances are examined.

Since safety standards for each of the substances appear to be often formulated for meat in general, it was decided not to focus on a particular type of meat. The type of meat is only specified if necessary for the validity of the analysis. In brief, principles of residue surveillance do not differ significantly across animal species. Similarities in the behavioral pattern of chemical substances in all animal species explain the formulation of safety standards for meat in general.

II.3 Formulation of Hypotheses

The relevant dependent and independent variables in the study are operationalized and combined in the form of hypotheses, the testing and subsequent interpretation of which forms the core of this project. The variables used to develop explanations for similarities and differences in safety standards include:

--the standard of living of a country

--the importance of meat trade for the national economy

--the level of meat consumption.

Accordingly, the following hypotheses are formulated:

A. The Standard of Living Hypothesis: The higher the general standard of living of a country, the stricter the safety regulations on meat and meat products.

This hypothesis suggests that the higher the general state of well-being of a country, the more likely the country will be to enact stricter statutes to eliminate human health hazards. The institutional network, set up to ensure the safety of meat and meat products, is expected to be more vast, more specified, and to reflect stricter standards in countries with higher standards of living. The underlying idea is that a higher standard of living allows for more attention by policy makers and consumers to qualitative aspects of food. To illustrate, most developing countries are believed to have low standards of meat hygiene and meat inspection [Kafel, 1975, p. 17]. Also, countries with higher levels of well-being tend to be inhabited by relatively conscious consumers who are more likely to protect their interests through organized groups. Those interests will be reflected in the institutional network which ensures the safety of meat products.

We use per capita gross national product (GNP/capita) to measure the standard of living of a country. We realize that this choice has its limitations [United Nations, 1954]. Since human needs and wants range from common biological to culturally defined needs and may differ from society to

society, as well as from individual to individual, the GNP/capita figure provides us with a limited indicator. Being often used for purposes of international comparison, the indicator is not based on purchasing power parities and does not reveal the actual income distribution. While recognizing the limitations in using GNP/capita data, it was decided -- for practical purposes -- to use this as the indicator of a country's standard of living.

B. The Importance of Meat Trade Hypothesis: The more important the exports of meat for a country, the stricter the safety regulations on meat and meat products.

This hypothesis suggests that a greater economic importance of meat trade for a country will be reflected in higher safety standards. The underlying notion is that countries whose meat exports form a substantial part of total meat production will attempt to ensure a continuous export flow. The strictness of safety standards is assumed to reflect the need to reduce the possibility of harming one's export position and/or the desire to improve meat export potentials. In countries for whom meat exports are of less economic importance, the urge for strict safety standards is expected to be less strong.

One illustration of the influence of economics on the development of food laws is the enactment of the U.S. Food and Drugs Act in 1906. Schultz [1981, p. 6] describes how European perceptions that meat from the U.S. was unfit for human consumption provided the impetus for the Act. A rapidly developing livestock industry made Congress aware of the need to protect U.S. export markets and a favorable balance of trade. Similarly, Welford [1972, p. 3] recounts that meat packers initiated legislation for meat inspection because of the primitive state of the U.S. meat inspection system at the turn of the century and the poor image of U.S. meat in world markets.

To measure the importance of meat exports we use total exports as a percentage of the total quantity of meat produced by a country. While meat trade data are expressed in both quantities and values in the relevant sources for statistical data, meat production data sources are expressed in quantities only. This is why we use quantities rather than dollar values in our comparison.

There is some difficulty in formulating a straightforward proposition about the importance of meat imports in explaining safety standards. It can be disputed whether the level of meat imports is likely to be inversely correlated with the strictness of safety standards. For example, the perceived need for having strict safety standards might decline with a greater dependency on meat imports because

strict standards might limit potential sources of imports. It should be taken into account, though, that standards applying to the domestic meat sector correspond with standards on imported meat and meat products. This follows from the General Agreement on Tariffs and Trade (G.A.T.T.) rule prescribing that standards concerning imported industrial and agricultural products shall be treated not less favorable than products of origin [G.A.T.T., 1979, p.6]. Conversely, countries that are more dependent on meat imports for their meat consumption might have stricter import standards simply because they do not have a large amount of domestic production of meat. In this respect, the strictness of safety standards may reflect an attempt to ensure that wholesome meat and meat products enter the country.

In brief, the expectation of both lower and higher safety standards on meat and meat products leaves us with an inconclusive proposition. Given this difficulty in formulating the counter-hypothesis on meat trade, we decided to approach the meat import variable inductively rather than deductively. Hence the findings will determine which proposition concerning the importance of meat imports appears to be most valid. While our export data are expressed as a percentage of meat production, the import data are expressed as a percentage of meat consumption.

C. The Consumption Hypothesis: The higher the level of meat consumption in a country, the stricter the safety regulations on meat and meat products.

It is hypothesized that the level of concern about the wholesomeness of meat and meat products is positively correlated with the level of meat consumption. This suggests that consumers in countries where, on average, meat is an important food item are more concerned about the wholesomeness of meat and meat products than consumers in countries where meat is a less vital food item. The following analogy with the neoclassical assumption of consumer sovereignty might clarify this proposition. Under this assumption, the production of goods and services reflects the needs/desires of consumers. The demand of consumers for wholesome meat and meat products can be expected to be satisfied in the form of safeguards built into the meat sector. As discussed in the introduction, this response is more likely to be public rather than private. Hence, the correlation between the level of meat consumption and the strictness of safety standards is an additional hypothesis to be tested in this study.

Per capita levels of meat consumption are used to measure the importance of meat consumption. It should be noted that differences in the levels of per capita meat consumption may be a reflection of a variety of factors,

such as the standard of living of a country, the price level of meat and also consumer preferences. In this respect, this consumption hypothesis partially overlaps the standard of living hypothesis. Nevertheless, we decided to examine the importance of meat consumption as a separate variable since consumer preferences are expected to be important in determining food safety rules.

We want to emphasize that these are not the only hypotheses that can be formulated to explain differences and similarities in safety standards on meat and meat products across nations. Initially, other hypotheses were formulated as well, including:

-- The importance of meat production in agriculture and, in turn, the economy at large. This variable resembles the importance of meat trade, with the difference that the latter is in fact an element of the former. The major problem in determining the importance of meat production originates in the fact that meat production data are expressed in quantities, whereas total figures on agricultural output are expressed in dollar values. Since trade and production statistics allowed for comparison in common units of account, we decided to focus on the importance of meat trade (Hypothesis B). Only in case of a cross-national comparison of safety standards on a particular animal species (e.g., poultry) is

attention paid to the importance of the particular subsector in the total meat sector.

-- The degree of concentration in meat slaughtering, processing and distribution. It can be hypothesized that a higher degree of concentration in these subsequent stages facilitates food safety control because it reduces the costs of food safety control. Obviously, the costs of regulation are an important factor in a country's decisions on setting standards. Thus, countries with higher regulatory costs may have the same preferences as other countries, but less strict standards. Greater feasibility of enforcing safety regulations may imply lower costs of enforcement which may be reflected in more detailed regulatory frameworks. However, informational obstacles in testing this proposition across nations explains the decision not to examine this factor.

-- The nature of the marketing process between the slaughtering stage and final distribution to consumers. This is a more technical potential determinant of the strictness of safety standards. It can be hypothesized that the need for safety standards is inversely related to the size of the piece of meat that is distributed. The reasoning here is that the more processed the meat that reaches the retail level is, the more likely it is that certain chemical

substances will be used, and, consequently, the greater the need for safety standards. Again, however, appropriate cross-national data are lacking in order to examine this proposition.

-- Last, another factor that might be of relevance in explaining the cross-national pattern of safety regulations with respect to meat and meat products is the actual amount of chemical substances used in the production, slaughtering and processing stages of meat. The use of chemicals is probably related to the technological development of a country. The corresponding hypothesis would be that higher levels of use of chemical substances in the meat sector generate a greater need to subject their use to control. However, we again face informational obstacles since the data needed for examining this hypothesis are not available.

Before concluding this section some additional comments on the testing of the hypotheses have to be made.

First, it should be noted that the information about the safety standards on the use of the various substances in different contexts covers diverse time periods. Consequently, the years for which the safety standards are examined -- which was solely determined by the availability of data -- set the time periods for which the independent variables are analyzed. Even though the periods over which

the dependent and independent variables are measured are not always perfectly congruent, we attempted to minimize time gaps.

Secondly, we have to explain which decision rule we used in testing the hypotheses. It will be clear that the nature of the data was not such that we could construct an explicit statistical decision rule for determining when the hypotheses could be accepted and when they had to be rejected. Consequently, we followed a general procedure in comparing the relative values of the dependent and independent variables. The hypotheses were accepted in case of a clear indication that a substantially greater proportion of countries with higher standards of living, greater dependency on meat exports, and the like, was found to have stricter safety regulations on the particular chemical substances than countries with lower values of the independent variables. A weaker indication of the above pattern was considered as providing us with some evidence that the hypotheses held. In case of a rather random pattern of observations, we decided to regard the results as inconclusive. Finally, the hypotheses were rejected in case of observations clearly opposite to the hypothesized pattern.

II.4 Selection of Countries

Ideally, one would compare countries that vary substantially as far as the expected explanatory factors are concerned. Hence, one would want to select countries that fall into substantially different categories regarding the standard of living variable, and whose economies depend on meat trade to a varying extent. Similarly, the examination of a range of countries, varying in the importance of meat as a food item, would be methodologically desirable. However, relevant data are spread out over a diversity of institutions within countries and internationally, if existing at all. In particular, data on food safety standards in less developed countries are hard to obtain. In sum, a selection of countries had to be made such that data collection was feasible and would allow for testing of the formulated hypotheses in a valid manner. Since the best data, even though sometimes limited and dispersed, are available for those countries that are involved in the international meat trade flows, it initially was decided to select countries on the basis of their importance in international meat trade.

However, it became clear in the actual research process that the pre-selection of 28 countries to be included in the comparison had its limitations. The categories of chemical substances on which regulatory data were obtained

did not overlap satisfactorily across the selected countries. In order to compare the safety standards on particular substances in as many countries as possible, another scenario was chosen. Rather than compare safety standards in pre-selected countries, the opposite, more practicable procedure was followed: compare safety standards on selected substances wherever possible. Since the availability of data determined the list of countries whose relevant variables are compared, a more comprehensive picture of cross-national patterns of safety standards on meat and meat products can be drawn.

As a result, the list of countries is not the same throughout the various comparisons of safety standards on a range of substances. However, the description of the safety standards in the different countries has to be considered as an instrument and not a goal of this study. We intend to provide a general picture of the cross-national pattern, and, subsequently, attempt to explain the findings as is described in the introduction. In this respect, it is less relevant which particular country is included in the analysis.

Notwithstanding the above justification, one final comment should be made on this choice of method in determining which countries to include in the comparison. Specifically, a major potential bias is created by comparing only countries for which data on safety standards were

obtainable. It is possible that the countries whose regulatory frameworks on meat wholesomeness are analyzed do not form a representative sample. The actual list of countries included in the comparison covers countries that are involved in international meat trade flows, but less developed countries are underrepresented. Hence, it should be kept in mind that the hypotheses are not tested in a sample of countries that ideally represent 'the world'. Nonetheless, the countries show substantial differences in terms of the explanatory variables. This implies that the hypotheses can be tested on a perhaps less ideal, but assumedly satisfactory, base.

II.5 Regulations and Their Enforcement

The examination of the compliance with safety standards is very important. After all, regulations alone do not ensure the wholesomeness of meat and meat products. It is the implementation of regulations that determines their success. High standards are not necessarily better from a food safety point of view if they are not obeyed or enforced.

Unfortunately, it is one thing to want to compare the rate of success of safety standards and another thing to actually go out and find the data needed. Although records of the actual performance across nations appear to exist,

the information is not publicly accessible given the sensitive nature of the data./1 Nevertheless, there are some publications upon which we will base some general, tentative conclusions about the enforcement side of the safety policies on meat and meat products across nations. Despite the approximate and, consequently, limited approach used -- as is further specified at the point of presentation of the findings -- a 'something is better than nothing' attitude is chosen.

II.6 The Client System

This final section on methodology briefly discusses the objectives of the researcher. This project has an international orientation. We will not focus on the implications of the findings for a particular country, nor set of countries. We want to describe and analyze the cross-national pattern of safety standards on meat and meat products without emphasizing 'the name of the players in the game'. In this respect, our results are of most potential use to the international organizations that attempt to harmonize safety standards in order to promote and improve

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1The appropriate data appear to be present at the U.S.D.A., Food Safety and Inspection Service, but are not publicly accessible given agreements with the countries of origin.

public health and facilitate international trade flows.

Furthermore, it is not intended to compile a user manual for, say, importers and exporters of meat and meat products. Obviously, the actual approach that is chosen indicates that the study is less pragmatic from the point of view of the above participants in the meat trade arena. The compilation of a user manual would be an enormous task and require a full-time and life-time project given the relative 'volatility' of safety standards. This is probably the reason for the scarcity of updated, comprehensive compendia of international food safety standards.

Chapter III

Public Action Regarding the Use of Growth Promotors in Meat Production: A Description, Cross-National Comparison and Evaluation

III.I The Use of Growth Promotors: A Global Description

Due to scientific progress, new approaches in agricultural technology have been adopted, particularly in the more developed parts of the world. The following tendencies in the meat subsector of agriculture illustrate this technological progress: increase in the size of feed lots because of economies of scale, transformation of the animal into what some call an assembly line object, and use of chemicals as an integral part of this assembly line process. In this Chapter we examine one of the chemicals used in meat production.

The increasing use over time of growth-stimulating substances is one of the important developments in meat production. Being substances frequently used in meat production, and posing some potentially undesirable impacts on human health, growth promotors have received substantial public attention in many countries over the years.

The use of hormones, either in the form of feed additives or injected directly, produces striking results. It is estimated that the DES (diethylstrilbestrol) hormone, a synthetic chemical, could improve feed conversion efficiency substantially. With the addition of 20 milligram DES per day to their feed, steers would be brought to a marketable weight (1000 pounds) in 30 days less time with a saving of about 500 pounds of feed for each animal. Furthermore, the estimated 10-12% increase in weight gain per unit of feed would amount to annual savings equivalent to the corn grown on 1.7 million acres of farmland [Food Technology, 1978, pp.52-53]. These direct savings to the cattle and feed lot industry are estimated as being over $90 million a year (estimates for the U.S., 1974) [Epstein, 1979, p. 219].

Due to its high effectiveness, and, hence, attractiveness, the use of hormones in meat production became the rule rather than the exception in many countries. This can be explained in terms of a general attitude favorable to improvements in operational efficiency from which producers, as well as consumers, could benefit. For the producers, the use of hormones contributes to a more competitive position in the domestic and/or international meat trade arena. Consumers, on the other hand, benefit from lower meat prices.

However, positive attitudes about the economic benefits of the use of hormones in meat production were countered by concerns about its costs in terms of potential health hazards. This is a reflection of a phenomenon which we discussed briefly in the Introduction. Heightened levels of concern about these growth promotors and their potentially harmful impacts on human health increasingly blocked the technologically oriented path to promote agricultural output levels [Kupferman, 1980, Ch. 7].

It became evident that the synthetic organic chemist could prepare new substances much faster than their safety could possibly be tested and considered within regulatory frameworks. For example, when DES was first synthesized in the United Kingdom in 1938, carcinogenicity was established in tests [Epstein, 1979, pp. 214-228]. However, regulatory action on the suspected cancer risk was not taken until after therapeutic use in both humans and animals and non-therapeutical use in animals only had reached a rather large scale level in many countries. Thus, direct economic rather than public health considerations seem to have predominated in the initial regulatory treatment of newly developed subtances such as chemical growth promotors.

This institutional gap between the recognition of potential health hazards and the development of specific regulations in order to reduce/prevent health risks was probably affected by the disagreements among scientists

concerning the assessment of the degree of danger to consumers. Often it is difficult to conclusively test a chemical for carcinogenic or other properties. Adequate tests that will totally eliminate doubt about the health impact of being exposed to residues of new synthetic substances with which the tissues and cells of the body have had no previous experience cannot always be devised. Furthermore, estimates of risk vary from one study to another. To illustrate, risk-estimation studies applied to DES vary in their conclusions. Mounting evidence of the carcinogenicity of DES is shown in some studies. Other studies point to 'non-evidence' in that DES was believed to be responsible for tiny, hardly detectable changes in the incidence of cancer [Epstein, 1979, p. 231; Lave, 1981, pp.62-64].

Despite uncertainties about the degree of risk exposure, concern about the use and residues of chemical substances like hormones increased. People became more suspicious about the food that they were eating, which was simultaneously reflected in and encouraged by a range of popular publications with catchy titles such as Panic in the Pantry, The Chemical Feast, and Eat Your Heart Out [Whelan, 1975; Turner, 1970; Hightover, 1976]. While these are expressions of American consumerism as a growing force in the market place, the occurrence of similar tendencies can be observed in other countries.

Note that the above phenomenon is not limited to concern about growth promotors, but applies to the substances that will be discussed in subsequent chapters as well. We mention it at this point in order to illustrate the socio-political forces behind the increase of public attention to the potential health hazards involved in the use of growth promotors. This is probably accelerated by technological forces such as large scale use of chemicals in animal production and improvements in the sensitivity of the testing techniques available to detect hormone and other residues in meat and meat products.

It is the actual regulatory response in various countries to these perceived risks that we address in this Chapter, the results of which are presented below.

III.2 The Use and Residues of Growth Promotors: A Cross-National Comparison

As is explained in the methodology Chapter, we will test the suggested hypotheses wherever possible using available data. Unfortunately, the multifarious character of the rules regarding growth promotors does not ease the task of summarizing regulatory patterns across countries. Yet it is attempted to compile data from a variety of sources into a framework that provides us with some insight into the regulatory pattern regarding growth promotors.

This description, as presented below, can be used as a limited, but sufficient, base upon which to formulate speculative conclusions about the validity of the hypotheses.

On the whole we observe a range of approaches for coping with potential health hazards resulting from the use of growth promotors in meat production. These regulatory actions can be categorized into two general types: (1) process standards, reflecting regulations on the use of these substances in meat production, and (2) output standards, indicating the tolerance levels on residues of these substances in meat and meat products. In fact, we observe a range of regulatory subcategories, such as rules for the direct use of the substances and rules for indirect use of the substances in animal feed. In addition, some legislation on food safety is prohibitive while some is conditional. For example, whereas some countries use a zero-risk decision rule and ban the use of a certain substance whatever its purpose (i.e., prohibitive legislation), other countries allow its use for therapeutic purposes and/or subject the sale of the substance to restrictions (i.e., conditional legislation). Thus, regulatory actions may show general similarities in terms of their purposes, though may vary in degree of strictness.

Consequently, a summary view of regulatory actions that vary in type and degree of intervention across nations

requires some simplification. First we present the pattern of regulatory action on a very specific use of growth promotors. This includes the range of countries prohibiting the direct and indirect use of hormones in the raising of poultry (III.2.1). Subsequently, we provide a more comprehensive cross-national picture of the set of rules regarding growth promotors in the meat sector (III.2.2).

III.2.1 The Use of Growth Promotors in Meat Production: The Case of Poultry

In the particular case of rules for the poultry subsector, we base our analysis upon a limited, but assumedly useful, source: a list of countries prohibiting the direct and indirect use of growth promotors in poultry production, published in the French equivalent of the U.S. Federal Register [Journal Officiel de la Republic Francaise, 1976, p. 5212]. This list, applicable to the regulatory situation in 1976, included the following major countries with a zero-risk decision rule: Belgium, Bulgaria, China (P.R.), Czechoslovakia, Denmark, France, W. Germany, Hungary, Ireland, Israel, Italy, Morocco, The Netherlands, Poland, Romania, South Vietnam, Sweden, Switzerland, United Kingdom, and Turkey.

Notice that all these countries chose the same rule, but that they are obviously very different countries.

Without ranking these countries according to their GNP/capita, it will be clear simply from the list of prohibiting countries that we should not yet accept the hypothesis that the legislative framework for growth promotors in poultry production is stricter in countries with higher standards of living. Notwithstanding the disparities in their standard of living, these countries have the same prohibitive regulatory attitude towards the use of growth promotors in poultry production.

When examining the importance of poultry meat production in these countries relative to the total quantities of meat produced, we observe that the production of poultry meat ranges from a small to a substantial share of the total meat production [U.S.D.A., January, 1983]. The actual shares (averages for the period 1974-1978) are as follows: Belgium (11%), Bulgaria (21%), China (12%), Czechoslovakia (11%), Denmark (9%), France (21%), Germany (7%), Hungary (22%), Ireland (7%), Israel (79%), Italy (32%), Morocco (not available), The Netherlands (21%), Poland (10%), Romania (25%), S. Vietnam (12%), Sweden (8%), Switzerland (5%), United Kingdom (24%), and Turkey (11%)./2

Similar to the standard of living hypothesis, we cannot accept the proposition that the importance of poultry

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2Note that the shares for China, Morocco and South Vietnam are averages for the period 1969-1971; Source: Adapted from F.A.O., November 1982.

production will be reflected in the type and level of concern about the safety of poultry meat on the basis of this limited analysis. Apparently the zero-risk decision rule of prohibiting the use of hormones in poultry production is not correlated with the importance of poultry production in the total production of meat in the countries included in the comparison.

The comparison of the relative importance of poultry meat trade in total meat production and total meat trade, is presented in Table 1.

It can be seen that the importance of poultry trade both in the poultry subsector and the meat sector varies substantially. Yet these countries are similar in terms of their regulatory action on the use of growth promotors in poultry production. Hence, we cannot conclude from the above analysis that greater dependency upon meat exports corresponds with stricter safety standards. Countries in which poultry exports are a less important segment of the meat trade sector apparently have similar regulatory attitudes. While exporters have to comply with the rules of the countries of destination, the absence of this incentive in the case of a negligible dependency on poultry exports clearly does not necessarily imply a lower level of concern about the use of growth promotors. The same conclusion can be formulated concerning variations in the importance of poultry meat imports since both major and minor importing

Table 1

Relative Importance of Poultry Meat Trade
in Total Meat Production and Total Meat Trade

	Poultry Meat Imports as a Percentage of Domestic Poultry Production	Poultry Meat Exports as a Percentage of Domestic Poultry Production	Poultry Meat Imports as a Percentage of Total Meat Imports	Poultry Meat Exports as a Percentage of Total Meat Exports
Belgium **	10.0%	19.0%	13.0%	7.0%
Bulgaria	--	23.0	--	37.0
Czechslovakia	3.0	2.0	20.0	17.0
Denmark	--	58.0	--	7.0
France	2.0	15.0	3.0	28.0
Germany	91.0	9.0	31.0	10.0
Hungary	--	40.0	--	49.0
Ireland	5.0	8.0	25.0	1.0
Israel	1.0	8.0	2.0	100.0
Italy	2.0	.2	3.0	4.0
Netherlands	5.0	75.0	11.0	27.0
Poland	.3	7.0	3.0	13.0
Romania	.3	3.0	na***	na
Sweden	--	3.0	--	3.0
Switzerland	110.0	--	48.0	--
United Kingdom	2.0	3.0	1.0	24.0

*Not all countries with prohibitive rules on growth promotors in poultry production are included because some were not covered in the data source used. The production data used cover the period 1974-1978 and the trade data cover the period 1975-1979 (expressed in average quantities/year).

**Data for Belgium include Luxemburg.

***na=not available.

Source: Adapted from U.S.D.A., January 1983.

countries appear to have a prohibitive attitude towards the use of growth promotors in poultry production.

Another cross-national comparison involves the relative importance of poultry meat consumption in these countries. The quantity of poultry meat consumed is expressed as a percentage of total meat consumption (averages for the period 1974-1978): Belgium (13%), Bulgaria (18%), Czechoslovakia (11%), Denmark (12%), France (18%), Germany (12%), Hungary (16%), Ireland (16%), Israel (65%), Italy (23%), The Netherlands (12%), Poland (10%), Romania (28%), Sweden (8%), Switzerland (9%), United Kingdom (18%), and Turkey (11%) [U.S.D.A., January, 1983].

Again, these figures reveal how countries, though varying in the level of poultry meat consumption as a percentage of total meat consumption, have the same safety standards on the use of growth promotors in poultry production.

Before turning to a more comprehensive analysis of the cross-national pattern of regulatory actions on growth promotors, it should be noted that the list of countries examined above does not contain some major participants in the world meat above does not contain some major participants in the world meat trade flows. Surprisingly, countries such as the U.S., Canada, Australia, Central and South American countries are not on the list of countries

Table 2

Importance of Poultry Meat Production, Trade and Consumption in Selected Countries

	Poultry Meat Production as a Percentage of Total Meat Production	Poultry Meat Exports as a Percentage of Total Meat Exports	Poultry Meat Imports as a Percentage of Total Meat Imports	Poultry Meat Consumption as a Percentage of Total Meat Consumption
U.S.	23.0%	50.0%	--	22.0%
Canada	22.0	2.0	12.0	22.0
Mexico	17.0	--*	50.0	17.0
Argentina	7.0	.5	100.0	8.0
Brazil	17.0	21.0	--	17.0
Australia	8.0	.4	--	12.0

*If no percentage is given, there were no imports/exports of poultry meat in the period covered (1974-1979; see Table 1).

Source: Adapted from U.S.D.A., January 1983.

with a prohibitive regulatory attitude on the use of growth stimulants in poultry production, yet such an attitude is a necessary condition for importing meat into France (1976).

Some relevant production, trade and consumption data of several exluded countries, are presented in Table 2. In order to interpret these observations it is important to recognize that the dependent variable has only one value. There is only one type of regulatory action (i.e., a prohibitive standard) while these countries vary on the

explanatory variable. It also should be kept in mind that the countries included are only a small subset of the countries that could have been examined.

The inference to be drawn from this 'negative' analysis (i.e., of some countries not included in the official list) is that these countries show as much variation on the explanatory variables as the ones included in the list. Hence, there seems to be no indication that these countries have distinct characteristics that could explain their absence on the list.

This does not imply that these countries tolerate the use of growth promotors without limits. In terms of French standards for imported meat (1976), however, their regulatory attitude towards the use of these chemical substances in poultry production was not considered sufficiently strict by the French. In this respect, any prohibition of their residues in meat and meat products, rather than of their use in poultry production, implied ineligibility to import poultry meat into France.

We now turn to a discussion of the regulatory treatment across nations of their use of growth promotors in meat production in general.

III.2.2 Growth Promotors in the Meat Sector: Simplification and Analysis of the Multifarious Rules Regarding their Use and Residues

The wide range of approaches used for coping with potential health hazards involved in the use of growth promotors in meat production again requires some simplification in describing cross-national patterns. Since countries differ in the type and/or number of rules, we decided to attach codes to all types of rules on growth promotors in order to compare the countries in a systematic manner. Every particular rule was given a score, and, additionally, in attaching scores, a simple weighting procedure was followed in which prohibitive rules were given twice the score of conditional rules (see footnote 2, Table 3, for further details on the method used). Consequently, the summation of the scores enables us to evaluate the relative intensity of the regulatory action on the use and residues of growth promotors. These results are presented in Table 3.

Before discussing the results of this procedure, the following limitations of the analysis have to be mentioned. First, countries are included in the comparison because of the fact that data were obtained on their rules for hormones in meat production. However, the observation that some

Table 3

Regulatory Action on the Use and Residues of Synthetic Growth Promotors in the Meat Sector

	Category of GNP/Capita	Use for Growth Purposes	Use for Therapeutic Purposes	Use in Feed	Rules for Import of Substance/ of Meat with Residues	SCORE
Germany	I	P	C	-	P	10
Denmark	I	P	C	P	P	14
Belgium	I	P	C	-	P	10
France	I	O	-	P	P	10
Netherlands	I	P	C	C	P	12
U.S.	I	O	C	C	P	10
Canada	I	O	C	C	P	10
U.K.	II	C	C	-	-	4
New Zealand	II	P	C	P	-	10
Italy	II	-	-	-	P	4
Spain	II	P	-	P	P	12
Israel	III	-	-	-	P	4
Greece	III	P	-	-	P	8
Poland	III	-	-	P	P	8
Uruguay	III	P	C	P	P	14
Yugoslavia	III	O	C	-	P	8
Argentina	IV	P	C	-	-	6
Mexico	IV	O	-	-	-	2
Jordan	IV	P	-	P	P	12
Peru	IV	P	-	P	P	12
Morocco	IV	P	C	P	-	10

1) Codes: P=Prohibited; C=Conditional (e.g., concerning waiting time after slaughtering); O=Output standards for residues of certain substances in meat and meat products; - = not available.

2) Scores: P=4; O=2; C=2 (arbitrarily set, with twice the weight given to P).

3) GNP/capita categories (in dollars, 1980; Source: World Bank, 1982):
I = $10,000
II = $5,000-$10,000
III= $2,500 -$ 4,999
IV = $2,500
Note that the above intervals are not even. However, the above categorization was believed to spread the countries most evenly. Consequently, categories covering only one or a few countries are avoided. The format is believed not to affect the outcomes of the comparison.

4) Note: The data are assumed to cover the currently existing legislation, although lack of information on amendments of rules found in the various sources, as well as the very flexible nature of food safety regulations, may imply that the above information is not up-to-date.

Source: Adapted from FAO-publications (Food and Agricultural Legislation), manuals for internal use of the Veterinary Service, Dutch Department of Agriculture/Public Health, and the Food Safety and Inspection Service, U.S. Department of Agriculture.

countries have a more expanded regulatory network than others may not only be a reflection of reality, but also of the fact that our data are limited. Moreover, in summarizing a wide range of data from a variety of sources, errors may have been made. Hence the possibility exists that different researchers could have come up with different outcomes. Yet the availability and nature of the information is such that it is virtually impossible to present an exact picture of the regulatory situation across nations. Nevertheless, this approximation of the actual situation provides us with limited, but sufficient, information for the analytical purposes of this study.

While realizing that the information in Table 3 has to be interpreted carefully, it seems at least possible to base some speculative conclusions about the validity of our propositions on these observations. First, the ranking of these countries according to their GNP/capita (1980) compared with their corresponding scores on the rules on growth promotors does not lead us to accept the standard of living hypothesis. Countries with a lower standard of living do not necessarily have less expanded safety regulations in this case. Table 4 below shows that the differences between countries in different GNP/capita categories do not seem to be significant. Even though countries in category I have an average that is higher than those in other categories, the remaining scores do not

seem to decline with a corresponding decrease in GNP/capita. This conclusion seems to be even more acceptable if we take into account that the categories I and II are larger in terms of the GNP-interval than the categories III and IV, and, moreover, that category II is relatively small.

Table 4

Distribution of Average Score on the Rules on Growth Promotors by Category of GNP/Capita

Category of GNP/Capita	Average Score	N
I	10.9	7
II	7.5	4
III	8.4	5
IV	8.4	5

As far as other possible explanatory factors of the differences and similarities are concerned, Table 5 shows their relative importance in the various countries. These figures show how the value of these variables differs across the countries included in the comparison.

The relative importance of these variables in these countries and their average scores are summarized in Table 6.

Table 5

Relative Importance of Meat Trade and

(Change In) Level of Meat Consumption

	Meat Exports as a Percentage of Total Meat Production 1)	Meat Imports as a Percentage of Total Meat Consumption 1)	Per Capita Consumption (kg), 1979 2)	Change in Per Capita Consumption of Beef and Veal (1961-1979) 3)
Germany	7.0%	19.0%	84.2kg	17%
Denmark	72.0	1.0	75.7	- 8
Belgium*	29.0	12.0	87.5	22
France	11.0	12.0	88.2	14
Netherlands	59.0	17.0	66.3	3
U.S.	2.0	5.0	109.6	16
Canada	5.0	9.0	93.9	14
U.K.	7.0	31.0	73.4	2
New Zealand	71.0	.3	100.2	46
Italy	2.0	19.0	63.7	67
Spain	.3	5.0	63.6	112
Israel	4.0	21.0	59.5	174
Greece	.3	21.0	66.9	311
Poland	5.0	1.0	84.2	97
Uruguay	33.0	.4	81.5	- 15
Yugoslavia	7.0	3.0	64.6	135
Argentina	18.0	.1	110.6	8
Mexico	2.0	.7	37.7	64
Peru 4)	--**	2.0	15.1	- 39

1) Based on average quantities of meat (expressed in thousands of metric tons) per year. Trade data cover the period 1975-1979. Production and consumption data cover the period 1974-1978. Source: Adapted from USDA, January 1983.

2) Source: USDA, January 1983.

3) Source: Simpson, J.R., Farris, D.E., 1982, pp. 286- 287.

4) Morocco and Jordan are not included because they are not covered in the sources used for the above data.

* Data for Belgium include Luxemburg.

** No exports in the period covered.

Table 6

Importance of Meat Trade and Consumption and Average Score on the Rules on Growth Promotors

6a Meat Exports as a Percentage of Total Meat Production	Average Score	N
>50%	12	3
11-50	10	4
5-10	8	5
< 5	7	7
6b Meat Imports as a Percentage of Total Meat Consumption	**Average Score**	
>15%	7	6
5-15	10.4	5
< 5	9.3	8
6c Per Capita Consumption (kg/yr)	**Average Score**	
>100 kg/yr	8.7	3
80-100	10.3	6
50-79	8.3	8
<50	7	2
6d Change in Per Capita Consumption of Beef and Veal (%)	**Average Score**	
positive >100%	8	4
51-100	4.7	3
0- 50	9.1	9
negative 0- 50	13.3	3

Table 6 suggests that countries in which meat exports form a more substantial part of the total production of meat have a higher average score on the dependent variable, which is consistent with our hypothesis. There is no evidence that greater dependency on meat imports for domestic consumption corresponds with a more liberal attitude towards the use of growth promotors in meat production. Regarding the observations on consumption of meat, it can be concluded that the differences in scores between the categories of

per capita consumption do not seem to be significant. Hence, we cannot accept the hypothesis that the level of concern will be positively correlated with the level of meat consumption. A look at the relative changes in the consumption of a specific type of meat (i.e., of beef and veal over the time period 1961-1979) does not alter the above conclusion. The observation that the countries in which per capita consumption of beef and veal actually declined have high scores should be interpreted with caution. The decline can reflect public concern about the safety of meat and meat products, which may have accelerated regulatory action on the use and residues of growth promotors. However, the decline can also reflect totally different phenomena, such as changes in the meat price level or income level. The number of countries with a negative change in per capita consumption of beef and veal over time is believed to be too small to formulate any further conclusions.

III.3 Evaluation

The above comparison of public action on the use of growth promotors in meat production and their residues in meat and meat products is an attempt to improve insight into the cross-national pattern of regulations. While the data base is limited and, consequently, evidence is not complete,

it nevertheless seems possible to formulate some general conclusions.

The information collected on the regulations on growth promotors covers countries that vary substantially in the economic characteristics that we examined. In testing the formulated hypotheses, the evidence presented in this chapter suggests that our propositions do not completely explain the actual pattern of regulatory action.

As far the standard of living hypothesis is concerned, the findings for either the specific case of poultry or the general description indicate that more expanded regulations are not limited to countries with high standards of living only. It should be noted that it was observed in the process of collecting the relevant information -- although not examined systematically -- that the safety standards concerning growth promotors were often developed in the same time periods in both countries with higher and lower levels of well-being. Hence, there does not seem to be an indication of some kind of time lag between the adoption of rules in countries with high standards of living, and the later 'catching up' of countries with lower standards of living.

Futhermore, economic dependency on meat, in the sense of importance of meat trade for the domestic economy, seems to be a sufficient, but not necessary, condition for explaining the pattern of regulatory action regarding growth

promotors across nations. Some countries in which meat trade is less vital have regulatory attitudes similar to countries in which meat trade is a more important factor. Except in the case of the weighted scores on regulatory rules, differences in the level of meat imports and exports do not seem to explain variations in the regulatory attitude on growth promotors.

Likewise there is no evidence that the level of meat consumption corresponds with the level of safety concern about growth promotors in a nation. Quantity of intake of meat and meat products does not seem to be correlated with public concern about its quality.

On the whole, over a range of levels of national well-being, economic importance of meat trade, and meat consumption levels, we find similar approaches to cope with the potential health hazards involved in the use of growth promotors in meat production. There is no indication that prohibitive rules, conditional rules, process standards and output standards each dominate in countries with a distinct set of characteristics. In addition, it should be noted that information on the changes in national regulations over time reveals that shifts in regulatory attitudes sometimes occur. In some countries (e.g., France and Canada) a shift from using process standards to using output standards on growth promotors in the meat sector was observed. Prohibition of their use was transformed into prohibition of

their residues in meat and meat products. This could be interpreted as a regulatory concession to technological developments in agriculture. However, systematic examination of regulatory changes was not possible given limitations created by data not being sufficiently detailed and covering only a few countries.

In brief, this chapter describes and explores potential explanations for the use of growth promotors in animal production, the concern about their use, and the resulting regulatory action across nations. In assessing the conclusion about the explanatory hypothesis, methodological limitations should be kept in mind. By subsequently analyzing the nature of regulations on other potentially hazardous substances in the meat sector, however, we will attempt to systemize and improve understanding of the international picture of safety regulations on meat and meat products.

Chapter IV

Public Action Regarding the Use of Antibiotics: A Description, Cross-National Comparison and Evaluation

IV.1 The Use of Antibiotics: A Global Description

The primary concern of the veterinary profession is to assist the agricultural community in producing high quality, wholesome meat for consumers. Animal drugs are crucial in performing this task. However, notwithstanding the savings that are generated in both the production and processing stage by the utilization of certain drugs, various public and private investigators have expressed concern about potential human health hazards which result from the widespread use of a variety of animal drugs.

At this point we will elaborate on the use of antibiotics. Like growth promotors, antibiotics have caused a lot of speculation and debate. Antibiotics are chemical substances that inhibit or destroy the growth of harmful micro-organisms. They are utilized as a treatment against infection or as immunization against infectious diseases.

Application of antibiotics takes place in both the production and the processing stage of meat. With respect to the former use, we can distinguish two major methods:

(1) application by injection, spraying, and dipping, and (2) oral application by feed and water. Regarding the latter (processing) stage, we observe the use of antibiotics as a method of maintaining ideal hygienic conditions in slaughtering/processing plants. Antibiotics may also be used in order to preserve meat, particularly poultry meat [Bowen, 1979, p. 23].

It has already been mentioned that concern was raised about the potential impacts of the use of antibiotics. Whether potential hazards are real or theoretical is debatable. Below we discuss the most important types of contamination and their potential effects on human health based on studies by Bowen [1979] and the American Association of Industrial Veterinarians [1979].

(1) Bacterial Contamination: Even under ideal hygienic slaughtering and processing conditions, contamination of meat by bacteria may be inevitable. If meat from animals treated with antibiotics contains bacteria that have become resistant to a number of antibiotics, the survival and multiplication of these bacteria can cause human health hazards. The fear is that a person infected with these resistant bacteria that contaminate meat might become resistant to the antibiotics that a physician would ordinarily prescribe to treat a particular disease. Essentially, this type of contamination of meat with resistant bacteria can be reduced by hygienic improvements

in the slaughtering and processing stage as well as by good preparation and storage at the stage of final consumption.

(2) Residues from Antibiotics: Residues from systematic medication are mostly concentrated in such organs as the liver and kidney in addition to their intramuscular concentration. Since certain antibiotics used in animal production were found to be carcinogenic in laboratory animals and were therefore suspected of being carcinogenic for humans, restrictions were imposed on their use [U.S. Senate, September 1977; ibid. July 1979, pp. 81-82]. Because the antibiotic residue problem is more important in milk production and its processing, more control is imposed on antibiotics used in this sector than on any other sector. In spite of the greater difficulty in detecting residues of antibiotics in meat, surveillance of residues in meat and meat products occurs given the alleged potential health hazards.

In brief, being suspected of causing the development and transfer to humans of organisms resistant to antibiotics, as well as of being carcinogenic for humans, concern was raised about the widespread use of antibiotics for (among other things) therapeutic and growth purposes in animal production [F.D.A. Consumer, September 1978, p. 14; ibid., October 1979, p. 16]. As a result of expressed concerns about potential hazards to public health, steps were taken by many countries to adapt existing safety

regulations to these developments.

It is this concern about the use of antibiotics that we subject to a cross-national comparison in this chapter. We will indicate briefly what kind of legislative scenarios we would expect to find before presenting the results of the comparison across nations.

In the case of antibiotics, members of the medical research community and consumer groups are likely to regard regulatory restriction or a complete ban of animal drugs as the most desired policy alternatives. However, for producers and members of the veterinarian community, these alternatives threaten a loss of management tools that reduce costs and increase profitability in animal production [U.S.D.A., November, 1978].

It is the task of policy makers to evaluate the trade-offs that are involved. In the case of some veterinary drugs, such as the DES-hormone, there are no health benefits for either the animal or the consumer. The benefits of this hormone are purely economical in that the animal grows faster on less feed. In the case of antibiotics, however, there are substantial trade-offs involved. On the one hand, the use of antibiotics creates benefits in the form of reduced risk and lower incidences of certain animal diseases. This reduces potential economic losses to farmers and may improve their income position. On the other hand, however, the use of antibiotics may create

costs in terms of potential health hazards. Strict regulations, such as prohibiting the use of the drugs, may reduce the potential health hazards to which human beings are exposed, yet increase production costs. Specifically, an increase in the incidence of animal diseases may result in higher price levels due to smaller meat supplies. Hence, in this scenario, a supposedly higher safety level is obtained, but not without generating higher costs of production and higher consumer expenditures on meat [U.S.D.A., November 1978, p. 1].

In addressing this safety issue, policy instruments that lie somewhere in between the extremes of prohibited use and unrestricted use seem to be most feasible. It is the actual regulatory response in various countries to perceived problems concerning the use of antibiotics that we turn to next.

IV.2 Cross-National Comparison of Regulatory Action with Respect to the Use of Antibiotics in Meat Production

Concern about the use of antibiotics reached the public agendas in the 1960's. The United Kingdom took the lead in reviewing the efficacy of existing regulations on the use of antibiotics in meat production. The conclusions of experimental animal studies which describe the potential

impacts on human health resulting from the use of antibiotics in meat production seem to have accelerated regulatory action in the United Kingdom, followed by other countries [Bowen, 1979, p. 23]. At the international level, concern grew over time, too. This is illustrated by the issuance of directives of the European Economic Community on animal drugs. Moreover, standardization attempts were started within other international contexts, such as the World Health Organization (W.H.O.) [Massart, 1980, pp. 136-140].

We will first present a cross-national comparison of the regulatory status quo of approximately two decades ago. A W.H.O. study (1963) enables us to analyze the particular issue of regulations on antibiotics over time [W.H.O., 1963]. It should be noted that we deal with a less than perfect time study. To the best knowledge -- and discomfort -- of the researcher, no similar, more recent studies exist and our more recent data are less comprehensive in their scope. We realize that the information representing the regulatory status quo in 1961 is unlikely to be the same two decades later given the frequent adjustments in food safety regulations. This is, in particular, a result of an ongoing evaluation process which draws on scientific developments and, correspondingly, makes flexibility and periodic reassessment a necessity. However, the nature of the questions we ask in this study allows us to analyze these

two decades old observations on permitted antibiotics and their allowed dose in animal feeds in various countries. After all, it is our objective to come up with potential explanations of similarities and differences in standards, in which case a tentative comparison of standards over time, where possible, adds an extra dimension to our understanding.

Before entering into the presentation of the results of the W.H.O. study, we have to indicate that the selection of countries whose legislation is compared is determined by the availability of data. Their 1961 status on the use in animal feeds of penicillin and tetracyclines -- both antibiotics that experts voiced concern about -- is contained in Table 7 which follows.

IV.2.1 Regulatory Action Concerning the Use of Antibiotics in Animal Feed: The Case of Penicillin and Tetracyclines in the Early 1960's

The figures in Table 7 show how differently the antibiotics-in-feed issue is addressed by different countries. Some countries make a distinction between the use of penicillin and tetracyclines in animal feed for either growth promotion or therapeutic purposes, whereas most other countries do not distinguish among possible

Table 7

Regulation of Use of Penicillin and Tetracyclines in Animal Feed

Country 1)	Category of GNP/ Capita 2)	Poultry		Calves		Swine	
		GR 3)	TH 3)	GR	TH	GR	TH
U.S.	I	50 4)	100-2000	50	100-2000	50	100-2000
Canada	I	50	100- 400	2-50	100-400	2-50	100-400
Sweden	I	NR 5)		NR		NR	
Australia	I	LL 6)		-- 7)		LL	
Switzerland	I	5-20		5-20		5-20	
New Zealand	I	LL		LL		LL	
U.K.	II	100		--		100	
Belgium	II	20-50		20-50		20-50	
Norway	II	15		15-50		15-50	
France	II	50		50		50	
Denmark	II	10-20		100		10-20	
Germany	II	10-100		10-100		10-100	
Netherlands	III	10		100		10-50	
Israel	III	4-10		4-80		--	
Italy	III	NR		NR		NR	
Ireland	III	NR		NR		NR	
Argentina	III	5-10	50-150	--		5-10	50-150
South Africa	IV	10-15	VP 8)	--		10-15	VP
Japan	IV	NR		NR		NR	
Spain	IV	4-50		4-50		4-50	
Kenya	IV	7.5		75		10	
USSR	na 1)	15-20		15-20		15-20	
Hungary	na	10-15		--		10-15	

1) The countries are ranked according to their per capita gross national product (1958; in U.S. dollars). Source: Statistical Abstracts of the U.S., 1970, Department of Commerce. Since other sources for these statistical data expressed national account figures in gross domestic product and/or in national currencies, it was decided to use the above source. The fact that we use data for 1958 rather than for 1960/1961 is believed not to impact the relative figures and ranking of the countries. Note that the USSR and Hungary are put at the bottom of the list because their GNP data were not mentioned (na) in the source used.

2) I = >$1500
II =$1001-1500
III =$ 500-1000
IV = <$500

Note: The above categorization spreads the countries most evenly.

3) GR = Growth promotion purposes.
TH = Therapeutic purposes.
Note: If no distinction between GR and TH was made in the legislation, the numbers (in parts per million) are put in the middle of the columns.

4) The interval notation reflects variations in the tolerance level of sub-types of the antibiotics, within subcategories of animal species, and/or implies variable use within any of these categories.

5) NR = Not regulated/without restrictions.

6) LL = Low levels. This notation in the W.H.O. study indicates that the rules in the particular country are defined rather vaguely.

7) Interpreted as 'prohibited' if one or two of the three types of animal species were omitted in the description of the regulations. Hence, the W.H.O. description is interpreted as a positive list.

8) VP = Veterinary prescription.

Source: Adapted from W.H.O., 1963.

purposes of their use. Moreover, the clearness in the formulation of tolerance levels varies. A 'low level' rule cannot be considered as being very transparent. Similarly, standards formulated in terms of intervals seem to allow for variable use, which may generate some uncertainty about the conditions under which certain levels of use are allowed. Correspondingly, the information costs for, particularly, feed producers and farmers, for whom knowledge about tolerance levels is of relevance, seem to be higher in case of an interval type of legislation.

On the whole, we observe a continuum from absence of restrictions on the use of penicillin and tetracyclines in animal feed to explicitly formulated maximum tolerance levels. In order to test our propositions, however, we need to analyze these findings more specifically. Table 8 facilitates comparison of the tolerance levels in the various countries in testing the standard of living hypothesis.

Among the countries that make a distinction in their legislation between the use of penicillin and tetracyclines in animal feed for either growth or therapeutic purposes (see Table 7), the tolerance levels tend to become stricter the lower the per capita GNP level of the country. Most countries, however, do not make the above distinction in their legislation, which could be explained in terms of the complexity of the enforcement in case of a dual system. The

Table 8

Distribution of Regulation of Use of Penicillin and Tetracyclines in Feed for Calves by Category of GNP/Capita

8a

Category of GNP/Capita ***	Type of Regulation Applied to Feed For Calves* (a) No Restrictions	(b) Vague** Standard	(c) Interval Standard	(d) Explicit Standard or Combination c/d	N
I >$1500	1	1	2	2	6
II $1001-$1500	-	-	3	3	6
III $ 500-$1000	2	-	1	2	5
IV <$ 500	1	-	1	2	4
	4	1	7	9	21

* Since there is no major difference in the regulations regarding the use of the two antibiotics in feed for poultry, calves, or swine, it is believed to be sufficient to examine the rules concerning only one category. The focus on feed for calves is arbitrary.

** See note 6, Table 7.

***GNP/Capita (1958; see note 2, Table 7). Note that the USSR and Hungary are not included in the comparison given their absence in the source used for the 1958 GNP data.

8b

Category of GNP/Capita	Level of Standards Applied to Feed for Calves* Prohibited	<25ppm	25-50ppm	51-100ppm	>100ppm	N
I >$1500	1	1	-	-	2	4
II $1001-$1500	1	-	3	2	-	6
III $500-$1000	1	-	-	2	-	3
IV <$ 500	1	-	1	1	-	3
	4	1	4	5	2	16

* In the case of interval standards we used the maximum level; this Table is a specification of the columns c and d in Table 8a.

examination of the level of the standards in the countries without dual legislation does not allow us to conclude that the strictness of the rules is positively correlated with the economic well-being of a country. In fact, the obtained pattern is random. Moreover, whereas three out of the four countries that are observed not to restrict the use of penicillin and tetracyclines in animal feed are lower ranked as far as their per capita GNP level (1958) is concerned, there are also countries with lower GNP levels that have

standards as strict as the standards of those at the top. Hence, the inference to be drawn from these Tables is that the hypothesis that the strictness of the safety standards on the use of certain antibiotics in animal feed is correlated with the standard of living of a country cannot be accepted.

Likewise, the countries were ranked according to their relative dependency on meat exports as one of the other explanatory factors suggested in this study. The findings are shown in Table 9 and subsequently presented in a format facilitating comparison in Table 10.

There is an indication that countries whose economies depend to a greater extent on meat exports have stricter regulatory standards on the use of penicillin and tetracyclines in animal feed. Hence, these observations enable us to accept the hypothesis that a greater importance of meat exports for the economy will imply higher safety standards.

In addition, a kind of counter-procedure was followed by calculating the meat import dependency of the countries as a percentage of domestic meat consumption. The underlying hypothesis that concern about the level of use of antibiotics in animal feed is likely to be inversely related to the share of meat imports in domestic meat consumption cannot be accepted on the basis of the findings summarized in Table 11. Also, there is no clear indication that the

Table 9

Regulations of Use of Penicillin and Tetracylines in Feed for Calves and Relative Dependency on Meat

	Exports of Beef and Veal as a Percentage of Beef and Veal Production 1)	Tolerance Levels on the Use of Penicillin and Tetracyclines in Feed for Calves (in ppm)	
		GR 4)	TH 4)
New Zealand	57.0%	LL 5)	
Denmark	52.0	100	
Ireland	50.0	NR	
Australia	31.0	-	
Argentina	24.0	-	
Hungary	16.0	-	
Netherlands	13.0	100	
Kenya **	13.0	75	
Israel**	4.0	4-80	
France	3.0	50	
Belgium*	3.0	20-50	
Canada	3.0	2-50	100-400
South Africa	2.0	-	
Norway	2.0	15-50	
Sweden	1.0	NR 6)	
Germany	1.0	10-100	
U.K.	1.0	-	
U.S.	.4	50	100-2000
Spain **	.4	4-50	
Japan	.3	NR	
Italy	.1	NR	
U.S.S.R.	.1	15-20	
Switzerland	.1	5-20	

* The data for Belgium include Luxemburg.

** The production and trade data for these countries are obtained from other sources. Source of the production data: FAO, Production Yearbook, 1966. Source of the trade data: FAO, Trade Yearbook, 1966.

1) Percentage = $\frac{\text{Quantity of exports of beef and veal (av.1956-1960; in million lbs.) 2)}}{\text{Quantity of production of beef and veal (av.1956-60; in mill. lbs.) 3)}}$

2) Source: USDA, November 1966.

3) Source: USDA, June 1967.

4) GR = Growth promotion purposes; TH = Therapeutic purposes.

5) LL = Low levels (see note 6, Table 7).

6) NR = Not regulated.

Table 10*

Distribution of Regulation of Use of Penicillin and Tetracyclines in Feed for Calves by Relative Meat Export Dependency

10a

Exports of Beef and Veal as a Percentage of Beef and Veal Production	Type of Regulation (a) No Restriction	(b) Vague Standard	(c) Interval Standard	(d) Explicit Standard or combination c/d	N
>20%	1	1	-	3	5
5-20	-	-	-	3	3
1- 4	1	-	5	3	9
< 1	2	-	3	1	6
	4	1	8	10	23

10b

Exports of Beef and Veal as a Percentage of Beef and Veal Production	Level of Standards (a) Prohibited	(b) <25ppm	(c) 25-50 ppm	(d) 51-100 ppm	(e) >100ppm	N
>20%	2	-	-	1	-	3
5-20	1	-	-	2	-	3
1- 4	2	-	3	2	1	8
< 1	-	2	1	-	1	4
	5	2	4	5	2	18

*The procedure is similar to the one used in Table 8. Table 10b is a specification of the columns c and d in Table 10a.

Table 11

Distribution of Regulation of Use of Penicillin and Tetracyclines in Feed for Calves by Relative Meat Import Dependency

11a

Share of Meat Imports in Domestic Meat Consumption 1)	Type of Regulation				
	(a) No Restriction	(b) Vague Standard	(c) Interval Standard	(d) Explicit Standard or Combination c/d	N*
>15%	1	-	2	2	5
5-15	1	-	2	2	5
< 5	2	1	3	3	9
na	-	-	-	2	2
	4	1	7	9	21

11b

Share of Meat Imports In Domestic Meat Consumption 1)	Level of Standards					
	(a) Prohibited	(b) <25 ppm	(c) 25-50 ppm	(d) 51-100 ppm	(e) >100 ppm	N*
>15 %	2	-	-	1	-	3
5-15	-	-	1	2	1	4
< 5	2	1	2	1	1	7
na	1	-	-	1	-	2
	5	1	3	5	2	16

*Note that the data in these Tables do not include Switzerland.

1) Percentage = $\frac{\text{Average imports of beef (1961-1963; in 1000 metric tons)}}{\text{Consumption of beef and veal (1961; in 1000 metric tons)}}$

Although it is not perfectly correct to compare imports of beef only with the consumption of beef and veal, this is believed not to affect our findings and conclusions.

Source: Adapted from Simpson, J.R., Farris, D.E., 1982, pp. 286-290.

opposite pattern dominates. The Table shows that the differences in the type and level of the safety standards do not follow a distinct pattern upon which we can base clear conclusions about the validity of the hypotheses.

In assessing whether countries with a higher level of per capita consumption of meat show more concern about the wholesomeness of the meat and meat products consumed, the countries were ranked according to their per capita consumption level. The findings are presented in Table 12. Since we intend to avoid further repetition of the specific safety regulations, as presented in Table 7, the figures in Table 12 only illustrate the levels of the per capita consumption of beef and veal across the countries included in the comparison. In Table 13 the information is again further categorized in order to facilitate comparison.

Again, there is not enough evidence to conclude from these figures that a higher level of per capita consumption of beef and veal clearly corresponds with higher safety standards. Safety standards, indirectly measured by the type of regulations on the use of antibiotics in animal feed (Table 13a) tend to be more explicitly formulated the higher the per capita consumption of beef and veal in a country. However, when looking at the actual standards (Table 13b), the pattern is such that high and low standards exist in countries with either high or low consumption levels without higher standards necessarily being predominant in the

Table 12

Per Capita Consumption of Beef and Veal*

Argentina	83.2 kg	Sweden	19.8
U.S.	42.8	Netherlands	18.9
Australia	42.2	Denmark	16.9
New Zealand	41.3	Ireland	16.2
Canada	35.6	Italy	15.0
France	29.0	Norway	14.9
U.K.	26.4	USSR	12.2
Switzerland	23.2	Hungary	9.6
Belgium**	22.8	Israel	7.3
South Africa	22.5	Spain	5.9
Germany	20.7	Japan	1.6

* Covering 1961; in kg.

** The data for Belgium includes Luxemburg. Note that the list excludes Kenya.

Source: Simpson, J.R., Farris, D.E., 1982, pp. 284-285.

Table 13

Distribution of Regulation of Use of Penicillin and Tetracyclines in Feed for Calves by Level of Meat Consumption

13a

Consumption of Beef and Veal (In KG/Capita)	Type of Regulation (a) No Restriction	(b) Vague Standard	(c) Interval Standard	(d) Explicit Standard or Combination c/d	N
>40 kg	-	1	-	3	4
20-40	-	-	4	3	7
10-19.9	3	-	2	2	7
<10	1	-	2	1	4
	4	1	8	9	22

13b

Consumption of Beef and Veal (In Kg/Capita)	Level of Standards (a) Prohibited	(b) <25 ppm	(c) 25-50 ppm	(d) 51-100 ppm	(e) >100 ppm	N
>40	2	-	-	-	1	3
20-40	2	1	2	1	1	7
10-19.9	-	1	1	2	-	4
<10	1	-	1	1	-	3
	5	2	4	4	2	17

categories of higher consumption levels. Proportionately, the higher standards appear more frequently in countries with higher levels of meat consumption, yet there is no clear evidence that the consumption hypothesis holds.

IV.2.2 Some Regulatory Developments During the Last Two Decades

Following this rather extensive analysis of the implications of the findings of the W.H.O. study (1963) for our suggested propositions, we now focus on more recent information on the legislation of antibiotics across nations.

As is indicated earlier, information constraints do not allow us to present precisely how this particular type of safety legislation developed in all these countries during the last two decades. Hence, an ideal time study cannot be done. However, using the available data, we attempt to indicate the trend of the rules on the use of antibiotics in various countries.

Overall, the growing concern about increases in the use of compound feeds containing antibiotics and more direct uses of antibiotics for therapeutic and growth promoting purposes seems to be institutionalized on a rather world-wide scale since the 1960's. A look at Food and Agricultural Legislation (a F.A.O. periodical) over time

provides us with the impression that this growing concern is not purely limited to the economically most advanced countries, but appears in less advanced countries as well./3 Many countries enacted new, or changed existing, regulations governing permitted levels of use of antibiotics in meat production and their residues in final meat and meat products. The regulatory attention applies to both domestically produced and imported meat. There is no indication that the countries whose regulations were mentioned in the F.A.O. source have distinct explanatory characteristics.

Unfortunately, the lack of sufficiently detailed information about currently existing specific rules on antibiotics does not enable us to follow a procedure similar to the one used in the presentation of the rules on the use of penicillin and tetracyclines in animal feed (IV.2.1). The F.A.O. periodical mentioned earlier appeared to be less useful for our purposes in that it only summarizes new or amended legislation in the various countries. Also, the low response rate to our request for detailed information on enacted or amended legislation sent to Dutch Agricultural Attaches in countries included in the comparison is another

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3See also W.H.O., International Digest of Health Legislation (periodical).

information obstacle./4 Hence, it is not possible to present a well structured overview of which country has what rule on various uses of different types of antibiotics.

Nevertheless, rather recent cross-national data on the regulation of the particular use of a certain antibiotic provides us with a specific picture that we can examine. This information covers the regulation of the use of tetracyclines as preservatives of meat. The actual findings are shown in Table 14.

Without ranking these countries again according to their standard of living, the importance of meat trade, and the level of meat consumption, it is evident that we observe similar regulatory responses in most countries to the use of tetracyclines in preserving meat despite variations in these factors.

The partial overlap between the list of countries whose rules on the use of tetracyclines we examined in Table 7 and the list of countries in Table 14 enables us to analyze the consistency in the particular case of regulations on the use of tetracyclines. We realize that the use of tetracyclines in animal feed differs from their use in preserving meat and that these uses probably imply different potential health hazards. No studies were found that address this issue of

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4Sent in August, 1982; only one answer was received (from the Attache in Greece).

Table 14

Regulations of the Use of Tetracyclines in Raw Meat, Poultry and Blood

Austria	P*	Japan	P
Belgium	P	Luxembourg	P
Canada	P	Netherlands	P
Denmark	P	Norway	NR
Finland	P	Portugal	P
France	P	Spain	NR
Germany	P	Sweden	P
Ireland	NR**	Switzerland	P
Israel	7ppm***	U.K.	P
Italy	P	U.S.	P

*P = Prohibited.
**NR = Not regulated.
***In poultry with special permission.

Source: Food Law Research Center, 1975. The data are up-to-date to the third quarter of 1974.

possibly varying levels of contamination. Furthermore, it should be noted that there is a substantial time gap between the description of the two sets of rules (1974 vs. 1961). However, we lack more congruent data. These limitations have to be kept in mind when interpreting the comparison in Table 15.

The comparison in Table 15 reveals that only one of these countries (Ireland) follows a 'no restriction' scenario in both cases. The other two countries that do not restrict the use of tetracyclines in preserving meat show a less 'liberal' attitude towards their use in animal feeds.

Table 15

Comparison of Regulation of the Use of Tetracyclines in Meat Preservation and Feed for Calves

	Tetracyclines in Meat Preservation	Tetracyclines in Animal Feed (Calves)
Ireland	NR*	NR
Israel	7ppm (poultry; special permission)	4-80ppm (4-10ppm, poultry)
Italy	P**	NR
Japan	P	NR
Norway	NR	15-50ppm
Spain	NR	4-50ppm
Sweden	P	NR

*NR = Not regulated
**P = Prohibited

Three other countries show stricter legislation on the use for meat preservation than their concern about meat production inputs seems to indicate.

The availability of recently published, updated Food Additive Tables enables us to examine whether the regulations on the use of tetracyclines in preserving meat have changed since 1974 [Food Law Research Center, 1982]. It is interesting to observe that changes in these regulations basically only occurred in countries that did not restrict their use as preservatives before (i.e., they are now also being prohibited in Norway and Ireland, but Spain is an exception where the use of tetracyclines is still not regulated). While the regulations in the other countries did not change, the U.S. appears to have slightly relaxed its rules (i.e., the U.S. now allows 0.25 ppm in uncooked edible meat tissues). Considering the above

comparison as the last illustration of regulatory actions across nations on the use of antibiotics, we will end this chapter on antibiotics with some general conclusions.

IV.3 Evaluation

Similar to the previous examination of the pattern of public action on the use and residues of growth promotors, we consider the above information on the cross-national pattern of regulations on the use of antibiotics as a limited but sufficient data base upon which to formulate some general conclusions.

The regulations observed in the countries included in the various comparisons show similarities and differences across nations. Again, the formulated propositions do not explain our findings very well. There is no clear indication that standard of living, dependency on meat trade, or level of meat consumption determines, or, to state it more moderately, contributes to, the strictness of the regulations on the use of antibiotics in either animal feed or in preserving meat. In fact, the pattern of variations and similarities of rules appears to be distributed rather randomly across the nations included in the comparisons. Particularly in the case of the rules on the use of penicillin and tetracyclines in animal feed, the list of countries was rather heterogeneous. Specific types of rules

and specific levels of strictness of rules do not appear to be dominant in countries with a distinct set of characteristics that could explain the patterns obtained. While most results are rather inconclusive, only the rules on the use of the examined antibiotics in animal feed provide us with some indication of the validity of meat trade as an explanatory factor.

As far as the regulatory changes over time are concerned, our observations are limited. Given the lack of details on the dynamics of the rules on the use of antibiotics, we have to base our conclusions on a limited set of observations. First, the findings of animal experiments on potential health hazards seem to have performed a kind of catalytic role in speeding up the enactment of new or amended regulations on the use of antibiotics and their residues in feed and foodstuffs. Furthermore, the following example illustrates that the speed of adjustment to the findings of animal experiments may differ across countries. While the U.K. restricted the use of penicillin and tetracyclines in animal feeds in 1971, the U.S. only did so in 1977 [General Accounting Office, 1978]. It obviously goes beyond the scope of this study to examine the role of political factors as possible explanations for the above described difference in adoption of safety regulations. In order to keep a broad topic like this manageable, we had to limit ourselves in the kind and

scope of questions to be answered.

With respect to the use of antibiotics, we restricted ourselves to a description of the general background of the concern, the resulting regulatory action across nations, and potential explanations for obtained patterns. By following the same procedure in the next chapters on other potential sources of the contamination of meat and meat products, we intend to end up with an overall picture that enables us to formulate more general conclusions.

Chapter V

Public Action Regarding the Use of Additives in Meat Processing: A Description, Cross-National Comparison and Evaluation

V.1 The Use of Additives in Meat Processing: A Global Description

Unlike growth promotors and antibiotics which are rather recent technological developments, additives have been used from early times in the preparation and preservation of food. Mankind has been concerned throughout history about the conservation of food resources. However, along with the increasing trend towards more highly processed and packaged foods, a whole range of new, extraneous substances added to food items has grown rapidly. The ever-increasing number of preservatives, flavourings, and colourants, combined with uncertainties about their potential health hazards, made food additive controversies regular, world-wide occurrencies. The fear grew that "we may be doing irreparable damage to ourselves without fully realizing it" [Hunter, 1975, p. 101]. Before elaborating on the regulations on additives used in meat processing,

we will examine the nature and purpose of additives in some more detail.

As is indicated above, it has been sought from early times to enhance the palatability of food and to prevent it from 'going bad'. Basically, there are two ways in which the latter can occur. The first and most serious one is spoilage caused by molds, bacteria and yeasts. This type of food contamination can cause digestive disorders and, in the extreme case, deadly botulism. Over the years a number of substances has been used to protect foods from these microbial actions. The oldest one to preserve meat and other food items is salt. Today about 30 chemicals exist that protect foods from micro-organisms. The second source of spoilage is oxidation. This less serious way in which food can 'go bad' is the undesirable change in colour and flavour that occurs with the exposure of foods to oxygen. The group of preservatives known as anti-oxidants retards this process [F.D.A. Consumer, May 1979, pp. 22, 23].

Generally speaking, the use of these colouring and flavouring substances can be typified as an indicator of the 'affluent society' in which consumers prefer goods that are attractive as far as colour and flavour are concerned. Moreover, consumers expect food items to be available out of their normal growing season. Food processors and manufacturers use colouring and flavouring substances that fulfill these more psychological demands, even though these

substances do not necessarily contribute to a basic improvement of quality of the food to which they are added. Also, the demand for out-of-season items can be fulfilled by the use of additives and other methods.

However, more and more questions were raised about the safety of their use. Although most countries had some sort of regulatory control in operation in order to deal with the potential hazards involved in the use of chemicals in food, tendencies in food technology led to the adjustment of existing regulations. A new, widespread level of awareness called for safety and nutrition in addition to aesthetics. The controversies over the potential health hazards generated by uncontrolled use of food additives imposed upon public authorities the responsibility for deciding whether certain additives should be allowed, and, if so, to what extent. The resulting regulations on food additives across nations seem to reflect a 'better safe than sorry' attitude.

Out of the wide range of additives used in the meat processing stage, we chose to focus on the following preservatives and anti-oxidants: nitrites, ascorbic acid, BHA/BHT, phosphates and sorbitol. Of these substances, nitrites have been subject to most public concern, given the perceived potential health hazards.

Nitrites are primarily used to prevent botulism, a bacterial contamination causing food poisoning. In addition, they are used to give a desirable colour and

flavour to meat and meat products. Bacon, ham, sausages and the like are meat items for which nitrites are an important element in the manufacturing process. Unfortunately, while used to prevent health hazards, nitrites may carry their own health hazards. Scientific findings that nitrites themselves -- as well as in combination with other chemicals in food that form nitrosamines -- cause cancer in laboratory animals made their widespread use in the meat curing process increasingly controversial [Crosby, 1976; U.S. Senate, September 1978; Franklin, 1980, pp. 166, 167].

The resulting regulatory action on nitrites has to be characterized as a rather slowly moving process. This lack of speed can be attributed to the controversies concerning their potential health hazards on the one hand and absence of good substitutes in meat processing on the other hand. The responsible agencies were faced with the dilemma of either allowing use with a potential long-run threat to public health or prohibiting use with a more immediate health threat. As can be expected, the actual regulatory action is likely to end up somewhere in between the extremes of unrestricted use and total ban. The argument against the latter as a potential regulatory scenario includes the risks of botulism and also the expectation that processing methods as well as consumption patterns would have to be adjusted substantially. It is interesting to mention in this context of risks of botulism the results of a study on outbreaks of

food borne botulism in the United States which indicate that over the period 1899-1973 only 7% of the outbreaks was accounted for by animal products. Moreover, these outbreaks were attributed to a great extent to home processed rather than commercially processed meat and meat products [U.S.D.A., Economics, Statistics, and Cooperatives Service, March 1979, p. 1].

While all the additives that we will examine more closely in this chapter are subject to regulatory action, they do not necessarily generate similar potential health hazards. As far as the other selected additives are concerned, we can briefly state that the degree of their perceived health hazards vary from one substance to the other. Studies on their impacts are, generally speaking, still inconclusive.

What we are basically interested in is not, however, the potential impacts on human health of the use of these substances, but the cross-national pattern of regulatory responses to expressed concerns. Before presenting the actual findings of the cross-national comparison, some additional comments on the regulation of additives in general need to be made.

As opposed to, for example, environmental contaminants, food additives appear to lend themselves to a more easy framework of control. It has to be taken into account, however, that they should not be considered as a homogeneous

set of substances. In this respect, variations in the nature and potential health hazards of food additives will be reflected in different types and levels of control.

In examining costs and benefits, responsible agencies will judge whether the use of an additive can be recognized as safe or needs further regulation in the form of labelling requirements, tolerance levels, or a total ban. To illustrate this: labelling requirements and tolerance levels can be expected to suffice in the use of ascorbic acid (vitamin C) in meat and meat products. In the case of nitrites, however, the alleged potential health hazards and benefits imply a more complicated decision-making. The strictness of the outcome of this process depends on the risk-attitude of the decision-makers.

Another point to be mentioned in the context of this general look at food additive legislation refers to the role of consumers in risk/benefit analyses regarding food additives. Generally speaking, more consumer autonomy appears to be retained in the safety decision on food additives than in any other case of potentially harmful substances in food. It is not necessarily true, though, that freedom of choice is preferred to governmental 'paternalism.' In fact, consumers may prefer protection as far as the toxicology of the food supply is concerned [F.D.A. Consumer, September 1979, p. 23]. This is what we observe in the meat sector. There is no differentiation

between, say, ground beef with and without nitrites. Hence, any demand for meat from 'naturally raised' animals (i.e., without chemicals) cannot be fulfilled through the regular marketing channels. By formulating tolerance levels and labelling requirements, public decision-making more or less substitutes for private decision-making on the degree of risk that is to be taken. At the same time, however, private information costs are reduced.

The similarities and differences in the public decisions on the use of certain additives in meat processing across nations will be presented next. Since tolerance levels lend themselves better to a cross-national comparison than labelling requirements, only the former are included in the comparison.

V.2 Cross-National Comparison of Regulatory Action with Respect to Additives Used in Meat and Meat Products

The notion that nobody shall sell food items containing substances that adversely affect human health can be found in early food legislation, but explicit rules for additives seem to have been formulated particularly during the last three decades. National as well as international bodies' activities since the 1950's reflect concern about the technical and administrative aspects of the problem of an increasing number of additives used in food. As in the case

of other chemical substances, regulatory toxicology -- aimed at providing a scientific basis for the regulation of food additives and other substances -- became an established activity in many parts of the world [Vettorazzi, 1978, p. 57]. A comparative view of the resulting national laws on the use of certain additives in meat and meat products is presented below.

V.2.1 Regulatory Action Concerning the Use of Additives in Meat and Meat Products: The Case of Nitrites Since the Late 1950's

Looking back in time at how concern about a controversial additive such as nitrites was reflected in various national regulatory frameworks, we surprisingly observe rather similar tolerance levels. Table 16 illustrates the similarity in standards among a variety of countries.

The inference to be drawn from this Table -- even without ranking the countries according to their relative standard of living -- is that concern about nitrites is institutionalized in a quite similar way in widely diverging countries. In addition, without calculating the specific importance of meat trade in each country, this variable is not expected to make a difference in explaining the pattern obtained. The same assumption is made about the potential

Table 16

Tolerance Levels Concerning the Use of Nitrites in Meat and Meat Products*

Australia	150	Mexico	200
Bulgaria	200	Netherlands	500
Canada	200	Nicaragua	200
Ceylon	200	S. Africa	200
Germany	200	U.K.	200**
Italy	150	U.S.	200
Malaysia	200		

*Period 1956-1965; in ppm.

**Tolerance level applies to cooked meat; no limit in the case of bacon and ham. Note that the remaining tolerance levels were not specified according to the type of species/product.

Source: Adapted from F.A.O., Current Food Additives Legislation, covering the period 1956-1965.

explanatory power of the proposition on the importance of meat consumption. Correspondingly, our hypotheses cannot be accepted in this case.

As studies on the subject of food additives developed considerably over the years, resulting scientific and consumer safety questions about the growing amount of additives used induced regulatory action. Previous approaches to safety regulations on additives were believed to be unsatisfactory by responsible authorities in many countries and were adjusted or replaced. Given the fact that we deal with a more or less continuous adjustment process of existing rules to new scientific data, the

tolerance levels that are presented below supposedly reflect the more recent regulatory status quo in the various countries, although they also may be already outdated. Nevertheless, as we stated earlier, it is not the objective to compile an updated user manual. Hence the standards formulated during the last decade are considered to be sufficient for our analytical purposes. Table 17 represents these more recent standards on nitrites in a variety of countries.

First, when comparing Tables 16 and 17, it is clear that our cross-national picture of the safety standards on nitrites in the 1970's is more comprehensive than the information obtained on the situation in the late 1950's and early 1960's. Apparently, more and more countries subjected the use of nitrites in meat and meat products to control over the years. Moreover, the countries included in both Tables show a rather consistent pattern of safety standards on nitrites over time. When focusing on the more recent standards (Table 17), we observe the same consistency in standards and trend to stricter standards during the 1970's.

The data do not seem to indicate that the nitrite issue is addressed differently by countries that vary in their standard of living. At first sight, the countries that seem to have formulated rules on the use of nitrites at a later point in time are in the lower categories of GNP/capita. However, the fact that the list of countries presented in

Table 17

Comparison of Tolerance Levels With Respect to the Use of Nitrites in Meat and Meat Products Over Time*

Country[1]	Up to 1974	Up to 1981
Sweden	200	200
U.S.	200	120-200[2]
Canada	200	150-200
Switzerland	200	200
Denmark	P-100	100-150
France	150	150
Germany	AWL[3]	150
Norway	P[4]	P-200
Australia	150	150
Belgium	200	200
Netherlands	500	500
Finland	50	75
U.K.	200	50-200
Austria	200	200
Israel	200	na
Japan	P-70	70
Italy	150	150
Ireland	200	200
Greece	na[5]	200
Spain	NR[6]	150-200
Portugal	NR	NR
Costa Rica	na	150-200
Guatemala	na	500
Egypt	na	200

* in ppm.

[1]The countries are ranked according to their GNP/capita, 1970 (source: World Bank, 1973). No major changes in the relative ranking are assumed to have taken place since 1970.

[2]The interval indicates that different standards are used for different products/species. An exact summary of the standards would require a long list of notes on which standard is used for which product/species.

[3]AWL = authorized without limitation.

[4]P = prohibited.

[5]na = not available.

[6]NR = not regulated.

Source: Adapted from a variety of sources. Most data were obtained from the Food Additive Tables (1975, 1982), see Table 14. Moreover, complementary sources were used in order to obtain a more comprehensive picture (i.e.,covering more countries) such as : export manuals (for internal use) of U.S.D.A./F.S.I.S. and of the Veterinary Service, Dutch Departments of Agriculture and Public Health. Also : British Food Manufacturing Industries Research Association Survey, 1981. It appeared that the tolerance levels for the same countries were not always exactly the same in the various sources. This may be the result of different timing of measurement. Since it is not the intention to provide an exact, up-to-date picture of the regulatory status quo, occasional disparities are not believed to be a major problem.

Table 16 includes some countries that also fall into these categories weakens the validity of the above interpretation.

The importance of meat trade and meat consumption in these countries are factors to be examined in the analysis of the pattern of standards on the use of nitrites. It appears to be less relevant to list the specific value of each country with respect to the two latter factors. Despite the fact that the range of countries compared at this point is not perfectly identical to the range of countries compared in the two preceding chapters, there appears to be such an overlap that it was decided not to present their specific values on the various variables at this point (in order to avoid repetition). In brief, the pattern and, consequently, conclusions are similar. The countries that are included in the comparison vary substantially as far as the importance of meat trade and the importance of meat consumption are concerned. Nevertheless, similarities in regulatory attitudes on the use of nitrites are observed. Hence, none of the hypotheses seem to hold in this case of specification of the research problem to nitrites. The findings of the analysis of the regulatory action on some other additives (V.2.2) will be presented in a more explicit format.

V.2.2 Regulatory Action With Respect to the Use of Additives in Meat and Meat Products: Some Additional Illustrations

We now turn to a similar discussion of some other additives selected out of a range of additives that are used in meat processing. In fact, less information was obtained on the regulatory action on these additives -- ascorbic acid, BHA/BHT, phosphates and sorbitol -- in the late 1950's and early 1960's than in the case of nitrites. The fact that concern about these additives became embedded in the law more explicitly only later in time can be considered as an indication of the initially more secondary concern about these substances. Table 18 shows which countries were found to have safety standards on the use of these additives in meat and meat products in the mentioned time period.

The inference to be drawn from this Table is that these additives were controlled only to a limited extent in the 1950's and 1960's. Of the few countries that are covered in the list, many lack explicit standards concerning several substances. Generally speaking, the regulatory action on these additives in the time period that is examined seems to be in an initial stage of development. The list consists of a relatively homogeneous range of countries in terms of their standards of living. Nevertheless, the pattern of safety standards varies substantially.

Table 18

Tolerance Levels Concerning the Use of Selected Additives in Meat and Meat Products*

Country[1]	Ascorbic Acid	BHA/ BHT	Sorbitol	Phosphates
Canada	AWL[2]	200	--[3]	--
Australia	--	--	--	3,000
New Zealand	--	--	--	5,000
France	300	--	--	3,000
Denmark	200	--	--	--
Germany	AWL	--	--	--
Netherlands	500	100	--	5,000
Italy	2,000	3,000	--	--
Japan	2,000	--	--	--

*in ppm.

[1]Relevant data were found on only these countries. The countries are ranked according to their GNP/capita (1958); see Table 7, note 1.

[2]AWL = Authorized without limitation.

[3]-- = no data obtained on the standards; assumed to be not required.

Source: F.A.O., Food Additives Legislation, issues published in the period 1956-1965; F.A.O., Food Additive Control Series, 1959-1963.

As far as the dynamics of the regulatory action on these additives is concerned, Table 19 is illustrative. Moreover, it provides us with a more comprehensive picture of later standards which allows for a closer examination of the findings in terms of the formulated hypotheses.

It follows from this Table that the strictness of safety standards varies across the types of additives, which

Table 19

Comparison of Tolerance Levels Regarding the Use of Selected Additives in Meat and Meat Products Over Time**

		Ascorbic Acid		BHA/BHT		Sorbitol		Phosphates	
		1974	1981	1974	1981	1974	1981	1974	1981
Switzerland	I [6]	400	AWL[1]	P	P	P	P	3000	P
Germany	I	AWL	AWL	P	P	AWL	P	3000	3000
Sweden	I	200	500	100	100	P	P	P	P
Denmark	I	P-500[2]	500	50	50	P[5]	P[5]	5000	P
Norway	I	AWL	200	200	200	NR	P	NR	P-20.000
Belgium	I	P-1000	1000	100	100	P	P	7000	3000
France	I	300	300	P	P	P	P	3000	3000-7500
Netherlands	I	500	500	P	P	P	P	5000	5000
United States	I	AWL	2000	100-300	30-100	20.000	20.000-AWL	500	5000-AWL
Saudi Arabia*	I	na	500	na	na	na	na	na	3000
Austria	I	500	P	P	P	P	na	5000	P-5000
Canada	I	na	AWL	P	P	P	P	5000	5000
Japan	II	P-AWL	AWL	1000[3]	1000[3]	NR	AWL	P-AWL	10.000
Finland	II	200	1000	P	P	P	P	1500-2000	1500
United Kingdom	II	P-AWL	AWL	P	P[4]	AWL	AWL	AWL	AWL
Italy	II	2000	2000	P	P	P	P	AWL	2500
Spain	II	NR	500	NR	P	NR	AWL	NR	2000-3000
Ireland	III	P	AWL	P	P	NR	AWL	NR	AWL
Israel	III	NR	na	P	na	NR	na	NR	na
Greece*	III	na	1000	na	2000	na	5000-7500	na	4000
Portugal	IV	NR	500	NR	200	NR	P	NR	P-AWL
Brazil*	IV	na	2000	na	na	na	na	na	5000

**Expressed in ppm.

1 AWL = Authorized without limitation. In the Food Additive Tables a distinction is made between 'good manufacturing practice' and AWL. Given the ambiguity in this notation, it was decided to use the AWL-category only, since it covers sufficient information for our purposes.

2 See note 2 , Table 7.

3 In whale meat products.

4 May not be added directly, but may be carried over from ingredients in which they are permitted (carry-over standard not specified).

5 Excludirg liver paste (5% = 50.000 ppm).

6 See Table 3 for categorization method.

Source: Adapted from Food Additive Tables (1975, 1981) as the major source. A (*) indicates that other sources are used (see Table 17 for these sources and additional notes).

we assume to be related to the degree of potential health hazards they are believed to incur. In interpreting these findings, we first present a general discussion of the changes in the safety standards over time. In the case of ascorbic acid, there is no linear trend indicating that the standards became more strict over time. While some countries appear to have strengthened the rules, others show the opposite. The dynamics in the regulatory attitude seem to follow a rather random pattern. The only more distinct pattern that can be observed is the loosening of standards occurring in countries that already have explicit safety standards. On the other hand, the strengthening of standards is particularly found in countries that previously had no or less restrictive regulations. Moreover, the standards tend to become more comprehensive over time in the sense of not differentiating among types of meat and meat products. With respect to the other three types of additives, similar conclusions can be formulated. Most countries show either a consistent or stricter regulatory attitude over time.

In order to facilitate the cross-national comparison, these findings have to be organized in a more manageable format. The structure that is chosen corresponds with the hypotheses. For simplicity we restrict the comparison to the regulatory status quo in 1981. Table 20 relates the safety standards on the four types of additives to,

Table 20

Comparison of Regulatory Action on Selected Additives By Standard of Living, Meat Trade and Meat Consumption

20a

	Ascorbic Acid							
	Safety Standards							
Category of GNP/Capita[1]	P*	<500 ppm	500 ppm	1000 ppm	>1000 ppm	AWL**	na**	N
I	1	2	4	2	1	3	-	12
II	-	-	1	-	1	2	-	5
III	-	-	-	1	-	1	1	3
IV	-	-	1	-	1	-	-	2
	1	2	6	3	3	6	1	22[5]
Meat Exports as a Percentage of Total Meat Production[2]	**P**	**<500 ppm**	**500 ppm**	**1000 ppm**	**>1000 ppm**	**AWL**	**na**	**N**
> 50%	-	-	2	-	-	1	-	3
11 - 50	-	1	-	1	-	-	-	2
5 - 10	-	-	1	1	1	3	-	6
< 5	1	1	2	1	2	2	1	10
	1	2	5	3	3	6	1	21
Meat Imports as a Percentage of Total Meat Consumption[2]	**P**	**<500 ppm**	**500 ppm**	**1000 ppm**	**>1000 ppm**	**AWL**	**na**	**N**
> 15%	-	-	1	1	1	3	1	7
5 - 15	1	2	3	1	1	2	-	10
< 5	-	-	1	1	1	1	-	4
	1	2	5	3	3	6	1	21
Per Capita Consumption of Meat (kg)[3]	**P**	**<500 ppm**	**500 ppm**	**1000 ppm**	**>1000 ppm**	**AWL**	**na**	**N**
> 100 kg	-	-	-	-	1	-	-	1
80 - 100	1	1	-	1	-	1	-	5
50 - 79	-	1	4	2	1	4	1	12
< 50	-	-	1	-	1	1	-	3
	1	2	5	3	3	6	1	21

20b

Category of GNP/Capita[1]	BHA/BHT Safety Standards						
	P	0-50 ppm	51-100 ppm	>100 ppm	Restricted Use[4]	na	N
I	7	1	3	1	-	1	12
II	2	-	-	1	1	-	5
III	1	-	-	1	-	1	3
IV	-	-	-	1	-	1	2
	10	1	3	4	1	3	22[5]
Meat Exports as a Percentage of Total Meat Production[2]	**P**	**0-50 ppm**	**51-100 ppm**	**>100 ppm**	**Restricted Use**	**na**	**N**
> 50%	2	1	-	-	-	-	3
11 - 50	1	-	1	-	-	-	2
5 - 10	3	-	1	-	1	1	6
< 5	4	-	1	4	-	1	10
	10	1	3	4	1	2	21
Meat Imports As a Percentage of Total Meat Consumption[2]	**P**	**0-50 ppm**	**51-100 ppm**	**>100 ppm**	**Restricted Use**	**na**	**N**
> 15%	3	-	-	2	1	1	7
5 - 15	5	-	2	2	-	-	9
< 5	2	1	1	-	-	1	5
	10	1	3	4	1	2	21
Per Capita Consumption of Meat (kg)[3]	**P**	**0-50 ppm**	**51-100 ppm**	**>100 ppm**	**Restricted Use**	**na**	**N**
> 100 kg	-	-	1	-	-	-	1
80 - 100	4	-	1	-	-	-	5
50 - 79	6	1	1	2	1	1	12
< 50	-	-	-	2	-	1	3
	10	1	3	4	1	2	21

20c

Category of GNP/Capita[1]	Sorbitol Safety Standards					
	P	Explicit Standard	AWL	Combination AWL/P/ppm-Standard	na	N
I	9	-	-	1	2	12
II	2	-	3	-	-	5
III	-	1	1	-	1	3
IV	1	-	-	-	1	2
	12	1	4	1	4	22[5]
Meat Exports As a Percentage of Total Meat Production[2]	**P**	**Explicit Standard**	**AWL**	**Combination AWL/P/ppm-Standard**	**na**	**N**
> 50%	2	-	1	-	-	3
11 - 50	2	-	-	-	-	2
5 - 10	4	-	1	-	1	6
< 5	4	1	2	1	2	10
	12	1	4	1	3	21
Meat Imports As a Percentage of Total Meat Consumption[2]	**P**	**Explicit Standard**	**AWL**	**Combination AWL/P/ppm-Standard**	**na**	**N**
> 15%	3	1	2	-	1	7
5 - 15	7	-	1	1	1	10
< 5	2	-	1	-	1	4
	12	1	4	1	3	21
Per Capita Consumption of Meat (kg)[3]	**P**	**Explicit Standard**	**AWL**	**Combination AWL/P/ppm-Standard**	**na**	**N**
> 100 kg	-	-	-	1	-	1
80 - 100	4	-	-	-	1	5
50 - 79	7	1	3	-	1	12
< 50	1	-	1	-	1	3
	12	1	4	1	3	21

20d

	Phosphates							
	Safety Standards							
Category of GNP/Capita [1]	P	AWL	Combination AWL/P/ppm-Standard	≤3000 ppm	3001-5000 ppm	>5000 ppm	na	N
I	3	-	3	3	2	1	-	12
II	-	1	-	3	-	1	-	5
III	-	1	-	-	1	-	1	3
IV	-	-	1	-	1	-	-	2
	3	2	4	6	4	2	1	22[5]
Meat Exports As a Percentage of Total Meat Production[2]	**P**	**AWL**	**Combination AWL/P/ppm-Standard**	**≤3000 ppm**	**3001-5000 ppm**	**>5000 ppm**	**na**	**N**
> 50%	1	1	-	-	1	-	-	3
11 - 50	-	-	-	1	-	1	-	2
5 - 10	1	1	-	2	2	-	-	6
< 5	1	-	4	2	1	1	1	10
	3	2	4	5	4	2	1	21
Meat Imports As a Percentage of Total Meat Consumption[2]	**P**	**AWL**	**Combination AWL/P/ppm-Standard**	**≤3000 ppm**	**3001-5000 ppm**	**>5000 ppm**	**na**	**N**
> 15%	-	1	-	2	2	1	1	7
5 - 15	2	-	4	2	1	1	-	10
< 5	1	1	-	1	1	-	-	4
	3	2	4	5	4	2	1	21
Per Capita Consumption of Meat (kg)[3]	**P**	**AWL**	**Combination AWL/P/ppm-Standard**	**≤3000 ppm**	**3001-5000 ppm**	**>5000 ppm**	**na**	**N**
> 100 kg	-	-	1	-	-	-	-	1
80 - 100	-	-	1	2	1	1	-	5
50 - 79	3	2	1	3	2	-	1	12
< 50	-	-	1	-	1	1	-	3
	3	2	4	5	4	2	1	21

*P = Prohibited.
**AWL = Authorized without limitation.
***na = not available.

[1]See Table 3, Note 3.

[2]See Table 5, Note 1.

[3]See Table 5, Note 2.

[4]See Table 19, Note 4.

[5]Including Saudi Arabia; the figures regarding trade and consumption of meat exclude Saudi Arabia due to lack of data.

consecutively, the standard of living of the countries, the importance of meat exports in total meat production, the share of meat imports in meat consumption and the per capita meat consumption level.

Before interpreting the Table in terms of the propositions, the over-representation of countries with higher standards of living has to be emphasized. Also, the distribution of the countries over the distinguished categories of each of the other variables is not very equal. Moreover, the small number of observations implies that a comparison of percentages is a statistically less valid method. These limitations are borne in mind in the more impressionist interpretation of Table 20.

There is some indication that the standard of living hypothesis may hold in the case of the regulations with respect to these additives. Total prohibition of the additives tends to be a more common regulatory action in countries with higher levels of well-being. Correspondingly, the highest tolerance levels seem to prevail in countries with lower standards of living. On the other hand, the pattern of the most liberal regulatory attitude (AWL) is rather randomly distributed among the different GNP/capita categories.

With respect to the share of meat exports in the domestic meat production, we can conclude that the pattern of safety standards tends to follow the predicted path.

There is an indication that complete prohibition of the use of the additives in meat and meat products (and also lower tolerance levels) tend to prevail in countries in which the export of meat and meat products is more relevant for the meat sector.

Regarding the importance of imports of meat for the domestic meat consumption, the pattern of safety standards obtained is rather random. There is no indication that the type and level of standards correspond with the importance of meat imports.

Finally, a lower level of meat consumption as such seems to correspond with a more liberal attitude towards the use of the additives in meat and meat products.

V.3. Evaluation

Of the wide range of additives that are used in meat and meat products, we examined the regulatory action on a limited amount of them over time and across nations. The analysis of the safety standards over time indicates a growing concern for the use of additives in meat and meat products. The legislation appears to have developed from a more general to a more explicitly formulated set of safety standards. Moreover, it should be noted that not all additives are treated in the same way. Some substances face less strict standards than others, which might correspond

with the level of expected potential hazards to human health. As far as the cross-national comparison is concerned, the findings can be summarized as follows:

1. In the case of a highly controversial additive, such as nitrites, there does not seem to be an indication that the hypotheses hold. Notwithstanding differences in the factors expected to be of relevance, the safety standards on their use show quite similar patterns across nations.

2. The analysis of the regulatory action concerning the other additives examined, on the other hand, provides us with an indication that the type and level of safety standards on meat and meat products tends to correspond with the standard of living, the importance of meat exports, and the level of meat consumption in the countries covered in the comparison. This general observation could be interpreted as follows. Additives such as ascorbic acid, BHT/BHA, phosphates and sorbitol generated less concern than nitrites. Consequently, they became embedded more explicitly in national food safety laws later in time. The 'forerunners' in this respect are countries with a relative high standard of living. Over time, the number of countries with explicit safety standards concerning these additives shows an increase. Nevertheless, the type and level of the standards apparently is not the same across the nations compared. In the case of the above additives, the findings are interpreted as an indication of the validity of the

hypotheses. The observed variations are believed to be a reflection of the need/want to have well-formulated safety standards on these substances.

Finally, we unfortunately lack insight in the extent to which these food additives are used in the various countries. Their amount used -- assumedly reflecting consumer preferences with respect to the colour and taste of meat and meat products -- may have an impact on the strictness of the safety standards.

The above description and tentative explanation of the cross-national pattern of regulations regarding certain additives used in the meat processing stage is believed to constitute another vital element in the process of attempting to gain systematic knowledge about food safety standards across nations. Following the analysis of these intentionally added substances, the problem of unintentionally added substances will be addressed in the two subsequent chapters.

Chapter VI

Public Action Regarding the Use and Residues of Chemical Pesticides in Meat and Meat Products: A Description, Cross-National Comparison and Evaluation

VI.1 Use and Residues of Chemical Pesticides: A Global Description

Population growth and urban expansion put pressure on agriculture to increase food production. The introduction of pesticides and their use in agriculture as a rather common practice has brought considerable benefits. For example, insecticides play a major role in the treatment against insects on crops. Moreover, pesticides are used in protecting stored food against the invasion of insects, which not only involves a saving, but also keeps the food in better condition [Jager, 1970, p. 5]. Consequently, the use of chemical pesticides has diminished pest borne diseases, an illustration of which we find in the case of DDT. Introduced in the 1940's as one of the best acts against pest borne diseases, growing knowledge about its chronic toxic effects made DDT one of the most problematic chemicals in the history of pesticides thus far. Hence, despite the undeniable benefits of the use of chemical pesticides in agriculture, it was realized that, if used

indiscriminately, certain risks were attached to their use.

In general, the problems associated with the use of chemical pesticides are potential hazards to human health and environmental contamination. Concern about human health and the environment, as well as perceived problems with respect to the international trade of food commodities, led to the establishment of government agencies attempting to minimize unwanted effects.

Multiple factors have to be taken into account in deciding whether or not and how much of particular pesticides should be employed or tolerated as residues. The challenge in establishing a safe use of pesticides involves a risk-benefit decision. In the case of pesticides, we are attracted by their real value in terms of guaranteeing an adequate supply of wholesome food, freedom from disease and the like. At the same time, however, we aim to prevent health and ecological hazards, as well as barriers to trade.

The regulatory schemes that are adopted on a world-wide scale reflect a variation in the manner in which nations cope with the task of managing the intentional and unintentional existence of pesticides in the environment, the food chain and, finally, human beings. Realizing that chemical pesticides may present problems in a range of areas, but having to constrain the scope of the cross-national comparison, we limit the analysis to regulations on the presence of residues of chemical

pesticides in meat and meat products.

These residues may be the direct result of the application of the substances in the meat sector itself or the indirect result of their application elsewhere (e.g., to crops). Some of the potential contaminants, such as the organochlorine pesticides dieldrin, aldrin, endrin, HCB, and lindane, are very toxic substances. Given the fact that these and other pesticides generally enter the human diet at low levels and over a longer range of time, their chronic toxicity is of special importance. Although it is hard to prove direct harmful impacts on human health -- which is reflected in the controversies among people with various interests in the pesticide issue and even within a presumably single interest category such as one consisting of toxicologists -- the minimization of their intake is generally recognized as being the most desirable.

Where to put the cut-off point between 'safe' and 'no longer safe' is not an easy question to answer. Hence, determining acceptable daily intake levels, upon which rules regarding the use and residues of the substances are based, involves risk assessment procedures. As a result of differences in national circumstances, environmental conditions of life, dietary habits and legislative backgrounds of countries, tolerance levels on the use and residues of chemical pesticides may vary across nations [Vettorazzi, 1978, p. 57].

It is not attempted in this chapter to establish more insight into the cross-national pattern of regulatory action on pesticides using dietary habits and the like as explanatory factors for observations obtained. Rather, the data base regarding the safety standards on the use and residues of pesticides will be treated as another test-ground for the formulated propositions.

VI.2 Cross-National Comparison of Regulatory Action With Respect to the Use and Residues of Chemical Pesticides in the Meat Sector

Numerous documents have been published about the use and residues of pesticides in the alimentary chain and their potential impacts on human health. However, these studies primarily refer to fruits and vegetables. Correspondingly, pesticide regulations address to a great extent the problems regarding the use and residues of pesticides in these agricultural sectors. This emphasis can probably be explained in terms of the intensity of the potential health hazards involved. The theoretical risk of residues of pesticides passing through the animal -- and often previously through the plant and then the animal -- nevertheless is embedded in food safety legislation as well.

The procedure that will be used in presenting the findings can be depicted as follows. First a picture of the general pesticide policy -- with an emphasis on the registration system -- in a range of countries is presented. The data allow us to examine a set of conditions for market entry and use of pesticides, as well as for the monitoring of their residues (VI.2.1). Subsequently, we will focus on a cross-national comparison of the safety standards on certain pesticides specifically applied to meat and meat products (VI.2.2).

VI.2.1 The General Regulatory Framework

A recent pesticide regulation compendium enables us to obtain a picture of the general regulatory framework on the use and residues of pesticides in a wide range of countries [Editions Agrochimie, 1982]. The information covered in the compendium is abstracted from published laws and decrees, as well as from data provided by pesticide registration authorities. Before presenting the findings, we have to point at one major weakness of this data source which is related to the fact that part of the data are directly obtained from the responsible authorities in the various countries. Although we do not want to question the integrity of these authorities, one has to keep in mind that the picture that they presented about their pesticide

regulations may make them look somewhat nicer than actually is the case. This potential overstatement is a characteristic problem when information is obtained through interviews/questionnaires in general, but particularly with a potentially sensitive issue as the one we are dealing with in this case. Nevertheless, it was decided to make use of the opportunity to extract a general picture of the regulatory status quo on the use and residues of pesticides in the food chain in a wide range of countries. The results are presented in Table 21.

These figures show whether or not the laws in which concern about food safety and environmental issues is embedded require data on a range of what may be called use dimensions and residue dimensions of chemical pesticides. Because the compendium uses a kind of dummy variable approach by indicating whether or not certain data are required by law in the various countries, we are not able to evaluate the variances in the intensity of the rules. This is another weakness of the compendium, although understandable given the desire of the publishers to present an aggregate rather than detailed overview.

When simply adding up the positive scores of every country, we observe the following distribution, categorized by per capita GNP in Table 22.

This table indicates that countries with a higher per capita GNP have more expanded regulatory frameworks on the

Table 21 Regulatory Arrangements with Respect to Use and Residues of Pesticides

	Category of GNP/Capita 1)	Regulatory Arrangements with Respect to the Use of Pesticides						Regulatory Arrangements with Respect to Pesticide Residue Data								
		Foreign Countries Whose Registration Rules Are Followed Most Closely	Toxicity Classification System; e.g. WHO	Waiting Time for Harvest or Consumption	Safety Phrases for Protection of Users/Operators/Livestock etc.	Information on Product of Methods of Disposal and Destruction	Disposal Methods for Surplus Product	Methods of Residue Analysis	Residue Data From Supervised Trials; Covering All Experimental Conditions and Details	Residue Data in Named Edible Crops/Foods/Feeding Stuffs	Other Residue Data if Available; e.g. Monitoring Programs of Food Commodities in Commerce	Effects of Industrial Processing/Cooking on Residues	Toxicity to Birds	Residues in Eggs	Environmental Hazards on Other Wildlife, Including Cattle	TOTAL SCORE 12)
Germany	I	U.S., EEC	1	1	1	1	1	1	1	1	1	1 (9)	1	0	1 (10)	12
Denmark	I	Scandinavia, EEC	1	1	1	1	1	1	1	1	1	1	1	0	1	12
Belgium	I	Sweden, U.S., Germany	1	1	1	1	1	1	1	1	0	0	1	0	0	9
France	I	EEC	1	1	1	1	1	1	1	1	0	1	1	0	1	11
Netherlands	I	U.S., Germany	1	1	1	1	0	1	1	1	1	1	1	1	0	11
U.S.	I	(2)	1	1	1	1	1	1	1	1	1	1	1	0	1	12
S. Arabia	I	(3)														
Canada	I	U.S.	1	1	1	1	1	1	1	1	1	1	1	0	1	12
Japan	II	U.S.	1	1	1	1	1	1	1	1	1	0	1	0	1	11
Australia	II	(4)	1	1	1	1	1	1	1	1	(11)	1	1	0	1	11
U.K.	II	none	1	1	1	0	0	1	1	1	0	0	1	1	1	9
N. Zealand	II	(5)	1	1	1	1	1	1	1	1	1	0	1	0	1	11
Italy	II	EEC, U.S.	1	1	1	1	0	1	1	1	0	0	1	0	1	9
Czechoslovakia	II	Germany, Netherlands	1	1	1	1	0	1	0	1	0	1	1	1	1	10
Spain	II	EEC	1	1	1	0	0	1	1	1	0	0	1	0	0	7
Israel	III	Germany, Netherlands, U.S., Switzerland	1	1	1	1	1	1	1	1	1	1	1	0	1	12
Greece	III	EEC	1	1	1	1	1	1	0	1	0	0	1	0	0	8
Bulgaria	III	EEC, U.S., Germany	1	1	1	1	1	1	1	1	1	1	1	0	1	12
Poland	III	Germany	1	1	1	1	1	1	1	1	1	1	1	1	1	13
Venezuela	III	(6)	1	0	1	0	0	1	1	1	0	0	0	0	0	5
Yugoslavia	III	Germany	1	1	1	1	1	1	1	1	1	1	1	1	1	13
Argentina	IV	(6)	1	1	1	0	1	1	1	1	0	0	1	0	1	9
Romania	IV	Germany, France	1	1	1	0	0	1	0	1	0	0	0	0	0	5
Mexico	IV	U.S.	1	1	1	1	1	1	1	1	1	0	1	0	1	11
Brazil	IV	(6)	1	1	1	n.a.	1	1	0	1	0	0	1	0	1	8
Turkey	IV	EEC, U.S.	1	0	1	1	0	1	1	1	0	0	1	0	1	8
Guatemala	IV	(7)	1	1	1	0	1	0	0	0	0	0	0	0	0	4
El Salvador	IV	n.a.	1	1	1	0	0	1	1	1	0	0	1	0	0	7
Egypt	IV	(8)														

1 = data required
0 = no data required

Table 21 continued

1. In dollars (1980); see Table 3.
2. No followers; close cooperation with Canada and Mexico and other countries in Africa, Asia and Europe.
3. To register a pesticide in Saudi Arabia, it is necessary to go through the Plant Protection Department of the Ministry of Agriculture and Water (in order to initiate biological trials to establish efficacy) and supply the Ministry with basic technological data. At present there are no regulations concerning environmental and toxicological data. The labelling of pesticides sold in Saudi Arabia follows the normal international standards.
4. A combination of the best features of the regulations in the U.K., U.S., New Zealand and Canada.
5. The scheme is somewhat unique, particularly the composition of the Pesticides Board.
6. Other South American countries.
7. Other Central American countries.
8. Permanent commission for recommendations, reviews, field trials, tolerances and the like (no further details available).
9. Including details on removal of residues.
10. Including feeding studies in cattle.
11. Such information is rarely obtainable with a new product, hence it is not reasonable to require long-term residue data from experiments.
12. Total of positive (1) scores.

Source: Adapted from Editions Agrochimie, Pesticide Regulation Compendium (1982).

Table 22

Distribution of Scores on Regulatory Action Regarding the Use and Residues of Pesticides by Category of Per Capita GNP

Category of Per Capita GNP	Scores*				
	<8	8/9/10	11/12/13	No Details	N
I	-	1	6	1	8
II	1	3	3	-	7
III	1	1	4	-	6
IV	3	3	1	1	8
Total	5	8	14	2	29

*The intervals are arbitrarily set; they are believed to categorize the findings into high, average, and low scores.

use and residues of pesticides. At the other end of the income-range, less expanded frameworks are more likely to be observed.

When splitting up the data into the category of use dimensions, on the one hand, and residue dimensions, on the other hand, we get the following result, as presented in Table 23.

Table 23

Comparison of Average Score on Pesticide Use Dimensions and Pesticide Residue Dimensions by Category of Per Capita GNP

Category of Per Capita GNP	Average Score on Regulatory Arrangements with Respect to: Use of Pesticides	Residues of Pesticides	N
I	5.0	6.4	8
II	4.1	5.7	7
III	4.5	6.0	6
IV	3.7	3.2	8
	Maximum Score = 5	Maximum Score = 8	29

Note: The numbers reflect the average score within each category of per capita GNP. Saudi Arabia and Egypt are not included in these figures given the lack of specific information.

It follows from this simple analysis that the use dimensions of the regulatory actions on pesticides are somewhat more emphasized in the various countries than are

the residue dimensions. On average, the scores on the first category are closer to their maximum than the scores on the second category. When examining the scores across the various levels of per capita GNP, the laws on pesticides tend to be less comprehensive in the lowest level. Moreover, the countries with lower standards of living tend to focus to a greater extent on the use dimension than on the residue dimension of the pesticide regulations. Although this tendency can be observed in all the countries included in the comparison, this appears to be particularly true for the countries with lower levels of well-being. This observation could be explained by the fact that appropriate testing and monitoring of residues of pesticides requires facilities that countries with lower standards of living might be unable to afford given financial and technical barriers.

Since the above information on the regulatory attitude towards the use and residues of pesticides applies to agriculture as such, it is less relevant to differentiate among levels of importance of exports, imports and consumption of meat and meat products since the meat sector is only one segment of agriculture. These factors will be examined when focusing on specific standards on residues of pesticides in meat and meat products.

Before turning to the analysis of safety standards more specifically applied to the meat sector, some additional

comments need to be made about the pattern of more general regulations on pesticides. First, the impression derived from the data obtained on these regulations is that concern about pesticides -- as reflected in the laws -- developed particularly in the last two decades. It should be noted that countries with higher standards of living were not necessarily 'regulatory forerunners.' Although not examined systematically, there is no indication that concern about the potential unwanted effects of pesticides in countries with lower standards of living became embedded in their laws later in time. In fact, the legal base for the pesticide regulations of several of these countries seems to correspond in timing with those on the upper end of the scale of well-being. As we saw earlier, this does not necessarily mean that the foci of the pesticide regulations are identical.

Furthermore, a look at the pattern of the countries that are named to be regulatory references for the responsible authorities in the various countries reveals the existence of a regional focus in this respect. This may reflect both geographical and institutional bonds between countries. Moreover, some countries appear to perform a kind of example function. Unfortunately, it cannot be evaluated whether the safety regulations of a particular country are followed because of their nature, or because of trade implications, or both.

IV.2.2 Regulatory Action Concerning Pesticide Residues in Meat and Meat Products: Some Illustrations

In addition to the general picture of the regulatory attitude toward the use and residues of pesticides across nations, another cross-national comparison will be made, although this time more specifically applied to tolerance levels of residues of certain pesticides in meat and meat products.

First, when looking back to the early 1950's, we find few specific safety standards on pesticide residues in food in general and meat in particular, as is illustrated in Table 24.

Table 24

Regulations on Pesticide Residues in Food*

Belgium	none
Canada	none (except regarding milk/bread)
Denmark	none
France	none (but problem being considered)
Germany	none
Greece	none
Italy	none
Switzerland	none
U.K.	no legal tolerance but unofficial ones for DDT and HCB
U.S.	no legal tolerance but unofficial ones (except regarding milk)

*Note that this list applies to pesticide residues in food and does not include pesticides used directly on animals.

Source: Barnes, 1953, pp. 68-71.

Over time, specific tolerance levels on pesticide residues were formulated in a wide range of countries. Table 25 summarizes the current status quo of tolerance levels on residues of four organochlorine pesticides -- endrin, aldrin, HCB and lindane -- in meat and meat products.

In order to facilitate the cross-national comparison, these findings are summarized in the following format, the structure of which corresponds with the hypotheses. Since the regulatory attitude within countries towards the four pesticides appears to be rather stable, the analysis of the residue tolerances is limited to only two of them (arbitrarily selected), namely endrin and lindane. The findings are presented in Table 26.

Although evidence is not complete, there seems to be an indication that countries with higher standards of living tend to have stricter tolerance levels on residues of these two pesticides. Moreover, data are more frequently 'not available' in the case of countries with lower levels of well-being. Although lack of data is not necessarily equivalent to absolute absence of regulations, it can be considered as at least a possible indicator of regulatory schemes that are less well or not developed.

Table 25

Tolerance Levels of Residues of Selected Organochlorine Pesticides in Meat and Meat Products

	Category of Per Capita GNP[1]	Endrin	Aldrin	HCB	Lindane
Switzerland	I	.001 ppm	.002 ppm	.004 ppm	.01 ppm
Germany	I	.2	.2	.3	2.0 .7 (poultry)
Denmark	I	.1	.2	1.0	2.0 .7 (poultry)
Belgium	I	.02	.2	.1	2.0 .7 (poultry)
France	I	o.f.[2]	o.f.	o.f.	.1 - 2.0
Netherlands	I	.1 .2 (poultry)	.2	.5	2.0 .7 (poultry)
U.S.	I	.3	.3	.5	7.0 4.0 (pork)
Canada	I	o.f.	.2	.1	2.0 .7 (poultry)
Japan	II	o.f.	o.f.	o.f.	o.f.
Australia	II	o.f.	.2	1.0	2.0
New Zealand	II	na	.2	na	2.0
Italy	II	0.0	.2	.5	.1
Czechoslovakia	II	na[3]	.2	.5	2.0 .7 (poultry)
Spain	II	0.0	0.0	0.0	o.f.
Ireland	III	.02	na	na	1.5
USSR	III	na	0.0	0.0	0.0
Israel	III	.01 1.0 (poultry)	o.f.	na	2.0 .7 (poultry)
Yugoslavia	III	.001	.1	.5	.5
Argentina	IV	o.f.	o.f.	na	7.0 4.0 (pork)
S. Africa	IV	na	na	na	2.0 .7 (poultry)
Mexico	IV	na	.3	.3	7.0 4.0 (pork)
Brazil	IV	o.f.	o.f.	na	o.f.
Peru	IV	1.0	.2	na	na
Kenya	IV	1.0	.2	o.f.	2.0 .7 (poultry)
India	IV	na	.2	o.f.	2.0

[1] 1980; see Table 3.

[2] o.f. = tolerance levels for these pesticides established for other food items than meat and meat products.

[3] na = not available.

Source: Adapted from Health and Welfare Canada, 1982; complemented with other sources (see Table 3).

Table 26a

Distribution of Tolerance Levels on Residues of Endrin and Lindane in Meat and Meat Products by Category of Per Capita GNP, Importance of Meat Trade and Level of Meat Consumption

Category of Per Capita GNP[3]	Tolerance Level on Residues of Endrin in Meat and Meat Products*					
	≤0.1 ppm	0.1-0.5 ppm	>0.5 ppm	o.f.[1]	na[2]	N
I	4	2	-	2	-	8
II	2	-	-	2	2	6
III	3	-	-	-	1	4
IV	-	-	2	2	3	7
	9	2	2	6	6	25[6]
Exports of Meat as a Percentage of Total Meat Production[4]	≤0.1 ppm	0.1-0.5 ppm	>0.5 ppm	o.f.	na	N
>50%	3	-	-	-	1	4
11-50	1	-	-	3	-	4
5-10	1	1	-	2	-	4
<5	4	1	1	1	5	12
	9	2	1	6	6	24
Imports of Meat as a Percentage of Total Meat Consumption[4]	≤0.1 ppm	0.1-0.5 ppm	>0.5	o.f.	na	N
>15%	3	1	-	1	-	5
5-15	3	1	-	2	1	7
<5	3	-	1	3	5	12
	9	2	1	6	6	24
Per Capita Consumption of Meat (kg)[5]	≤0.1 ppm	0.1-0.5 ppm	>0.5 ppm	o.f.	na	N
>100 kg	-	1	-	2	1	4
80-100	1	1	-	2	1	5
50-79	8	-	-	-	1	9
<50	-	-	1	2	2	5
na	-	-	-	-	1	1
	9	2	1	6	6	24

Table 26b

Category of Per Capital GNP[3]	Tolerance Levels on Residues of Lindane in Meat and Meat Products*				
	≤2 ppm	>2 ppm	o.f.[1]	na[2]	N
I	7	1	-	-	8
II	4	-	2	-	6
III	4	-	-	-	4
IV	3	2	1	1	7
	18	3	3	1	25[6]
Meat Exports as a Percentage of Total Meat Production[4]	≤2 ppm	>2 ppm	o.f.	na	N
>50%	4	-	-	-	4
11-50	3	1	-	-	4
5-10	3	-	1	-	4
<5	7	2	2	1	12
	17	3	3	1	24
Meat Imports as a Percentage of Total Meat Consumption[4]	≤2 ppm	>2 ppm	o.f.	na	N
>15%	4	-	1	-	5
5-15	5	1	1	-	7
<5	8	2	1	1	12
	17	3	3	1	24
Per Capita Consumption of Meat (kg)[5]	≤2 ppm	>2 ppm	.o.f.	na	N
>100 kg	2	2	-	-	4
80-100	5	-	-	-	5
50-79	8	-	1	-	9
<50	1	1	2	1	5
na	1	-	-	-	1
	17	3	3	1	24

*In case of different standards for different animal species, the standard for red meat/the highest standard is chosen.

[1] o.f. = tolerance levels for other food items (see note 2, Table 25).

[2] na = not available.

[3] See Table 3, note 3 (it is realized that the intervals are uneven; yet this is believed not to affect the findings; Note that this comment also applies to the export and consumption variables).

[4] See Table 5, note 1.

[5] See Table 5, note 2.

[6] Including Kenya; the figures regarding trade and consumption of meat exclude Kenya due to lack of data.

As far as the trade variables are concerned, there seems to be an indication that the strictness of the standards correlates positively with the importance of meat exports. The same holds true for the imports of meat. Countries that depend to a greater extent on imports for their meat consumption tend to have stricter tolerance levels on residues of the pesticides examined.

With respect to the relevance of the last factor -- the importance of met consumption -- the findings are inconclusive. A higher level of meat consumption does not seem to imply more concern about potential health hazards of pesticide residues in meat and meat products, which is reflected in the rather random distribution of the different tolerance levels over the range of consumption levels.

VI.3 Evaluation

The use of pesticides has led to an increase in the efficiency of agricultural production. However, their use is simultaneously plentiful and controversial. The control of chemical pesticides has become more and more a matter of prime importance over time, not only as a result of their vast and increasing number available, but especially because of the uncertainty about their safety.

In this chapter, a general description of the wave of pesticide legislation appearing over time in many countries is presented. Furthermore, a move from a general to a more specific focus is made by applying the analysis to a set of pesticides whose residues in meat and meat products could imply a threat to human health if present in high concentrations or in case of the regular intake of small quantities.

As such, pesticide control is effected through regulations on their manufacturing, distribution and use, on the one hand, and their residues, on the other hand. While a total ban seems to be an exception, the risk-benefit decision usually results in safety standards implying a restricted use and limited level of residues. The actual outcome of the balance of risks and benefits can vary from country to country.

Our findings suggest that countries with higher standards of living tend to be in a 'comparative regulatory advantage' in the case of pesticides, having more explicit and stricter safety standards on average. Moreover, it is observed that countries with lower standards of living tend to focus more on regulatory actions on the use of pesticides than on their residues in food items. Problems with respect to the economic and technical feasibility of regulating residues of pesticides might explain the somewhat greater

emphasis on regulations on the use of pesticides in these countries. Similarly, there is an indication that a greater economic dependency on meat trade corresponds with a stricter regulatory framework for pesticide residues in meat and meat products. This finding applies to both exports and imports of meat. Finally, the level of meat consumption does not seem to be an explanatory factor of observed similarities and differences in the tolerance levels for the residues of the pesticides that are examined.

A final comment to be made in this chapter refers to the actual use of pesticides, the level of which could contribute to the strictness of the corresponding regulations. In the methodology description it is explained that the actual amount of chemical substances used is recognized as a potentially relevant factor in explaining the pattern of safety standards, though not researchable due to the lack of appropriate data. However, the only chemical substances of which international records appear to be kept are pesticides./5 Yet their coverage of countries is far from complete and comparison of pesticide use levels among the covered countries raises difficulties given differences

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5See F.A.O., Production Yearbooks, Section Means of Production.

in the way in which countries report these data. Hence, it was decided not to compare the actual levels of the use of pesticides in agriculture cross-nationally. Besides, even if the data were more complete and more comparable, a picture of the use of pesticides in agriculture would provide us with a less than perfect approximation of the potential link between the level of use and the strictness of the standards. Namely, it should be realized that the absolute level of use in agriculture is not necessarily linearly related to the degree of potential contamination of meat and meat products. Consequently, the discussion of the regulatory action on the use of pesticides and their residues in meat and meat products is limited to the above examination of the findings in terms of the formulated propositions.

Chapter VII

Public Action Regarding Residues of Heavy Metals in Meat and Meat Products: A Description, Cross-National Comparison and Evaluation

VII.1 Use and Residues of Heavy Metals: A Global Description

The unintentional nature of the presence of residues of heavy metals in food links this chapter with the preceding chapter on the unintentional residues of pesticides in food. Some metals are known to be essential for human life. Others, however, are undesirable given their accumulation and toxicity even in very low concentrations.

Although metals may be directly absorbed through the air and water, most of the metals come in with our food, entering the alimentary chain via fertilizers, chemical substances used in production and/or processing, and industrial/traffic pollution. It should be mentioned that non-food sources such as processing equipment and packaging material can also cause the contamination [Reily, 1980, chs. 5 and 6; Crosby, 1981, Chs. 4, 5 and 8].

Legislation is expected to prevent any excess of undesirable metals in the human diet. However, there exist

more questions than answers regarding the potentially acute and particularly chronic impacts of these residues on human health. This is reflected in the complexity of the decision-making that responsible agencies face.

Of the variety of metals, the analysis is concentrated on the following metals whose intake is considered to be undesirable if present in more than trace quantities due to their potential toxicity: lead, cadmium and arsenic. As in the case of pesticides, legislation on these metals seems to focus on their residues in food items other than meat and meat products. Again, this regulatory attitude could be explained in terms of differences in the relative severity of the metal contamination across food items. Nevertheless, the problem of environmental contamination of meat due to residues of heavy metals is embedded in several national food law frameworks. Tolerance levels are set for the amount of contamination that is permissible and monitoring programs are designed to ensure that substances do not exceed the prescribed limits. Yet this scenario for dealing with the issue of potential metal contamination of meat is not as widespread as the regulatory activities on the use and residues of other chemical substances covered in this study. Generally speaking, explicit residue standards for heavy metals as potential contaminants of meat are found to exist in only a limited number of countries. In this respect, the length of this chapter probably is an

indication of the extent to which this potential contamination of meat is embedded explicitly in national food safety regulations.

VII.2 Cross-National Comparison of Regulatory Action with Respect to Residues of Heavy Metals in Meat and Meat Products

It is not easy to draw up a summary of regulations on the problem of residues of heavy metals in meat and meat products simply because the information obtained on the regulatory action on this issue is rather limited. Consequently, the base upon which to test the propositions is restricted. When examining the findings, this has to be kept in mind.

A look at the regulatory status quo in the late 1950's and early 1960's reveals that specific safety standards on the potential metal contamination of meat did exist in a small number of countries. Table 27 summarizes these findings and also includes more recent observations.

Without applying the earlier used ranking procedures -- based on criteria such as standard of living and importance of meat trade -- the observations do not seem to indicate an affirmation of the propositions. With respect to the older data, it can be observed that lead and arsenic are most widely faced with specific residue tolerances. Cadmium

appears to be least embedded in the law, especially if one assumes that the lack of availability of data is likely to reflect the absence of standards. A look at the more recent tolerance levels reveals that, in the few cases that we have observations on, the standards became stricter over time. The data are believed to be too limited to base any further conclusion on the findings.

Table 27

Safety Standards Regarding Residues of Heavy Metals in Meat and Meat Products*

Country[1]	Lead		Arsenic		Cadmium	
	'50/'60's	'80's**	'50/'60's	'80's	'50/'60's	'80's
Australia	5	1.5	1.5	1.15	5.5	5.5
Canada	2	na	1	na	na	na
Denmark	5	na	1	na	na	na
Germany	na***	0.2-0.5[2]	na	0.05-0.25	na	0.08-0.50
Hungary	na	1	na	0.5	na	0.1
India	5	na	1.1	na	na	na
Netherlands	na	.2[3]	1	.05	na	.05
Saudi Arabia	na	0.3	na	1	na	na
S. Africa	5	na	1	na	na	na
U.K.	2	1	1	na	na	na
U.S.	5	na	0.5-1[3]	0.5 -0.7	na	na

*Expressed in ppm.

**These standards represent the most recent data obtained.

***na = not available.

[1]Standards apply to canned meat.

[2]This reflects a proposal (may be an official standard in the meantime). Note that the interval implies that different standards apply to different types of meat.

[3]Standard applies to poultry.

Source: Adapted from F.A.O., Current Food Additive Legislation, issues in the period 1956-1965. The more recent data are obtained from a variety of sources (see Table 3).

In the same source, data were found on the standards on the use of metals in colouring matters used in meat and meat products in a range of countries. The findings of the regulations with respect to this potential indirect source of metal contamination are presented in Table 28.

Again, without presenting the explicit ranking of the countries according to the hypothesized explanatory factors, there does not seem to be an indication that the pattern of standards corresponds with any of the propositions. Actually, the standards appear to follow a rather random pattern.

Table 28

Safety Standards Regarding the Metal Content of Colouring Matters (Food Additives)*

Country	Lead	Arsenic	Cadmium
Australia	10	1.5	na[1]
Canada	10	2	P[2]
Chili	5	5	5
Denmark	20	5	na
France	20	2	30
Hungary	20	5	P
Netherlands	20	5	na
S. Africa	20	1	na
U.S.	20	na	na
Yugoslavia	200	5	200

*Expressed in ppm.

[1]na = not available.

[2]P = prohibited.

Source: Adapted from F.A.O., Current Food Additive Legislation, issues in the period 1956-1965. Note that we did not examine more recent data on the metal content of colouring matters.

VII.3 Evaluation

The length of the above discussion reflects the supply of information on the regulatory action concerning the presence of residues of heavy metals in meat and meat products across nations. This in turn is likely to reflect the position of this potential contamination problem on the list of priorities regarding the objective of ensuring the wholesomeness of meat and meat products. Few countries were found to have specific regulations on more than a few metals in food. Moreover, food refers, in this case, more to beverages, vegetables and fish than to meat and meat products. In the absence of specific legislation on residues of metals in meat, it is assumed that the protection against metal contamination is covered under basic, general food laws formulated like '...food shall not contain residues of substances that have undesirable effects on human health and the environment.'

It should be realized that the hazards involved in consuming meat which contains traces of heavy metals are ill-defined and likely to vary in proportion in different parts of the world. Given differences in the extent of environmental pollution and in the methods used in meat production and processing, the probability of metal contamination of meat will vary. Consequently, the state of development of laws on this aspect of the purity of meat may

vary across nations. This does not explain, however, why countries with relatively similar probabilities of metal contamination differ in their concern about residues of heavy metals in meat. There is no evidence that our hypotheses have some explanatory value in this respect. Hence, we might have to conclude that some countries simply give more weight to the risks involved than other countries.

Finally, it has to be kept in mind that alternative routes can be chosen in controlling the potential metal contamination of food. In this respect, we can mention more preventive measures such as industrial/traffic pollution control, rules regarding the substances, equipment and the like used in the production and processing stage. The illustration of the tolerance levels across nations regarding the amount of metals used in colouring matters also fits into this range of alternatives. The underlying idea is that the earlier the control is introduced, the easier it is to maintain control during the later stages in the food chain and the more effective the result in the ultimate product will be [Dennis, 1979, p. 111].

In brief, the cross-national comparison of regulatory action on residues of heavy metals in meat and meat products may provide us with a reflection of only part of the concern about the potential contamination involved. In the case of the other adventitious residue problem -- chemical pesticides -- we were able to present a picture of the

general regulatory framework, including the requirements that the pesticides have to meet in order to be allowed on the market. A similar, comprehensive view on how the issue of heavy metals is addressed more generally across nations cannot be presented since we lack the data to examine this.

Chapter VIII

Safety Regulations With Respect to Meat and Meat Products and Their Enforcement

VIII.1 Introduction

In the preceding chapters we examined regulations on the use of a variety of potentially toxic substances in meat production and their residues in meat and meat products across nations. These regulations play a role in helping to ensure that meat reaches consumers in the best possible conditions. The next issue that needs to be addressed is the enforcement of the regulations. Compliance with food safety regulations is a vital element in determining their efficacy. Hence, we would like to examine the effectiveness of the regulations in the various nations in keeping meat and meat products contaminated with residues of toxic substances from being marketed.

However, we again face data problems. Even if countries keep records of the number and value of meat and meat products that are found to contain violative levels of residues, this does not mean that these data are easily available. Given the lack of an ideal set of cross-national data covering the outcomes of inspection programs, it was

decided to use imperfect, but approximative, indicators of the actual meat safety status quo in various nations. In this respect, we use general information on the meat inspection systems that exist cross-nationally. In addition, the outcomes of the U.S. meat import inspection program are used in order to analyze the distribution of rejections of meat imports among the countries of origin and the trend in this distribution over time.

It should be realized that this approach generates an internal validity problem. Exporting countries have to comply with a variety of standards of the importing countries, of which the standards on residues of toxic substances are only one segment. Consequently, imported meat and meat products may be rejected for a variety of reasons at the port of entry. These reasons include adulteration with bone, pathological lesions, failure to meet composition, and labeling standards. Non-compliance with the safety standards that we examined in the previous chapters is not recorded separately in the listings of rejected meat and meat products. Hence, by examining these records we get an impression of the general compliance with hygienic, safety and economic standards across nations and over time that have to be met when importing meat and meat products into the U.S. Due to the lack of specific data on the problem of toxic residues in meat, we decided to use the import inspection records as a next best approach in

obtaining information on the enforcement of residue standards across nations.

Another point to be mentioned refers to the assumption that the cause of the rejection of meat imports is genuine. Part of the rejections may be the result of, for example, inadequate storage facilities at the port of entry as the result of which adulteration can occur. Moreover, differences in methods of inspection and laboratory analysis may lead to different opinions about the extent of contamination. In brief, meat and meat products may be determined to be adulterated and non-marketable due to factors beyond the direct control of the exporting country. Nevertheless, we assume that the U.S. records of meat import rejections reflect genuine, externally originated types of adulteration.

The above remarks regarding the validity of the indicators should be kept in mind when interpreting the findings. Consequently, the efficacy of the regulations that are formulated in order to prevent meat contaminated with residues of toxic substances from being marketed is not measured directly, but indirectly through a range of approximative indicators.

Finally, another limitation of the following analysis results from the fact that only countries that are allowed to export meat and meat products to the U.S. are included in the cross-national comparison. As a result, we can only

formulate a tentative conclusion about the enforcement of safety regulations on meat and meat products for these countries. It should also be noted that it is not unusual that meat destined for export is subjected to more and better inspection that meat for domestic consumption. Consequently, it could be hypothesized that a contamination problem detected in exported meat reflects a larger contamination problem regarding the part of the meat supply in the country of origin that is consumed domestically. It goes beyond the purpose of this study to elaborate on this proposition. In order to examine its validity, one would need detailed inspection records to which we do not have access at this point. The results of the relevant information that is actually obtained on the enforcement part of safety regulations on meat and meat products are presented below.

VIII.2 Outcomes of the U.S. Import Monitoring Program

Before presenting the findings we first have to explain briefly the nature of the U.S. inspection program that monitors the wholesomeness of imported meat and meat products. Only those countries which have meat inspection systems with standards at least equal to those of the U.S. meat inspection program are permitted to ship meat to the U.S. Meat imported into the U.S. is inspected at import

points, and part of this inspection procedure involves sampling for residues of toxic substances. The outcome of this residue monitoring program can be considered as a measure of the effectiveness and quality of foreign residue inspection programs [U.S.D.A., Food Safety and Inspection Service, July 1980].

The frequency of the sampling is based on the quantity of meat that is imported from a country during the preceding year. In order to prevent excessive sampling of the shipments of high volume exporters and insufficient sampling of the shipments of low volume exporters, a sliding scale is used submitting the former to a maximum of 300 and the latter to a minimum of 15 samples per year. If violations are found, specific restrictions may be put on the exporting plant involved, or even on the country. Once a violation is reported, subsequent shipments from the particular plant/country are held at the port of entry and are tested (the surveillance phase). The objectives of the follow-up activities are in fact two-fold. In the first place, potentially contaminated meat from the particular establishment is prevented from being marketed. Secondly, intensive examination of meat imports from the country of origin as such determines whether the contamination problem is country-wide [U.S.D.A., Food Safety and Inspection Service, December 1981; idem, March 1982, Part III].

VIII.2.1 The Distribution of Meat and Meat Products, Refused for Entry and/or Condemned: A Comparison Across Nations and Over Time

Table 29 shows the relative share of the total quantity of meat intended for import that did not reach the U.S. market due to non-compliance with U.S. standards.

The inference to be drawn from this Table is that the stability of the pattern of non-compliance over time varies across nations. The variance in the level of a country's non-compliance with U.S. import standards relative to the average level differs from one country to another. It is interesting to observe that the largest outliers -- meaning relatively high percentages of violations -- involve countries with higher standards of living. The latter factor, as well as the relative importance of meat exports, are related to the average level of non-compliance with U.S. standards in Table 30.

Table 29

Percentage of Meat and Meat Products, Offered for Entry, but Refused and/or Condemned[1]

Country[2]	1968	1972	1976	1980	1981	Average[3]
Germany	1.0%	2.0%	1.2%	3.0%	--[4]	1.4%
Denmark	1.4	1.0	0.6	0.5	0.8	0.9
Belgium	0.2	--	--	18.8	--	3.8
France	17	1.3	5.3	0.4	1.1	5.0
Netherlands	1.6	5.5	1.7	0.9	0.6	2.2
Canada	1.3	1.0	1.6	0.7	0.7	1.1
Japan	--	--	na	na	na	--[5]
Australia	2.0	1.7	0.5	0.1	0.3	0.9
U.K.	0.7	0.9	na	na	na	0.8
New Zealand	0.9	1.5	0.3	0.03	0.7	0.7
Italy	4.3	--	--	0.6	--	1.0
Czechoslovakia	0.5	0.04	2.5	1.2	0.4	0.9
Spain	18.0	47.4	na	50.0	na	38.5
Ireland	1.8	1.0	1.5	0.4	--	0.9
Poland	0.1	1.7	0.6	0.7	0.6	0.7
Uruguay	0.05	na	--	1.0	2.1	0.8
Yugoslavia	3.5	3.1	1.0	0.6	0.8	1.8
Argentina	0.5	2.0	1.0	3.3	1.0	1.6
Mexico	2.5	1.5	0.3	--	--	0.9
Brazil	0.5	2.4	0.5	0.8	1.8	1.2
Panama	4.5	7.6	--	0.02	2.0	2.8
Costa Rica	1.2	0.6	0.7	0.4	2.1	1.0
Paraguay	2.2	2.1	0.1	na	na	1.5
Guatemala	0.1	0.8	1.2	2.6	0.7	1.1
Nicaragua	0.2	0.5	0.3	0.2	1.5	0.5
Honduras	--	0.8	0.5	0.1	1.0	0.5

[1]Percentage = $\frac{\text{quantity of meat refused/condemned (in pounds)}}{\text{quantity of meat offered for entry (in pounds)}}$

[2]The countries are ranked according to their 1980 GNP/capita (source: World Bank, 1982).

[3]Average non-compliance percentage in these five years. This is calculated in order to facilitate comparison.

[4]This implies compliance of all imports with U.S. standards.

[5]Average of the years in which meat and meat products are exported to the U.S. The absence of meat exports (na) may be caused by a variety of reasons. For example: difficulty in meeting the import requirements (apparently in the case of Spain); lack of excess meat supply (as in the case of Japan, a net importer of meat and meat products).

Source: Adapted from USDA, Food Safety and Inspection Service, Meat and Poultry Inspection, 1968, 1972, 1976, 1980 and 1981.

Table 30

Average Percentage of Violations Over Time [1]

30a

Category of GNP/Capita[2]	<1.0%	1.0-2.0%	>2.0%	N
>10,000	1	2	3	6
5,000-10,000	5	1	1	7
2,500- 5,000	3	1	-	4
1,500- 2,500	1	3	1	5
< 1,500	2	2	-	4
	12	9	5	26

30b

Meat Exports as a % of Total Meat Production[3]	<1.0%	1.0-2.0%	>2.0%	N
>50%	4	1	1	6
11-50	3	2	2	7
5-10	2	4	-	6
<5	3	1	2	6
na*	-	1	-	1
	12	9	5	26

* na = not available.

[1] See note 3, Table 29.

[2] See Table 3; the intervals are not equal but are believed to distribute the countries most evenly.

[3] See Table 5; the above remark with respect to the intervals applies to this variable as well.

It does not follow from the above findings that less meat and meat products are rejected from countries with higher levels of well-being than from countries with lower levels of well-being. In fact, the average percentage of violations is relatively the highest in the former countries. Furthermore, the distribution among the different levels of violations in countries whose meat sector is highly dependent on exports is almost the same as in countries in which meat exports are economically less important. Hence, there is no indication that a higher standard of living and greater importance of meat exports in the country of origin correspond with imports of meat and meat products that show less deviation from the U.S. safety standards.

VIII.3 Cross-National Comparison of Meat Inspection Systems

General legislation covering animal and carcass inspection, the construction of slaughterhouses, storage temperatures and the like can be observed in many countries. While realizing that meat inspection systems have many dimensions, we limit ourselves to a cross-national comparison of some general characteristics that can be expected to be of relevance in ensuring the safety of the meat supply. The cross-national comparison we present

includes the following structural characteristics: the degree of centralization of the inspection system and the average number of licensed inspectors per plant certified for exports. We also examine inspector intensity over time.

It is realized that there are limitations involved in the above structural variables that we use as criteria for the cross-national comparison of meat inspection systems.

1) It can be assumed that authorized meat slaughtering and processing plants that are geographically more concentrated require less inspectors. For example, one inspector could be able to monitor more than one plant in this case. However, we simplify the analysis by ignoring this aspect. It goes beyond the purpose of this study to measure the relative distance and, subsequently, the degree of geographical concentration of authorized plants in all the countries that we include in the comparison.

2) We are not able to examine the importance of the size of plants. It can be assumed that a larger size plant requires more inspectors in order to carry out the basic inspection activities.

3) We are not able to take into account possibly existing differences in the job description of meat inspectors across nations. For example, there could be a difference in the education and skill requirements which may result in differences in the activities that can be and are performed.

4) Only plants that are authorized to export meat and meat

products to the U.S. are included in the comparison. This does not provide us with insight into the number of inspectors per plant in general. In fact, as is described earlier, there may be a difference in the inspection of plants that produce for exports and of plants whose clientele is solely domestic.

The last limitation also applies to a performance characteristic of meat inspection systems as measured by the percentage of authorized foreign slaughtering and processing plants visited by U.S.D.A. inspectors and found not in compliance with the U.S. standards. The findings of the analysis of this performance dimension as well as of the above structural dimensions of meat inspection systems are presented in Table 31.

It follows from these findings that all countries have centralized inspection systems. This is not surprising since a necessary condition for being authorized to export meat and meat products to the U.S. involves the existence of a centralized meat inspection system. The main relevance of this observation for our analysis is that a centralized inspection system is not limited to countries with only certain economic characteristics, such as a higher standard of living or substantial importance of meat exports.

Furthermore, the average number of inspectors per authorized plant varies over time. Table 32 facilitates the interpretation of the findings over time.

Table 31

Comparison of Structure and Performance of Meat Inspection Systems Across Nations and Over Time

Country[1]	(a) Degree of Centralization	(b) Average Number of Inspectors Per Authorized Plant			(c) Percentage of Authorized Foreign Plants Visited and Found Not in Compliance with U.S. Standards		
		1968	1974	1981	1974	1978	1981
Germany	C	6.9	9.9	2.3	11.6% (18)	-[3] (13)	- (8)
Denmark	C	6.1	6.5	8.9	0.6 (160)	0.7 (143)	- (137)
Belgium	C	35.4[2]	2.0	6.0	- (2)	- (6)	20.0 (5)
France	C	2.0	1.8	2.2	12.5 (16)	- (19)	- (17)
Netherlands	C	6.8	9.9	8.5	11.8 (51)	2.2 (46)	18.8 (32)
Canada	P+C	3.8	3.1	2.8	0.3 (403)	1.3 (449)	3.9 (510)
Australia	P+C	5.5	9.6	10.4	5.7 (174)	- (201)	5.3 (187)
U.K.	C	2.6	0.5	na	- (2)	- (-)	- (-)
New Zealand	C	15.4	24.0	27.8	6.3 (48)	- (47)	3.6 (56)
Italy	C	7.3	0.9	0.9	57.1 (7)	- (12)	- (3)
Czechoslovakia	C	5.0	24.0	11.5	50.0 (2)	- (2)	- (2)
Spain	C	2.0	1.0	na	100.0 (2)	100.0 (1)	- (-)
Ireland	C	2.5	28.7	30.0	18.8 (16)	9.1 (11)	- (4)
Poland	C	7.4	12.6	31.3	7.1 (28)	3.7 (27)	- (26)
Uruguay	C	10.0	24.0	8.9	- (1)	- (8)	- (11)
Yugoslavia	C	6.0	7.6	8.3	- (8)	- (12)	- (12)
Argentina	C	5.9	3.9	16.3	6.5 (31)	- (27)	8.7 (23)
Mexico	P+C	1.2	2.3	6.0	13.3 (30)	17.6 (34)	33.3 (3)
Brazil	P+C	8.6	15.2	14.4	- (15)	66.7 (21)	4.3 (23)
Panama	C	2.0	1.5	6.0	33.3 (3)	50.0 (2)	50.0 (2)
Costa Rica	C	3.8	3.9	5.3	14.3 (7)	- (6)	- (4)
Paraguay	C	5.0	6.3	na	25.0 (4)	- (2)	- (-)
Guatemala	C	2.5	3.3	6.7	- (5)	16.7 (6)	25.0 (4)
Nicaragua	C	1.5	6.8	11.0	- (4)	0.2 (5)	14.3 (7)
Honduras	C	1.0	5.3	5.6	- (7)	28.6 (7)	- (7)

Table 31 continued

(a) C = Centralized inspection system; P = Provincial inspection system.

Source: U.S. Senate, October 11, 1979, pp. 18, 19.

(b) Average number of inspectors per authorized plant = $\frac{\text{number of inspectors}}{\text{number of authorized plants (end of year)}}$

Source: Adapted from U.S.D.A., Food Safety and Inspection Service, Meat and Poultry Inspection, Reports 1968, 1974, and 1981.

(c) Percentage = $\frac{\text{plants visited \& found not in compliance with U.S. standards}}{\text{authorized plants (beginning of year)}}$

Note: The number in parenthesis is the total number of authorized plants (beginning of the year).

Source: Adapted from U.S.D.A., Food Safety and Inspection Service, Meat and Poultry Inspection, Reports 1974, 1978, and 1981.

1) The countries are ranked according to their 1980 GNP/capita. Note that Japan is not included in the list (limited data).

2) This high number of inspectors is rather misleading. During 1968 many authorizations were removed (260 out of 269). Hence a calculation of the average number of inspectors based on the number of authorizations in the beginning of the year would have resulted in a much lower average (1.3).

3) The absence of information is assumed to imply total compliance. However, in the source used it is not indicated how many plants are actually visited. Only the number of visited and rejected plants is given. Hence, if not all the authorized plants are visited in the given time period, it is possible that the picture of non-compliance is partial.

Table 32

Change in the Average Number of Inspectors Per Authorized Plant Over Time

	Increase*		Decrease*			
	≤ 1	> 1	≤ 1	> 1	na**	N
1968-1974	3	13	5	4	–	25
1974-1981	5	11	3	3	3	25

* Expressed in absolute numbers.

**na = not available.

The inference to be drawn from Table 32 is that the majority of the countries show an increase in their inspector intensity. These increases reflect to a great extent more considerable changes (i.e., of more than one additional inspector, on average). Furthermore, if the amount of minor decreases (i.e., smaller or equal to one inspector, on average) is taken into account, the upward trend in the average number of inspectors per plant over time is even more evident. Finally, it appears that the more substantial increases over time did not occur in the countries with the higher standards of living, but in those that are lower on the list. It is interesting to notice that the latter countries show rather rapid increases in their meat (particularly beef) production and corresponding export level during the last two decades [Simpson and Farris, 1982, Appendix A.2, A.5]. However, similar changes did occur in countries with higher standards of living, and these countries show smaller increases in the inspector intensity over time. Nevertheless, the more evident upward trend in the average number of inspectors per plant over time in the countries with lower levels of well-being could be considered as a reflection of their increasing export potentials.

As far as the comparison of the findings across nations is concerned, it should be noted that the inspector intensity apparently varies substantially across nations.

In analyzing these data, we limit ourselves to a comparison of the situation in 1981. In Table 33 the different levels of inspection intensity are categorized according to standard of living and importance of meat exports.

It does not follow from the above findings that the average number of inspectors per authorized plant is higher in countries with higher levels of general well-being. In fact, the opposite pattern is observed. On the other hand, there is some indication that countries whose meat sector is highly dependent on meat exports tend to have a higher average inspection intensity per plant.

Incidentally, it is interesting to observe that there are more inspectors per foreign plant authorized to export meat and meat products to the U.S. than there are per federally inspected domestic establishment in the U.S. [U.S. Senate, July 27, 1978, p. 65]. To illustrate this: in 1976 there were 7.5 inspectors per foreign plant, whereas the corresponding number for the U.S. was 1.3. For 1981 the inspector intensity was 7.8 and 1.2, respectively. Note that state inspectors are not included in these calculations.

We now turn to the data on the performance dimension of meat inspection systems. Table 34 displays the percentage of authorized foreign plants visited and found to be not in compliance with U.S. standards. The findings are

Table 33

Average Number of Inspectors Per Authorized Plant by Category of GNP/Capita and Relative Importance of Meat Exports

33a

Category of GNP/Capita[1)]	< 5.0	5.0-10.0	>10.0	na*	N
>10,000	3	3	—	—	6
5,000-10,000	1	—	3	2	6
2,500- 5,000	—	2	2	—	4
1,500- 2,500	—	3	2	—	5
< 1,500	—	2	1	2	4
	4	10	8	3	25

33b

Meat Exports as a Percentage of Total Meat Production[1)]	< 5.0	5.0-10.0	>10.0	na*	N
>50%	—	5	2	—	7
11-50	1	2	3	—	6
5-10	2	1	2	1	6
< 5	1	2	1	1	5
na	—	—	—	1	1
	4	10	8	3	25

*na = not available

1) See Tables 29, 30.

Table 34

Comparison of Percentage of Authorized Plants Visited and Subsequently Removed From List of Authorized Plants Over Time by Category of GNP/Capita and Relative Importance of Meat Exports

34a

Category of GNP/Capita[1]	1974					1978					1981				
	Percentage				N	Percentage				N	Percentage				N
	>30	30-10	9.9-5	<5		>30	30-10	9.9-5	<5		>30	30-10	9.9-5	<5	
> 10,000	-	3	-	2	5	-	-	-	3	3	-	2	-	1	3
5,000 - 10,000	3	-	2	-	5	1	-	-	-	1	-	-	1	1	2
2,500 - 5,000	-	1	1	-	2	-	-	1	1	2	-	-	-	-	-
1,500 - 2,500	1	2	1	-	4	2	1	-	-	3	2	-	1	1	4
< 1,500	-	1	-	-	1	-	2	-	1	3	-	2	-	-	2
	4	7	4	2	17	3	3	1	5	12	2	4	2	3	11

34b

Meat Exports As a Percentage of Total Meat Production	1974					1978					1981				
		Percentage			N		Percentage			N		Percentage			N
	>30	30-10	9.9-5	<5		>30	30.10	9.9-5	<5		>30	30-10	9.9-5	<5	
> 50%	-	3	1	1	5	-	1	1	2	4	-	2	-	1	3
11 - 50	-	1	2	-	3	-	1	-	1	2	-	2	2	-	4
5 - 10	-	1	1	1	3	1	-	-	2	3	-	-	-	2	2
< 5	4	1	-	-	5	2	1	-	-	3	2	-	-	-	2
na	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
	4	7	4	2	17	3	3	1	5	12	2	4	2	3	11

*na = not available

[1]See Tables 29, 30. It is realized that the intervals are uneven yet this is not believed to affect our findings. The same remark applies to the intervals categorizing the percentage of foreign plants visited and found to be not in compliance.

categorized according to the standard of living and importance of meat exports.

First, it should be noted that we only examined the distribution of the rejected plants over time and across nations. This was decided especially since it is not exactly clear whether the other plants are all inspected and found to be in compliance, or whether only part of them is visited by U.S. inspectors. Consequently, it cannot be evaluated whether the decline in the total number of plants found to be not in compliance over the three periods covered can be attributed to more compliant behavior over time or to the fact that less foreign plants are visited.

The above findings do not indicate that a higher standard of living corresponds with a lower percentage of authorized plants found not in compliance with U.S. standards. In fact, the observations are rather randomly distributed among the per capita GNP categories. This holds true for all three periods examined. However, there is some evidence that less economic dependency of the meat sector on exports corresponds with a higher percentage of noncomplying plants.

It may be interesting to add that the U.S. import monitoring program is not designed to keep all adulterated meat from reaching the consumer. By the time results of tests for residues of chemical substances are evaluated, the meat may have passed already into distribution. An

exception to this is the case of residues of antibiotics, for which relatively fast testing methods are developed. Consequently, the program merely monitors the incidence of violations and tries to prevent recurrences [New York Times, March 15, 1983]. The variability in the success of keeping contaminated imported meat from the U.S. market is illustrated in Table 35.

Table 35

Performance of U.S. Import Monitoring Program

	Number of Monitoring Samples Taken	Number and Percentage of Violative Samples	Contaminated Meat	
			Total Pounds	Percentage Traced and Kept From the Market*
1979	3561	41 (1.2%)	6,230,364	72.4%
1980	4322	34 (0.8%)	1,089,710	95.3%
1981	5263	12 (0.2%)	437,781	13.8%

*Percentage = $\frac{\text{Pounds of product traced}}{\text{Pounds of contaminated imported product}}$

Source: Adapted from USDA, Food Safety and Inspection Service, Meat and Poultry Inspection, Reports 1979, 1980, and 1981.

VIII.4 Evaluation

Our picture of the enforcement of safety regulations is far from complete. Limited information is obtained on the

outcomes of monitoring programs on residues of hormones, antibiotics, additives, pesticide residues and heavy metals. It is known that many countries establish residue tolerances and have agencies for policing legislation. Yet the laws appear to be more accessible than the outcomes of their enforcement. Consequently, we used rather indirect, approximative data in assessing the incidence of violations across nations.

The most interesting observation is the fact that the inspector intensity, the extent of violative meat imports, and non-compliance of foreign plants with U.S. standards are not purely concentrated in countries where this is commonly expected to be the case (i.e., countries with lower standards of living). Furthermore, there is some indication that greater dependency on meat exports corresponds with a higher average inspector intensity per plant. However, although the plants in these countries are less frequently found to be in non-compliance with U.S. standards, this does not seem to correspond with a lower percentage of violations among meat and meat products that are offered for import. Since our data are derived from export related meat inspection information, only the hypotheses on standard of living and relative importance of meat exports are considered.

Ex post, it probably would have been a useful step to ask responsible agencies in various countries for outcomes of their residue monitoring programs. At the same time, however, it should be realized that such an attempt is likely to fail. We deal with a rather sensitive issue, and, unless the violation incidence rate approximates zero, the responsible agencies might be reluctant to provide the data. Nevertheless, the procedure that is followed is believed to be an indirect and limited, but at least indicative assessment of the action of meat safety control.

Chapter IX

International Institutional Arrangements Towards Harmonization of Safety Regulations with Respect to Food in General and Meat and Meat Products in Particular

IX.1 Introduction

Food laws are built on the following pillars: the protection of public health, the protection of the economic interests of consumers and the facilitation of food marketing. As we saw in the preceding chapters, safety regulations on meat and meat products vary across nations. Consequently, this may have an impact upon the safety and supply of meat and meat products and may create obstacles for international trade.

Efforts undertaken at the international level reflect the recognition that undesirable health and economic effects need to be minimized by harmonizing food laws. These activities may be truly internationally, or more regionally oriented. The former includes the efforts of international organizations such as Food and Agriculture Organization (F.A.O.), World Health Organization (W.H.O.) and General Agreement on Tariffs and Trade (G.A.T.T.), whereas the harmonization of food laws within the framework of the

European Economic Community (E.E.C.) constitutes a regional approach.

Below we discuss the major international efforts concerning the safety, supply and trade of meat and meat products with a special focus on the problem of residues of toxic substances. The analysis is divided into sections, each covering part of the international institutional framework for food in general and meat in particular.

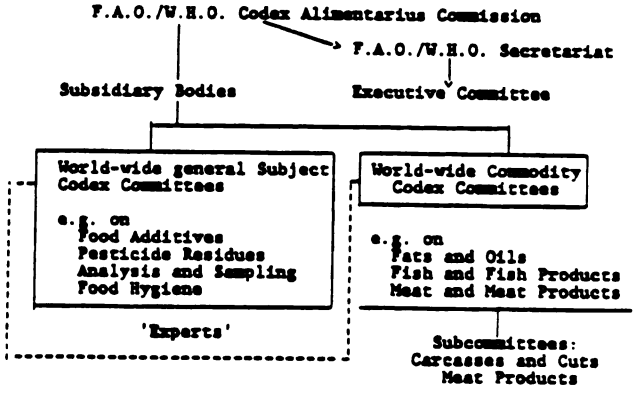
Before presenting this international picture, it should be emphasized that we ignore the activities of the international organizations on an important set of safety regulations involving the meat sector, namely veterinary health programs. Inspection and treatment programs designed to limit the spread of animal diseases are more expanded in some countries than in others. Consequently, the animal disease status shows cross-national differences. For countries reporting incidences of certain diseases this may be undesirable from a public health point of view, and affect the supply of meat or be a major obstacle to expand trade [Ellis, 1975; Kafel, 1975; Simpson and Ferris, 1982]. The F.A.O. and W.H.O. are active in devising programs for animal disease control and surveillance. While realizing their importance, these health aspects of world trade in animals and animal products are not addressed in this study.

IX.2 Activities of the F.A.O./W.H.O.

At the beginning of the 1960's member governments of the F.A.O. and W.H.O. decided to create arrangements for international action in order to facilitate trade in food and to protect the consumer against health risks and fraud by harmonizing food legislation. Established in 1962, the Codex Alimentarius Commission (C.A.C.) -- a joint F.A.O./ W.H.O. institution -- got the task to draw up internationally acceptable food standards (the Food Standards Program). While developed countries of the world are the oldest members of the C.A.C., the last decade shows an increase in the number of developing countries that have become members. The structure of the C.A.C. is schematized below [Leive, 1976].

Figure 1

The Structure of the Codex Alimentarius Commission



The implementation of the Food Standards Program is such that delegates from member countries and experts from subsidiary C.A.C. bodies cooperate in subcommittees in evaluating contaminants, and establishing methods of analysis, levels of acceptable daily intake, and maximum residue limits. The draft of a standard has to go through many steps for elaboration before being published. During this process the draft is sent to the member countries at least two times for comments [F.A.O., 1979]. The general process is slow since recommendations have to be formulated for many food items and safety subjects.

A wealth of information has been assembled and disseminated on the toxicology of drugs, food additives, pesticides and chemicals in general [Taylor, 1980; Van Tiel, 1979; Vettorazzi, 1975]. The central function of the C.A.C. is to provide countries with a world-wide forum in which to discuss problems, exchange views and get specific information and assistance. C.A.C.'s actions can be considered as a blueprint for devising general laws and specific standards in order to set up or update food safety control systems. There is an orientation towards the assistance of developing countries for whom specific regional coordinating committees are instituted.

The C.A.C. constitutes a useful forum and information source for issues involving food safety. In fact, it not only reflects an attempt to contribute to the harmonization

of food laws, but also involves the concentration of research in what could be called an international food safety think tank.

A major weakness, however, stems from the lack of an international machinery for enforcement of the standards that are developed. For example, when the C.A.C. establishes maximum limits for pesticide residues in meat and meat products, these standards have the status of recommendations or guidelines. Hence, the success of the work of the C.A.C. depends upon the willingness of member countries to accept and implement these recommendations in their national food laws. Also, acceptance may take different forms varying from immediate full acceptance, full acceptance in a later period of time, to partial acceptance. As a result, the hodge podge of regulations appears to converge, but, as we saw in our cross-national comparison of safety standards on the various potential sources of meat contamination, the stage of unification is not reached yet. Since true harmonization would involve the coordination of enforcement, C.A.C. standards at best partially contribute to the facilitation of international trade and protection of consumers [Karl, 1972; Alexandrowicz, 1973; Leive, 1976].

The process of harmonizing international food safety standards has proved to be rather slow thus far, and it is probably illusory to hope for acceleration since the problems that are addressed are complicated. Moreover, it

should be taken into account that countries with different problems, needs and interests are involved in this harmonization process. In sum, the C.A.C. efforts in harmonizing food safety standards have come a long way, yet still have a long way to go.

IX.3 Activities of the G.A.T.T.

In contrast to the F.A.O. and W.H.O., the activities of the G.A.T.T. are explicitly directed toward the facilitation of international trade. While international trade in meat and meat products may be hampered by a variety of tariff and non-tariff barriers, our focus is on qualitative non-tariff restrictions such as health and safety requirements. As explained earlier, regulatory measures on the trade of animals and carcasses that are known or expected to be affected with contagious diseases are ignored in this study.

According to the G.A.T.T. (Article XX) "health measures shall not be applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade" [F.A.O., 1973, p. 13]. It will be clear that, in practice, it is not easy to assess when health and safety measures are applied in a justifiable manner and when they are misused. While it is often emphasized in the literature that the decrease in tariff

barriers over time is substituted by an increase in non-tariff barriers, it is hard to quantify the impact on the world trade of meat products [Garnreiter, 1979; Rubin, 1982, Ch. 1; Hillman, 1970]. Whether or not the safety regulations of the importing country are intentionally more restrictive than those of the exporting country, the exporter is put in a disadvantage. It implies a loss of the competitive position of meat exporting establishments and may affect the trade balance of the country as a whole.

The G.A.T.T. became active in formulating codes of conduct in the field of non-tariff barriers in the 1960's, as is illustrated by the anti-duping codex that was adopted at the end of the Kennedy Rounds (1964-1967). More directly applicable to our topic is the Agreement on Technical Barriers to Trade which emerged from the Tokyo Rounds (1979). It is the goal of this code -- usually referred to as the Standards Code -- to ensure that nations do not use health and safety standards for food, plants and animals as a disguised barrier to trade [G.A.T.T., 1979]. The two principal means to this end that the Code provides are: (1) exchange of information, and (2) dispute settlement. As of September 1982, 35 countries were signatories to the Standards Code. Apparently, the list of countries is quite diverse [U.S.D.A., Foreign Agricultural Service, Standards Code].

Argentina	Finland	Korea	Singapore
Austria	France	Luxembourg	Spain
Belgium	Germany	Netherlands	Sweden
Brazil	Greece	New Zealand	Switzerland
Canada	Hong Kong	Norway	Tunisia
Chile	Hungary	Pakistan	United Kingdom
Denmark	Ireland	Philippines	United States
Egypt	Italy	Romania	Yugoslavia
E.E.C.	Japan	Rwanda	

That the Code has some weaknesses follows from the one and only dispute that arose thus far, namely, between the U.S. and U.K. (E.E.C.), involving poultry chilling systems. Differences in the chilling methods used in poultry processing excluded the U.S. from exporting poultry to the U.K. According to the U.S., this difference had no effect upon the quality of the final product. The E.E.C. defended its policy before the Standards Code Committee by stating that processing and production methods were not covered in the Code. Finally, the issue was dropped after many U.S. producers decided to take the expensive option of converting to the E.E.C. requirements regarding chilling methods [U.S.D.A., Foreign Agricultural Service, Standards Code].

The above case is not directly related to product specifications, including the issue of toxic substances in meat and meat products, but is described given its clear

illustration of difficulties involved in putting the principles regarding non-tariff barriers to trade in practice. Disparities between the rhetoric of trade and the practice of trade, however, appear to be a rather widespread problem that will not be solved easily.

IX.4 Regional Intergovernmental Activities

IX.4.1 The E.E.C.

The harmonization of food laws is a necessary condition for the realization of an economic union like the E.E.C. Similar to all international efforts in this area, the E.E.C. food legislation has the objective of protecting public health and ensuring fairness in trade. The only difference involves its regional focus. While simultaneously participating in the C.A.C., it is the aim of the E.E.C. to superimpose a European food regulation or substitute it for national laws whenever legal differences would impede the free circulation of food items within the Common Market and with non-member countries and/or would affect consumers.

The relevant issues that are dealt with in this context can be divided into three categories: (1) legislation concerning food stuffs for human consumption, (2) veterinary legislation, and (3) legislation concerning feeding stuffs.

Limiting our focus on the first category, attempts to harmonize national laws can be described in terms of horizontal and vertical regulations. The former refers to substances (e.g., food additives), whereas the latter involves food items in various conditions/stages (e.g., meat and meat products). The general legal instruments used are regulations and directives. A regulation is binding in its entirety, whereas in the case of a directive, the member country is bound by the outcome that is to be achieved but can determine itself how to obtain the outcome. In practice, however, it is not always easy to make a distinction in the degree of constraint that an E.E.C. decision imposes on the member countries [Gowan, 1981, Ch. 2].

A certain sequence of decisions can be distinguished in the attempts to harmonize regulations on meat and meat products. The first common decisions involve the development of standards and are applicable only to products traded between member countries. Abolishing the disparity between standards on traded products and standards for products produced and marketed domestically constitutes the second stage of harmonization. The third stage involves a common policy covering standards on trade with non-member countries [E.E.C., 1981, pp. 4, 5].

Not all harmonization stages have been completed yet. Many rules are still incomplete and not all the relevant food safety issues are covered. Progress has been made, but

homogeneity of food laws of member countries is not a fact yet. Different interests between countries and between other participants in the decision-making process, such as representatives of consumers and industry, probably explain the step-by-step progress made. Experience has shown that the desired objectives of eliminating technical obstacles to trade and the establishment of a common consumer protection policy cannot be achieved by the simple statement of some principles in a directive. Also, some countries may adjust their national food laws to the E.E.C. regulations, whereas others may evolve additional requirements that are not decided upon yet at the E.E.C. level. It will be clear that this maintains the divergence among food laws of member countries [Gerard, 1972, pp. 483-501].

In brief, the coordination of the food laws of countries is not an easily attainable objective. In the case of the C.A.C. -- being truly internationally oriented in its harmonization attempts -- we concluded by stating that there still is a long way to go. With regards to the E.E.C. -- whose focus is only regional -- this statement can be repeated. There is no European Food Law yet.

IX.4.2 Other Regional Intergovernmental Activities

Of the remaining regional intergovernmental activities,

we briefly mention the following ones:

-- Council of Europe: As opposed to the more general orientation of the E.E.C., the activities of the Council are limited to particular fields of study (e.g., the use of additives and the transportation of perishable goods). Its role is advisory [Gerard, 1976, p. 37].

-- Organization of Economic Cooperation and Development (O.E.C.D.): Its role in the context of food safety issues is similar to the role of the Council of Europe with the exception that this intergovernmental organization covers a wider range of countries [Gerard, 1976, pp. 36, 37].

-- The Latin-American Food Code: This reflects an attempt (approved in 1959 by 16 countries in the region) to promote uniformity in their food safety regulations in order to facilitate interregional and international trade. The only information obtained on the development of the Food Code reveals that up to 1972 no member country adopted the Code in its entirety [Zimmerman, 1972, pp. 645-650].

-- Central American Harmonization Activities: In 1960, six Central American countries (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama) agreed to adopt uniform food standards. With the assistance of the Regional Office of the W.H.O. and other agencies, drafts of standards were formulated (1965) and used as guidelines. The only information obtained on this development reveals that only Honduras (1969) and Guatemala (1970) formally incorporated

the standards in their national food law (up to 1972) [Zimmerman, 1972, pp. 645-650].

IX.5 Non-Governmental Activities

Of the non-governmental activities regarding the harmonization of food laws across nations, we restrict ourselves to a brief description of the following organizations:

-- International Organization for Standardization (I.S.O.): This is an international federation of national institutes specialized in standardization activities. In the case of food standards, I.S.O. deals with terminology, sampling and test methods, storage and transport. There is a close cooperation with the C.A.C. [Chopra, 1976, pp. 141-157].

-- Consumer Organizations: During the last decade, consumer organizations grew in number and became a force which all authorities must take into account. With regards to food legislation their main focus is, logically, on the set of objectives that involve the protection of the health and economic interests of consumers. At the international level, consumer organizations group together in the International Organization of Consumer Unions (I.O.C.U.). The I.O.C.U. is represented in the C.A.C., in which it has observer status. At the regional European level, the European Bureau of Consumers Unions (B.E.U.C. by its French

initials) officially represents European consumers in the E.E.C. decision making process [Richardson, 1976, pp. 168-172]. It may be interesting to add that the B.E.U.C. is named as a major catalyst in the formulation of E.E.C. regulations on the use of hormones in meat production and their control [Financieel Dagblad, October 2, 1980, p. 13].

-- Organizations representing Industrial/Trade Interests: While consumer organizations focus on the health and economic interests of consumers as the objectives of food legislation, producers' interests correspond with the other objective of international food legislation, namely, the elimination of technical barriers to trade. Producer organizations represent not only the food industry, but also chemical manufacturers. Like the consumer organizations, they are represented in regional and international regulatory bodies. It should be noted that the focus of the industry on the facilitation of trade does not necessarily imply that the protection of the health and economic interests of consumers are completely ignored. At this point we should mention another important dimension of food regulations, namely, the costs they generate. For example, if the law requires that consumers are to be given another piece of information in the form of, say, labeling requirements, production/distribution costs presumably increase. Conversely, the prohibition of the use of a certain additive may imply that potential savings are

forgone [Goldby, 1979, Ch. 12]. In fact, conflicting consumer and producer interests contribute to the lack of speed in the national, regional and international decision-making processes on food safety issues.

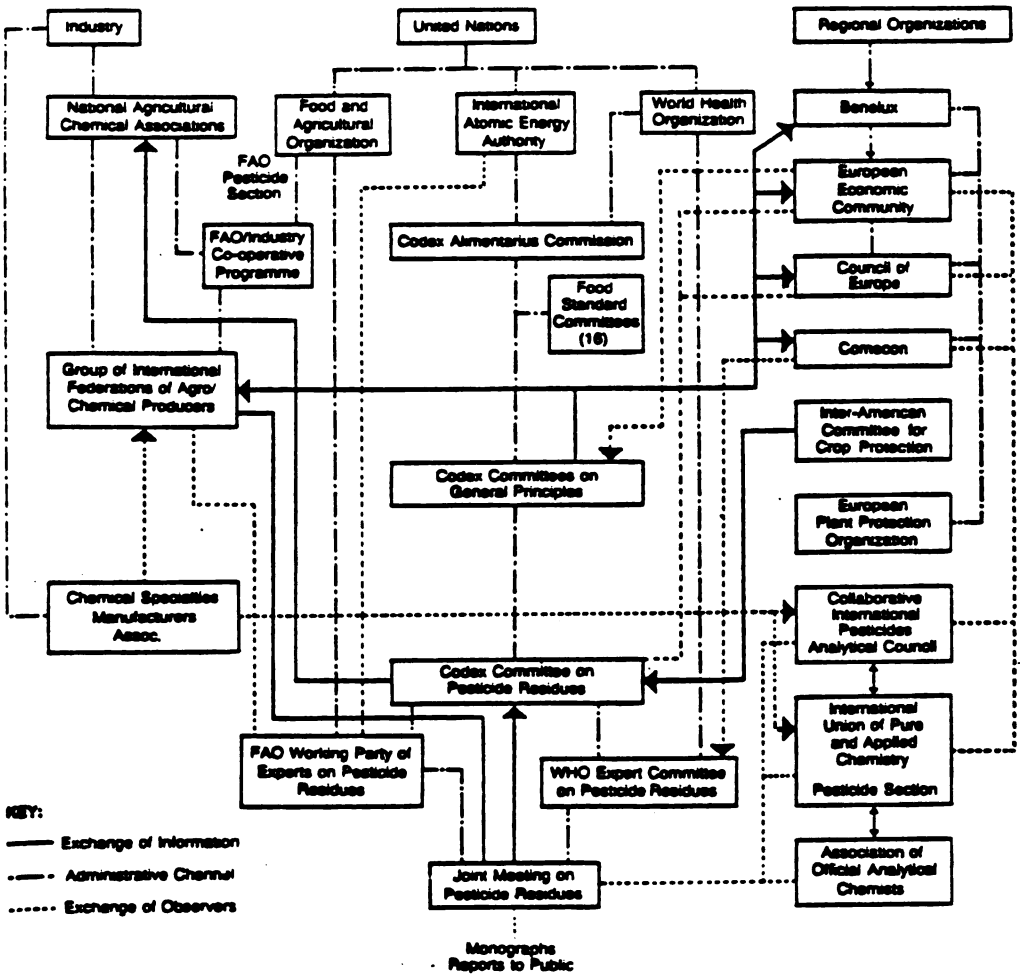
IX.6 Schematic Overview of International/Regional Governmental and Non-Governmental Organizations Involved in Food Safety Legislation: An Application to the Field of Pesticides and Their Residues

Before turning to the evaluation (IX.7) we include a brief section in which the existing international institutional framework for food safety legislation is summarized (Figure 2). The Figure displays the institutional machinery operating in the field of pesticides and their residues, but is also applicable to other food safety issues given the multiple duties of several organizations and committees. It can be seen that the various international governmental and non-governmental entities are linked by a complex network of informational and administrative channels. It should be noted that the chart does not reveal the intensity of the inter-organizational coordination. However, there is at least an indication that international institutional

linkages exist in the area of food safety policy issues. These joint efforts are believed to be a vital component of the objective of harmonizing food laws across nations.

Figure 2

Summary of the International Institutional Framework Concerning Pesticides



Source: Van Tiel, 1979, p. 131.

IX.7 Evaluation

The above analysis illustrates the role of numerous regulatory and advisory international regimes concerning activities in the field of food safety issues designed to guide and/or govern national activities. The need to internationalize food safety regulations corresponds with increases in the international trade of food over time. Internationalization of food safety issues also results from the fact that national food laws may have health and economic impacts on other countries.

The complexity of the international institutional arrangements reflects the complexity of the issue itself. At this point, we will not repeat the strengths and weaknesses of particular international efforts to harmonize food safety regulations. Rather, we will conclude with a more general look at the international activities in this field.

It is rather commonplace to state that international/ regional bodies with regulatory authority in the field of food safety issues operate slowly. Moreover, a common criticism involves the fact that the establishment of national food control systems falls outside their control. The limitations of agencies with only advisory status seem to be even more present. However, there is at least an undeniable educational function involved in that experts,

government representatives and representatives of the views of consumers and producers seek to reach agreements on complex and often controversial matters. As such, international cooperation on research and attempts to devise appropriate instruments for coping with potential discrepancies between technological needs and toxicological effects is vital. In this respect, we may perceive of these international bodies as performing the role of indispensable mediators/catalysts rather than as international food regulators and controllers.

At the same time, some usually ignored dimensions of the attempts to internationalize food laws should be borne in mind. We should first mention some general theoretical notions regarding international institutions. In the literature on international organizations, international cooperation is conceptualized as administrative and executive action taken by those acting in the name of humanity within universal international organizations. Consequently, international civil servants are perceived to be the main institutional articulators of sentiments of the global community [Weiss, 1975, Preface xviii]. When applying the rather rhetorical idea of 'the world interest' to our case of international cooperation on food safety issues, we have to realize that the activities are not necessarily uncontroversial and apolitical. To use the C.A.C. as an illustration: although the membership of

developing countries apparently shows a substantial increase over the years, the meetings tend to be dominated by developed countries. Many developing countries are not effectively represented in the committees in which the important decision-making actually takes place because the few experts cannot be spared for C.A.C. work or because of lack of financial resources. Moreover, the standards that are formulated may not reflect 'the world interest,' but more 'the developed world interest.' Hence, developing countries complain that the standards are of little relevance to them and mostly involve foods traded between developed countries [Leive, 1976, pp. 588-589]. Qualified personnel, equipment, food inspection systems and food control laboratories are believed to be of more practical value to developing countries that residue standards on chemical substances.

Generally speaking, what may be within the need and capacity of some countries may not be true for all countries given differences in general circumstances. While some may be concerned about removing every known contaminant down to the last microgram, others might give a higher priority to improving the general quality of water or maximizing crop yields. Each country's priorities may be as good as another's, but choice is the name of the game. In brief, a decision about the appropriate regulatory action in the case of a food safety problem not only involves technical

judgments, but also the weighing of non-technical factors. This should be kept in mind when evaluating the role of international activities in harmonizing food laws in order to protect consumers and facilitate international trade in food.

Chapter X

Summary and Conclusions

The preceding chapters of this study have presented a general analysis of the cross-national pattern of regulatory action on the use of chemical substances in meat production and/or their residues in meat and meat products. We concentrated on safety regulations on growth promotors, antibiotics, additives, chemical pesticides and heavy metals. The description of each of these substances, the potential health hazards involved, and the specific regulations across countries, and (when possible) over time, was followed by an examination of the validity of the hypothesized explanations for similarities and differences in safety regulations. Since any food law system is only as good as its enforcement, attention was paid to enforcement practices in various countries. Finally, we examined the international efforts concerning the harmonization of national food laws. Now we will briefly summarize our findings.

First, our evidence does not suggest that the regulatory framework on food safety subjects is always less well developed and less strict in countries with a lower standard of living. Similar national regulatory attitudes were observed with regard to growth promotors and

antibiotics despite differences in the standard of living of the countries compared. We observed the same rather random distribution of regulatory attitudes in the case of nitrites -- one of the most controversial additives in the meat processing stage. The findings on the regulatory action in the case of heavy metals are inconclusive in terms of this hypothesis. With respect to the other additives that we examined, however, countries with higher standards of living tend to be forerunners on safety. The same conclusion also applies to the pattern of regulatory action on pesticide residues. Moreover, countries with lower standards of living tend to concentrate more on process standards and somewhat less on output standards. These cases in which the expansion and strictness of safety standards tend to correspond with the relative standard of living could reflect differences in the need/want to regulate the particular substance or in the capacity to control these potentially toxic substances in the meat sector.

Secondly, we examined whether countries whose meat exports represent an important part of total meat production have a more expanded and stricter regulatory attitude. This hypothesis reflects the idea that it is important for countries to ensure the wholesomeness of their exported meat and meat products when their incomes from meat exports are a substantial proportion of their export and farm earnings. According to the findings, the economic dependency on meat

exports does not generally appear to explain the nature of a country's regulatory attitude on growth promotors and antibiotics. The only exception was standards for the use of antibiotics in animal feed. Similarly, economic dependency on meat exports seems to have no explanatory value in the case of regulatory action on nitrites. On the other hand, the hypothesis tends to hold in the case of the safety standards on the other additives examined and in the case of pesticide residues. Again, the results in the case of standards concerning residues of heavy metals are inconclusive. Finally, our findings on the explanatory value of the importance of meat imports are inconclusive. Only in the case of safety standards on pesticide residues was a tendency found for countries that are more dependent on meat imports for their meat consumption to have stricter tolerance levels.

For the third hypothesis, we conclude that the level of meat consumption does not seem to explain observed similarities and differences in the tolerance levels and other regulatory actions of nations on the various substances we examined.

We attempted to obtain an impression of the cross-national pattern of meat control in action. While limitations need to be borne in mind, the recorded observations do not indicate that a lower inspector intensity per plant, a higher level of violative imports of meat and meat

products, and higher frequency of non-compliance of foreign plants with U.S. standards are concentrated in countries with lower standards of living. A greater dependency on meat exports was found to correspond with a more intensive inspection system. However, we saw that this does not automatically guarantee a lower level of import violations.

In brief, the findings lead us to question patterns that are often believed to exist. As in any research project structured around hypotheses, alternative explanations can be formulated for the recorded observations. This issue is addressed in the methodology and will not be repeated at this point. The same is true for the remarks, made throughout this study, on the limitations involved in the several steps taken.

It should be re-emphasized that we base our conclusions only on limited observations regarding the safety regulations in the field of toxic substances in the meat sector. Ideally one would want to examine a wider range of countries. One weakness of this study is that it underrepresents less developed countries. As a consequence, our data may not have captured the range of variation in the independent and dependent variables. The implication is that, although we cannot generally accept our hypotheses, we cannot reject them either.

Furthermore, the nature of the data ruled out the use of statistical methods which would aid us in developing consistent and reliable tests of our hypotheses.

Also, it is possible to address more dimensions of food laws on meat and meat products and to examine safety standards on the use of additives, residues of pesticides and heavy metals in other sectors within the food system than the meat sector. Since our study is limited in the number of products and standards examined it is possible that the hypotheses we cannot accept may appear to be valid when a broader approach is taken.

Another potential problem with the results is the fact that regulations for meat safety are related to other safety regulations. In determining the daily acceptable intake of chemical substances all potential sources of exposure are taken into account. For example, tolerance levels for pesticides are crop/food source specific. It can be argued that the tolerance level for a pesticide in meat may be high, if all other sources of exposure to the pesticide are low. Namely, overall exposure to the pesticide -- upon which the daily acceptable intake for the pesticide is based -- would be low. One might expect, therefore, that technologically advanced countries would have lower tolerance levels on meat simply because other sources of exposure are high.

Rather than further elaborate on the possibilities of generalizing the findings, it seems to be more useful to interpret the relevance of the findings in terms of the possible implications for international efforts of harmonizing national food laws. In the last chapter we examined the trend towards the internationalization of food laws. The strengths and weaknesses of the major international/regional organizations were discussed. The findings of the cross-national comparison of safety standards on the use of chemical substances in meat production and/or their residues illustrate that the stage of uniformity of regulatory attitudes is still more ideal typical than real. Safety standards appear to converge, but the harmonization efforts probably have to be continuous given the dynamics in the field of food safety and the corresponding legislation.

Attempts to facilitate international trade in food by harmonizing food laws would probably benefit from the availability of a central international databank for food regulations. Similar to the concentration of data on national accounts and trade flows, a comprehensive and continuously updated international information system would benefit national and international regulatory agencies as well as private users who are involved in international trade. Currently, countries seem to update their knowledge on the safety regulations of the countries that they trade

with through their Agricultural Attaches. It appears to be more effective from an international point of view to centralize the relevant information on food safety standards. By making it an international obligation to report on changes in food laws to a central point -- e.g., within the F.A.O. -- it can be assured that the information system is comprehensive and updated. We realize that the F.A.O. currently reports on food legislation across nations, but the nature of the information is too general to be of direct use. Modern communication techniques make it possible to provide those who request updated information on specific standards in a certain country with a relatively quick answer. Hence the multifarious data need not necessarily be published regularly as long as there exists some central resource system. Attempts to protect public health by harmonizing food laws would benefit from a similar databank covering information on the enforcement of food laws across nations. There definitely seems to be a lag in this respect. A better information system would probably accelerate follow-up activities and, in general, contribute to the protection of public health.

It should be realized that internationally set standards may not reflect the differences among countries in terms of their preferences for safe food. Furthermore, the costs of achieving such standards may vary significantly from one country to another. Thus both preferences and the

costs of achieving them should be taken into account when formulating international standards as guidelines for national regulatory action on food safety subjects.

The role of food safety standards applied to international trade constitutes only one part of a vast range of different factors that affect international trade flows. In the case of trade in meat and meat products, deficiencies of the animal health status, tariffs, export taxes, import quotas, and the like may have an impact on international trade potentials. Similarly, the role of food safety standards applied to public health constitutes only one part of a vast range of different factors that affect public health. For example, a lack of international harmonization of environmental policies could offset the public health benefits generated by the harmonization of food laws.

There is still not enough hard information about the differences and similarities in the food safety regulations of nations, why these patterns obtain, their potential consequences and corresponding policy implications. The usual statement is appropriate: further study is needed to provide accurate answers to such questions. Nevertheless, this study is a modest start in the process of gaining systematic knowledge on these issues.

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