THE HOG AND PORK INDUSTRIES OF DENMARK AND THE NETHERLANDS:

A COMPETITIVENESS ANALYSIS

March 1997

TABLE OF CONTENTS

List of Tables

List of Figures

ABSTRACT

The hog and pork industries of Denmark and the Netherlands are very successful exporters. The Netherlands supplies mainly other countries in the European Union (EU), and Denmark supplies both other EU and more distant countries. While the groundwork for this success was laid a long time ago by giving hog producers access to low cost feed, the hog and pork industries have continued to change to take advantage of growing export markets. These industries in the Netherlands and, especially, Denmark are characterized by well developed institutions for vertical coordination, which helps in responding to market needs. Border measures protect against low cost imports and offset the high cost of many production inputs, but protection has not bred complacency. Accountability for many industry-wide activities, such as research and quality control, rests to a large extent with industry rather than government. Investment in research and technology, in combination with the rapid rationalization of farm and processing industry structure, enables the Danish and Dutch industries to further strengthen their performance as exporters of pork that meet the specific needs of current and emerging markets. By matching their strength to the overall strength of the supply chains of Denmark and the Netherlands, pork exporting industries in other countries should profit.

PREFACE

This analysis of the hog and pork industries of Denmark and the Netherlands was carried out to help address questions arising in the development of government policies and industry strategies concerning the hog and pork industry in Canada: In what ways is the policy and institutional environment in other countries conducive to their strong competitive performance? Are there aspects of the Danish and Dutch models from which lessons could be drawn or are there other, more suitable models?

The analysis follows the approach outlined in "Framework for Analysing the Competitiveness of the Agri-Food Sector" (Working Paper 3-93, Policy Branch, Agriculture Canada, June 1993). Much of the information needed for the analysis was obtained from published sources, from industry organizations in both countries, and from work sponsored by the Excellence in the Pacific Research Institute at the University of Lethbridge.

Several recent studies have examined issues arising in Canada's hog and pork industry (for example: Sparks Companies, Inc. 1993; and Klein et al. 1995). This report therefore leaves Canada-specific questions aside.

Lars Brink and Jamie Oxley are with the Economic and Policy Analysis Directorate, Policy Branch, Agriculture and Agri-Food Canada. Marc McCarthy is with the Review Branch, Agriculture and Agri-food Canada. Jill E. Hobbs is in the Faculty of Management, University of Calgary. William A. Kerr is in the Department of Economics, University of Calgary. Kurt K. Klein is in the Department of Economics, University of Lethbridge.

The careful, professional work of Susan Clause in preparing this paper for printing is gratefully acknowledged.

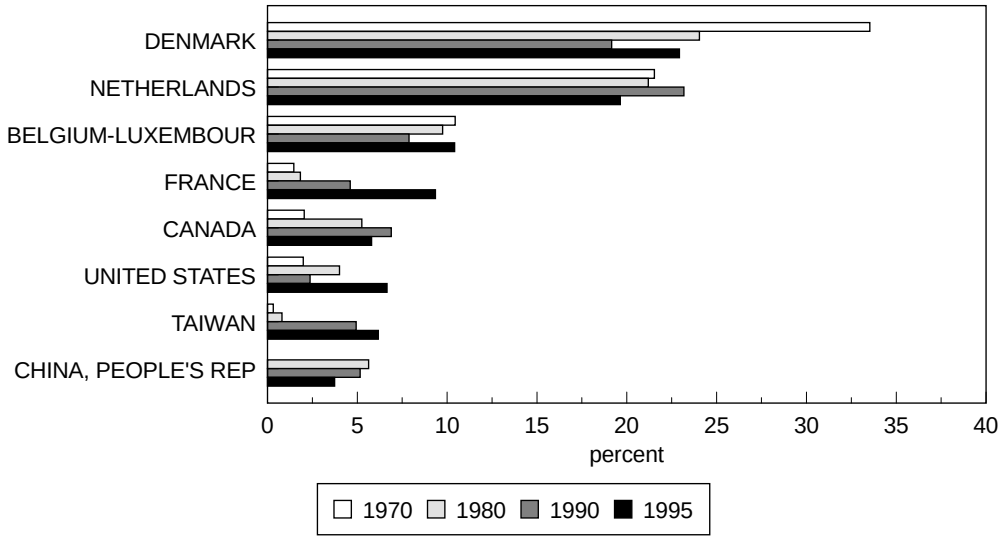
SECTION A: INTRODUCTION

A.1 Rationale

This report is intended to give a better understanding of how the hog and pork industries are structured in Denmark and the Netherlands, and how government policies and the institutional environment have affected the performance of the industry in each of these countries. The hog and pork industries of Denmark and the Netherlands were chosen for analysis because of their strong export orientation, their large market shares in certain export markets, and their success in maintaining large shares in export markets for hogs or pork[1].

Denmark and the Netherlands accounted for 2.0 and 2.1 percent of world pork production[2] in 1995, respectively. Together these two countries produced 21 percent of all pork in the 15 member countries of the European Union (EU). In the EU, 65 percent of inter-country pork trade was sourced in these two countries. In world trade (net of intra-EU trade), Denmark accounted for as much as 20 percent of all exports while the Netherlands supplied 2 - 3 percent.

Figure 1: Shares of World Pork Exports, Selected Countries, 1970-1995



Note: Share refers to quantity of exports, including intra-EU trade.

Source: USDA 1996a.

[1]The interest is in reviewing the performance of the Danish and Dutch hog and pork industries, leaving aside many other important phenomena in world pork markets (such as the recent emergence of the United States as a major exporter of pork, or the growth in production and consumption of pork in China from an already high level). Unless otherwise stated, pork refers to swine carcasses and all parts and products thereof.

[2]Data in this and the following paragraph are derived from USDA 1996b, i. e., "PS&D View".

Denmark and the Netherlands have maintained very large shares of world export markets for pork over recent decades despite the emergence of several other large exporters (Figure 1). The shares of Denmark and the Netherlands dwarfed those of other exporters in the 1970-95 period.

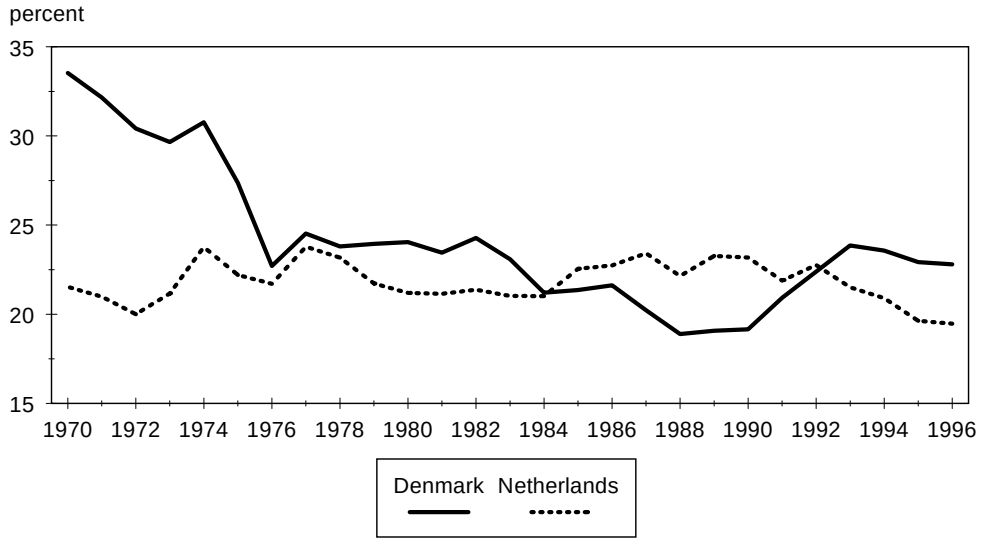
Over the period 1980-95 Denmark held a market quantity share in the 20 - 25 percent range, after having seen a share of 34 percent in 1970 (Figure 2; world trade defined inclusive of intra-EU trade). The Netherlands also maintained a share of 20 - 25 percent in the whole 1970-95 period. However, from the 1970s the trend has been downward sloping for exports of pork from Denmark, in spite of a marked recovery between 1988 and 1993. The share of the Netherlands has been more stable, but shows a clear drop in the 1992-96 years.

Denmark has a much larger presence than the Netherlands in export markets outside the EU (Figure 3; trade defined exclusive of intra-EU trade). Denmark is also a major supplier of pork to other EU countries. The Netherlands is the dominant source of imports of live pigs (hogs and weaners) and pork to many EU countries. Denmark and the Netherlands are thus established as strong competitors against the domestic hog and pork industries not only in overseas markets but also in major EU countries, many of which have advanced hog and pork industries of their own.

A.2 Objectives and Outline

Denmark seems to have no natural advantages in hog and pork production over other countries. By all conventional input measures, Denmark appears to have a significant cost disadvantage

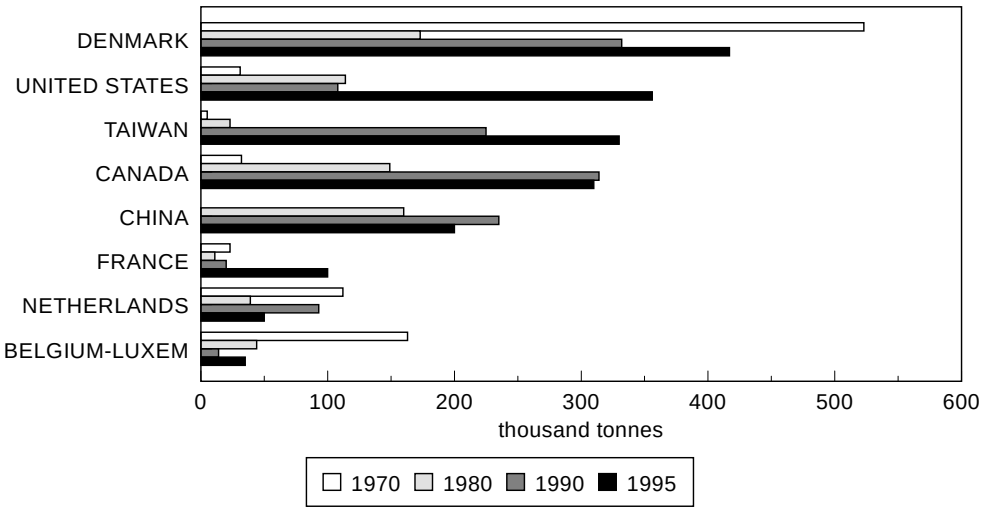
Figure 2: Share of World Pork Exports, Denmark and the Netherlands, 1970-1996



Note: Share refers to quantity of exports, including intra-EU trade.

Source: USDA 1996a.

Figure 3: Exports of Pork, Selected Countries, 1979-1995



Note: Quantity of exports is net of intra-EU exports.

Source: USDA 1996b.

when compared to major competitors: land is scarce and high priced, manure disposal regulations are strict, wage rates in farming and processing are well above those of other major pork producing countries, feed costs are high as a result of the EU Common Agricultural Policy, line speeds in processing plants are slow and the growing markets in East Asia are distant.

The Netherlands also seems to have no natural production advantages. It too has significant cost disadvantages: land is scarce and expensive, manure disposal regulations are very restrictive and wage rates at both primary and processing levels are high.

While some of the explanation for the performance lies in the historical agricultural policy environment in Denmark and the Netherlands, further explanations need to be sought in the structure and conduct of the industry, including the role of government. The question that arises is: What are the factors in industry structure and policy that have enabled the hog and pork industries of Denmark and the Netherlands to gain and maintain a strong competitive position in markets other than their own domestic markets?

The report has six sections. This first section moves on to provide some background on Denmark and the Netherlands, including an overview of the long-term evolution of the policy environment for agriculture in the 2countries. Section B reviews the Danish hog and pork industry under three headings: industry structure, performance and determinants of competitiveness. A similar outline is used in Section C on the Dutch hog and pork industry. Section D introduces

some features of EU policy, including the Common Agricultural Policy. Section E identifies strengths, weaknesses, opportunities and constraints of each country's industry, and Section F gives concluding remarks about the possible interpretation of the analysis.

A.3 Denmark and the Netherlands: Overview of the Hog and Pork Industry

A.3.1 Denmark: Production and Export Today

Denmark comprises the peninsula of Jutland (bordering on northern Germany) and numerous islands. The country has 5 million people on a land area of 43,000 square kilometres (about 60 percent the size of New Brunswick), resulting in a population density of 121 people per square kilometre.

With a pig herd of 10.9 million, Denmark produced 20.6 million pigs in 1995 (Agra Europe 1996a)[3]. The country slaughters about 20.2 million hogs per year, representing 1.6 million tonnes of carcass weight equivalent and a value at the farm level of Dkr 15.2 billion (Cdn $3.2 billion)[4] (Danske Slagterier 1995). (See also Figure 4.)

Almost 80 percent (about 1.2 million tonnes) of Danish pork production is exported, representing a value of pork and pork products of about Dkr 21 billion (Cdn$4.5 billion) (Danske Slagterier 1995). The majority of exports, both in quantity and in value, go to other EU countries, but the value of exports to the rest of the world is close to that of exports to EU countries. The Danish pork production, processing and marketing industry is recognized as one of the most successful in the world.

A.3.2 The Netherlands: Production and Export Today

The Netherlands, bordered to the east by Germany and to the south by Belgium, faces the North Sea. The population is 15 million people on a land area of 34,000 square kilometres (about half the size of New Brunswick), resulting in a population density of 453 people per square kilometre.

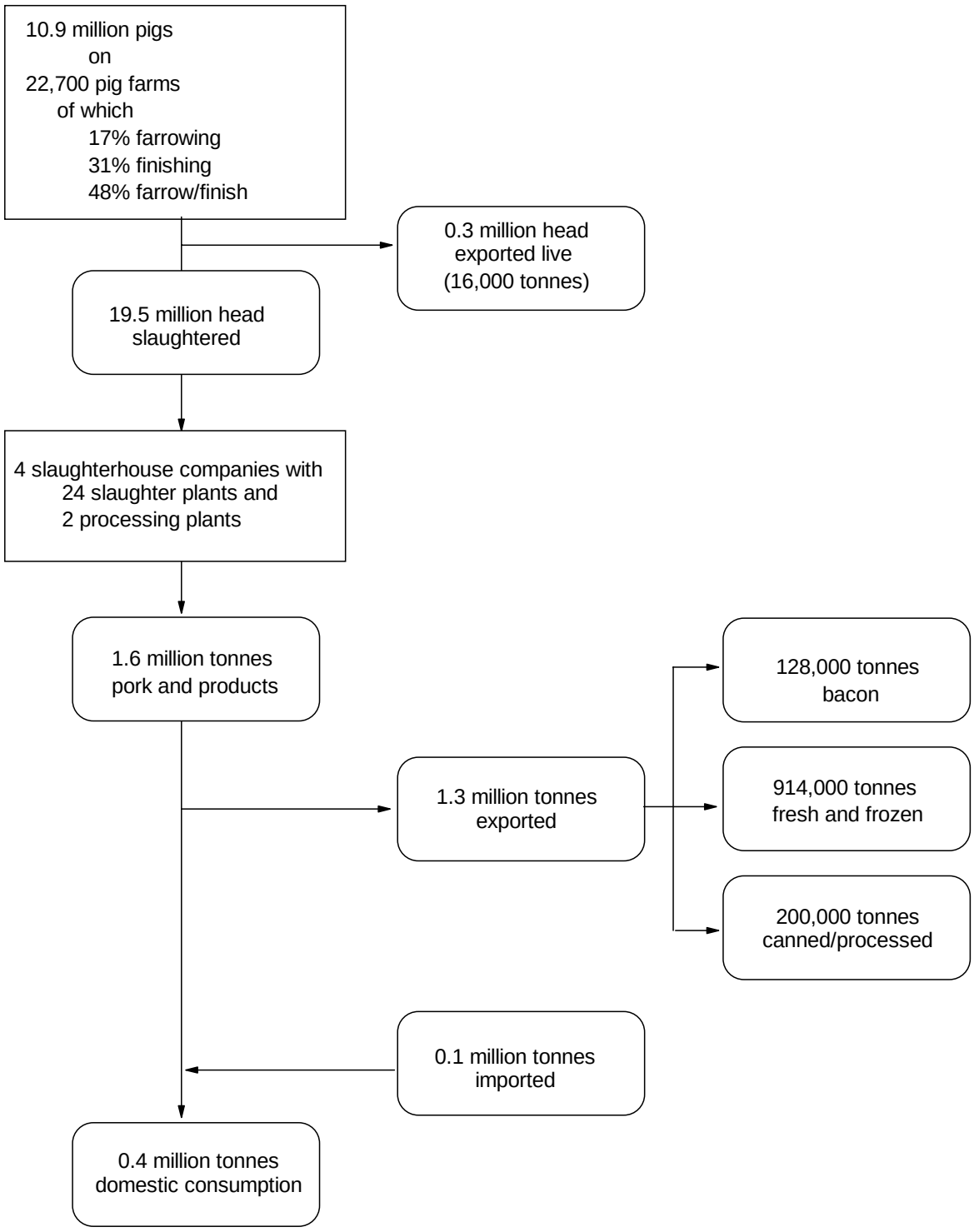
With a pig herd of 14.1 million, the Netherlands produced 23.8 million pigs in 1995 (Agra Europe 1996a)[5]. Out of this total, about 2.3 million piglets and 2.6 million live market hogs are exported (PVVE 1995a; van Dongen 1996). The number of live hogs exported is almost ten times the number of live hogs exported from Denmark. Thus, at 18.7 million, the number of hogs slaughtered in the Netherlands is less than in Denmark in spite of the pig herd being larger. (See also Figure 5).

[3]This production number appears to include slaughter hogs and other slaughter pigs for domestic slaughter or live exports, as well as piglets/weaners for export.

[4]The average value of the Danish krone (Dkr) was Dkr 4.68 per Canadian dollar in 1992-95.

[5]See footnote 3.

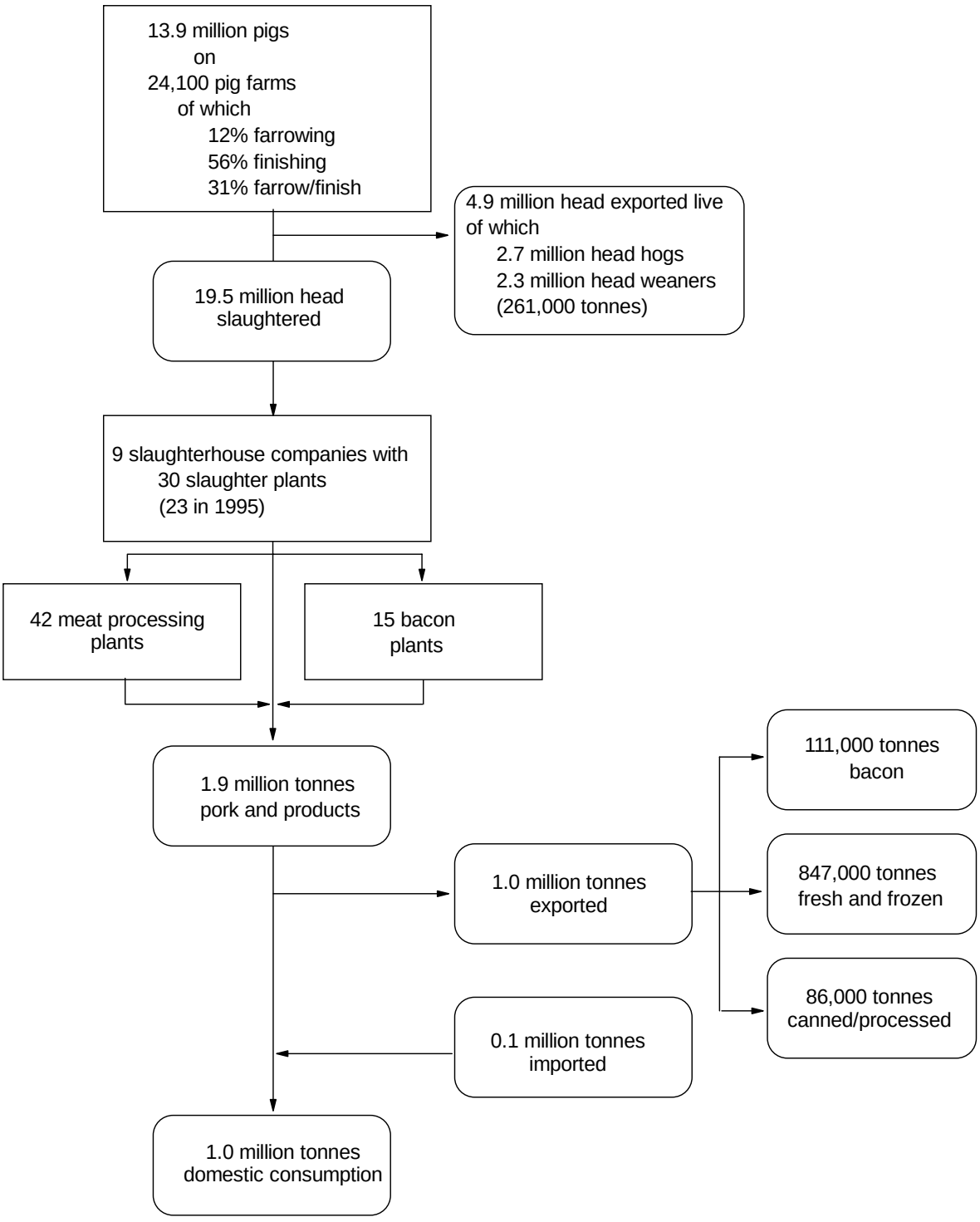
Figure 4: The Hog and Pork Industry in Denmark, 1994



Notes: Domestic consumption is derived as a residual.

Source: Based on Danske Slagterier, 1995

Figure 5: The Hog and Pork Industry in the Netherlands, 1994



Notes: Domestic consumption is derived as a residual.

Source: Based on PVVE 1995a and PVVE 1995b.

Almost 75 percent of the Netherlands' pork production is exported (about one million tonnes of bacon, pork, and pork products). The overwhelming majority of exports (95 percent) are destined to countries in the EU. The export value of agricultural products from the pig sector in 1994 was Gld 4.7 billion (about Cdn$3.5 billion)[6].

A.3.3 Denmark and the Netherlands: Change over Time in Production and Exports

Especially Denmark, but also the Netherlands, has experienced a drastic reduction in the number of pig farms over the last 15 years (Table 1). The number of pigs on farms increased moderately in both countries over that period. The

Table 1: Structural Indicators on the Hog Industry in Denmark and the Netherlands, 1980-1994

	Unit	1980	1990	1994
Pig Farms	number			
Denmark		73,326	29,903	22,716
Netherlands		44,127	29,211	24,058
Pigs on Farms	million heads			
Denmark		9.7	9.3	10.9
Netherlands		10.4	14.0	13.9
Hogs Slaughtered	million heads			
Denmark		14.1	15.9	19.5
Netherlands		13.2	19.9	19.5
Pigs Exported (live)	million heads			
Denmark (all pigs)		0.02	0.2 (1991)	0.3
Netherlands (hogs)		2.7	2.3	2.6
Netherlands		n.a.	2.1	2.3

Source: Danske Slagterier (various years), PVVE 1995a, PVVE 1995b.

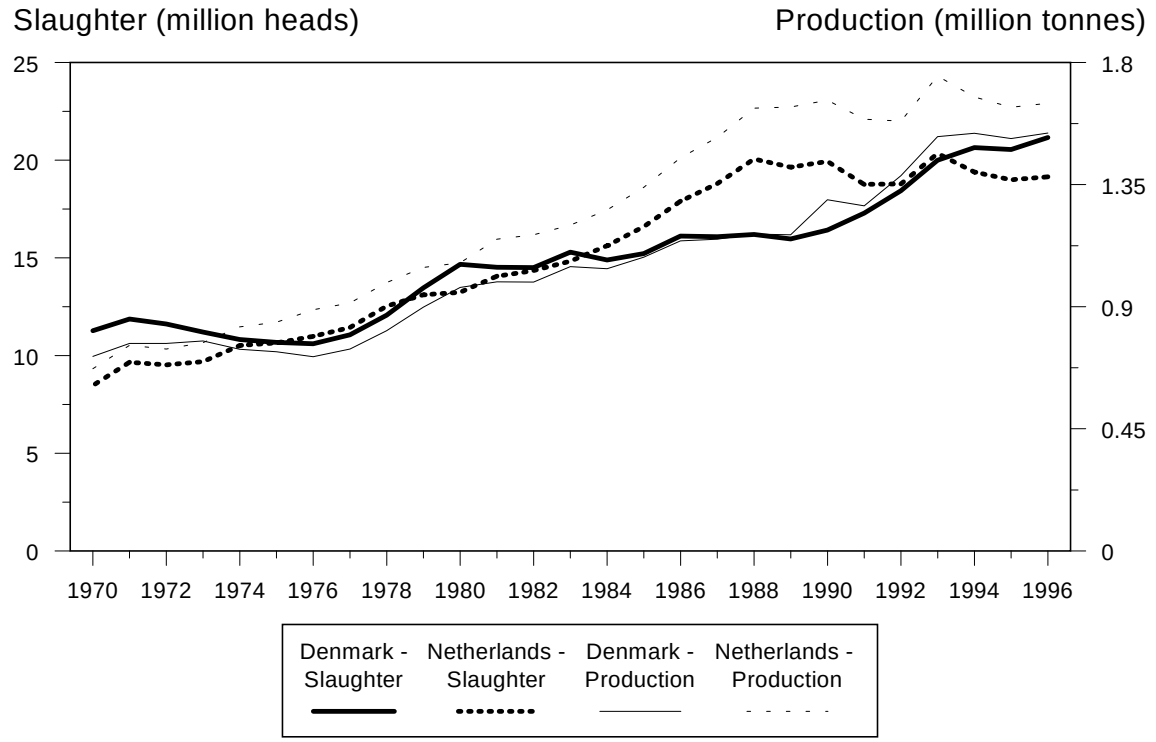
[6]The average value of the Dutch guilder (Gld) was Gld 1.35 per Canadian dollar in 1992-95.

number of hogs slaughtered increased considerably more however, indicating a significant increase in efficiency in hog production. Denmark exports only very few pigs live, whereas live exports of both hogs and weaners has been a dominant feature of the Dutch hog industry for many years.

The number of hogs slaughtered has increased quite continuously from 1970 in Denmark (Figure 6). In the Netherlands, however, the number of hogs slaughtered has stabilized from 1988. Production of pork in the two countries has increased somewhat faster than hog slaughter from 1970, as evidenced by the widening gap between the two curves in Figure 6. Both Denmark and the Netherlands has seen a drastic reduction over the last few decades in the number of companies operating slaughterhouses and processing plants. The numbers of slaughterhouses and processing plants have also declined dramatically, especially in Denmark.

The value of exports of pork from Denmark to the world tripled over the 1980-92 period, while exports from the Netherlands doubled (Table 2). More than half of Denmark's exports, both in quantity and in value, are destined to other EU countries. Almost all exports of pork from the Netherlands go to the rest of the EU. Denmark shows a diversified set of customer countries even within the EU, whereas the Netherlands relies predominantly on Germany as a

Figure 6: **Hog Slaughter and Pork Production, Denmark and the Netherlands, 1979-1996**



Source: USDA 1996b.

Table 2: Exports of Pork from Denmark and the Netherlands - 1980,1992

	Quantity (1,000 tonnes)		Value (US$ million)		Unit Value (US$/kg)
	1980	1992	1980	1992	1992
From Denmark					
to World	269	614	727	2,118	3.45
to EC	205	414	530	1,261	3.05
to UK	30	37	74	123	3.32
to Germany	80	155	219	477	3.08
to Japan	31	154	117	709	4.60
to Non-EC	64	200	197	857	4.29
From Netherlands					
to World	453	761	989	2,004	2.63
to EC	451	751	986	1,988	2.65
to UK	3	4	7	11	2.75
to Germany	209	334	434	832	2.49
to Japan	n.a.	0	n.a.	0	n.a.
to Non-EC	2	10	3	16	1.60

Notes: "Pork" in 1980 consists of "Pigmeat, fresh, chilled, frozen" (011.3 SITC) and in 1992 consists of "meat of swine" (012.2 SITC Rev. 3).

Source: United Nations, Commodity Trade Statistics, 1980 and 1992.

customer for pork. Interestingly, the average export unit value of pork from Denmark, regardless of the destination, is higher than any unit value of pork exports from the Netherlands.

Both Denmark and the Netherlands export bacon, for which the United Kingdom is the dominant buyer country (Table 3). Bacon exports from Denmark declined from 1980 to 1992, while exports of bacon from the Netherlands increased by more than that decline. This occurred in spite of the price (average export unit value) of Dutch bacon exports being higher than that of Danish bacon exports.

The Netherlands increased its already large exports of live pigs between 1980 and 1992 (Table 4). The increase in exports to the EU as a whole was larger than to Germany, indicating a slight diversification of export destinations over the 1980-92 period. Exports of live pigs from Denmark are small compared to those from the Netherlands[7].

[7]Although exports of live hogs from Denmark to Germany increased dramatically between 1994 and 1996 (Agra Europe 1996c), they are still small in comparison to those of the Netherlands.

Table 3: Exports of Bacon from Denmark and the Netherlands - 1980, 1992

	Quantity (1,000 tonnes)		Value (US $ million)		Unit Value (US $/kg)
	1980	1992	1980	1992	1992
From Denmark					
to World	194	123	527	458	3.72
to EC	193	121	525	445	3.68
to UK	193	117	524	424	3.62
to Germany	0	2	0	12	6.00
to Japan	n.a.	0	n.a.	0	n.a.
to Non-EC	1	2	2	13	6.50
From Netherlands					
to World	48	97	135	376	3.88
to EC	48	96	135	375	4.00
to UK	47	89	132	348	4.00
to Germany	0	1	0	2	2.00
to Japan	n.a.	n.a.	n.a.	n.a.	n.a.
to Non-EC	0	1	0	1	1

Notes: "Bacon" consists of "Pigmeat, dried, salted, smoked" (012.1 SITC in 1980 and 016.1 SITC Rev. 3 in 1992).

Source: United Nations, Commodity Trade Statistics, 1980 and 1992.

Table 4: Exports of Live Pigs from Denmark and the Netherlands - 1980, 1992

	Quantity (1,000 tonnes)		Value (US $ million)		Unit Value (US $/kg)
	1980	1992	1980	1992	1992
From Denmark					
to World	17	19	21	35	1.84
to EC	17	19	21	35	1.84
to U.K.	n.a.	n.a.	n.a.	n.a.	n.a.
to Germany	16	17	19	30	1.80
to Japan	n.a.	n.a.	n.a.	n.a.	n.a.
to Non-EC	0	0	0	0	n.a.
From Netherlands					
to World	287	378	434	749	2.00
to EC	287	378	434	749	2.00
to UK	n.a.	0	n.a.	0	n.a.
to Germany	73	170	105	310	1.82
to Japan	0	n.a.	0	n.a.	n.a.
to Non-EC	0	0	0	0	n.a.

Notes: "Live Pigs" consists of "Swine, Live" (001.3 SITC in 1980 and 001.3 SITC Rev. 3 in 1992).

Source: United Nations, Commodity Trade Statistics, 1980 and 1992.

A.4 Evolution of Agricultural Policy in Denmark and the Netherlands

A.4.1 The Early Years

Today's hog and pork industries in Denmark and the Netherlands operate in a policy environment that is influenced by the choices policy makers have made over a long time. The following review highlights the defining characteristics of policy choices made over the last 100 years and notes the similarities between Denmark and the Netherlands in the choices made. The discussion draws mainly on Tracy (1989).

The 19th century saw the emergence of an independent peasantry in Denmark, where a farmer was the owner of a consolidated piece of land. Independent farmers also became the norm in the Netherlands, but farm holdings were fragmented. Agricultural trade consisted mostly of grains, which tended to be traded without encountering import barriers. Towards the late 1800s, large quantities of grains began to flow in from overseas, resulting from the opening of new land and cheaper harvesting and transportation methods.

Most countries in Europe, such as Germany, France, and Italy, met the growing inflow of cheap grains by erecting tariff barriers against imports. The United Kingdom, on the other hand, did not protect agriculture and experienced a transformation of its agricultural sector in which farmers found employment elsewhere and arable land was returned to grass. One of the consequences of this was the establishment of a large Danish presence as a supplier of livestock products (butter, cheese, eggs, bacon) to the United Kingdom.

The ability of Denmark to become a major supplier of livestock products to the United Kingdom was also founded on a major transformation of the Danish agricultural sector. From having been exporters of grains, Danish farmers took advantage of the low grain prices to become major livestock producers for export. Between 1881 and 1914 the production of butter almost tripled, egg production increased five times, and production of pork and bacon rose almost five times. With domestic use rising much less, exports of livestock products from Denmark increased dramatically over a span of a few decades around the turn of the century.

The importance of the United Kingdom as a destination of Danish bacon exports was consolidated in the 1890s as a result of an import ban on live pigs imposed by Germany in 1887 (under the pretext of disease control). Exports of live pigs to Germany had accounted for a very large share of Danish exports. With this outlet closed, and exporting live pigs to other countries being difficult because of the need for sea transport, Denmark became a major producer and exporter of bacon (i.e., a pork product that could be transported great distances without spoiling on the way).

Producing bacon required industrial processing plants - it was not easy for individual farmers to produce it themselves. Farmers established cooperative bacon factories, following the model of cooperative dairies.

Tracy (1989, p. 115) attributes much of the continuing success of Danish agriculture to the choices made around the turn of the century:

> *... Denmark emerged from the crisis with an agriculture adapted to the new situation, profiting from the opportunity of turning cheap grain into livestock products which were increasingly demanded as standards of living rose and which found a ready market in Britain. Further, Danish farmers had built a highly efficient and integrated structure of production, processing, distribution and marketing, based upon a highly-developed co-operative system. This foundation made possible Denmark's development in the twentieth century as a great agricultural exporter ...*

The Netherlands was also one of the few European countries that withstood the pressure to introduce import protection on grains. Organizations representing farmers reasoned that tariff protection would raise the price of agricultural inputs, making Dutch exports less competitive. Farmers subsequently set up organizations to improve the processing of their products, while the government set up training institutes for farmers' use. An increase in exports of livestock products and fruit and vegetables was observed.

During World War I (1914-18) and the years following, agricultural prices were high and tariffs on agricultural products were generally suspended. In the 1920s agricultural import protection was reinstated by many European countries and (in 1931) also adopted by the United Kingdom. Denmark and the Netherlands, however, lagged behind other countries in raising agricultural import barriers. Only in 1933 (the Netherlands) and 1938 (Denmark) did these countries introduce milling ratios for grains[8].

Although Denmark and the Netherlands thus displayed greater reluctance towards imposing import barriers trade than did neighbouring countries, a number of market regulations were introduced in these countries to deal with the agricultural crisis of the 1930s.

Denmark was able to secure duty-free entry of bacon and hams into the United Kingdom in the early 1930s, but only in a severely limited quantity (about half of previous exports). To limit production of bacon in Denmark to match this reduced outlet, a hog marketing quota scheme was introduced[9]. The distribution of quota rights favoured small farmers for whom livestock enterprises were more important than crop enterprises.

[8] A milling ratio is a mixing regulation, requiring that a certain proportion of domestic grain be mixed with imported grain.

[9] Tracy (1989) surmises that this was the first agricultural marketing quota scheme used in any country.

The Netherlands saw the government taking a very active role in regulating agricultural markets as a response to the difficulties facing exports. The government-run Central Pig Office kept the number of pigs in line with what could be sold and operated an export and import monopoly for both live hogs and pork[10]. "The Netherlands thus became one of the first countries to have an extensively planned organisation of its agricultural markets" (Tracy 1989, p. 126).

A.4.2 Agricultural Policy after World War II

Following World War II (1939-45), Denmark dismantled its system of government control of agricultural markets. As many other European countries maintained various barriers to imports, Denmark encountered difficulties in exporting livestock products. Bacon exports to the United Kingdom met strong competition from domestic production and from East bloc countries. While Denmark consequently chose to re-introduce various market regulations in the years around 1960, a "rationalization fund" for aid to farmers was also established. This fund not only made it possible for the domestic price of pork to exceed the average export price, but it also assisted promotion of agricultural exports and research to improve quality.

The Netherlands, in contrast to Denmark, maintained the agricultural marketing arrangements of the pre-war period. In 1957 new legislation consolidated these policy measures and introduced new provisions that continued the various forms of market intervention.

In 1962 the agricultural market regimes of the European Community were established, among them the market regime for pork (see Section E) . The Netherlands was one of the original six countries participating in this common market organization, and Denmark became a participant upon its accession to the EC in 1973.

A.4.3 Effects of Historical Choices in Agricultural Policy

The history of agricultural policy in Western Europe over the last 100 years makes it plain that Denmark and the Netherlands stood apart from their neighbour countries, large or small, in the policy orientation they chose in the face of rapidly falling grain prices in the late 1800s[11]. The choices made at that time, rejecting import protection, reinforced the trading nature of their economies and initiated major adjustments in the agricultural structure. These adjustments had the effects of enabling farmers to take advantage of low grain prices to produce livestock, and creating a livestock processing industry oriented towards, and dependent on, export markets.

[10]A Central Cattle Office and a Central Dairy Office also operated, with similar powers.

[11]Developments in Denmark and the Netherlands parallel each other and contrast against those in other European countries, such as France, Germany, Italy and sometimes the United Kingdom, to a remarkable extent in Tracy's (1989) presentation.

Additional factors have been important in explaining the evolution of the agricultural economies of Denmark and the Netherlands. They include such things as an early preference shown in Denmark for cooperative solutions to marketing problems (contrasting somewhat with the more government-reliant solutions favoured in the Netherlands). Physical characteristics (limited farm land and high population density in the Netherlands; need to use sea transport for shipping products from Denmark to important markets) also have played a role.

The explanation for Denmark and the Netherlands having specialized in pork production and exports to the extent they have is thus partly found in historical policy decisions and adjustments. This explains why other European countries (such as the United Kingdom or Switzerland) have not become equally specialized producers and exporters of pork.

page intentionally left blank

SECTION B: THE DANISH HOG AND PORK INDUSTRY

B.1 Introduction

This section begins by describing the structure and development of the Danish pork industry. This is followed by an examination of Denmark's performance in EU and world markets, documenting the sector's growth and viability. Next, the sector is examined from a competitiveness perspective. The section concludes with a discussion of cost efficiencies versus product differentiation highlighting the strategic path chosen by the Danish pork sector[12].

B.2 Industry Structure

B.2.1 Farm Structure

Denmark has a relatively large number of mixed farms which combine crop and pig farming. Farmland makes up 64 percent of the total area of Denmark. Grains account for approximately 60 percent of the crop area, a large proportion of which is used for domestic animal feed.

Pig production is spread throughout Denmark, with 76 percent of the pig population based on the mainland of Jutland, nine percent on the island of Fyn, almost seven percent on the island of Zealand and just under 2 percent on the distant island of Bornholm.

Hog production in Denmark is essentially all on family farms whose operators are members of the Danish Farmers' Union. The Farmers' Union is a national federation of local unions and is the principal farm organization in the country.

Approximately 17,700 farms in Denmark have slaughter pigs. Of those farms, 6,900 have only slaughter pigs (i. e., they are specialized hog finishing operations). Hog production represents 32 percent of the output value of Danish agriculture. In gross value terms, it is the largest sector in the industry. Milk production is the second largest at 26 percent of output value (Danish Farmers' Union, 1992).

The last twenty years have seen a rapid rationalization and concentration of pig production in Denmark. Between 1980 and 1994, the number of farms with pigs in Denmark declined by almost 70 percent (see Table 1). At the same time, the Danish pig herd experienced some expansion, from around 9.7 million pigs in 1980 to about 10.9 million in 1994. The number of suppliers[13] to slaughterhouses fell from 84,429 in 1974 to 27,446 by 1994.

Herd sizes increased considerably between 1970 and 1994 (Table 5). By 1994, large herds (those with at least 500 pigs), representing 30 percent of all herds, accounted for 80 percent of all pigs. Seventy percent of the herds thus accounted for only 20 percent of the total pig herd. This is similar to the trends in other European pig producing countries, such as the Netherlands and Germany.

[12]Much of the material in this section was originally presented in Hobbs et al. (1995).

[13]The "number of suppliers to slaughterhouses" is a different variable from "number of farms with pigs" and may involve some double-counting.

Table 5: Structure of Farms in Denmark by Size of Pig Herd, 1970-1994

	1970		1980		1993		1994	
	Share of Total Number of:		Share of Total Number of:		Share of Total Number of:		Share of Total Number of:	
	Farms	Pigs	Farms	Pigs	Farms	Pigs	Farms	Pigs
	(percent)							
1-49 pigs	51	17	43	6	27	1	26	1
50-199 pigs	43	59	36	25	28	7	22	6
200-499 pigs	5	20	15	32	20	15	19	13
500 pigs +	0	4	7	36	36	77	30	80
	100	100	100	100	100	100	100	100

Source: Danske Slagterier 1995

Developments in breeding and production technology have enabled considerable increases in productivity since the early 1970s. For example, the number of pigs weaned per sow increased significantly from 14.0 in 1975 to 19.9 in 1994 (Danish Institute of Agricultural and Fisheries Economics, 1995).

B.2.2 Manure Disposal

Concerns about environmental issues in connection with hog production (such as contamination of ground water and surface water) have given rise to a variety of restrictions affecting the further growth in size and concentration of the hog industry in Denmark. For example, due to the problems of manure disposal, regulations limit stocking densities to 1.7 animal units per hectare regardless of the quality of the land and soil. One animal unit for pigs is calculated as one sow and the fattening of her piglets[14].

Larger livestock farms must own 75 percent of their land. In order to reduce such effects as nutrient run-off and leaching, animal waste can only be spread at certain times of the year and in specified volumes. Producers with more than 200 hogs must have storage tanks with capacity to hold waste material for up to nine months. This makes it possible to spread manure only at times when the effects on the environment are relatively minor.

B.2.3 Structure of the Pork Industry

Approximately 97 percent of throughput in the Danish pork industry is channelled through four cooperatively owned slaughterhouse and meat processing

[14]If it is assumed that one sow produces 20 pigs per year, an operation producing 4,000 hogs per year would correspond to 200 animal units. At a maximum of 1.7 animal units per hectare, that operation would need at least 118 hectares of land, or 290 acres.

companies: Danish Crown, Vestjyske (Foodane), Steff-Houlberg and Thisted-Fjerritslev (Tican). Capacity utilization in the plants owned by these four companies is reported to exceed 90 percent (Buhl, 1996).

The four cooperative companies are what remains of an industry that, in 1970, numbered as many as 54 companies (Table 6). Thus, industry restructuring has been drastic. The four companies operate a total of 24 plants, which is down from 60 in 1970.

Danish Crown dominates the industry, with almost 50 percent of hog throughput in the cooperative sector (Table 7). Vestjyske is also a major player. Danish Crown was formed in 1990 and amalgamated with two other companies in 1994. Vestjyske was formed in 1986 and merged with two other companies in the early 1990s. Steff-Houlberg was formed in 1968 and merged with another meat cooperative slaughterhouse in 1987. The smallest of the cooperatives, Thisted, was formed in 1978.

The structure of the industry is highly regional in nature. Danish Crown operates largely in the east of Jutland and on the island of Fyn. Currently there are nine Danish Crown pig slaughterhouses (and one sow slaughterhouse at Skærbæk) on Jutland. Danish Crown operates another slaughterhouse at Odense on Fyn and a further one at Samsø on one of the islands to the north of Fyn. Vestjyske operates eight slaughterhouses, most of which are in western Jutland (with the exception of the slaughterhouse at Allingåbro in the east). Along with Thisted, Vestjyske also part-owns Silkeborg, a sow slaughtering plant, in central Jutland. Steff-Houlberg operates just two slaughterhouses, the major one being at Ringsted on the island of Zealand and the second being at Rønne on a relatively distant island. Finally, Thisted operates a slaughterhouse at Thisted in the northwest part of Jutland.

The processing companies own a number of secondary processing and distribution companies. Often these are jointly owned by two or more of the four meat processing cooperatives. Tulip and ESS-Food are two examples. ESS-Food is owned by Danish Crown, Steff-Houlberg and Thisted. In turn, these secondary processors operate processing and distribution companies located in export markets. To take the United Kingdom market as an example, ESS-Food owns the Danish Bacon Company Plc, which supplies bacon as well as pre-cooked and fresh meat products. ESS-Food, Danish Crown, Steff-Houlberg and Thisted jointly own Danish Bacon Independent (DBI) UK Ltd. which supplies bacon products to the UK market. Celebrity Food Factories (UK) Ltd. is owned by Danish Crown and supplies restaurants and grocery multiples in the UK.

Consequently, the ownership structure downstream in the Danish pork marketing chain is quite complicated. It is clear, however, that the four pork processing cooperatives have common commercial interests in some of these secondary processing companies.

Table 6: Number of Slaughterhouse Companies and Plants in Denmark, 1962-1994

	1962	1970	1980	1993	1994
Companies					
Cooperative companies	62	50	18	5	4
Privately owned slaughterhouses	15	4	2	0	0
Total number of companies	77	54	20	5	4
Slaughter Units					
Number of cooperative units	62	56	34	24	24
Number of privately owned units	15	4	2	0	0
Total Number of Units	77	60	36	24	24

Note: Only companies that are members of Danske Slagterier are shown, which accounts, however, for almost all slaughter.

Source: Danske Slagterier 1995

Table 7: Number of Hogs Slaughtered by Major Slaughterhouse Companies in Denmark, 1994

Slaughterhouse Company	Hogs Slaughtered ('000 head)	Share (percent)
Danish Crown	9,570	49
Vestjyske (Foodane)	6,200	32
Steff-Houlberg	2,778	14
Thisted-Fjerritslev (Tican)	886	5
Total	**19,434**	**100**

Source: Danske Slagterier 1995.

Establishing the degree to which these four cooperatives actually compete with one another in the marketplace becomes difficult, considering the extent of their common ownership interests in the secondary processing firms.

The four meat processing cooperatives are primary members of The Federation of Danish Pig Producers and Slaughter-houses (Danske Slagterier (DS) in Danish). The Federation's objectives as a sector association are to take care of the Danish pork industry's commercial interests, both domestically and internationally, and to carry out activities that will enhance the economic conditions of the hog production and processing sectors. The Federation's professional activities are managed by a number of committees, in which both hog producers and processors are represented.

B.2.4 Prices and Grading

The four meat processing cooperatives do not use price differences to compete for pig supplies. Through DS, a common price is set for all pigs sold through the cooperative system. The weekly price is determined by a quotation committee consisting of four farmer representatives and three slaughterhouse company representatives. The price is based on the return per carcass earned in the previous week. Each of the slaughterhouse companies records the prices it receives for carcasses in the marketplace, costs of production are deducted and this information is sent to DS each week. This forms the basis of the price that farmers receive in the following week. Hence, producer prices of hogs follow product prices with a 1 to 2 week lag.

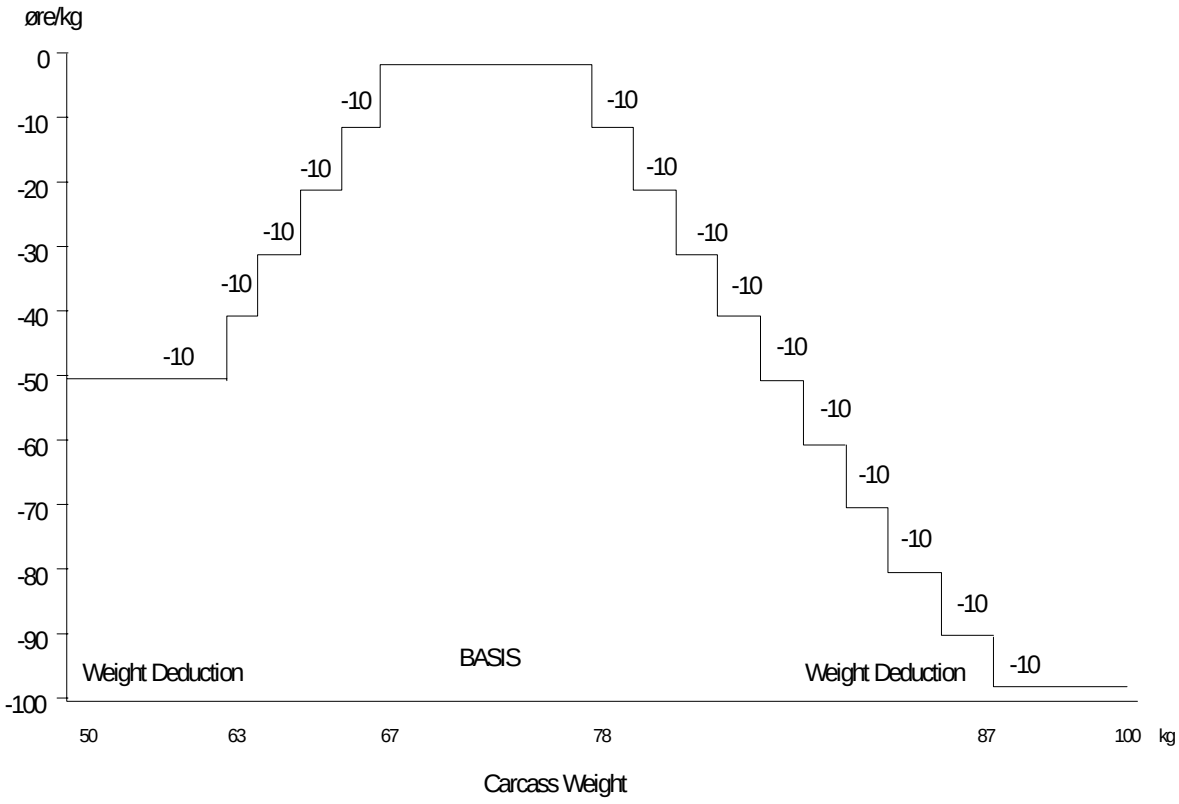
The actual pricing decision is made by the quotation committee. This price is then the base price, which all farmers are offered for their pigs. Slaughterhouse companies pay premiums above this base price for high quality carcasses and make deductions from this price for lower quality carcasses. The final payment to the farmer therefore reflects the quality of the pig carcass. Quality is measured by two criteria: carcass weight and meat percentage.

Weight payments apply to slaughter pigs between 50.0 kg and 99.9 kg (Figure 7).

The ideal hot carcass weight is judged to be between 67.0 kg and 77.9 kg. There is no deduction applied for carcasses in this range. Price deductions apply if pigs are underweight. Carcasses between 66.9 kg and 63.0 kg are penalized with a price reduction of 10 øre (about 2.1¢ Cdn.) per kg for each kg below 66.9. The price for pigs under 63 kg is reduced by a total of 50 øre below the basic quotation. The price paid for pigs heavier than 77.9 kg is also penalized. Carcasses between 78.0 kg and 86.9 kg are penalized with a 10 øre per kg price reduction for each kg above 77.9. Exceptionally heavy carcasses - those over 87.0 kg - are penalized a total of Dkr 1 (approximately 21¢ Cdn.) per kg.

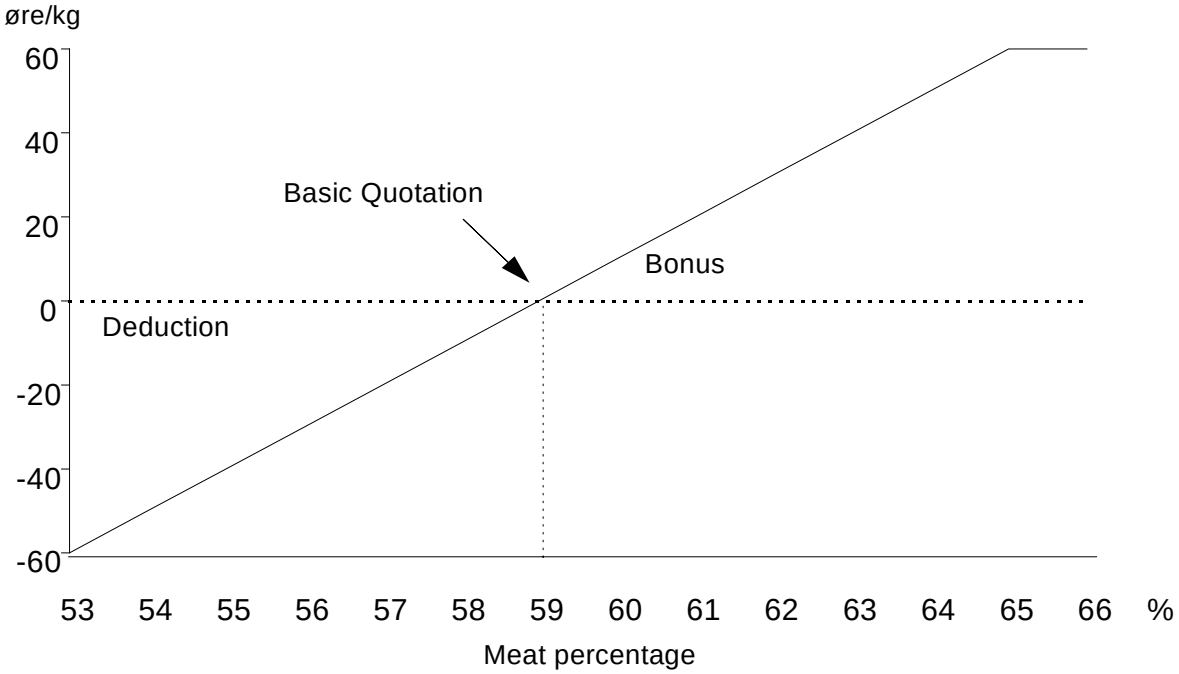
The weight payment system is combined with a meat percentage payment to arrive at the final price per animal (Figure 8).

Figure 7: Deduction Rates for Carcass Weight



Source: Danske Slagterier 1995

Figure 8: Bonus and Deduction Rates for Meat Percentage



Source: Danske Slagterier 1995

The basic price quotation applies to a meat percentage of 59 percent. Carcasses with a meat content above 59 percent receive a 10 øre bonus for each percentage point up to a maximum of 60 øre per kg for pigs with more than 65 percent meat content. Carcasses with a meat content below 59 percent are penalized with a 10 øre price reduction per percentage point. The maximum meat percentage deduction is 110 øre per kg for pigs with less than 48 percent of meat.

The grade payment system therefore encourages farmers to produce carcasses in the 67-78 kg weight range with at least 59 percent meat content by rewarding pigs which fall into these categories. The average carcass weight of hogs in Denmark is about 75 kg (European Commission, 1994, Table 4.16.1.1). The processors can make a price deduction for poor quality but they cannot refuse to accept a producer's pigs (Danske Slagterier, 1995).

At the end of the year, any cooperative profits are divided among members according to the numbers of pigs which they have sold through the cooperative. These payments are the main method by which the processing cooperatives compete for members. In 1996, Danish Crown, Vestjyske, and Tican all paid their members a bonus of 80 øre per kg delivered. Steff-Joulberg paid a bonus of 70 øre per kg (Agra Europe, 1997).

B.2.5 Product Markets and Exports

Cultivating and maintaining successful export markets are the lifeblood of the Danish hog and pork industry. Countries in the EU accounted for 60 percent of Danish pork exports by quantity in 1994, representing 53 percent of the value of exports (Table 8). Key export markets within the EU are Germany, the UK, France and Italy.

The dominance of EU countries as export destinations for Danish pork increased in 1995, when quantities going to EU countries rose to 823,000 tonnes and those to non-EU countries fell to 402,000 tonnes.

Some of this change would be due to the enlargement of the EU from 12 to 15 countries. Denmark's share in total exports of pork from the EU is about 65 - 70 percent.

The Danish industry is extremely successful at differentiating its product to meet the needs of specific markets. Two good examples of this are exports to Germany and to the UK. Germany takes 20 percent of Danish exports by quantity and 17 percent by value. Over 60 percent of Danish pork exports to Germany (both in terms of value and quantity) are in the form of cuts, compared with around 2 percent in the form of bacon (Table 9). The UK accounts for around 19 percent of Danish exports by quantity, 18 percent by value. Exports to the UK, however, consist of a product mix very different

Table 8: Exports of Pork to Major Destinations from Denmark, 1994

Destination	Quantity		Value	
	Weight ('000 tonnes)	Share (percent)	Value (Dkr millions	Share (percent)
Germany	247	20	3,517	17
UK	238	19	3,874	18
France	122	10	1,807	9
Italy	94	7	1,298	6
Other EU	54	4	685	3
Total EU	**755**	**60**	**11,171**	**53**
Russia	69	5	805	4
Poland	55	4	564	3
United States	93	7	1,648	8
Japan	143	11	4,841	23
Other Non-EU	142	11	1,932	9
Total Non-EU	**503**	**40**	**9,789**	**47**
Total	**1,258**	**100**	**20,960**	**100**

Source: Danske Slagterier 1995

Table 9: Composition and Destination of Exports of Hog and Pork Products from Denmark, 1994

Destination	Live Pigs and Sows	Bacon	Carcasses Fresh/ Frozen	Cuts	By-products	Canned Meat	Other Proc. Products	Total
				(1000 tonnes)				
Germany	12	4	22	152	33	21	2	246
UK	-	119	-	56	25	33	5	238
France	0	2	0	98	11	2	9	122
Italy	0	0	-	85	6	3	0	94
Other EU	4	1	0	35	10	4	1	55
Total EU	**16**	**126**	**22**	**426**	**85**	**63**	**17**	**755**
Russia	0	1	2	30	6	14	17	70
Poland	0	-	1	53	1	0	0	55
United States	0	0	-	51	1	40	1	93
Japan	0	0	0	133	3	6	1	143
Other Non-EU	0	1	2	72	28	20	19	142
Total Non-EU	**0**	**2**	**5**	**339**	**39**	**80**	**38**	**503**
Total	**16**	**128**	**27**	**765**	**124**	**143**	**55**	**1258**

Source: Danske Slagterier 1995

from those to Germany. Around 50 percent of exports to the UK (by value and quantity) are in the form of bacon, compared with 23 percent in the form of cuts.

Denmark supplies a 26 percent share of British bacon consumption, compared with a 20 percent share for the Netherlands, a 42 percent share for domestic suppliers and an 11 percent share for other countries. Denmark has experienced reduced bacon exports to the UK over the last couple of decades however, as the total quantity of bacon imported to the UK has declined and exports of bacon from the Netherlands to the UK have increased[15]. Stagnating consumption of bacon is part of this evolution: the consumption of bacon at breakfast has fallen as the composition of

[15]For example, exports of bacon from Denmark to the UK fell from 208,000 tonnes in 1976 to 119,000 tonnes in 1994 (Danske Slagterier, various years). Exports of bacon from the Netherlands to the UK increased over that same period: from 25,000 tonnes in 1976 to 84,000 tonnes in 1994. In the most recent years, however, such exports from the Netherlands dropped steadily: from 111,000 tonnes in 1990 to 84,000 tonnes in 1994 (PVVE 1995b).

this meal has broadened to include a wider variety of foods.

Denmark exports only relatively small quantities of bacon to countries other than the UK. Exports of single-ribbed bellies, especially to Japan and Korea, have largely taken the place of bacon exports.

By far the fastest growing destination for Danish pork exports has been Japan. Danish exports to Japan began in 1972. By 1980 they represented just under 7 percent of Danish exports by value. However, in 1994 Japan accounted for as much as 23 percent of the value of Danish pork exports.

The expansion of exports to other EU countries has been largely in the form of tailor-made cuts to suit the requirements of individual markets. For example, eighty percent of Danish exports to France are in the form of cuts. Denmark's slaughtering and meatcutting industry has developed several special delicatessen products for the French market.

The Danish pork industry has adapted well to the changing requirements of its growing number of export markets. In 1970, 47 percent of Danish pork exports by quantity were bacon products (Table 10). By 1980 this proportion had fallen to 29 percent and by 1994 to 10 percent. This reflects the declining importance of the UK bacon market for the Danish industry.

Over the same 1970-1994 period, there was a corresponding rise in the proportion of exports in the form of tailor-made cuts. In 1970, cuts represented just 5 percent of Danish pork exports (Table 10). However, this type of product had risen to 31 percent of Danish pork exports by 1980 and to 61 percent by 1994. The increasing need to provide export markets with high quality, value-added products has provided the incentives for these changes.

Denmark exports pork products to a number of non-EU countries in or near Europe, including Poland, Russia, the Czech Republic and Hungary. Exports to states of the former Communist bloc have increased rapidly in recent years.

However, these represent relatively low quality products. Due to the lack of functioning and reliable legal and financial institutions, Danish exporters require cash payments in advance when delivering product to many of these countries.

Japan is the most important single destination for Danish pork exports in terms of value - even more important than Germany. Exports to Japan consist of relatively high-valued products. Around 11 percent of Danish pork exports (by quantity) go to Japan. However, this represents 23 percent of Danish exports by value, indicating a very high unit value. It has been estimated that the Japanese market offers an Dkr 8-10 per kg (Cdn$1.70-$2.10 per kg) premium over other markets (Stenbæk, 1995). Boneless cuts account for much of these exports.

Table 10: Composition of Exports of Hog and Pork Products from Denmark, 1979-1990

Product	1970		1980		1994	
	Quantity ('000 tonnes)	Share of Total Quantity (percent)	Quantity ('000 tonnes)	Share of Total Quantity (percent)	Quantity ('000 tonnes)	Share of Total Quantity (percent)
Live pigs and sows	22	4	17	2	16	1
Sow meat	18	3	36	5	-	-
Bacon	284	47	214	29	128	10
Carcasses[a]	14	2	13	2	26	2
Cuts	29	5	228	31	765	61
By-Products	55	9	70	10	123	10
Canned meat	171	28	137	19	144	11
Other processed meats	12	2	14	2	56	5
Total	**605**	**100**	**729**	**100**	**1,258**	**100**

[a] Fresh and frozen

Source: Danske Slagterier 1995

The vast majority of Danish pork exports to Japan (92 percent by quantity, 97 percent by value) are in the form of cuts. The main cuts sold to Japan are bellies, loins, tenderloins and collars. Most cuts are shipped frozen by sea transport and are sold to the meat processing industry in Japan. The Danish industry seems able to supply products to meet the strict specifications of Japanese buyers (such as a requirement that loins must be 54 cm long). This attention to detail and consistency of quality, along with the particular product mix offered, is regarded as one of the reasons behind the success of Danish pork exports to Japan.

In 1994, Taiwan dominated Japanese pork imports in terms of quantity, with Denmark being the second most important supplier (Table 11).

Considering, however, that Japan's imports of pork from Taiwan consist of a wider range of cuts than the selection of high-valued cuts supplied by Denmark, Taiwan's lead over Denmark in value of pork imports is smaller[16].

[16]Comparisons for 1995 would be difficult to interpret, given the application of certain restrictions on imports of pork to Japan. It appears imports from Denmark were affected to a considerable extent.

Exports to other Asian-Pacific markets have also been increasing. Imports to Korea will be fully liberalized by mid-1997, and Denmark is one of the suppliers that consider this market to hold great potential. In 1994, Denmark exported 23,000 tonnes of pork to Korea. The realization of increased exports of pork from Denmark to Korea is of course predicated on the ability of the Danish industry to cater to the specific requirements of Korean consumers.

One of the Danish trading companies, ESS-Food, has an office in Hong Kong, from where it directs some of its Asia-Pacific trade. Exports to Hong Kong are extremely minor, representing just 0.7 percent of total Danish pork exports in 1994; exports to Singapore represent just 0.4 percent.

In 1994, Denmark exported 93,188 tonnes of pork to the US (7.5 percent of total Danish exports) and just 5,656 tonnes (0.4 percent) to Canada. US imports of fresh and frozen pork come almost exclusively from Canada (73 percent) and Denmark (25 percent) (Table 11). Denmark is thus Canada's main exporting competitor in this market.

As the US itself has emerged as a significant pork exporter, imports from Canada to the US have displaced some imports from Europe, such that Canada's share of US imports of pork has increased. The decline in exports from Denmark to the US is expected to continue.

B.3. Industry Performance Measures

B.3.1 Growth in Production

Worldwide pork production has increased annually at a 2.5 percent rate over the past two decades (1973-1993). In comparison, poultry meat, mutton and lamb, and beef have, respectively, experienced annual growth rates of 5, 1.6 and 0.5 percent, reflecting, in part, a trend to meet protein needs from sources other

Table 11: Imports of Pork to the US and Japan from Selected Countries, 1994

		Imports to Japan		Imports to the US	
		Quantity (tonnes)	Share (percent)	Quantity (tonnes)	Share (percent)
From					
	Taiwan	234,800	48	0	0
	Denmark	133,500	27	51,200	25
	US	72,300	14	-	-
	Canada	29,400	6	153,400	74
	Other	23,900	5	3,600	1
Total		493,900	100	208,200	100

Source: Danske Slagterier 1995; Ministry of Agriculture, Forestry and Fisheries 1996.

than beef. Pork production in Europe has also increased, but at a slower rate: 22 percent over the twenty-year period.

In Denmark pork production increased at a dramatic rate of 3.5 percent annually over the same period. This resulted in annual production doubling from 774,000 tonnes to 1,588,000 tonnes (Figure 6). A significant portion of this growth occurred recently with an increase in annual production of 360,000 tonnes between 1989 and 1993.

B.3.2 Growth in Exports

Over the past twenty years annual world trade in meats has increased from 5.5 to 13 million tonnes, an average annual growth rate of 4.7 percent. World pork trade has been a significant component, expanding from 2 million to 4.8 million tonnes, an average annual growth rate of 4.3 percent.

Denmark also experienced growth in pork exports over this time period. Export quantities initially declined, reaching a low of .5 million tonnes in 1976. From that point, quantity expanded fairly consistently until 1990, when the growth rate increased, resulting in an export quantity of 1.3 million tonnes by 1994.

Due to higher rates of growth in world exports, Denmark's share of world exports declined from a high of 34 percent in 1970 to a low of 19 percent in 1990. Stemming from its more recent growth in exports, however, Denmark's share has increased to close to 25 percent of world trade (see Figure 1).

B.3.3 Growth in Competition

Over the past two decades, Denmark has maintained its top ranking in world pork exports, with a slight decline in market share. The US, Canada, France and Taiwan have all increased their market shares, while those of China have declined significantly (see Figure 1).

The US and Taiwan are Denmark's largest competing suppliers in Japan. Taiwan, advantaged by distance and by being allowed to supply a wider range of cuts than other exporters, boosted its share of Japan's imports of fresh and chilled pork to 57 percent in 1994. Chilled pork from the US is able to compete against fresh pork from Taiwan. The chilled pork from the US is in fact an extended shelf-life (six to nine weeks) fresh pork[17]. The Danish industry is attempting to catch up on this technology in order to maintain its large share of the Japanese import market for pork, where Danish supplies consist predominantly of frozen pork.

In 1994, when the Korean pork market first opened, Denmark rapidly positioned itself as the major supplier, capturing 77 percent of imports. However, a year later, Denmark's share fell rapidly to 35 percent (11,900 tonnes) with the US, Canada and UK capturing respectively 30, 14 and 13 percent. The tendering

[17]The process was developed in New Zealand for lamb and was adapted to pork in the US and Canada.

system for imports to Korea is scheduled to end on June 30, 1997, following which competition among suppliers may further intensify. With Danish exports to Japan and Korea under increasing competition, the Danish industry is rapidly developing new transport and chilling techniques (Agra Europe 1996a).

B.3.4 Hog Production Costs

It is difficult, if not impossible, to directly compare production cost between countries. Exchange rate fluctuations, different accounting methods and different definitions of cash and non-cash items contribute to the difficulty of obtaining comparable costs. Product specifications for the final output also differ between countries. For example, North American market hogs have tended to be heavier and older than Danish hogs.

In Denmark, 86 of hog production costs (i.e., the costs associated with raising a weaner to market weight) are associated with the purchase of weaners and feed. Costs for maintenance, interest and depreciation account for 9 percent of expenses. Remaining expenses, including veterinary services, producer levies, taxes, insurance and energy costs, account for 4 percent of total expenses (Table 12).

The cost of feed is raised by certain policy measures under the EU Common Agricultural Policy, designed to support incomes of grain and oilseed producers. For example, at a time when the unsupported (cif Rotterdam) price of barley was around US$100 per tonne, the price of barley for animal feed in Denmark and in the Netherlands was US$228 per tonne[18]. The price of complete compound feed for fattening pigs was at the same time US$263 per tonne in Denmark and US$271 per tonne in the Netherlands.

B.4 Determinants of Competitiveness

B.4.1 Cost Competitiveness versus Product Competitiveness

Competitive performance is improved by lowering cost and by adding value through product differentiation. Cost is generally thought of as the primary determinant of competitiveness for agricultural products, where commodities are fairly homogeneous. However, product differentiation can reduce the importance of price and cost factors. Improving competitiveness through product differentiation refers to the provision of non-price characteristics, such as physical attributes, delivery services, guarantees and other conditions of sale (Agriculture Canada, 1993).

The collective strategy of the Danish hog and pork industry is not to produce a bulk homogeneous product in the largest

[18]Data are from 1992 (European Commission, 1994). The unsupported (cif Rotterdam) price of barley was around 77.42 ECU per tonne (Table 4.1.5.5), and the price of barley for animal feed in Denmark and in the Netherlands was 175.80 ECU per tonne (Table 3.3.5). The price of complete compound feed for fattening pigs was at the same time 202.50 ECU per tonne in Denmark and 208.80 ECU per tonne in the Netherlands (Table 3.3.5). Exchange rate: 0.77 ECU/US$ (Table 1.0.2).

Table 12: Hog Production Costs in Denmark, 1993/94

Item	$/Hog[1]	Share of Total Cost (percent)
Weaner[2]	$65.50	45
Feed[3]	$59.87	41
Veterinary	$0.95	1
Energy	$1.10	1
Contract Associations	$0.54	<1
Association Fees	$0.15	<1
CO2 Tax	$0.10	<1
Insurance	$0.93	1
Misc.	$2.45	2
Maintenance	$2.34	2
Equipment 1.70		
Machinery 0.64		
Sub-Total	$133.93	**93**
Interest	$5.26	4
Livestock 1.26		
Equipment 0.77		
Machinery 3.23		
Depreciation	$5.56	4
Equipment 2.99		
Machinery 2.56		
Total Cost (excl. labour)	$144.75	100

Notes:

[1] Based on an exchange rate of Cdn$0.2073 per Danish krone.
[2] Weighted value of market prices and imputed weaner costs from farrow/finish operators.
[3] Includes purchased and homegrown feed costs

Source: Danish Institute of Agricultural and Fisheries Economics 1995.

quantity possible, but to produce a high quality, market specific, differentiated set of products. The focus is on product competitiveness rather than cost competitiveness. The following sections analyze determinants that have contributed to making this strategy successful. Specifically, the Danish hog and pork industry is examined with respect to: factor conditions, demand conditions, sector structure, linkages and strategies, and government policies.

B.4.2 Factor Conditions

Labour: Danish hog production methods are not significantly different from those in North America and in other European countries. However, labour costs in hog production in Denmark (as in some other European countries) are reported to be high in international comparisons. This could result from the labour input in Danish hog production coming from a highly trained work force, in combination with this skilled labour also being attractive to employers outside the hog or farming sector.

Denmark places considerable importance on the education and training of people in its farming sector. Anyone wishing to buy a farm larger than 30 hectares must complete a series of training courses at one of the country's 28 agricultural colleges. The basic education module involves a mixture of on-farm practical training and in-class schooling lasting 18 months. Students wishing to receive a certificate showing that they are "skilled farmers" must proceed to a second module of professional/technical education, which takes a further two years to complete. These training courses prepare students to become farm labourers.

If a person wishes to purchase a farm, he or she must complete a further module of education, which concentrates on farm management skills. The third module takes 18 months to complete and involves a combination of practical managerial experience on farms plus college courses. The successful student earns a "green certificate". This certificate is a prerequisite for anyone wishing to buy a farm larger than 30 hectares, and it is also a prerequisite for having access to loans at preferential interest rates.

Students must receive practical experience on more than one farm - at least one with livestock and one with crops. Students must work on at least one farm that is not their home farm and cannot be on any one farm longer than 24 months. The government provides the major part of funding of the schools involved in farmer training, but students pay tuition and employers of students pay a fee to contribute to the financing of the training scheme.

Education programs for established farmers are jointly financed by the Ministries of Agriculture and Culture. The Ministry of Agriculture refunds a portion of the cost of tuition and also covers the cost of a relief worker while the farmer takes the course.

Training is not confined to new entrants into farming. The industry has instituted an ISO 9002 quality management project, which aims to foster a "total quality management" culture among hog producers[19]. The National Committee for Pig Breeding, Health and Production (1994) reported that 93 herds had received an ISO certificate over the length of the project (1992 - October 1994). The system involved producers documenting a series of work routines and standards for their farm which demonstrated attention to and awareness of quality management. The cost of obtaining the certificate was Dkr 12-20,000 (Cdn$2,600 - $4,300), plus an additional Dkr 5-10,000 (Cdn$1,100 - $2,100) per year to maintain the certification.

Wider adoption of the quality management standard likely will depend on whether producers perceive any efficiency improvements and/or price premiums for pigs produced under this management regime. The low participation rate of farmers in the 1992-94 project casts doubt on these benefits. However, the fact that the National Committee for Pig Breeding, Health and Production instituted the quality management project in the first place indicates that quality improvements are high priority for the Danish industry (Hansen and Hansen, 1994).

Labour costs in the processing sector are also high. Average wages for the approximately 15,600 Danish slaughterhouse workers were Dkr 150.59 (Cdn$32) per hour in 1994 (Danske Slagterier, 1995). Good specialist meat cutters, who earn a piece-wage, are able to make considerably more than this. To the extent that workers' social benefits are funded by employers, industry's cost of labour may be still higher.

Labour costs for Danish slaughterhouses are thus far higher than those in many competitor countries (including Canada)[20]. Hourly wages have also increased more rapidly over the last ten years in Denmark than in the Netherlands and the US (Danske Slagterier 1995). Denmark has high levels of income and sales taxes which reduce the real value of these wages for the employees but does not alter the fact that the industry must contend with high labour costs.

It costs the processors between Dkr 25,000 and Dkr 40,000 (Cdn$5,300 - $8,500) to take on a new slaughterhouse worker (Stenbæk, 1995). The companies therefore use careful selection criteria. Employees at all levels in the company undergo constant retraining to ensure that they are kept up-to-date with new processing methods, hygiene standards, and product specifications.

[19]The ISO project was carried out cooperatively by the Steff-Houlberg Company, The Danish Meat Research Institute, and The National Committee for Pig Breeding, Health and Production (Hansen and Hansen, 1994).

[20]For example, average hourly wage rate for Canadian slaughterhouse workers is approximately $12.50.

Part of the competitive success of the Danish pork industry lies in its attention to quality and the ability to provide customers with a product tailored to their particular needs. One of the keys to this is having a skilled and flexible labour force. The Danish industry has at its disposal an extensive system of training for slaughterhouse workers. How did this emerge?

In the early 1960s the Danish slaughterhouses recognized the need for a skilled workforce because of the importance of meat exports to the industry (80 percent of production). Consequently, in 1964 they formed the Danish Meat Trade College (at Roskilde on the island of Zealand). The college has gained a worldwide reputation in meat education, from slaughtering and meat cutting skills to production of value-added meat products (sausages, canned meats, pies, etc.), retailing, catering and laboratory training in microbiological skills for supervisors and laboratory technicians. All Danish slaughterhouse workers take training courses. The Meat Trade College trains around 6,000 students per year - from those on full-time courses, to short training courses tailored to the needs of particular slaughterhouses.

Around 25 percent of slaughterhouse workers undergo a four year apprentice-ship through the college. Students are usually between 16 and 18 years old when they begin the apprenticeship. Apprentices must have a contract with a particular meat processor at least by the end of their first year. The training forms a mixture of college courses and on-the-job practical experience. The students attend the college for 40 weeks in total: an initial 20 weeks at the start of their apprenticeship, then in 5 week blocks in the remaining years of their training.

All students are required to take courses in basic safety and hygiene and are then divided according to their intended specializations within the plant. For example, some will train as specialist gut cleaners, others as pig or cattle slaughterers, others as sausage makers, and so on. Approximately 30 percent of students drop out of the training program. The costs of this apprenticeship training are met by the Danish Ministry of Education.

All apprentices undergo the basic education described above which enables them to become specialist slaughterers, meat cutters, etc. Further education courses are available to train employees to become line supervisors, laboratory technicians, etc. Higher education courses (taking 2 ½ years) train people to become food technicians, meat inspectors, supervisors, etc.

The Meat Trade College runs special short courses for particular slaughter-houses. These are used to train potential new workers who have not undergone the four year apprenticeship. The basic course for new workers lasts five weeks - then workers are trained to work in a particular area of the slaughterhouse. The cost of this training is paid by the

government. The workers receive unemployment benefit while undergoing the training and, provided that they pass the course, are offered a job by the company. The only cost to the processor is for the trainee's work clothes, the raw materials and the use of slaughtering facilities at the plant.

The College also runs periodic short courses at slaughterhouses to keep existing slaughterhouse employees up to date, particularly when the needs of the processors' customer base change, requiring a change in processing methods, or the imposition of new hygiene and quality control procedures.

The College maintains close links with the meat industry. Committees from the industry oversee the training courses to ensure that they meet employers' requirements. The College operates a training slaughterhouse at Roskilde (the only slaughterhouse in the world run solely for educational purposes). Here students learn to slaughter, debone and process carcasses to various standards, e.g., EU standards, US standards. The College maintains close contacts with the Danish Meat Research Institute (also at Roskilde) and often tests new technological developments at its training slaughterhouse. In this way, students are exposed to the very latest in meat processing technology. The College has an overall budget of Dkr 235 million (Cdn$57 million) (Jensen, 1995).

The Meat Trade College has an international department, which runs courses and carries out feasibility studies for meat processors in other countries. Some of these courses take place at the College's facilities in Roskilde, others are run on site in the foreign country so that they can be tailored to the specific needs of the company. Previous clients have included firms from Iceland, Norway, Sweden, Ireland, Japan, Uganda, Pakistan, Indonesia, Botswana, Thailand, China, Nepal, Korea, the Philippines, Venezuela, Ecuador, Russia, Estonia, Lithuania, Hungary, Poland, Bulgaria, Portugal, France and the UK. Of course, these courses also help keep the Danish industry informed about technical developments in Danish export markets.

Capital: There has been a significant structural change in hog production over the past 20 years. Average pig production per supplier has increased almost sevenfold from 110 to 700 hogs per year. As a result, many farmers are highly leveraged, resulting in high costs of capital. While this can be interpreted as a production disadvantage, making the industry vulnerable to interest rate fluctuations, it also acts as a "mirror" reflecting the confidence of producers and investors in the Danish hog industry.

The Danish processing sector has also undergone substantial structural change. The number of slaughter units has declined from 60 to 24 over the past two decades. The number of companies fell from 54 to 4 over the same period. Through this period of adjustment significant investments were made in

modernization[21]. For example, the Danish Pig Carcass Classification Centre is now used by all four slaughtering companies to automatically grade carcasses, in spite of the Cdn$2.9 million price tag for installing it. Highly automated systems of within-plant logistics are also costly.

These technical systems save labour costs and enhance efficiency, which may offset the initial high capital investment costs. Still, producing high quality, tailored-made products require Danish plants to operate at slower line speeds than many plants in their competitor countries. Hence, the throughput is lower and the per unit costs higher. The emphasis given to technical solutions has contributed to slaughterhouses being highly leveraged, having a 9 to 1 debt/equity ratio.

Animal Breeding Program: The structured system of hog breeding in Denmark is overseen by the National Committee for Pig Breeding, Health and Production. The Committee is set up by DS and the two of the major farmer unions (The Danish Farmers' Union and the Danish Family Farmers' Association). The activities of the Committee are funded mainly through levies on slaughter pigs and on the value of farm land, and through contributions from the founding organizations and public funds. Revenue through user service fees is increasing.

One of the Committee's activities is to register breeder and multiplier herds. Over 95 percent of breeder hogs are registered. The Danish hog breeding sector comprises approximately 170 breeding herds, which develop the genetic base of four purebred breeds: Danish Landrace, Yorkshire, Duroc, and Hampshire. Approximately 60 percent of these herds employ the Specific Pathogen Free (SPF) management system. Offspring from the breeder herds are sold to or placed in multiplying herds.

There are about 370 multiplying herds, of which 120 are owned by breeding herd owners. Multiplying herds are classified as purebred or crossbred. The majority are crossbred operations, representing 70 percent of the herds and over 90 percent of the sows. As with the breeding herds, around 75 percent of production is under SPF. Pigs produced by multiplier herds are then sold or transferred to commercial herds.

All breeding herds are performance tested, with an average of 5.5 pigs per litter being tested. This information is stored in the Pig Breeding Databank and is used to monitor inter-generational performance. The Committee also sponsors a number of projects to assess breeding and production traits of purebreds as well as crosses.

The registration and monitoring system provided by the Committee, along with its other activities, have been instrumental in the development of high quality and standardized pork products.

[21]For an overview of this evolution, see Madsen and Jensen (1994).

Especially the introduction of cross breeding has allowed for rapid growth in the number of pigs per sow (Walter-Jørgensen 1993). The earlier (until 1990) provision of a subsidy for the purchase of boars has been credited with helping to disseminate breed improvements (The National Committee for Pig Breeding, Health and Production 1990).

B.4.3 Demand Conditions

Characteristics of domestic demand (size, composition, rate of growth, etc.) can stimulate industry growth and innovation. In Denmark, with a population of only a few million people, domestic consumption is small in comparison to the quantity of pork produced. However, with pork consumption in Denmark as high as 60.8 kg per person per year, the role of domestic demand should not be underestimated[22].

The consumer price of pork in Denmark, as in the rest of the EU, is high as a result of market regulations under the CAP. In 1994 the price of pork tenderloin averaged Dkr 76/kg (Cdn$16/kg) and ground pork averaged Dkr 31/kg (Cdn$7/kg) (Danske Slagterier, 1995). About 60 percent of meat and meat products in Denmark are sold through supermarkets, other retail stores account for 35 percent and butchers for 5 percent.

For over forty years the Danish pig industry has exported the majority of its production, thus meeting the combined challenges of local and foreign demand. As an example of Denmark's ability to respond to emerging demand abroad, consider the situation in Korea.

Per capita consumption of pork in Korea was, for along time, about 8 kg per year but had almost doubled to 14.2 kg by 1995. From 1994, when Korea opened its market to some imports, Denmark's pork industry quickly mobilized and captured 77 percent of the trade. While its share declined to 35 percent in 1995, Danish pork is well established and is expected to be in a strong position for increased trade when Korea further liberalizes imports of pork, as committed under the GATT Agreement on Agriculture.

B.4.4 Sector Structure, Linkages and Strategies

Denmark does not appear to have a particular set of endowments that would provide a comparative advantage in hog and pork production. The continued success of the Danish hog and pork industry is expected to be related to its structure, achieving strategic linkages along the marketing chain through the cooperative approach.

The striking characteristic of the Danish hog and pork industry is its cooperative ownership structure. Cooperatives are prevalent throughout Danish agriculture but are the strongest in the pork and milk sectors. The cooperative movement

[22]The 60.8 kg per person per year figure (forecast for 1996) is low in relation to the peak of 75.8 observed in 1993. The per capita consumption of pork in Denmark is higher than in any other country in the EU (average for the EU is 40.8 kg per person per year) and indeed in the world. Source: USDA (1996).

began in Denmark in the late nineteenth century. The first cooperative slaughterhouse was established in 1897. By 1903 there were 27 cooperative slaughterhouses in the meat sector, with 65,824 farmer members. This can be compared to 15 privately owned slaughterhouses in operation across the country at the time.

The cooperative sector has undergone considerable rationalization of its structure. By 1994 about 97 percent of total throughput in the industry was channelled through just four large meat processing cooperatives, owned by around 26,000 members and operating 24 plants.

The cooperatives have a processing, distribution and marketing function only. Farmers do not farm cooperatively - most farms are family farms. Farmers own a share in one of the meat cooperatives and are required to supply all of their pigs to the cooperative of which they are a member. The cooperative is obliged to accept all of the farmers' pigs.

Denmark does not have a specific cooperative law. All cooperatives are bound by the general tax, labour market and environmental laws that govern other businesses. The cooperative principles followed by the Danish industry are similar to those followed by cooperatives in other countries. Voting rights are not determined by the size of each farmer's throughput but on the one-person, one-vote principle. Membership is voluntary and open.

Farmers are not required to join a cooperative, nor can they be prevented from joining. Once farmers have joined a particular cooperative, however, they are bound to that cooperative for two or three years, after which time they may apply to join one of the other cooperatives instead. Members each invest a limited sum of capital in the cooperative but only receive nominal interest payments on this capital. Any profit made by the cooperative is distributed among members in proportion to the size of the farmer's sales to the cooperative. The rates for these distributed profits are the primary means by which the cooperatives compete with one another for members.

All agricultural cooperatives in Denmark belong to the Federation of Danish Cooperatives: a lobbying arm for agricultural cooperatives with the various levels of government on issues such as taxation, legislation, and regulations. The Federation also provides information to individual cooperatives on a range of factors from pricing policies and procedural issues to financing.

The most significant industry-wide actor in the Danish pork sector is The Federation of Danish Pig Producers and Slaughterhouses, i. e., "Danske Slagterier" (DS). It is an umbrella organization encompassing all of the Danish pork cooperatives[23]. DS fulfils a number of

[23]The primary members of DS are the four slaughterhouse companies: Danish Crown, Vestjyske, Steff-Houlberg, and Tican. Secondary members include sales and meat processing companies (ESS-FOOD, DAT-Schaub, Tulip International, DAK A/S and 3-Stjernet Salami) and (continued...)

roles, including representing the pork industry in consultations and negotiations with outside bodies, formulating industry-wide strategies, developing new products and services for its producers and encouraging close cooperation among all stages of the pig production and marketing chain.

DS is run by a fourteen member board of directors. Each of the four cooperatives has at least one member of the board, with its total number of members determined by the proportion of industry throughput accounted for by the cooperative. Others members represent companies involved in meat processing, exporting, and other activities related to the pork industry (although several of these are themselves owned by the four cooperatives). In addition, two members are drawn from Denmark's two large agricultural unions. All segments of the hog and pork industry are therefore represented by DS.

DS plays a pivotal role in coordinating advances in production and processing technology, market research, and training for the pork sector. Its close links with all sectors of the pig marketing chain mean that DS stays extremely well informed about developments within the chain and can respond quickly to changes in the production and marketing environment. Furthermore, because DS represents many stages of the pig marketing chain, adversarial relationships between buyer and seller, which are common in the marketing chains of meat industries in many other countries, appear to be largely absent. Instead, DS fosters a cooperative spirit permeating the whole Danish pork industry[24].

DS obtains funding from three main sources: slaughter levies on pigs and cattle, levies on the value of farm land[25] and contributions from member companies. Its main activities are: sales promotion on home and export markets (30 percent of expenditure), breeding and production research (28 percent), veterinary services to slaughterhouses (10 percent), and meat quality control and training (7 percent of expenditure).

DS plays a central role in marketing and trade policy relations and in the collection and dissemination of information on the Danish pork sector abroad and at home. Export promotion in the United Kingdom is targeted at retailers and the final consumer. In Germany, DS targets the processing industry and retailers, emphasizing the quality guarantee to which the industry as a whole is committed. The same segments are targeted in Japan, in addition to which increased consumer awareness of the

(...continued)
others (SFK, Hudecentralen, etc.).

[24]The role of DS as a representative of the whole Danish pig industry is not absolute. The National Association of Danish Hog Producers (Landsforeningen af Danske Svineproducenter) is reported to organize about 20 percent of Denmark's hog producers, including producers who are also members of DS (Svensson 1992). The National Association has proposed a number of changes in the structure and conduct of DS, focussing on some of the weaknesses of this large, all-encompassing organization.

[25]In the early 1990s the levy on the value of farm land (or area levy) was imposed at rates approaching 0.5 percent of the land value.

Danish origin of pork products is promoted.

DS operates the Danish Meat Research Institute (DMRI). Founded in 1954, its objective has been to promote the competitiveness of the Danish meat industry through joint research and development, technology transfer and consulting activities (Danish Meat Research Institute, no date). The total annual budget (1994) of the DMRI is approximately Cdn$25 million. Forty-five percent is financed by a pig slaughter levy, five percent from cattle slaughter and 50 percent from own earnings, government grants and licences.

Owned and financed by the industry, DMRI's work is guided by a number of industry advisory committees. This close relationship ensures that the DMRI has a practical aim. Key programming areas include pig health, meat quality, pig and beef carcass classification, animal welfare, meat processing technology, refrigeration technology and production management (Danish Meat Research Institute, 1994).

The work of the Quality and Food Legislation Department of DS is another example of how industry strives to maintain and improve food quality and hygiene standards. A Quality Committee coordinates activities aimed at improving quality in all stages in the production, processing and distribution chain, from pig breeding through to meat inspection and product development. Along with DS staff and scientists, the managing directors of the four cooperatives also sit on the Quality Committee. The committee oversees an ongoing quality improvement program that has six main aspects: (1) carcass-related parameters; (2) food safety; (3) reduction of residues; (4) biotechnical issues; (5) quality assurance and; (6) nutrition.

Ongoing research targets seven main areas related to carcass improvements. These are lean meat content, carcass weight, Pale-Soft-Exudative (PSE) meat, colour, pH levels, intramuscular fat and taste/tenderness. For example, ongoing research aims to increase the average lean meat content in Danish hogs. The quality committee has set 61 percent as the optimum, with a goal of reaching 60.5 percent by 1998 (Larsen, 1995). The average in 1995 was 59 percent. The improvement is to be achieved through scientific breeding (DS controls 95 percent of pig breeding in Denmark) and using the payment system, which rewards lean meat content. The benefits of increased lean meat content are reduced trimming of cuts. For example, the Japanese market requires a maximum of 3 mm of fat on pork cuts. Cuts with excess fat fetch a much lower price or require trimming.

Considerable effort has been devoted to reducing occurrence of PSE in Danish pork products. This is partly due to the need to satisfy the requirements of the Japanese market. Japanese buyers are particularly sensitive to problems of PSE as it lowers the quality of the finished processed product. Danish processors supplying Japan often have a representative of the Japanese importer

stationed in the cutting plant checking, among other things, for PSE meat.

The problem of PSE pork has been reduced by removing the stress sensitive gene from the breeding stock. The industry also improved the conditions under which pigs are transported. Ninety-five percent of all pigs are slaughtered within three hours of being transported to the slaughterhouse. The farmer must notify the slaughterhouse four days before the pigs are ready to be slaughtered. The pigs are taken off feed at least twelve hours before being slaughtered.

The Danish industry recognizes that different markets may require products with different coloured pigmentation. Japan prefers pinker (or redder) pork while many other markets, such as the US, prefer paler pork. Research aimed at finding a method of objectively measuring meat colour is being undertaken. The DS breeding program may then try to breed for different coloured carcasses; currently, processors simply sort carcasses by colour if needed.

Different markets also require different pH levels in their pork products since pH affects the taste of the meat. Higher pH levels are particularly important in the French market for cooked hams. Regulations prevent processors from using phosphate in production, which makes the meat pH level more important. The Japanese market also requires relatively high pH levels (over 5.6 pH). The pH level is determined by the degree of sugar present in the muscle, which, in turn, is related to glycogen. Genetic research is being undertaken to influence this aspect of meat quality.

The taste and tenderness of pork is influenced by the breed, the carcass weight and the method used to cool and mature carcasses. This is particularly important for the domestic Danish and the German market. Improvements in processing practices have given slaughterhouses more control over this aspect of meat quality. This extends to such areas as mastering the problem of boar taint associated with non-castrated male hogs.

The second major area of quality control and research is in the area of food safety. In early 1995, DS began a salmonella testing program across the industry. This was, in part, a reaction to more stringent Danish food safety legislation and, in part, an industry initiative to improve quality. The program involves monitoring all herds with more than 100 slaughter pigs; 5 percent of throughput from these herds is tested for micro-biological pathogens. If a problem is detected, the farmer must consult a veterinarian and devise a plan to rid the farm of the salmonella contamination. Farmers face a fine if they refuse.

All pigs from salmonella herds are slaughtered separately from other pigs at the end of a day's slaughtering. Since salmonella occurs in the intestine, these are removed intact so that the rest of the line is not contaminated. End products

are also tested for traces of salmonella. In the first four months of the program, 840,000 samples were taken. The incidence of salmonella has now dropped to 0.7 percent. Danish pig slaughter plants operate at far slower speeds than is the case in many other countries: 360 carcasses per hour on average, compared with 1,000 per hour in many US plants. This facilitates microbiological testing and reduces food safety problems.

The Danish industry operates a residue testing program. This is particularly important for its Japanese markets. Products are tested for antibiotics and chemotherapeutics, growth promoting hormones, pesticides, heavy metal residues and mycotoxins. Only traces of antibiotic residues have been detected in Danish products in the past ten years. Approximately 0.1 percent of all slaughtered pigs are sampled at random for traces of residues.

Farmers who infringe regulations and send animals for slaughter that have been exposed to any of the above substances face fines. There was an increase in antibiotic levels in 1993, with the result that some farmers were penalized. In the first half of 1995, there had been no positive results from the residue testing.

Farm animal welfare has become more of a concern among Danish consumers in recent years. Consumers are increasingly scrutinizing the rearing conditions of pigs on farms (in such terms as weaning age, space per pig, and access to water) and during transport between farms or to slaughter (see, for example, Gade et al., 1994). Farm animal welfare is a major and increasing concern in some export markets (e.g., the UK). The industry is responding with plans to introduce a national farm animal welfare scheme to satisfy consumer concerns that might arise in domestic or export markets.

Traceability of animals and products is also becoming more important in the hog and pork industry. Food retailers in Europe are increasingly demanding information from wholesalers/processors about the practices used to produce and process the products they sell. In some countries, such as the United Kingdom, this interest is tied to the legal responsibility placed on food retailers (Hobbs and Kerr, 1991). Vertical integration facilitates the satisfaction of such information requirements.

Vertical coordination through DS has strengthened the linkages between all points along the marketing chain, enhancing market signals from consumer to producer and all points in between. It has also perhaps reduced destructive competition in international markets - where Danish firms once competed, they now supply a market cooperatively.

B.4.5 Government Policies

Environmental Legislation: In Denmark, pig stocks are evenly spread across the country and in many cases are part of mixed farming operations, which allows for a significant proportion of the animal effluent to be disposed of on arable land and grassland. As a result, the costs of

complying with effluent disposal and other environmental rules are significantly less in Denmark than in some other countries of the EU. Nonetheless, the Danish government, as other Nordic governments, is keen to limit the extent to which agriculture can damage the environment.

The most significant piece of agro-environmental legislation in Denmark has been the 1987 Aquatic Environment Program. This legislation was introduced to prevent the contamination of water courses and ground water by agricultural activity. The objective of the legislation was the elimination of run-off from livestock units, and to reduce the levels of nitrogen leaching by at least 50 percent. The effectiveness of environmental regulations is considered low, as many of the environmental problems persist. Farmer organizations therefore anticipate a gradual tightening of the rules.

The legislation forces farmers with more than 30 livestock units (i.e., 90 hogs) to have a minimum of at least nine months' storage capacity for animal manure effluent, and imposes fertilizer application management plans on all farms larger than 10 hectares. The plan must state the crop nutrient needs and outline how these needs will be met using manure and inorganic fertilizers. In addition, 65 percent of farm land must be sown to a green cover crop in the autumn.

An estimate of nitrogen utilization from manure must be made. This nitrogen utilization is the percent of nitrogen available to crops after losses during storage and land application. After 1997, a minimum of 50 percent of the nitrogen in pig manure must be available for the following year's crop utilization. The minimum nitrogen utilization for other livestock are: cattle 45 percent, deep litter systems 15 percent, and other types of manure 40 percent.

By December 31 of every year, a fertilizer balance sheet must be prepared for every farm. The balance sheet must state the nitrogen needs and intended consumption of nitrogen manure and inorganic fertilizers on the farm. Subsidies are paid (up to 30 percent) to cover some of the costs associated in meeting the stringent conditions of the legislation, which nevertheless imposes significant costs on Danish hog producers.

Other requirements for manure storage entail: 1) a minimum five year written contract if the storage capacity is achieved by utilizing storage on other farms or in biogas plants; 2) starting in 1997, manure storage containers must be checked every 10 years for strength and tightness; and, 3) a setback of 15 metres must be maintained from watercourses, public roads and property lines.

Veterinary Inspection: Denmark devotes considerable resources to veterinary inspection. The high veterinary standard thus obtained is one of the reasons why Danish animal products can be exported to so many countries world-wide. Every

slaughtering plant has state employed veterinarian inspectors and veterinarian supervisors, present at all times, to inspect and analyse all slaughtered pigs for disease and abnormalities, and to ensure slaughtering hygiene.

It is unclear how much of Denmark's veterinary budget is allocated to pig production and processing and to what extent any government costs are recovered from industry.

Land Tenure and Stewardship: As of 1995, a producer with over 500 livestock units (1,500 hogs) must own all the land required for manure incorporation. Operations under 500 livestock units are tied to private land ownership on a sliding scale. The industry expects to experience increased competition from countries not bound by the same level of environmental and animal welfare measures. To ensure there is sufficient land available to utilize the nitrogen from manure, a "Harmonization Rule" stipulates the area of land required for livestock farms. Farmers who do not have enough land of their own must have written agreements with other farms or biogas plants.

Investment Support: Government supports farm investment in pork production within rules laid down by the European Union. Investment support can be granted under the condition that the production capacity of the farm does not increase. The farm operation itself must be capable of supplying at least 35 percent of its total feed requirements after the investment. The total investment that is eligible for support must not exceed ECU 90,000 per yearly worker or ECU 180,000 per farm (roughly Cdn$160,000 and Cdn$320,000, respectively). Support can usually be provided to a maximum of 35 percent of the cost of building investments and 20 percent for other investments. A 25 percent share of this support is funded by the European Commission, with the remaining funds being provided by the national government.

In Denmark, the investment support is paid out in portions over a seven or ten year period (i. e., not as a lump sum), with adjustments being made for the time value of money. This means that the farmer's cash flow is supported by government payments amounting to several percent of the original investment cost.

Young farmers also benefit from an additional investment support, in the form of a lump sum payment of 25 percent of the original amount of investment support. The government also guarantees the loan that a newly starting farmer takes for investment purposes.

Research and Development: The Ministry of Agriculture and Fisheries provides about two-thirds of the funding for publicly funded agricultural research, partly by means of operating research institutes attached to the Ministry (Danish Council for Research Policy, 1992). The Ministry of Education and Research provides the rest, mainly as funding for the Royal

Veterinary and Agricultural University and the Danish Agricultural and Veterinary Research Council.

The Ministry of Agriculture and Fisheries has contributed to industry development primarily through two instruments: the product development regulation (*Produktudviklingsordningen*) and the food technology research and development program (*Fødevareteknologiske Forsknings- og Udviklingsprogram - FØTEK).* The product development regulation aims to promote the production and marketing of quality food, while FØTEK seeks to strengthen and develop the position of the Danish food industry in the Danish and international market.

The product development regulation contributes to the improvement of products and processes as well as to market analyses, marketing strategies and test marketing. Funds are directed at product and process development in primary agriculture, secondary processing, and at industrial suppliers and R&D institutes. Public funds usually cover up to 40 percent of the cost of a development project.

The Ministry emphasizes support to market development and marketing. The priority is on branding strategies, aiming to increase the share of Danish food products with a branded status in order to reduce the sensitivity to price when selling to further processing and in retail. The Ministry has agreements with two marketing consulting firms, whose expertise is made available to firms and industry associations.

FØTEK was first established in 1990, funded by the ministries of Agriculture and Fisheries, Research, and Industry and Commerce. Since 1994, the Education ministry also participates. The program supports projects that increase the Danish food industry's utilization of domestic and foreign research results, and that increase the cooperation between research and business and between the parts of the food value-chain. Other priorities are to give business a more international orientation and to lay the groundwork for Danish participation in the EU research and development programs in the food industry.

Over the period 1988-94, a total of Dkr 156 (Cdn$33) million of government funds was spent on the pork industry under the product development regulation, with an additional Dkr 16 (Cdn$3.4) million spent on the hog industry (Landbrugs- og Fiskeriministeriet 1995a). From 1991 to 1994, FØTEK spent a further Dkr 40 (Cdn$9) million. The yearly average expenditure under these two programs together was thus about Dkr 30 (Cdn$6) million per year. Total spending, however, has been increasing. In 1993, FØTEK spent Dkr 32 million (Cdn$7 million), and product development programs spent Dkr 15 million (Cdn$3 million) on primary agriculture and as much as Dkr 154 million (Cdn$33 million) on secondary processing.

The spending under the product development regulation at the farm level was mainly directed at developing systems both in pure-bred and production herds in order to reduce the prevalence of salmonella. Support at the processing level is increasingly directed at adapting its raw materials to the requirements of the market in such areas as meat quality, hygiene, animal welfare, and the environment.

Pork support from FØTEK tends to be channelled to the Danish Meat Research Institute. Also, the product development regulation supports work in cooperation with the Institute. Such work includes collecting, organizing and disseminating market information on major customer countries, and promoting and facilitating the use by slaughterhouse companies of market information in product development and marketing. Other projects seek to put in place methods to control salmonella in breeding herds, and develop quicker methods to analyze meat for contents of residuals. A particularly market-driven project is one that will enable Danish slaughterhouses to give guarantees about the absence of boar taint in pork.

Future priorities for the allocation of public funds in the Danish hog and pork industry are those that continue to sustain the evolution towards an industry that competes more on the basis of the attributes of its products than on their low price.

Export Promotion and Export Credit: The Ministry of Agriculture and Fisheries participates with the Ministry of Industry and Commerce, the Foreign Ministry and the industry in the setting of priorities for export promoting activities. Such activities include the placement of food export experts abroad. It has been observed that agriculture and food accounts for only 17 percent of the total export promotion support provided to all Danish industry (Landbrugs- og Fiskeriministeriet 1995a).

The Ministry of Agriculture and Fisheries operates a corps of agriculture and food trade experts placed in embassies around the world (about 12 people). The Foreign Ministry also has agriculture and food experts in some capitals. Danish experts thus report continuously to the Ministry and agriculture and food organizations on market developments abroad, and they provide service to individual companies by carrying out market surveys or gathering specific information on import requirements. In most cases the companies benefiting from this service also pay for it.

The Ministry of Agriculture and Fisheries ensures that ongoing training of new experts is carried out. One means of doing so is to place trainees in positions around the world for 6 - 12 months during their university studies. Trainees pay their own costs for such placements and are required to prepare a report, such as a market analysis.

The Danish Export Credit Council operates two main programs to support exporters. It offers exporters a guarantee against losses on foreign export revenue, arising, for example, when the foreign buyer becomes insolvent or when political turmoil in the importing country prevents collection of the amount owing. Exporters pay a fee for this guarantee and have to accept a part (such as 10 percent) of the risk of loss. The Export Credit Council also guarantees loans to Danish producers/exporters for the purpose of undertaking an export activity. This guarantee makes it easier for the producer or exporter to obtain a loan from suppliers of credit who would otherwise charge a larger risk premium for the funds.

Education: Denmark puts a priority on the education and training of agricultural entrepreneurs and their workforce. This emphasis is perhaps unparalleled elsewhere. The cost of these intensive training programs are borne by the government. Most students receive wages from the employer with whom they are obtaining practical experience. The employer is reimbursed the cost of the wages from an "Employers Reimbursement Fund" to which all employers contribute. Students completing the farm management level "green certificate" course, and those who are not paid by employers, receive government educational support.

Government funding of education and training for the private sector is a recurrent theme throughout the Danish pork supply chain. The Danish industry obtains a skilled and educated labour force at little cost to the private sector. This enhances the ability of the industry as a whole to respond to changing market conditions since farmers may more easily adapt their production methods to changing market signals.

Advisory services: The Danish Agricultural Advisory Service is organized and directed by farmers' organizations (the Federation of Danish Farmers' Unions and the Danish Family Farmers' Association). Local advisors are employed by local farmer unions and give advice directly to farmers. National specialists are employed by the Danish Agricultural Advisory Centre to give advice to the local advisors.

Funding for advisory services comes mainly from fees for cost recoverable services (about three-quarters of total funding), with the rest being funded by government grants and part of farmers' membership fees in the local farmers' union. Cost recoverable services include accounting and business analysis, livestock management packages, and feed ration formulation. The Ministry of Agriculture and Fisheries lays down overall rules and expectations for the operation of the advisory service, but the farmers' organizations are responsible for program planning and implementation.

B.5 Summary

Denmark has one of the most integrated and coordinated structures in the world for production and marketing of hogs

and pork. This has been accomplished chiefly through the slaughter cooperatives and the development of DS. Apart from market regulation under the EU CAP (which is less pervasive for hogs and pork than for many other commodities), government involvement in the industry takes the form mainly of research, education, and inspection as well as enabling legislation for industry associations to collect production levies and regulate themselves.

SECTION C: THE DUTCH HOG AND PORK INDUSTRY

C.1 Introduction

This section describes the structure and development of the Dutch pork industry. This is followed by an examination of the Netherlands' performance in EU and world markets, and the industry is examined from a competitiveness perspective.

C.2 Industry Structure and Linkages

C.2.1 Hog Farming

Farm land makes up 60 percent of the total area of the Netherlands. Farm land consists of 6 percent horticultural land, 41 percent arable land, and 53 percent grassland. Hog production is mainly located in the eastern and southern portions of the country, with 64 percent taking place in two provinces: Noord-Brabant and Gelderland (PVVE, 1995a).

Over the period 1980 to 1995, the number of pigs for fattening on farms in the Netherlands increased by 17 percent, while the number of piglets on farms almost doubled. However, from about 1990 the number of pigs for fattening on farms has stabilized at more than 7 million. This stagnation in hog production is mainly due to environmental constraints having to do with the disposal of manure.

The structural rationalization of hog production has been considerable, with a 45 percent decrease in the number of pig farms between 1980 and 1994. There were 24,700 farrowing operations in 1980, declining to 10,500 by 1994. Finishing operations declined at a slower rate from 28,600 to 21,100 over the same period. The decline in number of farrow-to-finish operations was less pronounced, from 9,500 to 7,500 farms (PVVE, 1995a).

The average number of pigs per farm thus increased from 235 in 1980 to 586 in 1995. About half of the farrow-weaner operations now have more than 100 sows, and one fifth have more than 200 sows, accounting for over 80 percent of all breeding sows. One fifth of the finishing farms have inventories exceeding 500 pigs (PVVE, 1995a).

Concentration at the farm level is stimulated by livestock health regulations. To limit health risks, the government promotes the formation of farrow-finish farms. Currently, finishing operations are allowed to obtain pigs from a maximum of three source (farrowing) farms. New regulations will reduce this to two. Consequently, the demand for larger numbers of piglets from each farrowing farm will increase. Smaller farrowing farms, with fewer than 80-100 sows, will have more difficulty finding buyers for piglets. If unable to expand their output, these producers may be inclined to fatten their own piglets;

that is, become farrow-finish operators (Agra Europe, 1994).

As in other European hog producing countries, productivity in piglet production in the Netherlands has increased significantly. By 1993 weaned piglets per sow per year reached 21.5, and farrowings per sow per year reached 2.25.

C.2.2 Hog Marketing

Dutch market hogs follow two marketing channels: (1) direct sales from producers to slaughterhouses and (2) sales to livestock traders who, in turn, market them to domestic and foreign slaughter-houses. Approximately 85 percent of the Dutch supply of slaughter hogs is slaughtered in the Netherlands, the remainder being shipped live for export. Livestock traders export weaners, primarily to Belgium, Spain and Italy.

A large part of hog production in the Netherlands takes place under a variety of contract arrangements. Feed compounders, breeding companies, and slaughterhouses are involved in prod-uction contracts with farmers (Hughes et al., 1993).

Cooperative feed manufacturers operate hog price stabilization schemes for their members. Based on the difference (negative or positive) between an established base price and the current price of hogs, participant producers either pay into or draw from their individual account under the fund. There does not appear to be any government funding involved in this scheme.

The number of livestock dealers was about 600 in 1995 (having declined from 3,000 in 1970). About half of the dealers specialize in weaners and live hogs. About 80 percent of the animals exported by specialized exporting companies were collected by domestic livestock dealers.

With the introduction of the IKB quality control scheme (see section on Sector Structure, Linkages and Strategies below), the roles and responsibilities of pig dealers are changing. More deals are struck on a commission basis and fewer on the dealer's own account. Dealers are also taking on additional functions, such as advising pig producers and planning supplies to slaughterhouses and live pig exporters.

The number of live pig exporting companies in the Netherlands was about 80 in 1995. Half of these companies exported more than 10,000 hogs each per year, accounting for more than 90 percent of live hog exports. The average number of hogs exported live per company was 62,000. Nine companies were large enough to export more than 100,000 live hogs, with the average per company reaching 170,000 hogs.

C.2.3 Slaughter Industry

Slaughtering in the hog sector increased by more than 40 percent between 1980 and 1995. It appears to have settled somewhat below 20 million hogs per year (after peaking in 1993 at 20.3 million hogs). Most slaughterhouses are located within the eastern and southern regions of the country, where hog production is

Table 13: Number of Hog Slaughtering Plants in the Netherlands, 1994-1995

Size of Plant (number of hogs slaughtered per year)	Number of Plants at End of Year	
	1994	1995
100,000 - 300,000	6	5
300,000 - 500,000	7	3
500,000 - 600,000	4	3
More than 600,00	13	12
Total	**30**	**23**

Source: PVVE 1995a, van Dongen 1996.

concentrated. Almost all slaughterhouses are "EU approved", allowing them to sell their products elsewhere in the EU. The five largest slaughterhouses handle 65 percent of the total slaughter.

At the end of 1994, the hog slaughter industry comprised 30 large slaughter-houses, each killing more than 100,000 hogs annually (Table 13). By the end of 1995, the number of such slaughter-houses had fallen to 23[26]. The decline in number of plants affected all sizes: even the large plants killing more than 600,000 hogs per year dropped from 13 to 12. The seven plants that were closed between 1994 and 1995 represented 3.6 million hog slaughterings per year.

In the late 1980s, it was recognized that the Netherlands faced significant over-capacity in hog slaughtering. The slaughter industry and the Product Board for Livestock and Meat (PVV) therefore started a restructuring plan in 1989, aiming to reduce the overcapacity. In 1990 hog slaughter capacity in the Netherlands amounted to 480,000 slaughter hooks for a 40 hour work week[27]. By the end of 1993 capacity had dropped to 440,000 - an eight percent decline over three years.

In 1994, the structural overcapacity in the hog slaughter sector was still estimated at 80,000 per week, i.e., eliminating the overcapacity would require a capacity reduction of close to 20 percent. A new, more ambitious, restructuring plan was introduced by the slaughter industry and PVV in concert in 1995. The plan involved the creation of a restructuring fund, used to buy out hog slaughter

[26]It is interesting to compare this concentration indicator with similar indicators for Denmark. In Denmark, with roughly the same number of slaughterings per year as the Netherlands, all slaughtering is done by 24 slaughterhouses.

[27]It is not quite clear how this capacity measure translates into other measures, such as number of kills per year. However, the slaughter hook per week capacity measure serves to compare capacity over time.

facilities on a voluntary basis[28]. This fund would have access to a total of Gld 113 million over five years.

The restructuring fund obtains financing from banks for the purchase of slaughtering facilities. Amortization and interest are funded by means of a levy of Gld 1.5 (Cdn$1.11) per hog slaughtered[29]. This levy is imposed under the authority of the PVV, which has taxing powers delegated to it by the government. The levy is not intended to be passed on directly to hog producers, but to be sourced in the revenue of the slaughterhouse (the thinking is that the restructuring is of direct benefit to slaughter industry and this industry should therefore shoulder the cost). Small slaughterhouses are exempt from the levy on up to 50,000 hogs per year. No direct government expenditures are channelled to the restructuring fund.

The restructuring fund operates by considering a secret offer from a slaughterhouse owner to sell an operating plant. The fund estimates the value of the plant (building and equipment, etc.) if it was not in operation. The difference between the offered price and the residual value is paid to the owner, who closes down the plant. In practice, plant buyouts of this nature have been particularly effective when carried out in combination with company mergers.

C.2.4 Meat Cutting and Processing Industry

In the Netherlands (as in some other countries in Europe) a separate meat-cutting or deboning industry handles part of the processing of primal carcasses. Much of the Dutch deboning industry has the same owners as the slaughter industry. However, a number of independent deboning facilities also exist that are not connected to the slaughter industry either by location or by ownership.

Carcasses are exported whole or after being cut up at the slaughterhouses. Carcasses are also processed by the specialized meat cutters or deboning operators before being exported. Domestically, slaughterhouses and meat cutters sell to both meat wholesalers and large-scale retail trade. There are approximately 650 meat wholesalers: 300 who specialize exclusively in meat and 350 who deal in other products as well.

Meat cutters and slaughterhouses also sell a significant amount of meat to further processors of meat. Ninety percent of the raw material of processed and preserved meat is pork. The total industrial production of processed and preserved meat, including bacon, is approximately 400,000 tonnes per year, using about 10 percent of the pork

[28] Stichting Saneringsfonds Varkensslachtsector (SSV) or Foundation for the Structural Adjustment Fund in the Hog Slaughter Sector. Similar initiatives were taken to reduce cattle slaughter capacity by almost one third.

[29] Various calculations can be made to relate the Gld 113 million to hogs slaughtered (say, 20 million per year), Gld1.5 per hog, and number of years (say, 5). These assumptions would yield a total of Gld 150 million. It has been suggested that while the cost of purchasing slaughter facilities may amount to Gld 113 million, a larger amount is needed to cover interest and other costs.

produced in the Netherlands. Of the total production, 260,000 tonnes are exported. A further 30,000 tonnes of processed meat is produced by butcher shops, mainly for home consumption.

Domestic retail trade consists of approximately 5,500 sales outlets. By far the largest proportion of these are businesses with just one store (4,500). These companies can be butcher shops as well as small supermarkets.

Until 1995, most of the larger slaughter-houses for pigs were owned by one of six umbrella organizations, two of which were cooperatives. As a result of mergers in 1995, the ownership structure changed significantly (Agra Europe 1995). Two large farmer cooperatives (Coveco and Encebe) merged with the private company, Gupa, to form Dumeco. Dumeco is reportedly handling 5.7 million hogs per year, which would represent a decline in capacity (likely resulting from taking some facilities out of production). Coveco and Encebe each runs two slaughterhouses. Gupa operates one slaughterhouse. In addition to slaughterhouses, the new group Dumeco has several processing facilities.
The owners of Dumeco include, in addition to the two cooperatives Coveco and Encebe, a cooperative of crop producers and a farmers' interest organ-ization. Coveco and Encebe consist not only of hog farmers. Coveco has 10,000 members, of whom 5,000 are hog farmers. Encebe is twice as large, with 20,000 members, of whom 7,000 are hog farmers. Thus, the ownership structure is quite mixed, combining private interests with interests representing both hog farmers and the farm sector more generally.

C.2.5 Grading and Inspection

The Product Board for Livestock and Meat (PVV) governs the slaughter and weighing of meat pigs, providing a standardized, objective evaluation method. Regulations are in place to ensure that pigs are slaughtered properly and producers are paid appropriately. These regulations are applied on behalf of the PVV by the independent Central Bureau of Slaughter Stock-Services (CBS)[30]. The CBS is overseen by the Commission of Quality Control Classification (CKC)[31], a commission of the Government.

Uniform slaughtering and weighing standards are applied at all slaughter-houses that process more than 1,500 animals a year. The carcasses are classified by CBS according to their lean meat percentage and condition. The fat/lean ratio is determined with Hennessey-Europe equipment in all Dutch slaughterhouses.

The origin of every animal can be traced by means of the identification number on its ear. The results of the classification determine the final price of more than 95 percent of all classified carcasses. Hog carcass weights in the Netherlands are

[30]Stichting Centraal Bureau Diensten aan Slachtdieren (CBS).

[31]Commissie Kwaliteitsbewaking Classificatie (CKC).

about 84 kg. This is significantly higher than in Denmark and close to the average for the EU (European Commission, 1994, Table 4.16.1.1).

Each firm in the processed meat and bacon industry is subject to strict health and quality regulations. The Government Agency for the Inspection of Livestock and Meat (RVV)[32] inspects each animal upon arrival at slaughtering sites, as well as along the processing lines. The RVV is responsible for assuring the wholesomeness of meat and meat products. Inspectors from the Veterinary Inspection of the Ministry of Welfare, Public Health and Culture are also involved.

Over the years, the trade and industry have added specific controlling agencies on their own initiative. This is to ensure the product quality required at the destination of the processed products. One agency, the Dutch Processed Meat Control[33], is responsible for these quality control activities. Quality mark bacon production (such as Royal Crest) is subject to additional quality standards. Maintenance of quality standards in bacon production is supervised by the Foundation for Dutch Bacon Control[34].

C.2.6 Product Market/Exports

Approximately 75 percent of Dutch pig production is exported, in the form of live weaners, live market hogs and fresh and processed pork. Ten percent of the supply of weaners and twelve percent of market hogs are exported live to European countries. In 1994 the values of live weaner and hog exports were Gld 212 million (Cdn$157 million) and Gld 880 million (Cdn$652 million), respectively (PVV 1995b). The value of live exports (weaners and hogs) corresponded to about 18 percent of the total value of exports from the hog/pork sector (weaners, hogs, fresh and processed pork).

Piglets are exported mainly to Belgium, Spain, and Italy, with Germany taking less than 10 percent of exports. Two-thirds of live hog exports are destined to Germany, with smaller shares going to Italy and France. The Netherlands supplies uniform quality swine and can fill international orders immediately. The Dutch Livestock Exporting Board (BNV), the Sector Board for Livestock Trading, the Dutch Association of Livestock Traders, and a number of private organizations (traders) are all involved in the promotion and export of live hogs.

Over 65 percent or 1.3 million tonnes of the Netherlands' pork production is exported. In 1994 the value of exports amounted to Gld 3.8 billion (Cdn$3.1 billion) as fresh/frozen pork, Gld 434 (Cdn$360) as pork products, and Gld 465 million (Cdn$390) as bacon[35] (PVV 1995b). Over 99 percent of the Netherlands' fresh/frozen pork is sold in Europe, with 68 percent going to Germany and Italy. For processed products (including bacon), shipments to

[32]Rijksdienst voor de Keuring van Vee en Vlees (RVV).

[33]Nederlandse Vleeswaren Kontrole.

[34]Stichting Nederlandse Baconcontrole.

[35]Bacon is often shown separate from other pork or pigmeat products in Dutch statistics.

the United Kingdom represent about 89 percent of exports (FAO (1996)) and U.N. Commodity Trade Statistics (various years).

The Netherlands is a premier bacon producing country, with fifteen companies producing more than 1,000 tonnes of bacon annually. Four have production in excess of 7,000 tonnes. Close to 90 percent of the entire bacon production is exported. In 1994 exports of bacon amounted to 90,000 tonnes (PVVE, 1995a). About 93 percent of exports go to the United Kingdom under the quality mark Royal Crest, representing approximately a 25 percent UK market share.

C.3 Industry Performance Measures

C.3.1 Growth in Production

Worldwide pork production has increased annually at a 2.5 percent rate over the past two decades (1973-93). In the Netherlands, pork production has increased at 3.8 percent annually over the same period. This has resulted in annual production almost doubling from 812,000 tonnes to 1,570,000 tonnes over the 20-year period. This growth occurred fairly evenly over the period, reaching a maximum output in 1990. Production has declined slightly since (USDA, 1995).

Production in Europe (excluding the Netherlands) increased as well, but at a slower rate. As a result, the Netherlands' share of European production has expanded from 5.2 to 7.6 percent.

C.3.2 Growth in Exports

World pork trade has expanded over the past twenty years from 2 million to 4.8 million tonnes per year, an average annual growth rate of 6.9 percent. Exports from the Netherlands show a similar annual growth rate of 6.5 percent. Dutch exports increased steadily until 1987. However, since then, growth has been practically nil (USDA, 1995).

The Netherlands' share of world pork trade has oscillated between 21 and 24 percent. With the recent stagnation in pork exports from the Netherlands, its market share has dipped below 21 percent.

C.3.3 Growth in Competition

The Netherlands has generally maintained its position in world exports of live pigs and pork, even though it recently has experienced a decline in market share in pork. The vast majority of exports are made to other EU countries. Government support to pork production is similar in countries within the EU and a number of border measures that distort trade between EU countries and non-EU countries do not apply to trade within EU. Exports from the Netherlands to other EU countries are therefore easier than exports to countries outside the EU.

The Netherlands is the largest exporter of live pigs in the EU (any exports of live piglets, weaners or hogs outside the EU would be minuscule) (Table 14). For many years, the Netherlands has been the major supplier of live pigs to Belgium, France, Germany and Italy, supplying considerably more than half of each

Table 14. Shares of Imports of Pork and Live Swine to France, Germany, and Italy from Selected Countries, 1980-1990

	Pork		Live Swine	
	1980	1990	1980	1990
	(percent)			
Share of Imports to France from:				
Netherlands	39	36	45	46
Denmark	19	25	-	-
Belgium	28	30	39	39
Others	14	8	16	15
	100	100	100	100
Share of Imports to Germany from:				
Netherlands	53	47	77	88
Denmark	27	21	14	0
Belgium	12	20	8	7
Others	8	12	1	5
	100	100	100	100
Share of Imports to Italy from:				
Netherlands	49	45	64	60
Denmark	16	14	0	0
Belgium	17	15	20	22
Others	18	26	16	19
	100	100	100	101

Source: Calculated from United Nations, Commodity Trade Statistics, 1980 and 1990

country's imports (with exception of France). Live pig imports to these countries have increased over this period.

Pork imports to France, Germany and Italy continued to grow over the past two decades. Imports to Spain, while small in comparison, increased significantly in the mid-1980s and have stabilized at approximately 65,000 tonnes per year. The Netherlands has been the dominant supplier to these markets over this period. While shipments have increased, the Netherlands' market share has declined somewhat.

Belgium and Denmark have been the Netherlands' key EU market competitors. As well, Germany and France have recently increased their presence, especially in the Italian market.

Ninety-three percent of the Netherlands' exports of bacon are shipped to the UK. In the 1980s the Netherlands was able to expand its market share from 16 to 50 percent of imports into the UK. This took place while the UK import market for bacon and other cured pork products was declining at an average annual rate of 1.2 percent from the early 1970s.

However, bacon exports from the Netherlands to the UK dropped steadily from 111,000 tonnes in 1990 to 84,000 tonnes in 1994 (PVVE 1995b), resulting in a falling market share. For example, between 1993 and 1994 such exports declined by 5,000 tonnes, at the same time as exports of bacon to the UK from Denmark increased by 18,000 tonnes. Competition between EU countries for market share in other EU countries is conditioned by many factors, such as inter-country differences in growth in production, consumption, and changing access to outlets in non-EU countries. Moreover, differential exchange rate changes among EU countries influence each country's export performance.

C.4 Determinants of Competitiveness

C.4.1 Overview

The collective strategy of the Dutch pork industry is to serve a variety of markets, from supply of piglets, live slaughter hogs, whole carcasses, through to prepared meats. While less focussed than Denmark in its approach to exports, the Netherlands has been as successful in maintaining its market share. The following sections analyze the more fundamental determinants that have contributed to this successful performance. Specifically, the Dutch pork industry will be examined with respect to: factor conditions, demand conditions, sector structure, linkages and strategies, and government policies.

C.4.2 Factor Conditions

Labour: As elsewhere in northern Europe, labour costs in the Netherlands are high in an international comparison. This results in high labour cost for hired labour and high opportunity cost for operator labour. The majority of Dutch hog farms are owner-operated. While Dutch farmers have lower levels of education than the average for the total Dutch workforce, they rank favourably when compared with other OECD countries.

Besides a standard curriculum, the Dutch educational system offers specialized and vocational training in agriculture at the lower secondary, upper secondary, college and university levels. Many of the institutions, at each level, offer continuing education and evening courses. As well, farmers' unions, product boards and cooperatives provide ongoing advice through several hundred extension education representatives.

The average age of people employed in Dutch agriculture is higher than in the civilian workforce. This is not unique to the Netherlands and can be attributed to two factors. Firstly, there is a significantly higher ratio of owner-operators to wage earners in agriculture. When comparing the median age of self-employed people in agriculture to the civilian workforce, the difference is not as significant. Secondly, the decline of the agricultural workforce has occurred with younger workers, who have had better opportunities to work elsewhere than established owner-operators.

The age distribution of wage-earners and self-employed people in the food processing industry roughly mimics those for the general working population. However, educational levels are lower and are comparable with farm owner-operators. This reflects, perhaps, a difference in the relative mix of labourers and office workers of food processing to other sectors of the Dutch economy.

Land: While land is not a direct constraining factor for hog production in the Netherlands, the disposal of manure on land has become a key environmental issue. Intensive livestock production has resulted in large surplus production of urine and manure. While animal waste production has declined by 12 percent since the mid-1980s, manure surpluses still exist in all livestock sectors. Hog operations and farrow-weaner operations[36] have the largest surpluses (42.5 and 30.5 percent, respectively).

The lack of land associated with hog farms and the set of environmental regulations faced by producers could have significant long-run negative effects on cost competitiveness.

Capital: The Netherlands is home to one of the world's largest food and agri-business financial institutions, Rabobank[37]. The Rabobank group comprises about 850 independent local farmers' credit banks, and is organized on cooperative principles. It has had over 90 years of experience in the Dutch agricultural sector. Rabobank provides more than 95 percent of all agricultural loans in the Netherlands. It also holds about 40 percent of Dutch savings accounts, and is thus important as a bank to many more than farmers. Rabobank also offers many other financial products and services to corporate and retail customers (Rabobank 1996).

As the result of close ties to local communities through savings accounts, Rabobank has been able to function as a source of finance for investment projects in rural areas. Many such projects of course are agriculture and food related. Moreover, because the owners of the cooperative bank often are farmers themselves, decisions on farm lending

[36]"Pig and pig breeding operations" is assumed to refer to hog and farrow-to-weaner operations.

[37]Rabobank: Coöperatieve Centrale Raiffeisen-Boerenleenbank.

tend to be taken on the basis of a more thorough understanding of the nature of the business than would be the case in banks with a different ownership profile. As farmers also own marketing and processing cooperatives, lending to such businesses would also more easily be based on an understanding of upstream/ farm issues.

It being a cooperative bank is not sufficient to explain Rabobank's success as a lender to farmers and the food industry in the Netherlands. Other banks are also able to lend to farmers and the food industry. Other factors, such as management factors, may have helped to secure Rabobank's leading position as a lender and provider of financial services to these industries.

It has also been observed that agriculture in the Netherlands has been able to benefit from lower interest costs (or at least lower nominal interest reates) than in other some countries (Hughes et al., 1993, and van Gaasbeek et al., 1993).

Feed: Most livestock feed in the Netherlands is produced by the compound feed industry. The feed grain component of compound feed is made more expensive by the market regulations of the EU Common Agricultural Policy. For example, when the unsupported (cif Rotterdam) price of barley was US$100 per tonne, the price of barley for animal feed was as high as US$228 per tonne in Denmark and the Netherlands[38]. The price of complete compound feed for fattening pigs was of course higher still: US$263 per tonne in Denmark and US$271 per tonne in the Netherlands.

In the Netherlands, however, much of the compound feed is made not with feed grains but with other feed materials imported from overseas through the Dutch port of Rotterdam. Such materials include corn gluten feed, oilseed meals and a number of other non-grain feed ingredients (such as tapioca pellets and citrus pulp). Although the nutrient composition of these ingredients often is inferior to that of feed grains, they are cheaper than feed grains.[39] Their lower price of feed has given Dutch hog producers a cost advantage in comparison with hog producers elsewhere in the EU. This advantage has been eroded somewhat with the 1992 reform of CAP, which made EU grain prices lower, *ceteris paribus*.

Compound feed produced in the Netherlands is subject to strict control. All Dutch compound feed companies have some form of internal control, which

[38]Data are from 1992 (European Commission, 1994). The unsupported (cif Rotterdam) price of barley was around 77.42 ECU per tonne (Table 4.1.5.5), and the price of barley for animal feed in Denmark and in the Netherlands was 175.80 ECU per tonne (Table 3.3.5). The price of complete compound feed for fattening pigs was at the same time 202.50 ECU per tonne in Denmark and 208.80 ECU per tonne in the Netherlands (Table 3.3.5). Exchange rate: 0.77 ECU/US$ (Table 1.0.2).

[39]At times of low world market prices of cereals, the price of feed grains in the EU is maintained significantly above world price levels by means of market regulations and border measures.

includes inspecting products entering the company. The entire production process and end products are subject to quality control. There are stringent tests for the presence of undesirable matter. In addition to the voluntary control in the industry, the government also monitors the use of additives and the way in which products are marketed.

The interests of the animal feed sector are served by the "Product Board for Animal Feed"[40] and the various industry associations.

Animal Breeding Programs: Dutch hogs are based on a fourway cross similar to those employed in Denmark. Animal selection is mainly based on feed conversion, meat quality, disease and stress resistance traits. Numerous organizations are involved in Dutch animal genetic research. In this research, the Experimental Station for Pig Breeding plays an important role.

Besides the Dutch Pig Herd-book[41], there are nine recognized breeding groups active in the Netherlands. They are supervised by the Foundation for Breeding Industry in Pig Farming[42]. The major breeds are Dutch Landrace and Yorkshire.

[40]Produktschap voor Veevoeder (PVV). This acronym is the same as the one for the "Product Board for Livestock and Meat" or Produktschap voor Vee en Vlees (PVV).

[41]Nederlandse Varkensstamboek.

[42]Stichting voor het Fokkerijwezen in de Varkenshouderij.

C.4.3 Demand Conditions

The Netherlands has a domestic market of 15 million inhabitants, which is small in relation to the quantity of pork produced in the country. Per capita, the Dutch consumer spends approximately Gld 600 (Cdn$444) on fresh meat and Gld 300 on meat and preserved products. The 1996 consumption of pork in the Netherlands is 43.6 kg per person per year, which is above average for the EU and high in comparison to North America and the rest of the world[43]. This amounts to more than half of total meat consumption.

Increasingly, the consumer is choosing ready-to-cook products and snacks. A part of the domestic market is making more stringent demands on the quality of pork produced. In addition to personal health considerations, consumers are paying increasing attention to the environment, animal welfare, convenience and the need for greater variety. The sector has responded by developing new products and implementing a quality control program throughout the production chain.

Supermarkets account for 64 percent of retail sales of meat in the Netherlands, with independent butchers accounting for 31 percent (PVV, 1994). The corresponding shares for retail sales of meat products are 78 percent and 18 percent, respectively.

[43]In 1993 pork consumption in the Netherlands peaked at 54.1 kg per person per year (USDA 1996).

Dutch pork is considered to be of lower quality than Danish pork (Kearney 1994). For example, the percentage of pork affected by PSE is as high as 10-15 percent (compared to 2 percent in Denmark). Only 30 percent of pork is sold with guaranteed quality (all Danish pork is sold with such guarantee). In Germany, pork of Dutch origin has a negative image, due to the lack of quality guarantees.

The perception of Dutch pork being of lower quality makes it difficult to sell this product to high-end retail chains. It has been forecast that Dutch pork will be primarily delivered to discount retailers (Kearney 1994). The difficulty with quality is compounded by the increasing interest among retailers to be able to trace the origin of the pork and the conditions of rearing and transporting the hogs.

The importance of meeting domestic demand has been declining for the Dutch pork industry for along time. For more than 40 years most of the pork produced in the Netherlands has been exported. Through established links in importing countries (predominantly in the EU), the Dutch hog and pork industry maintains direct contact with changing consumer tastes and preferences.

The Dutch pork industry is also exploring new export markets, including Japan and Korea as well as Russia and Eastern Europe. In this respect the Netherlands looks towards meeting the same demand that several other exporting countries anticipate meeting.

In 1992, after resolution of some long-standing veterinary and animal health issues, the Netherlands exported less than 100 tonnes of pork to Japan. That expanded to 1,700 tonnes the following year. The Dutch industry foresees 50,000 tonnes of exports to Japan. The Netherlands has established a technical support office in Japan, which liaises between the Dutch industry and Japanese wholesale buyers. Specifically, the office provides information on Japanese pork markets and veterinary requirements to Dutch exporters and information on the Dutch pork industry to the Japanese pork importing industry.

The export strategy of the Dutch pork industry includes a shift from exporting carcasses, half carcasses, and bone-in cuts to exporting more deboned cuts. This development may be driven by the need to compete with Danish exports of high-valued cuts outside the EU.

C.4.4 Sector Structure, Linkages and Strategies

Product Board for Livestock and Meat (PVV): The Dutch hog and pork industry is market driven within the framework of EU market regulatory policy. There are significant numbers of independent entities at each level of the marketing chain from breeding stock through to retail and export. The Netherlands accomplishes a coordinated approach through government-sponsored product boards, industry boards and farmer

unions[44]. The product boards are bodies empowered to issue regulations concerning all segments of the production chain.

Originally established in the 1950s to promote production in the post-war period, the PVV now focuses on providing support throughout the marketing chain to promote value added. As a vertical organization, representing both the livestock and meat industry, the PVV performs a number of roles including acting as a focal point for individual firms, private and government organizations.

While some administrative costs of the PVV are covered by the Dutch government (in particular those arising from delivering EU agricultural policy and programs), most expenses of the PVV are covered by mandatory levies on slaughter and live exports of livestock. The point of collection of the levies is the slaughterhouse, but there is an obligation on the slaughterhouse to pass the levy back to the hog producer[45].

In 1994 the PVV expected to raise Gld 53.5 million (Cdn$40 million) from livestock farmers (PVV 1994). The dominant part (over 80 percent) of this would come from the hog sector: Gld 43.9 million (Cdn$32.5 million). In addition, Gld 2 million would be raised as a bacon levy. The amount raised through levies accounted for 88 percent of the revenue of the PVV in 1994 (the rest was interest and miscellaneous revenue).

The levy per hog amounted to Gld 1.86 (Cdn$1.38), with a somewhat smaller levy applying to weaners. The major components of the Gld 1.86 were "hog funds A and B", "quality control", and "propaganda fund".

The major expenditure items of the PVV in 1994 were market promotion and public relations (27 percent), quality and technical regulations (27 percent), and health care (20 percent). These expenditure items were the largest ones also in earlier years, but the amounts were lower. In addition, the PVV paid out Gld 58 million (Cdn$48 million) in 1993 in support to the pork sector under EU regulations.

An important feature of the PVV is self-regulation of the livestock and meat industry. Under Dutch law, product boards are authorized to establish industry regulations. The government's view is that decisions should be left to organizations or entrepreneurs and employees where they are better suited to further their own interests and thus the industry's viability.

In the livestock and meat industry, quality control, inspection, animal health care, animal welfare, the environment and structural improvement are, to varying degrees, the responsibility of the

[44]This can be contrasted against the model used in Denmark, where vertical coordination is achieved through vertical expansion of the cooperatives and through the umbrella organization, Danske Slagterier.

[45]The exception from this is the levy raised by the PVV for the Restructuring Fund. It is not passed back to hog farmers.

PVV. In particular, the PVV has developed an integrated quality control system that governs the entire production process. As well, it is involved in various research projects aimed at quality improvement. In order to prevent unfair business practices, the PVV applies voluntary and compulsory regulations on the slaughter, weighing and classification of live animals and carcasses.

The PVV conducts publicity campaigns both at home and abroad, and plays a pivotal role in opening new markets. For example, PVV was involved in intensive consultations with Dutch and Japanese veterinary authorities that resulted in the first exports of pork from the Netherlands arriving in Tokyo in 1992.

The PVV is involved in animal health care and welfare. A portion of the levies collected is spent on the prevention of animal diseases. Contributions are made to the costs of the National Health Committee, as well as towards compensation funds for entrepreneurs who have financially suffered from disease outbreaks.

Animal welfare is becoming an important priority, partly as a result of pressure by social organizations. The PVV is responsible for animal welfare regulations and represents the industry on the Council for Animal Affairs, which is a forum for discussion of animal health and welfare issues. Financial contributions by the PVV are made toward a number of projects aimed at solving the manure problem faced by the livestock sector. At the processing level, the PVV, together with a number of private organizations, is working with the Government to reduce energy consumption by 20 percent.

The PVV supports and gives guidance to initiatives designed to reduce over-capacity in slaughterhouses (such as the Restructuring Fund). The PVV produces sectoral structure reports and slaughter-house business comparisons to facilitate improvement in the industry's competitiveness. Further, the PVV lobbies Dutch and EU politicians and officials on behalf of the meat and livestock industry.

One of the most important tasks of the Product Boards is the implementation of EU regulations in the livestock, meat and poultry sectors. These duties are carried out in the form of "co-administration" on behalf of the Dutch government, and they include making restitution payments and collecting import duties. The cost of these activities is borne by the Dutch government.

Integrated Chain Control (IKB):
Recognizing the weaknesses as regards the quality positioning of Dutch meat products in export markets, the system known as IKB[46] was developed [47]. The primary objective of IKB is not so much to improve product quality, but rather to strengthen the guarantees that whole-

[46]Integrale Ketenbeheersing (IKB), or Integrated Chain Control. Sometimes translated as Integrated Quality Control.

[47]This section benefitted from discussions with Mr. Jerry Bouma, Toma and Bouma Management Consultants, Edmonton, Alberta.

salers and exporters are able to offer their customers concerning safety and quality of the product.

The PVV, at the request of the industry, developed standards for a system of IKB in the pork industry. The government supervises the operation of the system. The IKB system defines the responsibilities of the actors in the whole chain in relation to the product and in relation to each other. Participation is voluntary. More than half of Dutch pork production is covered by the system as of 1996.

The objectives of IKB include better safety and quality guarantees, improved consumer image (of Dutch pork), improved animal health care and welfare, and improved farm production management (van Dongen, 1996). The system allows the Dutch industry to give guarantees to buyers about such things as the origin of the animal, the feeds used in raising it, the hygiene in production and processing, the use or non-use of certain veterinary products, and the absence of residues. Some aspects relating to animal welfare (in addition to those already applying to the raising and transportation of hogs) are in the process of being added to the system. An important element of the system is the formalized exchange of information among actors in the value chain.

The operation of the system is predicated on comprehensive identification and registration procedures. Every pig in the Netherlands is identified by means of an earmark. Plans are underway to introduce procedures under which all piglets would be injected with a subcutaneous registration chip at the age of four weeks. This would allow speedy reading and processing of data on the hog in the slaughtering plant.

When a hog under the IKB system is delivered to the slaughterhouse, a delivery certificate is issued. The certificate guarantees that all information on the hog has been entered into the IKB recording system and that all standards of the system have been met. If the hog is delivered from the farm to the slaughterhouse with a trader as an intermediary, the trader has to become the legal owner of the hog. This condition aims to ensure that the obligations of all participants in the chain, such as transmission of IKB information upwards and downwards in the chain, are carried out without fail. IKB hogs are handled separately from other hogs in the slaughterhouse.

Hog producers at one time received a premium of Gld 3 per IKB hog (Cdn$2.22) (van Dongen, 1996). This was intended as an incentive to join the system. Presumably there are advantages accruing to the hog farmer, sow breeder, and other participants in the chain, which would also help to offset the additional costs incurred in complying with the standards of the IKB system.

In 1995, the IKB information on pork started to be provided to Dutch customers. Since January 1996 IKB information is provided at the retail level in the Netherlands. Plans are underway

to also introduce the information to foreign customers. Meeting the information needs of buyers in Japan is a particular target in this expansion of the system.

In a sense, the activities performed by the Product Boards in the Netherlands are similar to those of Danske Slagterier, the cooperative umbrella in Denmark, providing necessary vertical liaison among members of the pork industry, their suppliers and markets, as well as providing horizontal integration through issue of regulations affecting all those involved at the same level of the marketing chain.

While the sector structure, linkages and strategies on the Netherlands thus could be considered to embody many strengths, there is also a view that the Netherlands is considerably weaker in this respect than is Denmark. Kearney (1994), for example, indicates the following weaknesses in the Dutch industry: farmers are oriented towards short-term profits instead of long-term success of the whole chain; the value-chain is fragmented, with large structural and organizational problems; overcapacity remains a problem; and German slaughterhouses have a large influence on the price of raw material (hogs) for the processing industry.

At the same time, other analysts have come to different conclusions about the structure and integration of Dutch agriculture, including the hog and pork industry. Hughes et al. (1993), for example, emphasize the extent of vertical and horizontal integration in the Netherlands. They attribute the benefits of integration not only to the presence of cooperatives and product boards (such as PVV), but also argue that the presence of sector boards in the Netherlands has helped to improve communications between participants in the marketing system.

Sector boards (*bedrijfschapen*) provide a form of horizontal integration in that they have powers to issue orders with respect to all involved in the same trade or profession (such as retailers who sell the same product). For example, three separate sector boards exist to promote the interests, respectively, of the independent butchers, the processed and preserved meats industry, and the livestock traders[48] (PVVE no date). Overlapping with the sector boards, a number of industry associations operate at various levels in the value-added chain. Coordination among such industry associations and sector boards can be facilitated by sharing office space and phone numbers, as in the case of the sector board for the processed and preserved meat industry, the association for the processed and preserved meat industry, the association of bacon producers, and the processed meats control organization.

[48]They are, respectively, Bedrijfschap Slagersbedrijf, Bedrijfschap voor de Vleeswarenindustrie, and Bedrijfschap voor de Handel in Vee.

Farmers' unions are organized under the Agricultural Board (*Landbouwschap*). Membership in a product board, which is mandatory, also confers membership in the Agricultural Board. This Board is charged with promoting the interests of the agricultural sector as a whole. Its statutory powers of economic regulation have been used sparingly - matters relating to protecting the environment have recently been addressed under these powers.

C.4.5 Government Policies

The Netherlands has maintained a comparatively open economy, for reasons of culture and geography. Recognizing the importance of trade, Dutch governments (past and present) have supported European integration and open trade policy. This has led to a market-oriented approach to trade and government policy, within the generally protective framework of EU policy.

More than 100 years ago, the State Commission for Agriculture recommended the formation of cooperatives, an agricultural credit system and governmental stimulation of innovation through support of three activities; agricultural education, extension and research. These are still viewed as appropriate policy foundations.

Approximately 25 percent of the pork slaughter sector is operated by cooperatives. The Rabobank, incorporated 90 years ago as a cooperative, provides a complete array of financial services from farm to export credit.

Education: The Netherlands has a comprehensive system of agricultural education. It is one of the top OECD countries in education spending per unit of GDP. The Ministry of Agriculture, Nature Management and Fisheries is responsible for providing agricultural education. Working closely with the Ministry of Education, agricultural education is organized largely along the lines of other types of education in the Netherlands and is governed by the same rules and regulations. In areas specifically related to the agricultural sector, the Minister of Agriculture, Nature Management and Fisheries pursues a policy which corresponds with the objectives of agricultural policy in general.

Agricultural education prepares students for the following specialties:

- primary agricultural production;
- planning, development and management of rural areas;
- ancillary industries, processing and marketing;
- horticultural services.

Agricultural education splits into pre-vocational education, secondary agricultural education (two-year, three-year and four-year full time courses and apprenticeship training), higher agricultural education, education at practical training centres, vocational education courses, international agricultural education, university agricultural education, and post-graduate agricultural education. Most schools of pre-vocational and senior secondary agricultural education have merged into

Agricultural Education Centres, which also cater to adult agricultural education. Specialized training for the meat sector is offered by an institute dedicated to this purpose.

The largest share of the total expenditure on agricultural education is devoted to secondary education, followed by expenditures on the agricultural university (Table 15).

Advisory Services: From 1990, the Agricultural Extension Service (DLV)[49] operates as a privatized agency (foundation). A major share of the funding is provided by the Ministry of Agriculture, with the share declining to 50 percent by the year 2002. The expectation is that the farmers' union (*Landbouwschap*) will take responsibility for the funding not provided by the government. Recognizing the shared funding, the DLV governing board comprises equal representation from the Ministry and from the farmers' union, plus a chairman appointed by the minister in consultation with farm organizations.

The DLV provides general extension services based on the shared funding from the government and the *Landbouwschap*. In addition, DLV offers specific consulting and advisory services on a full user-pay basis. This could include structural design, farm accounting, and pest management related tasks.

Local farmer organizations, with 50 percent financial support from the government, operate a number of bookkeeping bureaus. Most farmers use the services of these bureaus for tax accounting.

Two Information and Knowledge Centres (IKC)[50] (one for animal production and one for crops) are devoted to technology transfer and work closely with the agricultural university and the research and experiment stations. The IKC are part of the Ministry of Agriculture.

Table 15: Agricultural Education Expenditure in the Netherlands, 1993

	(million guilders)
General	87.8
Secondary Agricultural Education	329.3
Higher Agricultural Education	109.0
Practical Training Centres	44.5
Agricultural University	236.8
Total	**807.4**

Source: Ministry of Agriculture, Nature Management and Fisheries 1994

[49]Dienst Landbouw Voorlichting.

[50]Informatie- en Kenniscentrum Centraal.

In addition to the government-funded (fully or partly) extension activities, there are about 1,500 consultants working for commercial interests, plus perhaps 300 private farm management and production technology consultants in the Netherlands.

Research: The government, along with product boards, farmers' unions and agribusiness companies, supports a sophisticated, integrated system of research and extension organizations. Half of the annual research budget comes from the government, the other half is from product boards (mainly funded by the industry) and private companies.

Of the research organizations, which together account for a total agricultural research budget of some Gld 700 million (Cdn$519 million), the Agricultural Research Department (DLO) accounts for 45 percent, Wageningen University of Agriculture 20 percent, the TNO Organization 10 percent, and the experimental stations 10 percent. The greater part of research performed by DLO is application-oriented research in agriculture and horticulture (DLO-NL 1996).

The DLO works in close cooperation with experimental stations and the University of Agriculture in joint research programs, which are financed by the Ministry or by the industry. Other research organizations also participate in these research programs, which have an average duration of about 4 years. To coordinate the research effort in an effective way within the broad policy sphere of the Ministry of Agriculture, Nature Management and Fisheries, the various policy directorates of the Ministry, the agricultural industry and a wide variety of socio-economic organizations are involved in planning and programming the research effort.

In 1993, there were approximately 150 research programs directed at, inter alia, livestock feeding, animal health care and welfare, manure processing, crop protection and selection, mechanization, nature management, forestry and fisheries.

The DLO also advises the government on the control of animal diseases, performs diagnostic research, and develops and produces vaccines and diagnostics. Altogether, around 600 people work at the Institute of which over 100 are employed in virological laboratories. In addition to the regular staff there has been an increase in the number of temporary jobs as a result of research contracts with industry, the European Union, and the Dutch Products Boards.

Contract research and the manufacture of diagnostics and vaccines earn money for the veterinary laboratory, recovering almost 50 percent of its total operating costs.

Sneep (1994) found that innovation managers in the agri-food industry rely heavily on government structures in performing their role. It is also reported that the processing industry's investment

in product development and marketing efforts is lower than in Denmark (Kearney 1994).

Animal Health: As an exporting country, the Netherlands places great importance on animal health and welfare. Any damage to the Dutch image could have significant financial consequences. As examples, in 1991 there were various instances of swine fever, and in 1992 there were occurrences of vesicular disease. These outbreaks halted trade in live pigs, increasing domestic slaughter and led to a drop in price.

The government has taken an active role in safeguarding the country's reputation, especially in animal disease control. A number of these tasks have been allocated to the PVV and the Animal Health Services. The Dutch veterinary authorities have imposed strict rules for the production and transport of pigs.

Investment Support: Investment support as governed by the rules of the European Union in the Netherlands targets manure and environment related investments. A tax rebate of 10 percent also applies. Moreover, the government provides loan guarantees for up to 70 - 80 percent of the amount of investment.

Manure and Ammonia Policy: Most Dutch pig farmers have little land, acquiring pig feed from the compound feed industry rather than growing it. In addition to feed grains (from the Netherlands or elsewhere in Europe), such feeds often include non-grain feed ingredients shipped in from overseas. The livestock industry as a whole (including dairy and beef cattle and poultry) produces far more manure than needed for crop production. Pigs accounted for 58 percent of this manure surplus in 1993 (Ministry of Agriculture, Nature Management and Fisheries 1995).

To address the manure surplus problem, legislation was passed already in 1984 to prevent the further expansion of livestock herds. This was followed in 1987 by a three-phase policy initiative directed at the manure surplus as well as the problem with ammonia emissions (smell and environmental degradation) from livestock production.

The first phase of the manure policy (1987-1990) sought to stabilize the manure burden on the environment through the introduction of manure production rights (quotas) and the regulation of manure applied to crops (based on the mineral contents - primarily phosphate - of manure). A manure surplus charge was instituted, but farmers were also encouraged to use feed formulations with lower mineral contents and to handle manure in improved ways.

The second phase of the manure policy (1990-1995) was designed to reduce the manure burden on the environment by gradually allowing less manure to be spread on the land. The sale of manure has been promoted, allowing manure to be redistributed to less livestock intensive areas of the country. It was expected that the development of manure processing

plants would help to reduce the manure burden by making dry manure pellets a product that could more easily be transported and even shipped out of the Netherlands. Manure processing has failed to live up to expectations, however, because of costs being higher than anticipated[51]. Disagreements between hog farmers and arable land farmers about the arrangements for collecting and delivering manure for processing also contributed to the difficulties in making manure processing work.

The manure policy also restricts the spreading of manure to a few months of the year, obliges farmers to plow down manure within 48 hours of spreading, and requires farmers to have sufficient manure storage capacity to enable them to comply with the seasonal restrictions on manure spreading. Some government subsidies are available to assist in building manure storage.

It was intended that, by the end of the third phase (1995-2000), a balance would be reached between the amount of minerals added to crop land (as manure or inorganic fertilizer) and the amount of minerals absorbed by the crops. Farm level minerals accounting was introduced first on livestock farms, to be followed in 1997 by crop farms. A farmer showing a minerals surplus (the surplus comprises the environmentally harmful losses of minerals) would incur a levy. Depending on the rate of levy, it would be advantageous for a farmer with a minerals surplus either to pay the levy or to incur the cost of changing to a less surplus-generating agricultural practice.

When putting in place the policy measures for the third phase, it became apparent that the targets set for the minerals balance in the year 2000 could not be achieved. This was attributed to difficulties in large-scale manure processing and an inability to reconcile environmentally acceptable mineral losses with losses occurring under "good agricultural practice" (Ministry of Agriculture, Nature Management and Fisheries 1995). A new manure and ammonia policy was therefore proposed in 1995.

The 1995 manure and ammonia policy recognized the technical and administrative burden of measuring mineral losses per farm. It therefore proposed that stocking densities, expressed in livestock units per hectare, be taken as the measurement tool, in combination with a minerals accounting system applied in a more limited way. Standards for minerals loss are becoming gradually more restrictive until the years 2008/ 2010. Two levy rates will be applied on phosphate loss: one for low phosphate loss, and a higher one for high phosphate loss[52].

[51]The cost of industrial processing is Gld 50 (Cdn$37) per cubic metre, and the cost of transporting from the southern surplus area ranges between Gld 10 and 20 (Cdn$7-15) per cubic metre (Agra Europe 1994).

[52]These levy rates are expressed as Gld 5 (low) or Gld 20 (high) per kilogram of excess phosphate loss per hectare. For example, in 1998, if a farmer's excess loss of phosphate is 40 kilogram of P_2O_5 per hectare, the total levy at the low Gld 5 rate is Gld 200 per hectare.

The restrictions imposed by the new manure and ammonia policy have been estimated to reduce the return to labour on the average pig farm by 15 percent in the year 2000 (Ministry of Agriculture, Nature Management and Fisheries 1995). The loss amounts to Gld 7,000 (Cdn$5,200). The reduction in the industry's value-added in 2000 would amount to about 1 percent. Analysis of the economic situation of various types of pig farms in the Netherlands has shown that farrowing operations are the ones most vulnerable to the costs incurred in complying with environment-related regulations (Brouwer and Godeschalk 1993).

The Dutch government is putting in place several programs to facilitate farm adjustment in line with the objectives of the manure and ammonia policy. Funding for such programs derives partially from the structural initiatives of the European Commission (see Section C). Over a six-year period starting in 1994, the European Commission will provide a total of ECU 118 million (about Gld 40 million per year or of the order of Cdn$ 30 million) for environmental programs in the hog farming industry.

Government support of about Gld 10 (Cdn$7) million per year until the year 2002 is earmarked for projects in research, extension and demonstration to improve mineral management (e.g., by lowering the mineral contents in animal feeds). A further Gld 10-15 (Cdn$10) million per year is to be spent on investment in clean technology, such as construction of low-emission housing and low-emission manure application to combat the ammonia problem. These funds will be used to carry out research, monitor ammonia emissions, and for investment subsidies and tax relief to farmers who make certain types of investment. In the years 1996-98 an additional Gld 27 (Cdn$20) million, on the average, is targeted to large-scale manure processing.

The government will encourage intensive livestock farms to relocate to regions of the country that are less manure-sensitive. In order to reduce manure production overall, the government withholds a portion of the manure production rights when these rights are transferred (e.g., when the farm is sold). Relocation is encouraged by withholding a smaller portion when the manure production rights are transferred to an appropriate region of the country. Farm transfers in the family are exempt from these rules.

The most costly policy measure is the establishment of a restructuring fund with the means to purchase manure production rights. Part of this fund will focus on helping farmers who wish to remain in the livestock business. Another part will focus on farmers who are leaving: the fund will offer to buy the manure production rights in competition with farmers who need more manure production rights (for example, those who have expanded production without having sufficient rights). The cost of the restructuring fund is estimated to be up

to Gld 80 (Cdn$59) million per year until 2002.

Towards the end of the 1996-2002 period, government expenditures for the new manure and ammonia policy, including implementation costs amounting to about one-third of the total, are expected to reach Gld 152 (Cdn$113) million per year. This expenditure is partially offset by revenues in the form of levies. The manure surplus levy will contribute Gld 27 (Cdn$20) million per year, which is somewhat lower than in the mid-1990s. The minerals levy to be introduced is expected to contribute Gld 16 (Cdn$12) million per year from 1999.

Overall, livestock density in the Netherlands is so high that the associated manure disposal and ammonia problems prevent further expansion of the total number of animals. Policy measures are being taken to alleviate the environmental burden to which pig production is the major contributor. Pig production in the Netherlands thus faces many restrictions on what is acceptable practice and incurs additional costs in complying with gradually tightening rules. Government funds facilitate this adjustment. Additional adjustment is possible through such steps as relocation of production within the country and elimination of high cost operations.

C.5 Summary

The Netherlands has developed a well integrated hog and pork industry. While not organized along the same relatively clear lines of Denmark's industry, it serves the protected EU market by providing weaners through to fully processed products. An important role in the evolution of the Dutch industry is played by the Product Board for Livestock and Meat (PVV), which operates with a mixture of governmental powers and industry self-regulation. Direct government involvement in the industry (apart from EU market regulation) is focused on research, education and environmental concerns.

D.1 EU Institutions

The 1992 Maastricht Treaty on European Union created a European Union (EU) from the earlier European Communities (EC), combining a Community moving towards economic and monetary union with intergovernmental cooperation in certain areas. The 1986 Single European Act had already begun the final dismantling of all internal borders to establish a single market within the EC.

From 1995 the European Union comprises 15 member states. The Netherlands was one of the six founding members of the EC in the 1950s, and Denmark became a member in 1973 (largely in reaction to the UK joining the EC).

The EU is governed by a democratically elected Parliament, a Council representing the member states and composed of government ministers, a European Council of Heads of State or Government, a Commission which acts as guardian of the Treaties and has the power to initiate and implement legislation, a Court of Justice which ensures that Community law is observed, and a Court of Auditors which monitors the financial management of the Union. In addition, a number of advisory bodies represent economic, social and regional interests. A European Investment Bank was set up to facilitate the financing of projects that contribute to the balanced development of the Union.

Two of the major expressions of EU legislation are regulations and directives, both initiated by the Commission[53] and adopted by the Council of Ministers. Regulations are directly applicable as law in all member states; directives are binding as to the result to be achieved by the member state, which usually passes suitable national legislation based on the directive.

D.2 The Common Agricultural Policy and CAP Reform

The EU's Common Agricultural Policy (CAP) is founded on three principles. These are the creation and maintenance of a single market (which means that the markets of all member countries should operate as one), the respect of the notion of Community preference (which means that demand in one member country should be met with supplies from other member countries in preference over imports), and the commitment to financial solidarity (which means that the funds needed to implement the CAP are provided jointly by member countries and that funds raised, such as import levies, belong to the EU and not to member countries). The fundamental aims of what became the CAP are set out in the EC's founding Treaty of Rome. They can be summarized as: increase

[53]The acronym EC has usually referred to the European Communities. That convention is continued in this paper. After the formation of the EU, however, EC has come to stand for the European Commission.

agricultural productivity, raise farm living standards, stabilize markets, guarantee security of supply of food, and ensure reasonable prices of food to consumers.

The CAP took shape from the early 1960s, at a time when important member countries were net importers of important agricultural commodities and products. Initially, therefore, at the heart of the CAP was a system of guaranteed prices for virtually unlimited production of many commodities. Farmers would generally receive a remunerative price for their products even if they sold them to be stockpiled by the EC intervention authorities for later resale at subsidized prices on the world market.

Efforts have been made over the years to reform the CAP in order to limit surplus production, to contain costs and to prevent farm incomes from falling. The latest major change was initiated in 1992, affecting primarily the cereals and beef sectors.

The amount spent on agriculture from the EC budget (under the Guarantee section) has been rising steadily: from ECU22 billion in 1986 to ECU41 billion in 1996[54]. The share spent on agriculture out of the total EU budget has nevertheless fallen, from 63 percent in 1986 to less than half in 1996. This largely reflects increased outlays on other policies, particularly regional and social development.

The instruments through which support to EU hog production has been delivered have been effective in protecting EU producers from facing competition in their home markets from non-EU suppliers. For example, annual imports of pork to the EU as a whole from outside the EU have been of the order of only 40,000 tonnes in recent years. This corresponds to a fraction of one percent of the quantity consumed. Non-EU imports to Denmark have been of the order of 4,000 tonnes, with similar magnitudes applying to the Netherlands. The low import penetration in the EU pork is ascribed to a combination of the CAP support regime for pork and a number of other EU policy measures, some of which are specific to hogs and pork and some of which are not.

D.2.1 The Pork Regime of the CAP

The production of hogs and pork in the EU is supported by a combination of export subsidies, import barriers and domestic support instruments. A minor share of the funds for this support comes from the government (i.e., the European Commission) and the major share comes from EU consumers of pork who pay elevated prices for pork.

The exposure of EU pork exporters to world pork prices is largely eliminated through the government's (the European Commission) payment of export refunds (i.e., export subsidies) on many kinds of pork products exported. Export refunds

[54]These amounts correspond to Cdn$30 bill. in 1986 and Cdn$73 bill. in 1996, assuming exchange rates of Cdn$1.363/ECU and Cdn$1.793/ECU, respectively.

are, in part, based on the difference in feed grain prices in world and EU markets[55]. The exporter of pork thus receives government payments to offset the higher price he has paid for the EU pork he wishes to export. This enables him to export EU pork at the lower world market price. The rate of refund is the same to each destination, but varies by type of product, such as dried ham (bone-in), dried ham (boneless), cooked sausages, cooked ham, luncheon meat, etc.

Pork in the EU is high-priced because CAP market regulations are designed such that hog producers are compensated for the high price of feed grains in the EU (which results from the support policies for cereals) via a high price of pork. While the price of pork is more or less equal across EU countries, there are obviously some countries where the high price of feed grains plays a smaller role than in others. In the Netherlands, for example, a large portion of total hog feed consumption consists of non-grain substitutes for cereals, which are imported at prices lower than the corresponding prices for feed grains. This suggests that the hog sector in the Netherlands enjoys somewhat larger policy support than in EU countries where cheap non-grain feed ingredients are less readily available.

EU commitments on subsidized exports under the GATT Agreement on Agriculture have reduced the range of products eligible for export refunds, from 1995 onwards. In particular, the range of processed products eligible for export refunds is now more limited. Quantity and expenditure commitments on subsidized exports under the GATT agreement also apply. For example, the maximum quantity of pork on which export refunds could be paid in 1995-96 in the EU-15 was 541,800 tonnes, declining to 443,500 tonnes in 2000-2001. The corresponding maximum expenditure commitments were ECU 288.8 million and ECU 191.3 million, respectively.

Some barriers against imports of pork and pork products to the EU (such as the system of sluice gate prices and variable import levies) were replaced with import tariffs and tariff rate quotas in 1995 as a result of the Agreement on Agriculture under the GATT. The quantities imported within the tariff rate quota attract lower tariff rates than the quantities in excess of the quota. The EU-15 quota quantity is set to rise from a very modest level in 1995 to 75,600 tonnes in the year 2000, distributed among different kinds of pork products. Exporting countries view this gradually expanding import access with great interest.

Pork and pork product imports to the EU above the tariff rate quota faced specific tariffs ranging from 685 ECU per tonne to 2,303 ECU per tonne in the year starting July 1, 1995. Ad valorem duties applied to some products. Additionally, special safeguards provide further protection

[55]This procedure is a result of pork being regarded in the CAP regime as a cereal-based product.

against imports to the EU. Import tariffs are being reduced over a six-year period. For example, the tariff on frozen pork carcasses, which was 788 ECU per tonne in the 1995-96 year, declined to 737 ECU per tonne in 1996-97, reaching 536 ECU per tonne at the end of the reduction period in 2000-2001.

The EU also supports pork market prices through an internal market support mechanism. A basic price is normally set for a 12 month period beginning July 1. A reference price (a weighted average price for member states) is calculated weekly. If the reference price falls below 103 percent of the basic price and is likely to remain below it, direct support buying may be undertaken. In practice, this has occurred only once since 1971 (CAP Monitor 1996).

Aid is provided more often by government support to private storage of pork products. Fixed amounts are paid to encourage traders to store quantities of product for specified time periods. For example, from November 1995 to 16 February 1996 a quantity of 47,274 tonnes of pork was contracted into private storage in the EU, of which 20,736 tonnes in Denmark and 7,442 tonnes in the Netherlands.[56]

The GATT Agreement on Agriculture also requires a reduction of domestic support, in addition to the commitments on export subsidies and import access. Thus, the EU is committed not to exceed a support ceiling, where support is measured through an "aggregate measurement of support". However, the commitment is not product-sector specific, and it is therefore not possible to say what the implications are for the hog/pork sector specifically.

Nevertheless, no domestic support to hogs/pork is counted for this purpose by the EU in the base calculation (established for 1986-88). Private storage aid meets "de minimis" criteria allowing it to be excluded; national programs and payments under the Guidance Section of FEOGA (see below) are considered to be not trade distorting enough to be counted in the aggregate measurement of support. The price gap between internal EU prices and world market prices is not counted at all, possibly because netting out the component attributable to high feed grain prices reduces the gap to zero.

Among international measures of policy support, the OECD's Producer Subsidy Equivalent (PSE) is the most widely known measure. However, it is calculated only for the EU as a whole, not for individual member states, such as Denmark and the Netherlands. The major component of PSE for pork in the EU is the price gap between domestic and international prices, maintained with the help of export refunds and import barriers. When this price gap is counted as support, the PSE for pork in the EU is about 33 percent (this means that policy

[56]Earlier in 1995, 24,000 and 6,000 tonnes of pork had been contracted into private storage in Denmark and the Netherlands, respectively.

transfers amount to 33 percent of the producer's gross revenue).

The price gap for pork is sometimes ignored, however, on the argument that it is intended to offset only the high cost of feed grain resulting from support to the cereals sector[57]. The price gap for pork possibly overcompensates for the high price of feed[58]. Moreover, to the extent that some hog producers, such as many Dutch producers, are able to cut feed costs by using low-priced non-grain feed ingredients, the grain-based price gap for pork would appear to be a profit-enhancing policy instrument.

Ignoring the price gap for pork (i. e., estimating a "net PSE") results in a PSE of only 9 percent. The components making up this support result almost entirely from national policies in EU member states, with only a small fraction resulting from FEOGA Guidance type support (see below). The measured level of support to hog production in the EU is low compared to the support channelled to other EU commodities.

[57]The price gap used in PSE estimation is derived from the difference between domestic market and border prices of pork in the EU. Thus, it is not derived from prices of feed grains using some feed conversion coefficient.

[58]It is sometimes argued, for example, that the accounting for the difference in feed grain prices between the EU and world markets is based on an outdated feed conversion ratio, thus exaggerating the need to compensate for this difference by means of a price gap on pork. Other observers have asserted that the export refunds on pork have not fully compensated for the differences in production costs or just compensate for the difference in feed grain price (Landbrugs- og Fiskeriministeriet 1995a, p. 63, p. 76).

D.3 Other EU Policy

Structural Funds: The EU uses its so-called "structural funds" as instruments for economic development. Funding under structural funds is provided mainly through three channels: the European Regional Development Fund, the European Social Fund, and the Guidance Section of the FEOGA[59]. Provision of such funding to activities in a member state is generally conditional on the member state contributing at least as much funding as the EU.

Monies contributed under the structural funds are directed towards seven major objectives. They are: (1) promoting development and improving the structure and infrastructure of less developed regions, (2) assisting regions affected by industrial decline, (3) combatting long-term unemployment, (4) improving employment opportunities for young people, (5.a) speeding up the adjustment of agricultural structures within the reform of the CAP, (5.b) promoting the development of rural areas. and (6) assisting regions with very low population density as provided for under Objective 1 (Objective 6 targets northern regions in Finland and Sweden).

EU structural funds could possibly be used to support the hog and pork industry in line with the objectives laid down for the funds. For example, one of the targets under Objective 5.a is to

[59]FEOGA: Fonds Européen d'orientation et de garantie agricole; European Agricultural Guarantee and Guidance Fund.

provide investment aids for processing and marketing. In 1991, $ECU5 million were appropriated for Objective 5.a in Denmark as assistance from FEOGA Guidance Section, while there was no such appropriation for the Netherlands. A few million ECU were paid towards Objective 5.b in each of Denmark and the Netherlands. In 1993 there were 11 projects in the Dutch meat processing sector (not only hogs and pork) receiving EU support to improve processing and marketing of products.

Information is not readily available on how much of the structural funds has been directed specifically to the hog and pork industries in Denmark and the Netherlands but, in view of the relatively small amounts involved in total, the amounts of support to the hog and pork industries specifically would be expected to be low. One reason for the assistance from structural funds to these countries being so low is that support is focused on those regions experiencing the greatest difficulties. Thus, both Denmark and the Netherlands have only very small areas qualifying for support under Objectives 1 and 5.b.

Environmental Policy: In all countries of the EU there is a growing body of regulation that imposes constraints on the intensive livestock industry. The stringency of this legislation and the way in which it is applied varies from country to country and is regarded as a major cause of distortion of competition among EU member states. As a result, the EU is attempting to harmonize environmental laws affecting the livestock sector through regulations and directives to be applied on an EU-wide basis.

At present the majority of EU countries are moving only slowly towards greater control of detrimental environmental effects of intensive livestock farming. The Netherlands and Denmark already have their own legislation that is stricter than EU legislation. Although these two countries therefore could be expected to seek stricter EU legislation applying in all member states, they do not seem to have enough support from other countries to achieve the desired EU-wide rules that would increase environment-related costs of producing hogs in other member states.

A major EU environmental initiative directly affecting the intensive hog industry in Denmark and the Netherlands is the "Nitrate Directive" (see, e. g., Leuck 1993). The purpose of this directive is to keep the concentration of nitrate in ground and surface water from exceeding certain levels. The requirements of the directive are to be fully implemented by 1999. The directive includes provisions designed to reduce the leaching and runoff of nitrate from manure.

These provisions have to do with, for example, the time of the year when manure may be applied, restricting manure application on sloping, waterlogged, flooded, frozen, or snow-covered ground, accounting for the effects of rainfall on runoff, and requirements to

have adequate manure storage facilities. The directive also specifies a kind of nitrogen accounting to be used for manure disposal, and puts a quantitative limit on the amount of nitrogen equivalent in the form of manure that may be applied per hectare.

Leuck et al. (1995) estimated that implementation of the nitrate directive could require significant reductions in livestock numbers in several EU countries, including Denmark and, particularly, the Netherlands. EU-wide, hog production would be reduced more than other livestock enterprises.

Animal Health: EU veterinary legislation concerning animal health seeks to harmonize the legislation of individual EU member states and to introduce new legislation where needed to deal with problems that EU member state legislation does not address adequately. EU activities in this area are designed to allow the market for animal products and live animals in the EU to operate as one single market, without hindrance from animal health-related border controls of individual EU member states.

The single market objective has largely been reached with the passing of common legislation on the control of major livestock diseases. As long as there is no serious outbreak of a major disease, EU rules allow livestock and products to move across borders within the EU on the strength of veterinary certificates issued at the point of dispatch in accordance with common EU standards.

EU animal health legislation and controls include the following:

1. measures to eradicate swine fever;
2. heat treatment for pork products;
3. measures to restrict the outbreak and spread of foot and mouth disease;
4. measures to prevent Aujeszky's disease;
5. outline measures for the transport of animals with a view to safeguarding their welfare;
6. rules governing the placing on the EU market of animals and products of animal origin which are not or will not be covered by specific EU laws; and
7. a proposal to adopt a general solution concerning controls in the EU for the presence of residues in farm animals, meat and meat products.

Meat Inspection: EU rules governing veterinary and health checks on slaughtering, meat handling and processing in establishments in the EU are extensive. EU standards largely reflect, however, the standards already imposed by authorities in the member states. The application of EU rules has put out of business many of the smaller and less efficient units that could not afford the costs of compliance. This has helped to improve the structure of the industry, although this was not the main purpose of the legislation.

The EU's "third country meat import directive" has, since 1972, laid down the rules for veterinary checks on animals and fresh meat entering the EU from non-EU countries ("third countries"). It specifies the conditions under which

fresh and frozen pork slaughtered in third countries may enter the EU. A wide variety of requirements are imposed. They include, for example, detailed conditions for the approval of slaughterhouses, meat cutting plants, and cold storage in the third country from where the meat is imported to the EU. Such requirements cover, *inter alia*, the layout of slaughter facilities, hygiene of staff and premises, and specifications for packaging, storage, and transport of meat.

Many of the requirements relating to slaughter and handling of meat are the same or similar to those applied by the authorities in the exporting country. The fact that they do differ in some ways and that inspection is required at the border entering the EU means that the requirements of the third country meat directive have the effect of impeding imports to the EU. They are thus seen as trade barriers by non-EU countries, whose efforts to export pork to the EU are frustrated.

With the advent of the sanitary and phytosanitary agreement resulting from the Uruguay Round of multilateral negotiations, in combination with the implementation of EU single market rules, the EU and major meat supplying non-EU countries are working towards reaching veterinary equivalency agreements. These agreements would replace or complement the third country meat directive as the framework of rules governing the import of animal products into the EU. The objective of the agreements is generally to recognize equivalency between the veterinary requirements of the EU and those of the supplying country. These agreements could result in less severe trade impediments than those related to the third country meat directive.

SECTION E: THE COMPETITIVE POSITIONS OF THE DANISH AND DUTCH INDUSTRIES

E.1 Introduction

The discussion of the competitive positions of the hog and pork industries in Denmark and the Netherlands follows the so-called SWOT scheme. This consists of systematically reviewing factors that influence or determine the future competitive performance of the industry. These factors are presented under the headings of, Strengths, Weaknesses, Opportunities, and Threats. The Danish industry is discussed first, followed by the Dutch industry[60].

E.2 SWOT Analysis of the Hog and Pork Industry in Denmark

The results of the SWOT analysis of the Danish industry are summarized in the following table:

STRENGTHS	WEAKNESSES
1. Vertical integration of industry through cooperative structure 2. Education and training of labour force - agricultural - processing 3. High quality products, tailored to the needs of individual markets 4. Efficient transfer of product quality information along production-processing chain 5. Research 6. Attitude - a culture of excellence	1. Farm cost structure: - highly capitalized - high labour costs 2. Processing cost structure: - high labour costs - high capital equipment costs 3. Cooperative structure - must take all pigs 4. Presence in Japanese market: - sell to processors/wholesalers - poor Danish brand identity with consumers - mostly frozen pork rather than fresh/chilled
OPPORTUNITIES	**THREATS**
1. Research and development advances e.g., measurement of carcass colour - genetic and feeding improvements 2. Cheaper feed grains (CAP reform) 3. Expanding existing export markets: - Japan 4. New markets - Central and Eastern Europe - Korea - Other Asia-Pacific markets, e.g., China	1. Farm level production: - restrictions on herd size (manure related) - consumer animal welfare concerns 2. Markets: - decline in UK market - difficulties of doing business in Central and Eastern Europe 3. Competitors: - rebuilding industries in Central and Eastern Europe; gaining EU membership - Taiwanese strength in Japanese market - industrialized US hog/pork production

[60] van Gaasbeek et al. (1993) provide a somewhat similar discussion.

STRENGTHS

Cooperative Structure

One of the strengths of the Danish industry is its cooperative ownership structure. About 97 percent of Danish pork output is processed and sold through farmer cooperatives. Although membership in a cooperative is voluntary, Danish cooperatives require members to sell all of their output through the cooperative. This facilitates planning and decisions for investment in slaughter and processing capacity: it is a more complicated and lengthier process for hog producers to switch between hog buyers when buyers' prices are different[61]. Thus, the cooperatives effectively are single buyers of hogs from their respective members. To the extent that cooperatives also operate in exclusive territories, their monopsony buying power is enhanced.

The meat industry organization, Danske Slagterier (DS), is a strength of the Danish pork industry. DS coordinates policy initiatives and research and development initiatives for the industry, and represents the interests of all segments of the pork industry. Furthermore it provides a forum within which different segments of the industry can communicate, thereby improving the information flow along the production-processing-marketing chain and fostering the cooperative spirit of the Danish pork industry.

The main advantage of the cooperative ownership structure, however, is that it facilitates vertical coordination between different stages of the pork value chain. The close vertical coordination within the Danish hog and pork industry may have evolved as a means to reduce transaction costs throughout the industry[62].

Cooperative ownership of slaughter and processing plants is sometimes an impediment to rationalization of industry capacity. In Denmark, however, the cooperative ownership structure has not impeded rapid and far-reaching rationalization of the slaughtering and processing industry, involving elimination of many plants.

Education and Training

Education and training of the agricultural workforce, as well as the processing sector workforce, is given special emphasis and government support. The government apparently underwrites most of the cost of training the agricultural labour force through the agricultural colleges. A well-trained, flexible agricultural sector may be more

[61] It is reported that in mid-1996 exceptionally high prices of weaner pigs in Germany attracted significant sales of live weaners to Germany by Danish producers (Agra Europe 1996b). Such export sales of weaners would apparently be permitted under Danish supply contract stipulations. However, it has been suspected that slaughter hogs also have been exported by members of Danish cooperatives, a practice that would contravene the farmer-cooperative supply contracts. The considerably higher hog prices in Germany would be an incentive to Danish hog farmers to leave their cooperative marketing arrangements.

[62] Transaction costs are the costs of carrying out a transfer of goods between technically separable phases of production and distribution. They arise whenever there is any form of economic organization, be it within a vertically integrated firm, or in a market.

responsive to market signals and more willing to try new production methods.

The high educational requirements that must be met by potential farmers also reduce the monitoring costs of cooperatives. Cooperatives must accept any farmer as a member and all the hogs a member wants to deliver. Therefore, the presence of a large number of poorly trained farmers could threaten the quality of the basic input to the industry, i.e., the hogs. The educational process has two cost reducing effects. It weeds out those who are not willing or able to manage their herds well enough to produce high quality hogs. Second, it improves the likelihood that farmers will be able to understand and implement new regulations and adopt new technologies. In the absence of the formal training, the cooperatives would have to spend considerably more to assure that farmers provided hogs of the desired quality.

The processing sector also has a well trained labour force - either through college apprenticeships or training courses run in the slaughter plants. The training and education which the Danish Meat Trade College is able to provide the Danish meat industry is invaluable. The existence of the training slaughterhouse at Roskilde also provides the Danish industry with a competitive advantage. Workers are taught how to cut products to the specifications of different markets and gain experience with the very latest technological developments in meat processing.

High Quality Products

One of the strengths of the Danish industry is its ability to produce high quality products, tailored to the specification of individual buyers. The industry invests resources in researching the types of products which various markets require, and in researching how to produce these products. The Danish industry essentially works as a complete system from breeding, on-farm production methods, training of agricultural workers and processing sector workers to in-plant logistics and distribution systems.

The system is also flexible and has adapted to the changing needs of the market place (for example, exports of tailor-made cuts increased from 5 percent of Danish exports in 1970 to over 60 percent in 1994). Other aspects of slaughterhouse management demonstrate the dedication to product quality that permeates the entire Danish industry. For example, the long-term stationing of Japanese representatives in the cutting plants to check product quality on the Japanese line; the use of far slower line speeds (300-400 carcasses an hour) than are typically used in hog slaughtering plants in Canada and the US; and the use of information technology to improve within-plant logistics.

Efficient Information Transfer

Efficient information transfer is central to the ability of the Danish industry to provide products of a consistent quality and tailored to the requirements of individual markets. Farmers receive a

great deal of information about each hog sent for slaughter, including carcass grades, weights, length, veterinary comments, etc. As payment is directly related to the carcass grades there is an incentive for farmers to improve their practices in order to produce hogs of a consistently high quality.

The ability to trace products throughout the production-processing chain improves the flow of product information both up and down the chain. For example, the Steff-Houlberg plant at Ringsted uses a sophisticated computer logistics technology, based on the use of a radio chip in each box of meat cuts which stores information on the specifications of these cuts. This facilitates efficient management of the plant. It also improves the flow of product information in both directions between different stages in the processing and further processing and distribution chain.

Research

Another noticeable strength of the Danish pork industry is its highly coordinated research efforts. Under the auspices of DS, research into genetically enhancing the four breeds used by the Danish industry is ongoing. Other research activities have led to improvements in transportation technologies and the means to reduce the incidence of PSE pork. At the processing level, the Danish Meat Research Institute at Roskilde develops more efficient processing technologies.

At the market level, DS undertakes market research into its main export markets and into potential new markets. These various levels of research activities cover all aspects of the producing-processing-distribution-marketing chain and appear to be well-coordinated.

For example, part of the DS research program includes an initiative to develop a method of objectively measuring meat colour at the carcass grading and processing stage. If this becomes possible, then genetic research would be undertaken to allow the industry to breed for varying degrees of pigmentation. This scientific research is undertaken because of the results of market research in Japan, which determined that Danish pork is a little too light-coloured for the Japanese market (while it is of an acceptable colour for other export markets). If the industry is able to control this characteristic through breeding enhancement and finds a method to determine the degree of pigmentation objectively at the processing stage, then products can be tailored even more accurately to the specifications of different markets.

Attitude

Perhaps the strength which is most pervasive throughout the Danish industry is the attitude of individuals. This can perhaps best be described as a *culture of excellence*. The requirements of the marketplace seem to be a paramount concern in all stages of the industry - from processing companies, to the meat

training college, to the meat research institute and at DS[63].

Denmark is one of the most successful pork exporting countries in the world. However, this does not appear to have made the industry complacent. Through the coordinating role of DS, many segments of the industry are striving to improve their production practices to better suit the changing needs of dynamic marketplaces.

WEAKNESSES

Farm Cost Structure

Farm-level production of hogs in Denmark is highly capitalized and, therefore, extremely sensitive to changes in the interest rate. This makes the industry somewhat vulnerable. Although Denmark typically has had high nominal interest rates, the high inflation rate has reduced the real cost of capital (Walter-Jørgensen 1993). As the European Union continues to integrate, both economically and politically, the influence of interest rate policies in other EU countries on the Danish economy inevitably increases. The eventual accession of Eastern European countries (such as Poland, Hungary, and the Czech Republic) into the EU in the future would have significant budgetary ramifications for the EU and could adversely affect interest rates in all EU countries.

The agricultural industry faces higher labour costs than in many other pork producing countries. As well, feed costs in the EU are higher than in most of Denmark's non-EU competitor countries. All these factors combined mean that the Danish industry begins with a relatively high-priced input to the processing sector. This accentuates its need to produce a high quality product since the industry is unlikely to be able to compete strictly on a cost basis. However, feed conversion ratios in Denmark may be lower than in countries with cheaper feed grains (such as Canada and the US), which would offset some of the Danish industry's higher labour costs and interest payments.

Processing Costs

A weakness of the Danish industry is the relatively high labour costs in the processing sector. Hourly wage rates for slaughterhouse workers in Denmark are around $36 compared with around $13 in Canada. It is not clear to what extent such a large difference is offset by productivity differences.

Cooperative Structure

Although the cooperative ownership structure is a source of several strengths of the Danish industry, in some circumstances it can also be a weakness. This can be the case as cooperatives are

[63]See Hobbs (1996) for further discussion of the culture of excellence. A sense of optimism and challenge is also very prominent in the policy debate in Denmark. For example, Jørgensen (1992), in a report prepared for the Ministry of Agriculture, proposed a dramatic increase (doubling) in the value of farm level production between 1990 and 2010, while the value of food processing would increase threefold or fourfold. Concerning the pork industry, Jørgensen envisaged a doubling of the number of hogs produced in Denmark, with associated increases in the activity of the processing industry.

obliged to take all the hogs delivered by their farmer members, regardless of quality. There are, of course, price penalties for poor quality hogs, but the cooperative cannot ultimately refuse to take any member producer's hogs.

The requirement to accept all hogs offered also means that slaughterhouses cannot reduce throughput if market conditions change and the demand for their products falls. This is why it has been essential for the industry to develop efficient grading processes that provide farmers with the correct incentives to produce the types of hogs which the market requires.

Poor Retail Presence in the Japanese Market

Japan is an extremely important market for the Danish industry. Currently the industry sells the vast majority of its products to secondary processors and to the wholesale trade in Japan. This means that, unlike in many other of its export markets, Danish products do not have a strong identity with Japanese consumers. Danish pork is seldom identified as such when purchased by Japanese consumers. This leaves the Danish industry somewhat vulnerable.

If Danish products had a strong brand identity in the Japanese market (as they do, for example, in the UK market), the cost to retailers and secondary processors of switching suppliers could be high. If consumers have developed a brand loyalty for a particular product, the brand manufacturer has more leverage with the retailer or distributor. If, however, the retailer or distributor sells the product unbranded, or sources from a number of different suppliers, the costs of dropping a supplier is much lower. Hence, should other exporters develop products of a consistently high quality that are cost competitive with the Danish product, the Danish industry could see its share of this lucrative market decline.

A related weakness lies in the fact that nearly all Danish exports of pork to Japan are frozen. Frozen meat products are heavily discounted in the Japanese retail market. Japanese consumers shop frequently for their meat products and freshness is of paramount importance. If the Danish industry were to attempt to penetrate the Japanese retail market, it would need to provide a chilled product.

Given the distance between Denmark and Japan, shipping chilled pork products would require air shipment. This likely would be prohibitively expensively. The alternative, shipping by sea freight, would require a very long shelf life for the product. Extensions of product shelf-life to ensure the freshness of delivered product would require the Danish industry to undertake considerable research and development into chilling and packing technology. Whether this weakness of the Danish industry in the Japanese market will become a serious threat to the industry depends on the ability of its main competitors in that market - Taiwan, the US and Canada - to develop competitive chilled products of a consistent and reliable quality.

OPPORTUNITIES

Research and Development Advances

The well-structured, coordinated research capability of the Danish industry creates numerous opportunities for product improvement, which helps to successfully meet evolving market needs. For example, the development of techniques to measure carcass colour and genetic improvements could enhance the ability of the industry to tailor its products to specific markets.

Reform of the Common Agricultural Policy

The reform carried out over the last few years of the EU CAP has resulted in lower feed grains prices within the EU than otherwise would have been the case. This helps to redress the lack of cost competitiveness of the Danish industry vis-à-vis non-EU competitor countries, a disadvantage that is usually offset through the use of export subsidies. CAP reform would thus constitute an opportunity for Danish hog production to become more cost competitive.

Expanding Existing Markets

Exports to other EU countries still account for the majority of exports of pork from Denmark, both in quantity and value. This EU market is largely protected against imports from low-cost non-EU pork exporters. Denmark has an opportunity to remain a major supplier of pork to EU countries, where even a constant share of the intra-EU trade is expected to translate into larger quantity of exports. The possibility of gaining a larger share of intra-EU trade is an opportunity for the Danish pork industry. This has been recognized in, for example, projections developed by a group analyzing the future trading environment of Danish agriculture (Landbrugs- og Fiskeriministeriet 1995b). That group anticipated a more than 40 percent increase in quantity of pork exported from Denmark to other EU countries between 1994 and the year 2000.

The Japanese market represents an opportunity to increase exports to non-EU countries. Some observers have anticipated that Danish pork exports to Japan would double in the next 5-10 years, while others (Buhl, 1996) expect Denmark's share of Japanese imports to remain constant. A challenge for the Danish industry would be to establish a brand identity in Japan and, perhaps, to tap into the retail market with Danish-prepared cuts. At the same time, other analysts anticipate a decline of about 30 percent from 1994 to the year 2000 in the quantity of pork exported from Denmark to Japan (Landbrugs- og Fiskeriministeriet 1995b).

New Markets

Numerous new markets present opportunities for the Danish industry to capture. The economic and institutional reforms in Eastern and Central Europe create a large potential market on the doorstep of Denmark. Some processors are already exporting products to Russia, Poland and other states of the former

communist bloc. The products delivered to these countries tend to be of a lower value relative to many other Danish export markets. This does provide an outlet for the lower quality cuts produced by the Danish industry, but it means that the revenues will not be as high as in markets where consumers have more purchasing power. Income distribution in many of these states is beginning to diverge wildly, so that there is a small percentage of relatively wealthy individuals but a growing percentage of relatively poor people. The small, wealthy percentage may represent a niche market for high quality Danish products.

In the Asia-Pacific region, export opportunities may arise. Danish industry expects Korea - with some 45 million people - to become a potentially lucrative export opportunity. The Philippines is also implementing its commitments under the GATT Agreement on Agriculture, resulting in considerably increased access for pork. Danish exporters have identified this market as an opportunity.

China is another potentially large consumer market - particularly if a middle class emerges. Supplying just one percent of the Chinese population with pork products would mean a market of more than ten million people - twice the population of Denmark. The Danish industry can be expected to target any market opportunities which arise there.

THREATS

Farm Level Production

Due to the problems of manure disposal, Danish hog producers are subject to restrictions on the size of their farms and on manure disposal practices (although the problems are not as acute as in the Netherlands). Industry observers in Denmark do not see this as a threat to the number of hogs produced, expecting an increase from currently 20 million hogs per year to 23 million hogs in the year 2000. As concerns over the environment grow, however, this could become a more significant threat to Danish hog production. It is likely to lead to higher production costs relative to competitor industries in Canada and the US, where hog production is more widely dispersed over a greater area.

In some European countries, consumer concerns over farm animal welfare have been growing in recent years. For example, in the UK widespread protests took place in 1995 over the shipment of veal calves from the UK to continental Europe. Governments in EU countries (such as the UK and Sweden) are addressing the concerns by means of strict farm animal welfare standards. Reforms to the CAP in the livestock sector encourage extensification of livestock production. Danish pork production tends to be highly intensive and could therefore come under some pressure to adapt to stricter animal welfare standards.

In response to consumer concerns in European countries, particularly in its export market in the UK, the Danish industry is developing a "welfare pig" production system. This system allows the animals greater freedom of movement and aims to satisfy many of the concerns voiced by consumers. A common industry scheme was preferred to the proliferation of a multitude of "welfare" programs, which could have generated confusion among concerned consumers. Should animal welfare concerns become a serious issue in other export markets, the Danish industry is thus in a position of preparedness to face such a threat.

Markets

Denmark's main export market for pork (including bacon) has historically been the UK. Although the UK is still an important market for Denmark, exports to the UK have declined with stagnating bacon consumption and the Netherlands gaining an increasing share. The response of the Danish industry to this threat has been to diversify its product offering in the UK market. Other export markets have also been cultivated so that the industry no longer relies on one country for most of its sales.

Although countries in Central and Eastern Europe are market opportunities for Danish pork, the transaction costs of doing business in these countries are high (Gaisford et al., 1995). Market economies are only just developing and often lack the reliable and functioning legal and financial institutions which form the basis of economic transactions in Western economies.

Searching out reliable buyers in Central and Eastern Europe is costly, as is ensuring that payment is made. As a result, transactions are often carried out on a cash-on-delivery basis. Not having a well-functioning commercial legal system to enforce contractual agreements also raises the cost of doing business in these countries. Similar problems arise in developing exports to China. However, the problems faced in developing pork exports to any of these countries are, of course, not particular to exports from Denmark. All potential exporters face them equally.

Competitors

The perhaps most important threat to the Danish industry is its competitors. For example, the process of rebuilding and modernizing the hog and pork industries of central and eastern Europe is underway. Although these countries currently represent an opportunity to expand exports from Denmark, they also pose a threat when their hog and pork industries become more efficient and competitive. Countries such as Poland have enormous production potential. Pork production was once an important industry in Poland and consumption of pork is high.

Some of the countries of central and eastern Europe could, if they gain membership in the EU, become a competitive threat to the Danish pork industry. However, given the extensive economic restructuring needed in the pork industries in these countries, this

threat is not likely to materialize in the immediate future.

Imports of pork to Japan from Denmark are second only to imports from Taiwan. Taiwanese exports represent a competitive threat in the Japanese and other potential Asia-Pacific markets. The Taiwanese industry has a cost advantage over the Danish industry, both in production and processing costs and in distribution costs, given its proximity to Japan. At the same time, hog production in Taiwan is facing severe environmental constraints and the number of hogs produced is not expected to increase.

While Danish exports to Japan are almost only high valued cuts, Taiwanese exports represent a range of values and are used for many purposes in Japan, both as lower value inputs for further processing and as substitutes for Japanese pork. Taiwan has greater problems with PSE pork than does Denmark. This gives an advantage to Danish pork, since in Japan the appearance and presentation of the food is as important as its taste. Should Taiwanese exporters, however, strengthen their capability to deliver products of a consistently high quality, exports from Denmark to Japan and other Asia-Pacific markets would be threatened.

The major current competitive threat to the Danish pork exports comes from the US The rapid industrialization of the US hog and pork industry, as evidenced in the growth of huge production and processing units, means that US producers will be able to gain considerable economies of scale. A major share of US slaughter occurs in large processing plants with a daily capacity of over 10,000 hogs (Klein et al. 1995; Kalaitzandonakes et al. 1996).

Contract production is part of the industrialization of the US hog and pork industry and is thought to improve vertical coordination in the industry. Improved vertical coordination reduces transaction costs and enables product information to flow more efficiently along the production-processing chain, resulting in more control over product quality. Moreover, the US has the potential to further improve quality by adopting carcass grading and pricing on a more widespread basis than is currently the case.

Through industrialization and closer vertical coordination, the US is expected to soon be able to produce high valued products tailored to the specifications of different markets. US exports will thus compete effectively in the same market segments as Danish exports. The "Achilles Heel" of the Danish industry could be its relatively high processing costs. The volume processed in a single US plant can rival total volume in the Danish processing industry. The possibilities of sorting and selecting products for specific markets are correspondingly large in such a US plant[64]. A US industry that can match the quality attributes typical of Danish

[64]See, for example, Boland et al. (1995) for a discussion of sorting techniques.

products, but at a lower cost, represents a serious threat to Danish exports of pork.

Analysis has even supported doubts about the ability of Denmark to remain a net exporter of pork in the event that all trade barriers were eliminated. In such a case, low cost supplies from the US and Canada would enter markets in the EU, including Denmark (Jensen et al. 1995).

E.3 SWOT Analysis of the Hog and Pork Industry in the Netherlands

The results of the SWOT analysis of the Dutch hog and pork industry are summarized in the following table:

STRENGTHS

Location and Transportation Infrastructure

The Netherlands has a well developed distribution system with excellent highways, railways, and waterways. Transportation links with the large and modern port of Rotterdam, among others, facilitate imports of feed ingredients from producing areas in Europe and overseas.

STRENGTHS	**WEAKNESSES**
1. Location and transportation infrastructure 2. Farm production efficiency and low cost 3. Production oriented research 4. Integrated and coordinated structure 5. Education and training 6. Financing 7. Access to protected EU market	1. Limited domestic market 2. Manure surplus and environmental standards 3. Animal health 4. Product quality perception 5. Overcapacity in slaughtering 6. Lack of market oriented research
OPPORTUNITIES	**THREATS**
1. Reduce cost by rationalizing slaughterhouse capacity 2. Structural reform of hog and pork industry 3. Strengthen animal health and quality control standards 4. Enter non-EU export markets - Central and Eastern Europe - Japan - Other Asia-Pacific markets (Korea, China)	1. Manure disposal 2. Cheaper feed grain elsewhere in EU (CAP reform) 3. Competition from other countries - rebuilding industries in Central and Eastern Europe; gaining membership in EU - Taiwanese strength in Japanese market - industrialized US hog/ pork production 4. Animal health and welfare standards

The Dutch hog and pork industry faces low distance-related highway transportation costs and easy access to such important consumer countries as Germany, France and Belgium. These three countries receive a significant portion of the 70 percent of Dutch hog production that is exported. Relations between transport companies and their clients in the agri-food sector are close. This results from the fact that many of the independent trucking companies that carry agri-food related goods were created by farmers or members of their families.

Farm Production Efficiency and Low Cost

At the farm level, many of the Netherlands' performance indicators are equal to or better than those of Denmark[65]. This applies, for example, to sow reproduction levels, daily gain, feed conversion ratio, production cost per kg of carcass, and share of large hog farms. However, the Netherlands has a dramatically lower share of integrated or closed operations than does Denmark, resulting in weaker disease control.

Hog production in the Netherlands has an advantage over hog production elsewhere in the EU through the easy access to imported, low-cost feed ingredients. This can make feed costs lower in the Netherlands than elsewhere and reinforces the cost advantage gained from good production efficiency.

Production Oriented Research

Research in animal welfare and reproduction, feeding, waste disposal, and management is a priority and is seen as vital for the future success of the industry. Good coordination is achieved between researchers and their clients. This relationship that has been institutionalized through interlocking memberships among commodity boards, farmer groups, and agribusiness companies, on the one hand, and the boards that direct the work of the extension services and the research stations, on the other. The fact that a large portion (about half)[66] of the agri-food research effort is funded by the agri-food industry itself may be a factor contributing to the successful coordination.

Integrated and Coordinated Structure

The Dutch hog and pork industry is integrated to a large extent. Many producers are linked to processors through cooperative ownership, and private companies (especially slaughterhouse companies) exert considerable control over supply and quality specifications. This integration allows hog producers to enter into long term contracts with buyers and enables slaughterers and processors to provide a consistent product to their customers. The Integrated Chain Control system now being introduced also helps to convey information from the downstream,

[65]See, for example, Kearney (1994).

[66]This portion refers to the whole agri-food research effort, not only to research related to hog and pork production.

buying participants in the chain to the upstream, selling participants.

Although cooperatives are not as dominant in the Dutch hog and pork industry as they are in Denmark, they are still prevalent enough to be an important structural characteristic of the industry. The cooperative structure gives hog producers more insight into and more responsibility for the factors that determine the price of hogs. It thus facilitates the relationship between primary producer and processor. Cooperatives also benefit from preferential taxation status.

The product boards of the Netherlands help to achieve an integrated and cooperative structure without relying on farmer owned cooperatives as the only actors in the slaughtering business. The Product Board for Livestock and Meat (PVV) provides support throughout the value-added chain, and represents the industry as a whole with the Dutch government and at the EU. As the PVV comprises the whole chain, PVV initiatives need to be taken on the basis of discussions with all participants in this chain. While this increases the impact of PVV initiatives, it could also, in some situations, result in less bold compromises being the end result.

Product boards are organized at the behest of government and operate under statutes that give them some powers of government (such as the ability to raise funds through levies). These character-istics distinguish them from pure industry-led organizations and perhaps reveal the importance Dutch policy makers have attached to achieving an integrated and coordinated structure in the agriculture and food industry.

Education and Training

Besides a standard curriculum, the Dutch educational system offers specialized and vocational training in agriculture at the lower secondary, upper secondary, college and university levels. Many of the institutions at each level offer continuing education and night courses. Many Dutch farmers participate in some form of continuing education. Specialized training for the meat sector is also available.

Farmers' unions, product boards and cooperatives provide on-going advice and training. The government also operates a system of agricultural information in close consultation with the industry. Several hundred experts in this system provide information through the media, meetings, and individual support.

The existence of a well established system for education and training in agriculture and food, in combination with an apparent ongoing interest on the part of government to maintain and improve this system, is a source of competitive strength for the Dutch hog and pork industry. This strength is reinforced if decisions about such things as training curricula and delivery mechanisms continue to be made in consultation with the industry that employs the trained individuals.

Financing

The creation of the Rabobank on cooperative principles has provided a sympathetic or at least well informed source of financing to the farming business. The overwhelming majority of credit extended to Dutch farmers is proved by Rabobank. The cooperative structure has facilitated closer relationships between borrower and lender than would have been the case in the sometimes more adversarial farmer/banker relations seen in other countries. At the same time, the success of Rabobank as a farm lender must, to some extent, be attributed to it having been managed in a business-like manner, not only to it being a cooperative bank.

The Dutch government can guarantee loans for hog producers via Rabobank. Loan approval is subject to a professional assessment of the financial viability of the enterprise. The guaranteed loan program provides for a preferential rate of interest.

Having access to an informed and business-oriented lender, with a commitment to continued relations with the agriculture and food industry, is a strength of the Dutch hog and pork industry in comparison to that of many other countries.

Access to Protected EU Market

All Dutch exports of weaners and live hogs and almost all exports of pork (including bacon) are destined to countries in the EU. Low overland transport costs are part of the explanation for this. At least as important, however, is that through a variety of policy measures, low-cost pork producing countries elsewhere in the world have no or only very limited access to this market. This situation confers a competitive advantage on hog and pork production in the Netherlands, compared to low-cost competitors outside the EU.

As a result of manure disposal problems in hog production, the Netherlands may not be able to take advantage of this strength to the same extent as other hog and pork suppliers in the EU, such as Denmark.

WEAKNESSES

Limited Domestic Market

With a population of 15 million, the Netherlands is a small domestic market in relation to the size of the hog and pork industry. The consumption of pork has stagnated at about 44 kg per person per year, which is only slightly higher than the average for EU. Meeting domestic demand in such areas as product development and innovation may not have been any particular challenge for the Dutch hog and pork industry. This may have impeded the transition from a cost/price leader strategy to a market leader or niche strategy.

Dutch consumers are only now beginning to move away from traditional products and are choosing more ready-to-cook products and snacks. Consumers are also starting to make more stringent demands on the quality of pork. The Dutch industry appears to be responding by

focussing on product development and quality control.

Manure Surplus and Environmental Standards

Pig farms account for over 70 percent of the manure surplus generated by livestock production in the Netherlands. Since 1987, regulations have been in force to reduce the environmental impact of manure. Standards for such things as storing manure, calculating the manure surplus, and disposing of manure have been established. Although initial standards were set relatively low, they are being gradually tightened.

As a result of the relatively greater surplus of manure in the Netherlands than in other EU countries, Dutch farmers will incur higher costs for manure disposal than will their colleagues in other countries. Dutch hog production is thus faced with a manure-related physical limit on additional hog production as well as a cost related to the disposal of manure generated at the current herd size. Without technological breakthroughs in manure production and handling, the cost related to manure will become even more significant in Dutch hog production. This creates a serious weakness in the future performance of the hog and pork industry in the Netherlands.

Animal Health

Only a minor share of hogs in the Netherlands are finished in farrow-to-finish operations. As a result of the physical separation of farrowing and finishing, weaners have be transported and this sometimes mixed with animals from other farms. This increases the risk of spreading diseases to a larger number of hogs than is the case in countries where farrow-to-finish operations dominate (e.g., Denmark). Farrow-to-finish operations are increasing. However, they continue to represent less than 25 percent of all hog farming operations.

In 1991, the Netherlands suffered several instances of classic swine fever; 1992 saw occurrences of vesicular disease. These outbreaks do considerable damage to export efforts and perception of product quality.

The Dutch industry (such as the PVV) and the government are, of course, very conscious of the competitive weakness caused by uncertain animal health status. A deliberate effort to address the problem appears to be behind initiatives such as the National Pig Health Care Program.

Product Quality Perception

Consumer surveys have suggested that the quality perception of Dutch meat is inferior to that of Denmark. This conclusion was reached by the Danish Meat Research Institute in 1993 in a survey of European and Far East markets (also cited by Kearney 1994). This is confirmed by comparing the export unit value of pork exports from the Netherlands and Denmark. Such a comparison reveals a lower export unit value for Dutch pork. This could be caused by a Dutch strategy to export lower-value

products (in contrast to the Danish strategy of exporting high-value cuts), or it could be caused by an overall relatively low ability of Dutch products to fetch prices in export markets equal to those of Danish exports.

Overcapacity in Slaughtering

The Dutch slaughterhouse sector has an excess capacity of the order of 20 percent of current capacity, at the same time as more than 20 percent of hogs raised in the Netherlands are exported live to be slaughtered abroad. This indicates that the excess capacity is the result of it being high-cost capacity. Although the industry is carrying out a program to reduce overcapacity, more capacity may, at the same time, become surplus as the number of hogs declines as a result of manure disposal problems.

The surplus slaughtering capacity brings the domestic slaughterhouses into competition with the export of live hogs, thereby exerting upward pressure on the domestic price level. Given the large number of weaners and hogs exported to other European countries, the export sales of pork from Dutch slaughterhouses also compete with hogs of Dutch origin that are finished or slaughtered in foreign countries.

The overcapacity in slaughtering and perhaps also in processing slows industry investment in product and process development, an area long given relatively low priority by the Dutch industry. Restructuring is taking place in the slaughtering and processing industry, involving both farmer cooperatives and private firms. Before this process achieves even more concrete results than to date, however, high-cost slaughtering overcapacity remains a weakness of the industry in the Netherlands.

Lack of Market Oriented Research

Although strong in production-oriented research, the Dutch industry has been traditionally weaker in market-oriented research. This has been due to the focus on intensive livestock production rather than on value-added products delivered to specific target markets. Some of this focus may have been attributable to sector's reliance on government-supported structures for agricultural research.

The production-oriented research that is currently being emphasized should benefit the industry in terms of improvements in breeds, feed-conversion ratios, etc. There are signs that such research is increasingly coupled with market-oriented research, following the Danish example. Market-oriented research would identify the market opportunities and suggest the characteristics of the products suitable for different markets. Production-oriented research would then be tailored to improved control over these characteristics so as to provide high quality products suited to different markets. Until more concrete steps have been taken, however, the research orientation in the Netherlands appears to remain production-oriented.

OPPORTUNITIES

Reduce Cost by Rationalizing Slaughtering Capacity

Significant rationalization of the hog slaughtering and processing sector has taken place in recent years. The merger of Coveco, Encebe and Gupa into Dumeco is the outstanding example. Dumecos's export division merged with Kishue to form Dumeco International, one of the country's largest trading houses.

The slaughtering industry in the Netherlands still comprises a considerable share of high-cost capacity that is not able to slaughter hogs as cheaply as competing slaughtering plants in neighbouring countries. The result is a large export of live hogs. Opportunities thus exist in the Netherlands for further industry restructuring and rationalization. Moves to reduce excess capacity could lead to greater efficiency throughout the value-added chain by reducing costs. This could also give the impetus for additional investment (e.g., in research, in physical plant, or in business structures) that could lead to the development of new products or products of a higher value.

Structural Reform of Hog and Pork Industry

Because of its manure disposal problems, the Dutch hog industry has in effect reached a production ceiling. With a stagnant or shrinking hog industry, in terms of hog numbers, there is still scope for development of the industry by switching to the raising of hogs of very high quality to meet very specific demands. This would be opposite of the strategy followed traditionally in the Dutch hog industry. Still, with the industry facing major changes in its operating environment (tighter manure restrictions), the possibility of it undergoing a dramatic change in orientation can not be totally dismissed.

At the same time as hog numbers are stagnant in the Netherlands, and Dutch slaughterhouses have significant excess capacity, a considerable number of hogs are exported live for slaughter elsewhere in the EU (mainly in Germany). The number of live hogs exported has in recent years corresponded to 13 percent of the number slaughtered in the Netherlands. This seems to point at the possibility of making the Dutch slaughter and pork industry capable of competing with slaughter facilities abroad, resulting in a reduced or perhaps even reversed flow of live hogs.

Strengthen Animal Health and Quality Control Standards

One of the problems identified by Dutch pork exporters is a difficulty in providing buyers with guarantees about the product meeting certain standards. This is a disadvantage particularly in demanding export markets for high-valued products, where it can be important to be able to deliver products of a consistent and known quality. If quality standards do not exist or are not applied throughout the value-chain, the exporter is unable to provide buyers with assurances about such things as origin of animals, the kind

of feed used, the use or non-use of certain pharmaceuticals, compliance with animal welfare standards, and slaughtering techniques.

The Dutch hog and pork industry, through the PVV, is putting in place a national scheme designed to enable exporters to give better guarantees about the quality of the products sold. Exporters will be able to rely on quality controls carried out by an independent body, under the supervision of national authorities. It is expected that the operation of this scheme will make it possible for Dutch exporters of pork increasingly to meet export demand on the basis of product characteristics rather than on the basis of price only.

Enter Non-EU Export Markets

The Dutch pork industry sees the same new, emerging or growing markets as other pork exporting countries see. They include Central and Eastern Europe, Japan, Korea, and other Asia-Pacific markets. Although the Netherlands has not been a major exporter of pork and pork products to overseas countries and markets, other Dutch food exporting industries have much experience from these countries. The Dutch pork industry has an advantage in this respect that some of its competitor countries lack.

The beginning of pork exports from the Netherlands to Japan is evidence of the desire to tap into growing markets. With increasing ability to compete not only on price but also in terms of having products suitable to specific demands, the opportunities open to the Dutch hog and pork industry are no less real than those open to other countries.

THREATS

Manure Disposal

The most acute threat for the Dutch swine industry is the lack of sufficient land for manure removal in hog production areas. The government has established legislation in an attempt to alleviate environmental concerns. The aim is to reach a balance between manure production and disposal by the year 2000. The consequences for hog production include higher costs for manure disposal, translating into higher raw material costs for the processing industry. This will erode the cost advantage that traditionally has characterized the Dutch pork industry.

The constraints on manure production also put a ceiling on the number of hogs raised in the Netherlands. This means that expansion of the hog industry cannot take the route of increased quantity, leaving improved quality as the only expansion option.

Cheaper Feed Grains Elsewhere in EU

The reform of the EU CAP that was initiated in 1992 has led to feed grain prices in the EU being lower than they would have been without reform. Ordinarily lower input costs in hog production would be interpreted as an opportunity. In the case of Dutch hog production, however, it translates as a threat.

Hog production in the Netherlands uses relatively cheap imported non-grain feeds to a much larger extent than in other EU countries. This has partly to do with the low cost handling of such feeds in the port of Rotterdam, with many hog facilities being located nearby. By using non-grain feeds, Dutch hog producers have had a cost advantage over producers in other EU countries. With the reduction in feed grain prices applying to all EU countries, this cost advantage has been lost.

The lost cost advantage in Dutch hog production should not disadvantage the Netherlands in non-EU markets. This is because the high cost of feed grain incurred both by some Dutch hog producers and hog producers in other EU countries is offset by export subsidies when pork is exported out of the EU.

Competition from Other Countries

Ninety percent of pork exports from the Netherlands are destined to other European countries. The obvious contender for pork market share in Europe is Denmark. However, other EU countries, such as France, are also increasing both quantity produced and the market orientation of their pork industries. With stagnant hog production in the Netherlands, it appears difficult for the Dutch pork industry to continue to compete as the low cost supplier of bulk product.

Similar concerns arise in overseas markets. Denmark is already a formidable competitor. In addition, the US is emerging as a highly competitive exporter of pork.

Animal Health and Welfare Standards

Animal health and animal welfare issues are becoming more important in countries importing Dutch animal products. The Dutch industry is taking steps both to improve the health status of animals and products in the whole value-added chain and to make it easier to issue health guarantees to buyers of the product. There is, however, some catching up to do before the health status of competitor countries, including Denmark, is achieved. At the same time, competitor countries are also continually improving their own systems for maintaining healthy animals and issuing guarantees.

Animal welfare standards, whether formalized or expressed through consumer preferences, are in a state of flux and it is difficult to assess the extent to which changes will pose more of a threat to the Dutch industry than to, say, the Danish industry. However, with Dutch hog production mostly relying on separate farrowing and finishing operations, the animals tend to be subject to more physical handling and transportation than in a system based on farrow-to-finish, as in Denmark. This could make hog production in the Netherlands more susceptible to charges of poor attention to animal welfare.

Overall

The overall assessment of strengths, weaknesses, opportunities, and threats for the hog and pork industry in the Netherlands in many ways parallels the assessment for the Danish industry. However, some issues stand out as particular to the Netherlands and are therefore highlighted in the above discussion. They include the structure of the hog farming and slaughtering industry, the severe limits on expansion of hog production imposed by manure disposal problems, and the limited experience in exporting to overseas customers rather than to European neighbours.

Summary

For many years, Denmark and the Netherlands have been established as successful exporters of pork, in competition with other suppliers within the EU or in world markets. Each of these two small countries accounts for only around 2 percent of world pork production, but each country is the source of at least 20 percent of world exports of pork[67].

Denmark's success as an exporter is primarily evidenced by its position as a leading exporter of high value products tailored to customer specifications, including those of demanding markets such as Japan. The Netherlands is the major supplier of pork, live hogs and weaners to importers within the EU, with only a very small presence in non-EU markets.

Today's presence of Denmark and the Netherlands as the world's largest export suppliers of pork is rooted in policy decisions taken almost a hundred years ago. At that time these two countries, contrary to the decisions taken by their neighbouring European countries, chose not to protect their farm sectors. Instead, Denmark and the Netherlands saw their livestock industries (especially hogs) flourish by having access to feed grains at world market prices. Exports of live animals was difficult, so a slaughtering and meat processing industry (including bacon) developed on the strength of having access to competitively priced raw materials. Trade policies aimed at securing market access rights helped this development.

While EU agricultural policy is generally protective and regulatory in its effects, the extent of protection and regulation of EU pork markets is somewhat less than in most other EU agricultural markets. Moreover, both Denmark and the Netherlands tend to be among those EU countries whose interest in freer agricultural trade is above the average of EU members states.

The resulting pattern of strengths, weaknesses, opportunities and threats, in combination with policy decisions, will determine the ability of the hog and pork industries of Denmark and the Netherlands to remain formidable competitors in the future. The analyses of strengths, weaknesses, opportunities and threats also point up the similarities and differences in the factors that explain the performance of the hog and pork industries in Denmark and the Netherlands.

Strengths

Denmark and the Netherlands are similar in being technically efficient producers of

[67]World exports of pork includes trade between EU countries.

high quality hogs and pork. The shared strengths in education and training of workers, including slaughterhouse and meat cutting employees, help to keep production efficient. In Denmark, for example, the industry-run, government-funded Meat Trade College not only generates a pool of plant workers that have the four year apprenticeship training (about 25 percent of slaughterhouse workers) but also provides for continuous upgrading of the skills for all meat trade workers.

In both countries, a research establishment that takes many of its priorities from the industry may also help to explain the high production efficiency on farms and in plants. In Denmark, in particular, research efforts have tended to cover all parts of the value chain, from hog farms, through slaughtering, processing, distribution and marketing. Much of the scientific research in Denmark is undertaken in response to the findings of market research in current or emerging markets.

Relatively little national government assistance is directed specifically to hog producers or the pork industry in Denmark and the Netherlands. National government assistance in both countries primarily supports education and research. Industry activities, to a large extent, are self-funded by way of producer and processor levies.

The Common Agricultural Policy of the EU provides support in the form of market regulation, barriers to imports from non-EU countries, and export subsidies. EU support has undoubtedly been an essential ingredient in Denmark's development of non-EU export markets over the last couple of decades. Likewise, EU barriers to imports from low-cost non-EU suppliers protects the higher-cost hog and pork industries of Denmark and the Netherlands and allows them to concentrate on strengthening their product competitiveness.

Both the Danish and Dutch hog and pork industries derive strength from having an integrated and coordinated industry structure. In Denmark coordination is very much helped by the integrated ownership structure of slaughtering and processing facilities; virtually all slaughtering takes place in plants owned by farmers themselves through producer cooperatives. With all cooperative slaughtering carried out by only four companies, and these companies cooperating in one industry organization, DS (Danske Slagterier), coordination in the industry is further facilitated.

The Netherlands achieves coordination in somewhat different ways. Government itself appears to be more proactive in encouraging vertical coordination in an industry where farmer cooperatives account for a much smaller share (25 percent) of slaughtering facilities than in Denmark. While the PVV (Dutch Product Board for Livestock and Meat, which is only one of several similar constructs for various product sectors) is an industry organization representing all parts of the

value-chain, it has certain powers to operate as an extension of government.

The hog and pork industry of the Netherlands has the additional strength of being close to major consumption centres in Europe, such as Germany. In combination with a good transportation network, shipping the product to its final destination is relatively easy and cheap, compared to shipping to overseas destinations. Also stemming from a location and transportation advantage, the Dutch industry has access to relatively low-cost feed ingredients from overseas. This can be an important advantage in hog production, where feed accounts for such a large share of total costs. The hog industry in the Netherlands is considered to derive strength from having access to credit from lenders who are familiar with agriculture in general and hog production in particular. Cooperatives in the Netherlands also derive some strength from certain advantageous tax provisions.

The hog and pork industry in Denmark is characterized by what has been described as "the culture of excellence". Success in export marketing has not led to complacency. Facing difficulties in achieving cost competitiveness, actors at all levels in the value-chain instead seek very deliberately to improve product competitiveness. Effective information flows is one means of achieving this, and the extensive vertical and horizontal integration evident in the Danish hog and pork industry helps to keep information flowing effectively.

Weaknesses

Costs of many inputs, such as land, labour (farm and processing) and feed are high in Denmark and the Netherlands. The feed cost disadvantage is more than offset, however, through the market regulations applying to the EU hog and pork market and the export subsidies available when exporting out of the EU. High labour costs provide an incentive to substitute capital and technology for labour. This requires ongoing investment, at a cost, in research and development in order to maintain the flow of know-how.

Although the Danish industry generally derives strength from its cooperative structure, there is also a weakness associated with it. The farmer-owned slaughtering company has to buy all hogs offered to it by its owners, which makes planning of slaughter capacity more difficult. This is to some extent offset by the requirement that cooperative members deliver all hogs to the cooperative slaughtering plant.

At the marketing end, Denmark's pork industry is generally strong in the Japanese market, but there are also some weaknesses. In spite of its focus on product competitiveness, the Danish pork export industry sells mostly frozen pork rather than fresh/chilled products. Moreover, Danish brand identity with Japanese consumers is weak as sales mainly go to processors and wholesalers.

In the Netherlands, costs of producing hogs are raised by the need to dispose of

the serious manure surplus. A point appears to have been reached where the manure-related costs prohibit further expansion of hog production. The high population density imposes additional cost-increasing practices on hog farmers, such as those designed to reduce smell. Denmark also faces costs for addressing problems related to hog manure, but the solutions appear to be less constraining on production than in the Netherlands.

The animal health situation in the Netherlands is considered a weakness, although both industry and government are taking steps to strengthen it. The perception among consumers that the Netherlands produces lower quality pork than Denmark is partly linked to the animal health situation, but is also related to such factors as quality consistency versus variability, and certain animal welfare indicators. The weak animal health situation is partly the result of a less vertically integrated hog production structure, with relatively few farrow-to-finish operations where disease problems are more easily addressed than in separate farrowing and finishing operations.

An important weakness of the hog slaughtering industry in the Netherlands is that it includes a large volume of high-cost slaughtering capacity. This is evidenced by the large share of hogs produced in the Netherlands that are shipped to other countries for slaughter, while the Dutch industry is operating considerably below technical capacity. Industry, with the institutional support of government, is in the process of reducing this high-cost capacity. This process imposes a cost on the slaughtering industry, although the resulting improved structure will strengthen the competitive performance of the industry as a whole.

A further weakness of the hog and pork industry in the Netherlands is the relatively low priority traditionally accorded market oriented research. Research efforts have tended to focus on production related problems. As such research is important for reducing costs, it has served to reinforce the focus on improved cost competitiveness in Dutch hog and pork production, at the expense of improved product competitiveness.

Opportunities

Advances in technical research and development, in conjunction with continued market research, are likely to provide opportunities for the hog and pork industry in Denmark to further improve its product competitiveness. Better genetic stock and better feed composition, for example, could help to make hogs even better suited for particular market demands. In the slaughtering plant, technical advances in such areas as measurement of meat colour would allow better matching of carcasses with specific market requirements. Similar opportunities might be found in the case of the Netherlands, although there is a greater need to improve product competitiveness by research focused on market needs, especially if the Dutch industry

anticipates finding new outlets outside of the EU.

With the reform of the EU agricultural policy initiated in 1992, feed grains have become cheaper in the EU. This reduces costs of hog production in both Denmark and the Netherlands. The high price of feed grains is offset by means of export subsidies on many pork products when exporting to non-EU countries. The opportunity may therefore lie less in improved cost competitiveness and more in a reduced need for application of market regulatory instruments, making it possible for the industry to respond more nimbly to emerging customer needs.

In the Netherlands, there are opportunities to reduce costs and improve coordination by further reforming the structure of hog production and slaughtering. Industry organizations are working on improving the links between the various segments in the value-chain, from suppliers of inputs to farrowing operations, to exporters and manufacturers of processed pork products. The need to tackle this problem is greater in the Netherlands than in Denmark, owing to the already more integrated structure of the Danish hog and pork industry, with a larger share of farrow-to-finish operations and almost 100 percent farmer-ownership of slaughtering facilities.

The Netherlands also has an opportunity to reduce costs at the slaughtering stage by removing high cost slaughtering plants that are not able to compete for Dutch hogs with slaughtering plants in neighbouring countries.

Both Denmark and the Netherlands have an opportunity to maintain and expand their positions in existing export markets. In the case of Denmark, the highest revenue earning existing market is Japan, where a large increase in imports over the next few years is expected. Catering even more effectively to the evolving needs of this market, in competition against other suppliers, is the obvious opportunity for the Danish industry. For the Netherlands, the most important export market is within the EU, where growth is anticipated only in exports to some of the southern member states.

New export markets holding some promise are largely the same for Denmark and the Netherlands. Central and eastern Europe are expected to increase pork consumption, and both Denmark and the Netherlands see opportunities both to expand exports to existing markets in the region and to develop and meet the needs of emerging markets. At the same time, the hog and pork industries of these countries themselves may develop into competitive threats to the industries of Denmark and the Netherlands.

Denmark sees opportunities in exports to the newly liberalizing pork market in Korea, following its success in exporting to the much larger Japanese pork market. The Netherlands, on the other hand, is only beginning to develop its skills in exporting pork to this region of the

world, having shipped its first small quantity of pork to Japan in 1992. Both Denmark and the Netherlands, as do most other pork exporting suppliers, see China as a very important potential importer of pork in the future.

Threats

Hog production in Denmark and the Netherlands faces threats arising out of problems in disposing of the manure generated by hog production. Such problems have to do with, for example, minerals from manure contaminating water courses and ground water, and ammonia emissions polluting the air.

The threat is more serious in the Netherlands, where physical limits on the disposal of manure (or the ingredient minerals of manure) have imposed a *de facto* ceiling on the number of hogs produced. The practices that hog producers have to follow, or are not allowed to follow, impose certain costs on hog production which threatens the position of the Netherlands as a cost competitive producer. If it turns out that the regulations currently applied on manure handling are not sufficient to remedy the problems, further threats in the form of still higher costs and even more limited quantity of hog production could materialize. One of the consequences could be a continued capacity in the slaughtering industry in excess of what is needed to slaughter hogs raised in the Netherlands.

In Denmark, where imported feed stuffs play a smaller role in hog production (there is a better balance between feed grain production and manure production), the manure disposal problem is less acute than in the Netherlands. The structure of hog production in Denmark, with most hog producers having easy access to farm land for spreading manure, also helps to alleviate the disposal problem. Nevertheless, concerns about the effects of intensive hog production on the quality of water and air are mounting, and more stringent restrictions applied also in Denmark would constitute a threat to the further expansion of hog production in that country.

Intensive hog production is increasingly the target of criticism based on animal welfare and ethical concerns. These concerns relate both to the rearing conditions on farms and to the conditions during transport between farrowing and finishing operations and to the slaughterhouse. While these concerns on the part of consumers provide an opportunity for product differentiation and improved product competitiveness, failure to address the concerns would constitute a threat.

Industries based on product competitiveness (as in Denmark) would need to continuously improve rearing and transport conditions, which gives rise to certain additional costs. Industries based on cost competitiveness (as in the Netherlands) could be threatened by a relatively shrinking demand for products produced cheaply with little regard for animal welfare and ethical concerns. The threat in the Netherlands is made more serious

by the relative weakness of the Dutch industry as far as animal health and quality control are concerned.

Hog production in the Netherlands has, to larger extent than in other EU countries (including Denmark), been based on non-grain feed ingredients imported relatively cheaply. This has provided a cost advantage to Dutch hog producers, in comparison to their competitors in the EU. As EU CAP reform proceeds, the price difference between grains and non-grain feed ingredients narrows. This reduces the cost advantage of Dutch hog production and helps to threaten the cost competitiveness of the industry.

Cost competitive hog and pork production in central and eastern Europe, as these countries rebuild their industries, constitutes a threat to the anticipated exports from Denmark and the Netherlands to these emerging markets. The rebuilt industries of these countries also have the potential, over time, to threaten established suppliers on the basis of product competitiveness. When central and eastern European countries become members of the EU, the current role of Denmark and the Netherlands as major suppliers of pork to importing EU countries could be threatened.

The possibility of competitor countries making inroads into current export markets is a threat faced especially by the Danish hog and pork industry. The Netherlands ships almost all its exports to other EU countries, where competition from low-cost suppliers from overseas is largely eliminated by means of various import barriers into the EU. The ability of exporters of pork in Taiwan to compete effectively across the range of quality segments in the Japanese import market is a threat to Denmark's continued reliance on that market.

The emergence of the US as a major exporter of pork is based on the so-called industrialization of that country's hog and pork industry. The enormous size of production units, both in hog production and in slaughtering and packing, confers cost advantages as well as some product quality advantages (such as quality consistency). This constitutes a threat to the ability of Danish exports to compete in established markets, such as Japan, and in newly opening markets, such as Korea.

Conclusions

The hog and pork industries in Denmark and the Netherlands are world class performers in export markets: Denmark both within the EU and outside, and the Netherlands within the EU. The Danish industry has embraced a customer-oriented approach to export markets and also has potential to further increase the quantity of hogs produced. The Netherlands, facing a number of problems (such as those relating to manure disposal, industry structure and coordination, and market-related research), and having little or no potential to increase hog numbers, appears less able to compete successfully in non-EU markets.

No single factor explains the successful performance of the hog and pork industries of Denmark and the Netherlands: it is a combination of many. Some key factors, however, seem to have made significant contributions. These include:

- Approaches and attitudes of individuals in all walks of life are heavily coloured by an international perspective (language skills and awareness of other countries - through travel, education and trade - are taken for granted).

- Over a long time span - hundreds of years - institutional models have evolved or been put in place that are conducive to successful export performance. For example, (1) education systems are closely linked to the industry and are thus geared towards the technical skills needed, and (2) research and development institutions are also closely linked to the industry, which helps to focus efforts on important issues and probable opportunities.

- Tolerance of industry concentration and perhaps even encouragement of vertical and horizontal integration in processing and marketing - the advantages of integration in serving export markets have been considered to outweigh the disadvantages often associated with closely integrated structures.

- Different paths to vertical coordination in Denmark and the Netherlands: stemming more from farmer cooperation and ownership in Denmark and more from government-sponsored organization in the Netherlands.

- In Denmark in particular, a sense of there being one hog/pork/pork-product industry in the country, where all participants have a stake in the success of the industry as a whole.

- The protection against imports provided by various measures, such as tariffs (formerly variable levies) and animal health and veterinary barriers, has allowed Denmark and the Netherlands to expand in European markets without having to compete with imports from low-cost hog producing suppliers, such as the US and Canada. This has likely been helpful when entering and developing new export opportunities outside the EU where exports, at least initially, can be more variable and uncertain than in well-known markets close to home.

- Policy support to exports of pork, in the form of export subsidies, are intended to offset the high feed costs in Denmark and the Netherlands. They are also thought to provide additional support to farmers and processors, allowing Danish and Dutch exporters to compete in non-EU markets on the basis of low price of the exported pork.

- Agricultural policy support to hog farmers in the EU is low, however, relative to support to producers of

dairy and beef. This may have helped to foster a sense of self-reliance in the hog industry.

Implications

The policy and institutional environment has been important for the successful export performance of the Danish and Dutch hog and pork industries. This has implications for the development of government policy and industry strategies in countries whose hog and pork industries compete with those of Denmark and the Netherlands in world export markets. The analysis of these two countries highlights implications in the following areas.

Role of government. The hog and pork industry in Denmark and the Netherlands was set on a path diverging from that of neighbouring countries by policy choices made by governments over the last one hundred years. Instead of receiving protection from low world prices of feed, the agriculture sector as a whole was expected to take advantage of the low prices and develop its livestock feeding and processing capability.

A number of policy choices in more recent times (such as the evolution of the Common Agricultural Policy) have reduced the market orientation of the hog and pork industries in Denmark and the Netherlands. These industries, however, have continued to adapt to changing conditions both in European and world markets and reinforced the export-oriented structure encouraged by earlier government decisions. The amount of policy support to do so has tended to be lower for hogs and pork than for many other important agricultural products in Europe. The protection against imports into the EU from low-cost suppliers has made it possible for the Danish and Dutch industries to develop their pork markets in the EU in competition only with other high-cost suppliers from within the EU.

While the historical orientation towards relative self-reliance has helped the hog and pork industries of Denmark and the Netherlands progress to where they are today, governments do assist in such areas as training, education and research and development. Such and many other industry-wide activities in these two countries are to a large extent, however, funded by levies on producers.

With industry responsibility for both funding and carrying out industry-wide activities has come a strong incentive to target the activities in a cost-effective way on the most significant problems faced by industry. Being accountable to industry participants may make it easier to redesign and develop new activities to meet specific emerging needs. One implication of this would be a need to question the traditional role of government in many countries in funding, carrying out, or directing agricultural and food research. Along with the questioning would, of course, also need to come constructive ideas on how research might best be organized in order to be as supportive as possible of

industry strategies, while also taking into account other societal goals of research. Research is only one example among many of traditional government activities that may need examination with a view to determining how they should be organized to best support the hog and pork industry's competitive strategy. Other examples include food safety inspection, application of animal health regulations, export certification of processing plants, and ensuring that certain standards are met with regard to animal welfare.

It is somewhat paradoxical that many of the activities that are funded by the hog and pork industry itself in Denmark and the Netherlands are activities that, if they had been funded by government, would have qualified for "green box" status under the Agreement on Agriculture of the World Trade Organization[68]. This means that they are considered to have no or only a minimal trade distorting effect or effect on production. In other words, while government support is generally subject to international discipline, certain government activities are considered not trade distorting enough to require discipline. If these government activities had been subject to reduction, it would have been tempting to shift responsibility for them from government to industry. In reality, however, there is little need arising from international policy discipline to shift such activities from government to industry responsibility and thereby to make the policy configuration more similar to that of Denmark and the Netherlands.

Industry structure. Horizontal and vertical integration characterize Denmark's hog and pork industry. Deliberate efforts are underway to make the Netherlands' hog and pork industry more integrated. The importance that government and industry in these countries attach to achieving an efficient industry improves the ability of industry to keep some costs down, in spite of many cost components being higher than elsewhere in the world, as in Canada. It also has a payoff in terms of improved market organization and information flow.

At the farm level, horizontal integration, particularly in Denmark, may have brought the advantage of making certain economies of size available to essentially small producers. For example, breeding stock with the right genetic make-up to support high-quality pork production is available to practically all of the country's farrowing operations as result of an industry-run, national breeding system.

Size rationalization of the processing segment in Denmark has been dramatic and is in progress in the Netherlands. The elimination of slaughtering plants in

[68]"Green box" status would have made these expenditures exempt from reduction commitments, i.e., while many other kinds of government-funded support to hog producers are subject to a ceiling or maximum allowed level (a level that is declining in the years 1995-2000), "green box" expenditures are not subject to such a ceiling. A further attribute of "green box" expenditures is that they are not, under certain conditions, subject to trade remedy action (i.e., countervailing duty) for a number of years.

Denmark has been carried out in spite of a large portion (now all) of the plants being owned by hog producers themselves, who would be expected to resist plant-closings on a local/regional basis. Thus, local/regional allegiances have not been able to stand in the way of structural changes that improve the efficiency of the country's industry as a whole.

Horizontal integration and cooperation at the processing level tend to raise issues about market dominance and anti-competitive behaviour. It does not appear that such issues have greatly inhibited the moves towards industry concentration in Denmark and the Netherlands. As the pork exporting industries of other countries seek to strengthen their performance, questions may arise about the extent to which domestic competition rules impede or allow the evolution towards an industry structure that fosters cost competitiveness or product competitiveness to the same extent as in Denmark and the Netherlands.

Marketing organization and information flow. Industry organizations in Denmark and the Netherlands, such as Danske Slagterier (DS) and Produktschap voor Vee en Vlees (PVV), act as conduits for efficiently transmitting information between the components of the industry marketing chain or they encourage the development of such conduits. In Denmark, in particular, the highly vertically integrated structure, in combination with the small number of slaughtering and processing companies (four), makes it very easy to convey information from the end-market to the hog producer. Hog producers in both countries are very receptive to the information so conveyed.

Many pork exporting industries, including those of Denmark and the Netherlands, rely on specialized trading houses for some of their export market development. Such arrangements can be conducive to the transmission of more valid information up and down the marketing chain. At the same time, challenges arise about how best to integrate the activities of the trading houses with those of the rest of the industry, whether vertically integrated or not.

A well functioning marketing organization and information flow has been essential for the successful performance of the Danish and Dutch hog exporting industries. Any country competing with these two exporters would therefore need to examine its strengths in those areas. This could concern such issues as the development of the most appropriate means to convey price, delivery and quality information in industries that are not vertically integrated to the extent observed in Denmark and the Netherlands. In other words, could the coordination achieved in a vertically integrated industry be achieved in other ways in a less integrated industry?

Propensity to invest. Denmark and particularly the Netherlands are

experiencing a stagnation in hog production, mainly as a result of manure disposal problems. Stagnating hog production does not seem to have dampened enthusiasm, especially in Denmark, for continued investment in technology that helps to reduce the cost of meeting very specific end-use demands. While such investment would not result in continued expansion of the number of hogs produced or quantity of pork produced, it would make it possible for the industry as a whole to maintain or expand value-adding activity and move into or develop new export market segments.

The competitive performance of the Danish and Dutch pork industries is not built on low-cost inputs and raw materials (such as labour, feed, breeding stock, and capital) but more on a capacity to understand the nature of demand and ability to tailor products to selected segments of that demand in a cost-effective way. That capacity has come about as a result of earlier years' investment, both in research and development and in physical structures and machinery.

Pork exporting industries competing in export markets with the industries of Denmark and the Netherlands need to pursue different investment strategies depending on whether they compete on a cost basis or a product basis. Investment in research and development intended to improve cost competitiveness needs to generate findings of a different nature than if intended to improve product competitiveness. Investment in physical plant and machinery needs to be tailored differently if the objective is to produce cheap output than if the objective is to produce high-valued output.

Cost competitiveness versus product competitiveness. Denmark and the Netherlands have gone in different directions, with Denmark emphasizing product competitiveness and the Netherlands emphasizing cost competitiveness. Government initiatives supporting the hog and pork industries in these countries have often been directly in line with one of these two different objectives. For example, government funding (albeit limited) for research in Denmark has tended to emphasize product development in response to market needs, while research in the Netherlands has emphasized cost reducing production technology.

Depending on the industry's choice of competing in world markets on the basis of cost or product, the policy environment in support of the industry strategy will need to be different. For example, negotiations to obtain market access rights would emphasize different potential customer countries, and education curricula would impart different skill sets to workers on hog farms and in hog packing plants. Supporting and related industries also need different strengths, depending on the strategy being followed by the hog and pork industry. For example, the transportation industry may need to provide different technical solutions depending on the kind of

products being shipped and where they are shipped.

Optimal structure and conduct of the hog and pork industry would be different, depending on the strategy chosen. Differential effects on the industry's ability to produce low cost pork or high valued pork would result from decisions on farm production structure (such as importance of farrow-to-finish operations in relation to separate farrowing and finishing operations), and slaughtering plant structure (cost advantages of size versus quality control disadvantages in large plants).

page intentionally blank

REFERENCES

Agriculture Canada 1993. "Framework for Analyzing the Competitiveness of the Agri-Food Sector:, Working Paper 3-93, Policy Branch, Agriculture Canada,

Agra Europe 1994. "Structural changes in Dutch pigkeeping", No. 1605, August 5..

Agra Europe 1995. "Dutch meat industry merger", No. 1648, June 9..

Agra Europe 1996a. "EU pigmeat production falling", No. 1679, January 19.

Agra Europe 1996b. "Danish pigmeat prices explode", No. 1705, July 19.

Agra Europe 1996c. "Boom in Danish live pig exports", No. 1713, September 13.

Agra Europe 1997. "Danish pig producers receive dividends", No. 1729, January 10.

Boland, M. A., K. A. Foster and J. T. Akridge 1995. "Packer Sorting Strategies for Fresh Pork", Agribusiness: An International Journal, Vol. 11, No. 5, pp. 423 - 430.

Brouwer, F. M. and F. E. Godeschalk 1993. "Pig Production in the EC: Environmental Policy and Competitiveness", Publikatie 1.25, Agricultural Economics Research Institute (LEI-DLO), The Hague, April.

Buhl, Knud 1996. "Denmark", presentation at annual meeting, Canada Pork International, Toronto, February.

Monitor 1996. Agra Europe (London) Ltd., Tunbridge Wells, Kent, England.

Danish Institute of Agricultural and Fisheries Economics 1995. Economics of Agricultural Enterprises, 1993/94, Valby (Copenhagen).

Danish Meat Research Institute (no date). "Facts about the Danish Meat Research Institute", Roskilde, Denmark.

Danish Meat Research Institute (DMRI) 1995. Annual Report 1994. Roskilde, Denmark.

Danish Council for Research Policy 1992. International Evaluation of Danish Agricultural Research, Copenhagen.

Danske Slagterier 1995 (and earlier years), Statistics 1994, The Federation of Danish Pig Producers and Slaughterhouses, Copenhagen, May.

DLO-NL 1996. "DLO-NL Research Programmes", Internet Website http://www.bib.wau.nl/dlo/programs.html, April.

European Commission 1994. The Agricultural Situation in the Community - 1993 Report. Brussels and Luxembourg.

Food and Agriculture Organization of the United Nations (FAO) 1996. Agrostat-PC, Rome, Italy.

Gade, Patricia Barton, Lars Blaabjerg, and Leif Christensen 1994. "Investigation of Transport Conditions for Slaughter Pigs in 7 European Countries", Manuscript No. 1198E, Danish Meat Research Institute, Denmark, February.

Gaisford, J.D., J.E. Hobbs, and W.A. Kerr 1995. "If the Food Doesn't Come - Vertical Coordination Problems in the CIS Food System: Some Perils of Privatization", Agribusiness: An International Journal, Vol. 11, No. 2, 179-186.

Hansen, Bert Ib and Tober Hansen 1994. "Quality Management of the Pig Production including ISO 9002", Manuscript No. 1186E, Danish Meat Research Institute, Danmark, January.

Hobbs, Jill E. 1996. "Danish Pork in Asia-Pacific Rim Markets: A Culture of Excellence", EPRI Study 96-01, Excellence in the Pacific Research Institute, University of Lethbridge, Lethbridge, Canada.

Hobbs, J. E. and W. A. Kerr 1991. "Implications of the Food Safety Act 1990 for Scottish Agribusiness", Scottish Agricultural Economics Review, 6, pp. 51-59.

Hobbs, J. E., K. K. Klein, and W. A. Kerr 1995. "The Danish Pork Industry: A Competitive Review", unpublished manuscript, Agriculture and Agri-Food Canada, November.

Hughes, D. R., H. M. Martin and M. Van Nieuwkerk 1993. "A Comparative Study of Agricultural Marketing in the Netherlands and the United Kingdom", Wye College, University of London, Food Industry Perspectives, Discussion Paper Series: Number 1, March.

Jensen, Helen H., Steven W. Voigt and Dermot J. Hayes 1995. "Measuring International Competitiveness in the Pork Sector", Agribusiness: An International Journal, Vol. 11, No. 2, pp. 169-177.

Jensen, T. 1995. Slagteriskolen i Roskilde, "The Danish Meat Trade College", Roskilde, personal communication.

Jørgensen, Erik Juul 1992. "En højvækststrategi for dansk landbrug, agro- og fødevareindustri til år 2010", reported prepared for the Ministry of Agriculture, Instituttet for fødevarestudier og Agroindustriel Udvikling - IFAU, Hørsholm, Denmark, July.

Kalaitzandonakes, N .G., H. Hu and M. Bredahl 1996. "Looking in All the Right Places: Where Are the Economies of Scale?", paper presented at the symposium "Global Markets for Processed Foods: Theoretical and Practical Issues", International Agricultural Trade Research Consortium and the The Retail Food Industry Center, Minneapolis, Minnesota, June 28-29.

Kearney, A. T. 1994. "Sectorobservaties: Varkensvlees", Ministerie van Landbouw, Natuurbeheer en Visserij, Amsterdam, September 23.

Klein, K.K., M.D. Faminow, K. Foster, B. Larue, R. Romain and A.M. Walburger 1995. "An Evaluation of Hog Marketing Systems in Canada", Working Paper 4-95, Policy Branch, Agriculture and Agri-Food Canada, Ottawa, April.

Landbrugs- og Fiskeriministeriet 1995a. "2. Rapport vedrørende opfølgning af GATT-aftalen", Den af landbrugs- og fiskeriministeren nedsatte arbejdsgruppe, Copenhagen, avril.

og Fiskeriministeriet 1995b. "2. Rapport vedrørende opfølgning af GATT-aftalen - bilag", Den af landbrugs- og fiskeriministeren nedsatte arbejdsgruppe, Copenhagen, avril.

Larsen, J. 1995. Head, Quality Control and Food Legislation Department, Danske Slagterier, Copenhagen, personal communication.

Leuck, Dale J. 1993. "Policies to Reduce Nitrate Pollution in the European Community and Possible Effects on Livestock Production", Staff Report No. AGES 9318, Agriculture and Trade Analysis Division, Economic Research Service, U. S. Department of Agriculture, September.

Dale, Stephen Haley, Peter Liapis, and Brad McDonald 1995. "The EU Nitrate Directive and CAP Reform: Effects on Agricultural Production, Trade, and Residual Soil Nitrogen", Foreign Agricultural Economic Report No. 255, Commercial Agriculture Division, Economic Research Service, U. S. Department of Agriculture, January.

Madsen, K. B., and W. Klinth Jensen 1994. "Mechanisation and automation in the Danish pig slaughtering process", Manuscript No. 1219E, Danish Meat Research Institute, Danemark, June.

Ministry of Agriculture, Forestry and Fisheries 1996. The Meat Statistics in Japan, Livestock Industry Bureau, Tokyo, Japan.

Ministry of Agriculture, Nature Management and Fisheries 1994. "Facts and Figures 1994", Information and External Relations Department, The Hague, The Netherlands.

Ministry of Agriculture, Nature Management and Fisheries 1995. "Policy Document on Manure and Ammonia", Department of Information, The Hague, The Netherlands.

PVV (Produktschap Vee en Vlees) 1994. "Jaarverslag 1993", rapportnummer 9404a, March.

PVVE (Product Boards for Livestock, Meat and Eggs) 1995a. "Livestock, Meat and Eggs in the Netherlands", Rijswijk, The Netherlands. March.

PVVE (Produktschappen Vee, Vlees en Eieren) 1995b. "De Nederlandse vee- en vleessector in cijfers", rapportnr. 9503a, January.

PVVE (Product Boards for Livestock, Meat and Eggs) (no date). "The Dutch Meat Sector", Rijswijk, The Netherlands.

Rabobank 1996. "Rabobank in Brief", Internet Home Page of Rabobank, http:\\rabobank.info.nl, mars.

Sneep, Anco G. 1994. Innovation Management in the Dutch Agro/Food Industry: An Empirical Factor Analysis, Thesis Publishers, Amsterdam.

Stenbæk, H. 1995. Information Manager, Steff-Houlberg, Ringsted, Danemark, personal communication.

Svensson, Mikael 1992. "Struktur, strategi och konkurrensförhållanden i mejeri- och slakteribranscherna i Danmark", Företagsekonomiska institutionen, Ekonomihögskolan, University of Lund, Lund, Suède, May.

Sparks Companies, Inc. 1993. "Enhancing the Competitive Position of the Canadian Hog and Pork Sector. Volume III: The Competitive Position of the Canadian Hog and Pork Sector", prepared for the Special Measures Committee for Hogs and Pork, Ottawa, May.

National Committee for Pig Breeding, Health and Production 1990. Annual report, Danske Slagterier, Copenhagen.

The National Committee for Pig Breeding, Health and Production 1994. Annual report, Danske Slagterier, Copenhagen.

Tracy, Michael 1989. Government and Agriculture in Western Europe 1880 - 1988, Third Edition, Harvester Wheatsheaf, Hemel Hempstead, United Kingdom.

United Nations (various years). Commodity Trade Statistics, New York, New York.

USDA (United States Department of Agriculture) 1996a. Livestock and Poultry: World Markets and Trade, Foreign Agricultural Service, Circular Series FL&P 1-96, March.

USDA (United States Department of Agriculture) 1996b. PS&D View, Economic Research Service.

van Dongen, Frans 1996. "The Netherlands", presentation at annual meeting, Canada Pork International, Toronto, February 7.

van Gaasbeek, A. F., M. H. Borgstein, J. J. de Ulieger, J. A. G. Verheigen, A. G. M. Colbers, and W. Rijnsburger 1993. Competitiveness in the Pig industry, Rabobank Nederland, Utrecht.

Walter-Jørgensen, Aage 1993. "Assessing the International Competitiveness of the Danish Food Sector", en Bredahl, Maury E., Philip C. Abbott et Michael R. Reed (eds.), Competitiveness in International Food Markets, Westview Press.