A STUDY OF THE SEASONAL PATTERNS IN THE ARGENTINE CATTLE MARKET

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CHAPTER I

1.1 INTRODUCTION:

Argentina has a long tradition as a beef producer country. Cattle in particular, have played a major role in the traditional environment as a source of food, employment and savings. Many of the typical symbols of this country are found within an environment of ranches, cowboys, horses and cattle, called in Spanish: Estancias, Gauchos, Caballos and Ganado. An illustration of what has been the role of cattle in Argentina can be found in the etymology of the words Hacienda and Ganado that mean cattle in Spanish:

Hacienda: An accumulation of goods and estate owned by someone. What is done daily. The work of every day where the logic idea of cultivated land, farm and wealth comes from; as a result of labor.

Ganado: Profit, gain.herds are called "ganado" because they always leave profit.

Source: Diccionario Etimologico de la Lengua Española. D. Roque Garcia, 1883.

The cattle sector not only represents a source of food, employment and savings to many people in Argentina, but also a social symbol which the Argentines are proud of and identify with.

Argentina's surface is 276.7 million hectares (685 million acres) of which 69 percent is used for agriculture. Of this proportion, 80 percent is used for

animal production in natural and permanent pastures; 14 percent for animal and crop production and 6 percent for crop production exclusively[1].

There are more than 527,000 ranches in the country, with the majority between 200 and 500 hectares (480 - 1,200 acres)[2]. Twelve percent of the total population live in rural areas, being the population density of ten inhabitants per square kilometer[3].

No single cattle breed dominates although some are concentrated in certain areas. The Aberdeen Angus, Hereford and Brahman are the major breeds found in Argentina. Cattle production is based mostly on grazing of natural pastures with little or no use of fertilizers, grain, machinery and irrigation. Seeded pastures are usually grown where rotation with crops is possible.

Many ranchers located on less productive land specialize in breeding stock for resale to other cattlemen located on more productive land. These ranchers in turn, will carry out the fattening process and sell the finished animal to slaughter houses. Yields of 50 and 90 lbs. of beef per year per acre are common in the breeding and fattening process respectively.

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[1]F.A.O. Production Yearbook, Yearbook of Food and Agriculture Statistics, 1982.

[2]Weil, Thomas et.al.; Area Handbook for Argentina, 1974

[3]F.A.O. Production Yearbook, Yearbook of Food and Agrculture Statistics, 1982.

Cattle can be sold at the ranch or at any city market. The selling and buying operations are performed through open auctions. If the animal is sold for fattening, the price is set per head. When it is going to slaughter the animal or group of animals are weighed and sold per kilogram. The Buenos Aires city market called " Mercado de Liniers " is the biggest in the country with an average of 60,000 animals sold per week. Here the great majority of operations are for slaughter, providing red meat to the city and to exporting slaughter houses.

The price at Liniers is taken as a reference for local markets. While auctions start early in the morning in Buenos Aires, local markets start usually at noon, after the prices at Liniers have been reported over the radio.

From 10 to 25 percent of the production is exported, the rest is consumed mostly as fresh meat. Agricultural production represents approximately 13 percent of Argentina's gross national product and nearly 50 percent of the value of agricultural production comes from meat production[4].

1.2. THE PROBLEM:

Complex interactions between supply and demand in a market cause prices to change constantly during the

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[4]U.N., Statistical Yearbook, Anuaire Statistique, 1981.

year. Movements in the price of a commodity which might seem random on a day to day basis, can be found to repeat a certain pattern when analyzed through longer periods of time. Seasonal price variation occurs when the pattern of prices is repeated every year. In this way prices will be expected to increase or decrease at certain seasons every year.

Seasonal patterns are also evident in the quantities supplied or demanded of a commodity. The supply of grains for example, typically increases at harvest seasons. The demand for refreshments on the other hand, increases regularly during summer[5].

The measurement of these variations in quantities or prices have some complications, especially in the cattle subsector. The presence of cycles, inflation and trends require the use of special techniques to quantify the seasonal effect. The direct observation of the market would lead in this case to biased results and wrong conclusions about seasonal patterns.

Inflation, specially in Argentina where it has been extremely high in the last ten years, makes prices not comparable from one observation to the other. The conversion to deflated prices using the consumer price index is necessary to understand the real magnitude of cattle prices.

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[5]More detail about seasonal variations will be explaned later in chapter 2.

An increasing or decreasing trend all through the period analyzed will lead to a general bias in the seasonal pattern observed directly, unless corrected. The last observation of every year will tend to be lower (higher) due to the decreasing (increasing) trend through the whole set of observations. To get unbiased seasonal patterns the trend effect should be removed through procedures explained later.

Cycles will make quantities and prices not comparable from one period to the next. If quantities or prices are in an ascending part of the cycle, the observations at the end of each year will be naturally higher; and the opposite will happen in descending parts of the cycle. The use of seasonal indexes, explained later, is necessary to correct for this bias.

Intricate markets require more information for good decision making. Farmers as well as manufacturers in Argentina operate in a risky environment due to the effects of hyperinflation. This is not only because holding currency represents a risk in itself, but also because it is impossible to get a feeling of the market's behavior due to the fact that prices are always changing.

The participants operating in such an environment lose perspective, tending to survive and make profit in the short run, rather than to plan and define their long run objectives. The sophistications used in this analysis are not usually available to farmers and neither to manufacturers, forcing both parts to operate with a very

limited knowledge of the market's behavior. This situation narrows the scope of the participants in the market, constraining the development of long run objectives. In this way participants tend to lose perspective, making it more difficult to plan.

However it would be naive to assume that farmers do not know about seasonality of the cattle market. In fact, experiences of the author working with farmers in Argentina showed several times that they know very well the seasonal patterns followed by the cattle market, by employing a different method.

Farmers are more concerned with how many new animals they can purchase with a finished animal rather than the value in currency itself. They know they have made a profit when money is left after they have sold their animals for slaughter and replaced them with new animals to fatten. In other words, farmers look at the replacement ratio at the moment of selling the animals.

During winter, farmers know that the replacement ratio is more favorable because there are more light animals for replacement and a small supply of finished animals for slaughter. This pushes prices up for finished and down for light animals for replacement. So farmers know that if they sell and replace in winter they can make more profit in the operation. During spring and fall the index is less favorable because the situation is inverse to the one explained above.

This approach has some advantages over looking at finished prices alone. First, it considers the whole operation that occurs in the cattle business. A farmer must both sell and buy cattle to complete an operation, and can win or loose money in either of these. The ratio shows the convenience of both buying and replacing at a certain time.

Second, the ratio is independent of inflation. The inflation rate affects the prices of finished as well as replacement cattle, hence the ratio is not affected by it because it is in both the numerator and the denominator when computed.

Third, the ratio is valid regardless of prices following cycles or trends. The reason for this has a similar logic as the previous one. The ratio would not be affected because both quantities move in the same direction during trends and cycles.

So farmers far away from knowing little about seasonality, have come up with a ratio that describes the entire operation and avoids most of the complexities that this analysis has to overcome.

But despite the simplicity and advantages of using the replacement ratio to analyze the cattle market, farmers using this approach face a serious limitation. The main problem is that they are considering the cattle sector as the only alternative for investment. The only decision that can be analyzed is to sell and buy cattle altogether at a certain point in time. No other information is given that

relates cattle with other goods or with itself in a different point in time.

The ratio doesn't tell if it is convenient to delay the purchase of the replacement cattle because the index is fixed at a point in time. Neither does it give information about what time of the year the price of cattle is maximum or minimum. By using the replacement index alone, the analysis loses perspective especially because it doesn't provide prices which would relate the cattle subsector to the rest of the economy.

The method used by farmers to analyze the market behavior that was described earlier is an example of how farmers can lose perspective in intricate markets due to a lack of resources. Given the special characteristics of the Argentine cattle market there is a serious need for this type of information to aid farmers and any other parts operating in the market to achieve better results from their decisions.

1.3. SCOPE AND OBJECTIVES:

The objectives of this work are the following:

- To do research on monthly prices of finished cattle to find out if a seasonal pattern exists for the following five categories of animals: calves, small steers, big steers, cows and heifers.

- To do research on monthly quantities slaughtered of finished cattle to find out if a seasonal pattern exists for the same five categories described below.
- To describe the patterns and present them in an easy and applicable way for decision making.
- To provide an explanation for the nature of the seasonal patterns.
- To estimate the variability of prices for each month in a risk analysis framework.
- To provide an idea of how the market works as a whole by combining all the seasonal patterns obtained for each category.

The analysis will be done based on data collected by the " Junta Nacional de Carnes " (a national meat board organization) at the Liniers auction market in Buenos Aires. The series of monthly average prices and heads slaughtered covers from the year 1957 to 1984. This data will be analyzed with the aid of microcomputer programs designed for this purpose.

1.4. VALUE FOR THE COMMUNITY:

Information has a clear value for the community. Obviously, the more informed the community is about a market, the easier it will be to achieve higher levels of

performance. However, there are several other reasons which make this particular analysis very valuable:

First, the marketing of livestock represents one of the main sources of risk for the farmer. This is an unavoidable step in the production of meat and is now becoming riskier as inflation increases over 400 percent per year. The description of the seasonal pattern will provide a solid base for analysis at a time that is needed, reducing a big portion of the risk and uncertainty involved in operating in the beef industry.

Second, the cattle subsector in Argentina represents an important part in the whole national economy. It is the activity that moves the regional economies in vast areas of the country where grain and industrial activities are not present. It provides for these regions directly or indirectly, the source of employment.

It also provides the source for savings, as people find investments in assets like cattle more convenient than financial ones during periods of high inflation. Cattle is easy to convert into cash, they keep their real value and even yield an " interest " by gaining weight. Financial investments usually yield negative real interest rates during these periods.

The cattle sector is also a major source of food for the country. Argentina has one of the highest consumptions of red meat per capita in the world: one hundred kilograms

per habitant per year (220 lbs.)[6]. Steak is, of course, the most traditional dish.

Third, the results of this analysis are directly applicable to practical purposes with no complex calculations. Anyone from the producer to the consumer can understand and apply these results with no further complications. This adds diffusion to the analysis, being the results more easily considered as an important tool by a greater amount of people.

Hence, this analysis will be of higher value for the community because it focuses on a major problem in the beef industry, helping a big subsector of the economy with the provision of applicable information.

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[6]Commodity Research Bureau, Inc.; Commodity Yearbook, 1981.

CHAPTER II

2.1. PRODUCTION ORGANIZATION OF THE BEEF CATTLE INDUSTRY:

Forage is the main source of food for cattle in Argentina. Both the breeding and fattening processes are performed on pastures with little or no grain feeding[1]. The forage necessary to feed the animals is provided entirely by either natural or seeded pastures. Usually the most intensive production systems situated in fertile regions of the country tend to increase the proportion of seeded pastures in the farm due to their higher productivity rather than shifting to grain feeding.

The supply of forage is not constant during the year and neither is the demand for it throughout the life of a bovine. The following is a description of the main factors affecting the growth rate of pastures, which represents the forage supply, and the animal requirements which represents the forage demand. The way the supply and demand of forage is structured will shape the organization of the beef cattle industry by placing limitations and opening possibilities to farmers in such an environment. The understanding of the factors affecting the supply and demand for forage is important because their effects will make it more expensive to produce and sell meat at certain seasons of the year. The

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[1]M.Regúnaga, Magister Scienticiae Thesis, Castelar, 1970, p.11.

difference in costs will in turn be reflected in the market through seasonal variations in prices and/or in quantities.

2.1.1 The Forage Supply:

The forage supply is heavily affected by weather. Temperature and precipitation are major variables that influence the rate of growth of pastures. The faster a pasture can develop new leaves, the greater the number of times it can be harvested during the year and hence, the higher the yield of forage achieved per unit of time.

According to the mix of plants, pastures have optimum temperatures and amounts of water in the soil at which their growth rate is maximum. Therefore, their growth rate will change at different seasons of the year. Typically, perennial pastures grow faster in spring and fall and slower in winter and summer (see fig. 1).

Hence the supply of forage is not constant during the year in a typical perennial pasture, showing peaks of production in spring and fall. This would represent a basic production system where no investments are made to smooth the forage supply all through the year. Studies made in the breeding area show that this is the case for a typical cow-calf farm, where 80% of the land is occupied with natural pastures[2].

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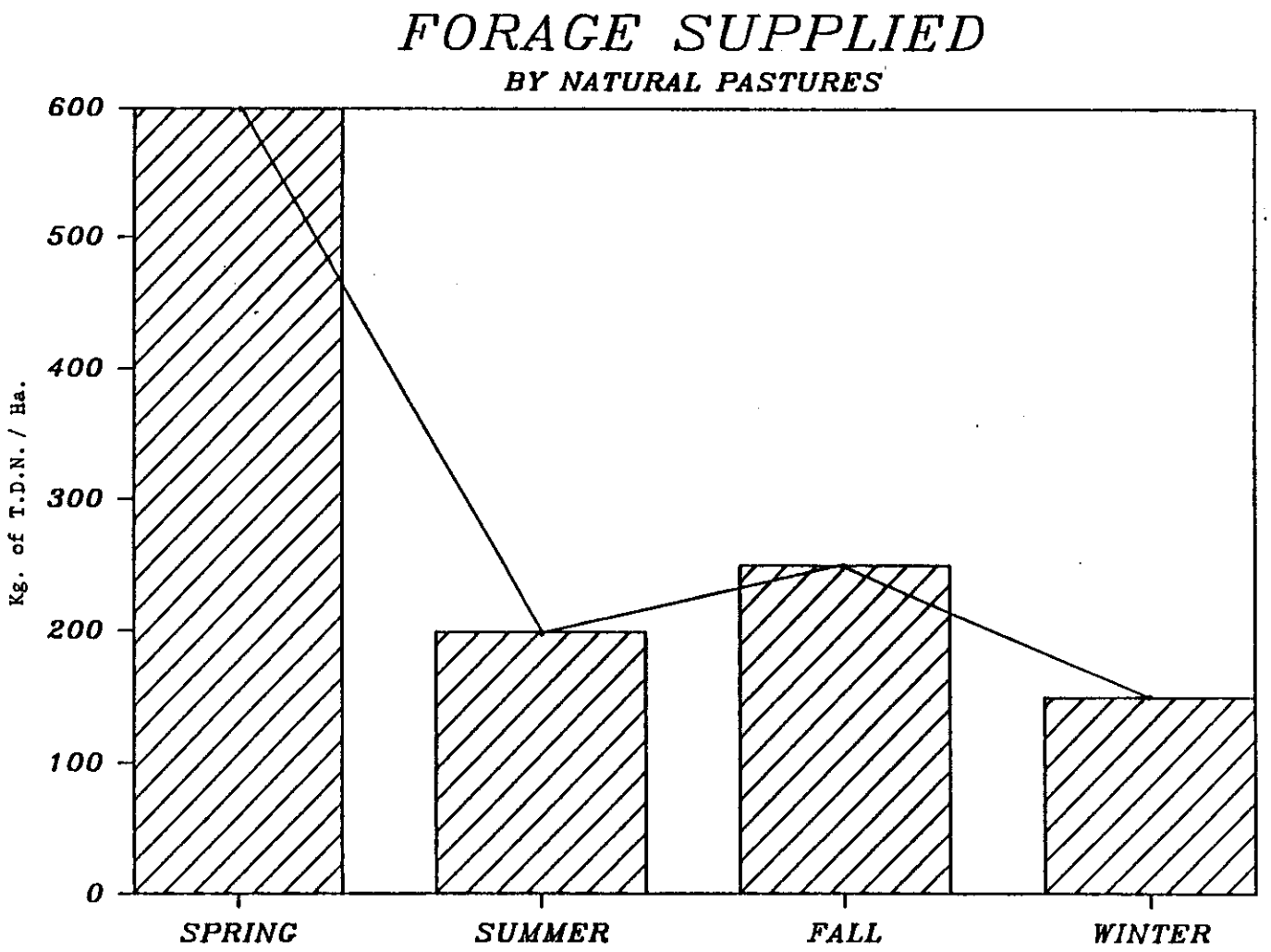
[2]R. Bochetto, PhD. Thesis, Michigan State Univ., 1981, p.86.

FIGURE 1



Source: M. Piñeyro, The Argentine Agriculture: Past and Potential Contributions to Country - wide Economic Growth, Ph.D.Thesis, Univ. of California, 1968.

The quality of forage follows the same pattern as the forage supply. Periods of high growth rates are associated with better quality of forage. As a plant grows, the proportion of new leaves which has more protein contents increases, resulting in a more balanced diet for the animal and hence a better conversion rate to meat. This makes spring and fall the best seasons in terms of quantity as well as quality of forage. These are the seasons where the highest supply is combined with the highest quality.

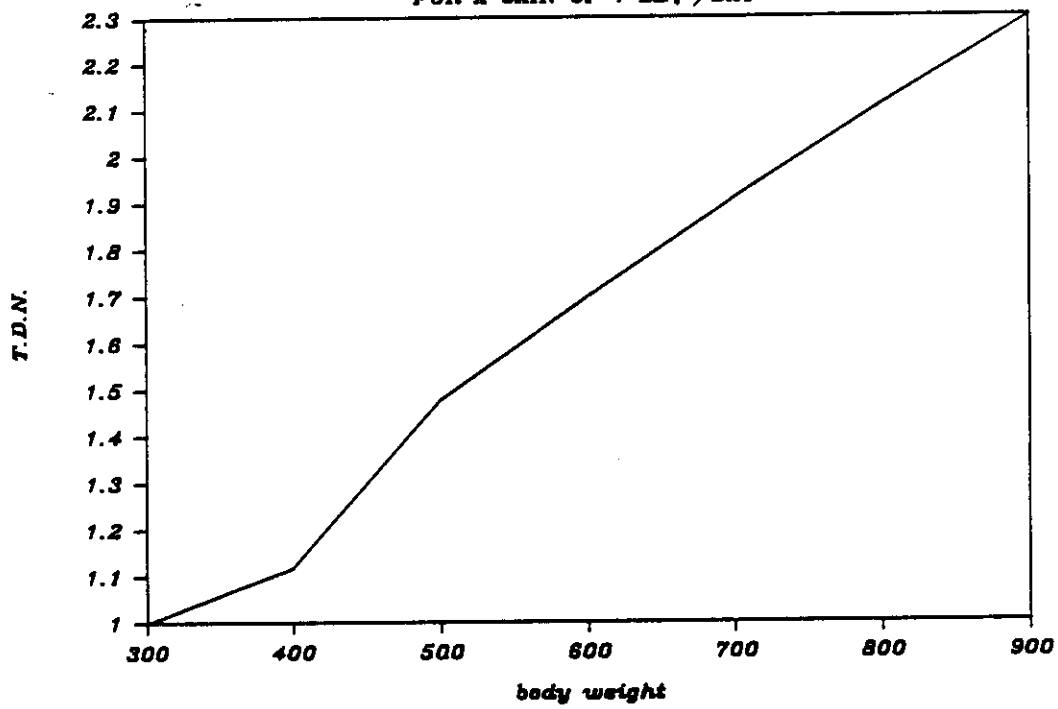
2.1.2 The forage Demand:

On the animal side, the demand for forage as well as its efficiency of use by cattle is also influenced by weather. At low temperatures the demand for energy to keep the body's temperature constant is higher. This makes the animal more hungry but at the same time less efficient to gain weight. The extra amount of food that it will consume will be used for body temperature maintenance rather than for fattening. In other words, the cost of maintenance of the animal increases during cold weather making it less efficient in meat conversion. On the other hand, if temperatures are too hot the animal will lower its metabolism by reducing the food intake, hence losing its appetite. Therefore spring and fall will be the most favorable seasons with regards to meat conversion due to weather.

FIGURE 2

ENERGY REQUIREMENTS

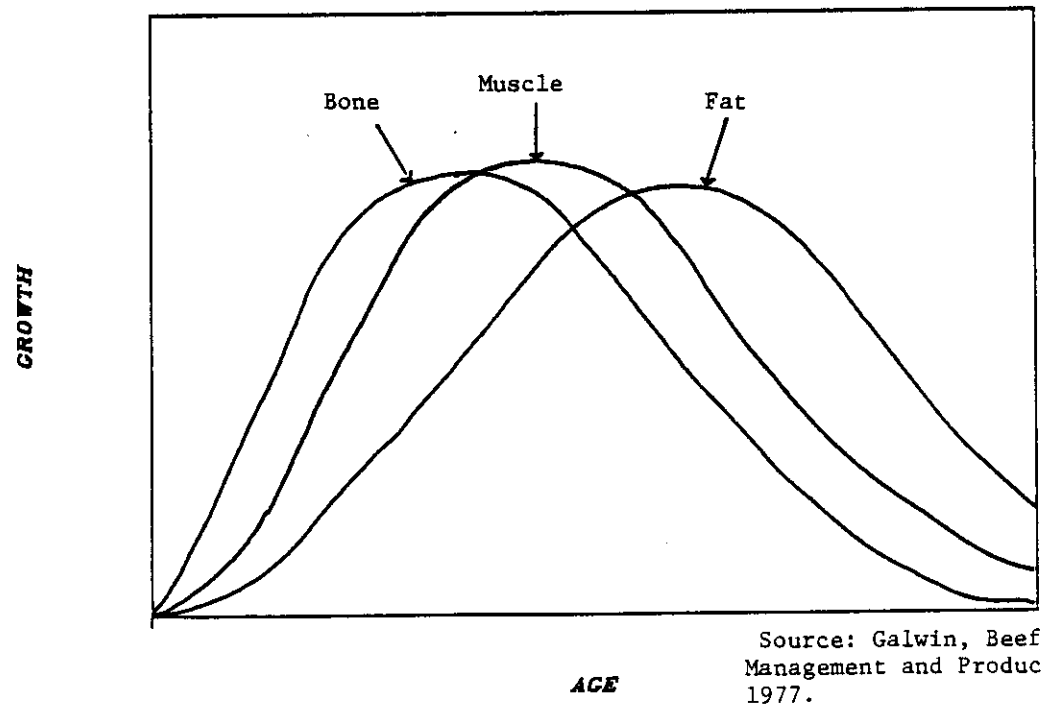
FOR A GAIN OF 1 LB. /DAY



Source: Cooperative extention service, M.S.U.

FIGURE 3

GROWTH WAVES



Source: Galwin, Beef Management and Production, 1977.

In addition to the weather, weight and age affect the meat conversion ratio of bovines. As animals get heavier their food requirements increase. The amount of total digestible nutrients (T.D.N.) necessary to maintain an animal has a positive correlation with body weight. This means that if two bovines of different weight are kept on the same diet, the lighter one will be able to utilize a bigger proportion of the diet for weight gain. Therefore, heavier animals have lower conversion rates to meat. Figure 2 shows the energy requirements for a daily gain of one pound per day on steers at different body weights. It can be noticed in this figure that the energy requirements more than doubles from a 300 to an 800 pounds steer although they are both gaining one pound per day.

The age of the animal is more relevant to the type of growth that it will achieve. Bovines tend to grow in a very finite order (see fig. 3). Bone is the first to develop, muscle is intermediate but tends to follow bone fairly closely, white fat is the last to develop and grows faster as the animal approaches maturity[3].

Therefore, the type of beef that will be obtained from a bovine depends on the age of the animal at slaughter. This is important because farmers will sell their cattle for slaughter only when it yields the type of beef preferred by consumers, as otherwise the price received would be low. The

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[3]D. Galvin, Beef Management and Production Manual, 1977.

type of beef demanded by Argentine consumers is lean at the center and bordered with white fat, therefore farmers will not send their cattle to slaughter until the animals have achieved stage three (fat deposition) of the growth curve. This stage is called the "finishing" of the animal.

The optimum stage of growth for slaughter can be determined up to some extent with a better diet. The nutritional level affects the three waves of growth considerably. Better fed animals tend to achieve the fat wave more rapidly than poorly fed animals.

To anticipate the fat wave, young animals have to be fed with a high concentration of T.D.N. in order to exceed the requirements by the other waves. Young animals have a limited capacity to consume forage because their digestive system has not been developed yet, therefore the diet must be more concentrated (higher quality) to provide the animal with enough energy to start accumulating fat.

Summarizing the last concepts we can say that the demand function for forage is characterized by a seasonal variation due to weather, and a positive slope due to the increase in weight; and that finished young cattle are expected to demand higher quality diets than older animals.

The factors just explained are more important for the organization of the fattening process. The organization of the breeding process is more concerned with the requirements of the breeding cow and heifers for replacement.

A breeding cow can yield one calf per year under good management (see fig. 4). The pregnancy period lasts 9.5 months and the post partum time (until it gets pregnant again) is ideally of 2.5 months. Throughout the year, the energy requirements reach a maximum when the cow is pregnant and lactating, and a minimum when it is pregnant and dry. This can be noticed in figure five, which represents the demand for forage of an 800 pound cow which is producing one calf per year. The requirements increase as the cow advances through the pregnancy period and the calf it is feeding grows bigger. When the calf is weaned, the drop in energy requirements is sharp and very substantial because the lactating requirements are suppressed suddenly.

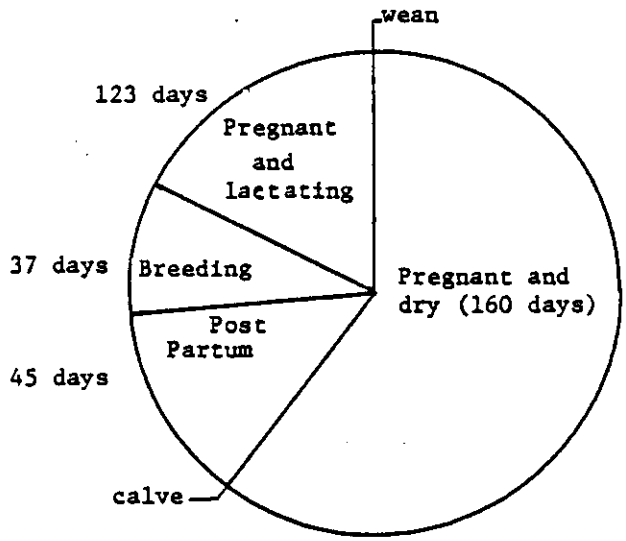
Replacement heifers will have a similar trend in demand for forage as the one explained for the fattening process: Increasing demand as weight goes up and a need for better quality of forage to achieve a mature stage in a short period of time.

2.1.3 The production organization at the farm level:

The beef production at the farm level has three stages in Argentina: the breeding process, the "recria" and the fattening process. The first one consists of the reproduction and feeding of cattle up to the weaning of the calf. The "recria" takes from the weaning of the calf (330 - 440 lbs.) till the end of its growing stage (770 - 840 lbs.), being the final product unfinished small steers

FIGURE 4

COW REPRODUCTIVE CALENDAR

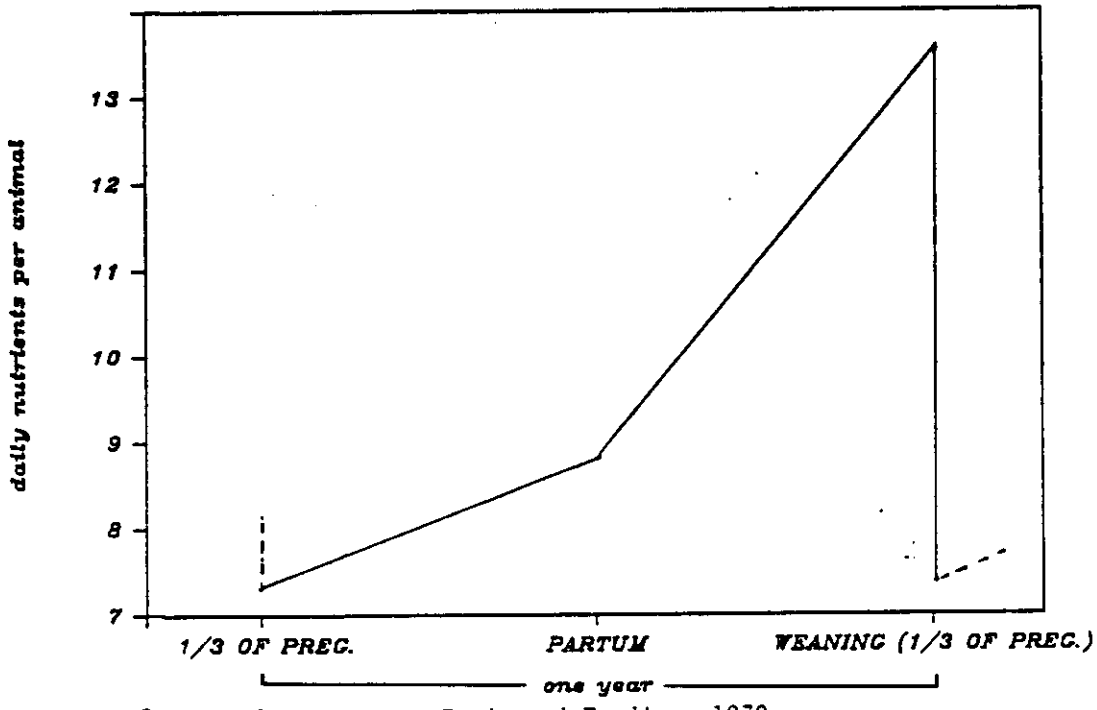


Source: Cooperative Extention Service, M.S.U.

FIGURE 5

NUTRIENT REQUIREMENTS

FOR BEEF CATTLE BREEDING HERD



Source: A. Cullison, Feeds and Feeding, 1979.

and heifers. The fattening process takes any category of animal, including "recriados" small steers to the finished stage when they are sold for slaughter.

In practice, the recria and fattening processes are difficult to separate due to their similarities and only two processes are well defined in terms of management : breeding and fattening[4].

The way the breeding process is organized gives the initial setting to the whole production and marketing chain. The calf breeder is vertically related through the sales of calves and cows to the market of animals for consumption as well as for fattening.

The weight and season at which the calves are weaned determines the future use of the animal and the length of the fattening process. If calves are weaned at lighter weights, the cattle feeder either has to prolong the fattening period or to accelerate the fattening process through the supply of more (or better) forage. On the other hand, if calves are weaned at different seasons, the yearlings might have to be in the field for a longer period of time while they wait for the favorable season (spring) to be finished.

The breeding area is located mainly in the Buenos Aires province. As it can be noticed from comparing figure 6 and 7, a great number of calves are sent from here to the

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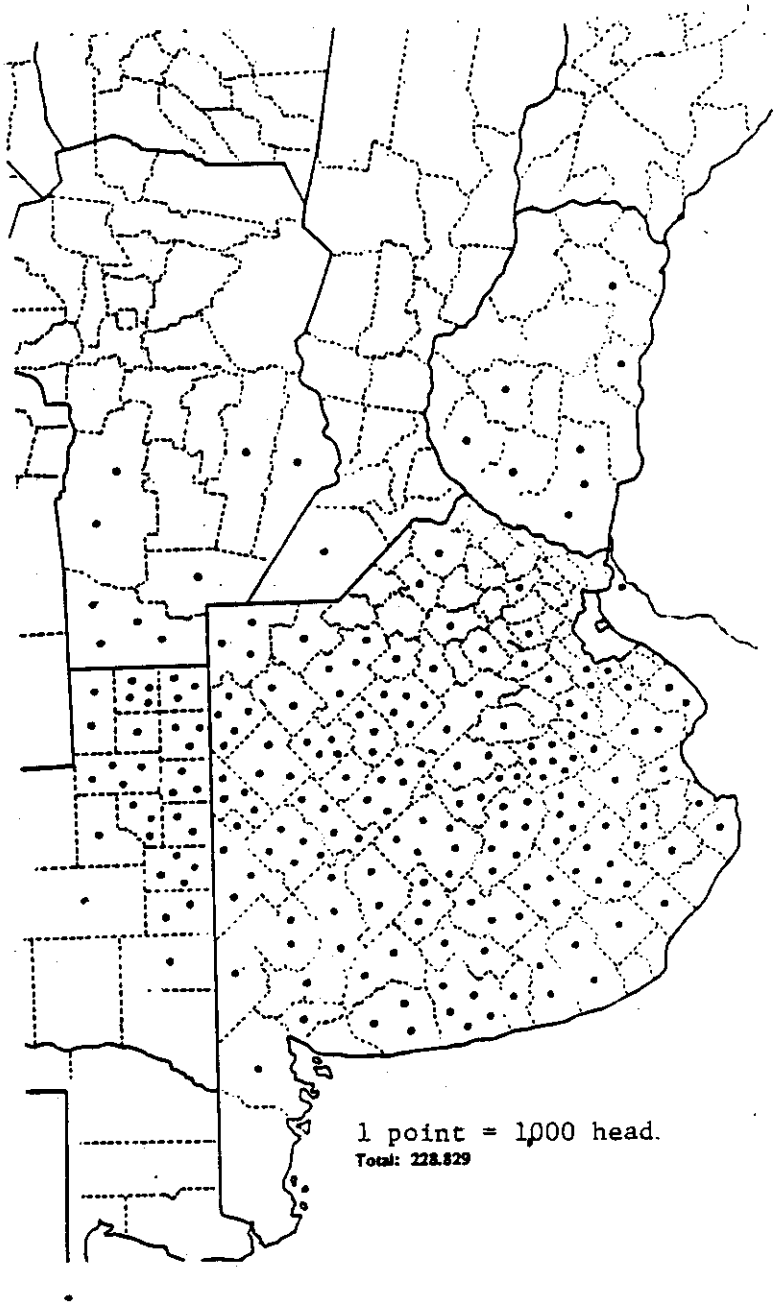
[4]M.Regúnaga, Magister Scienticiae Thesis, Castelar, 1970, p.10

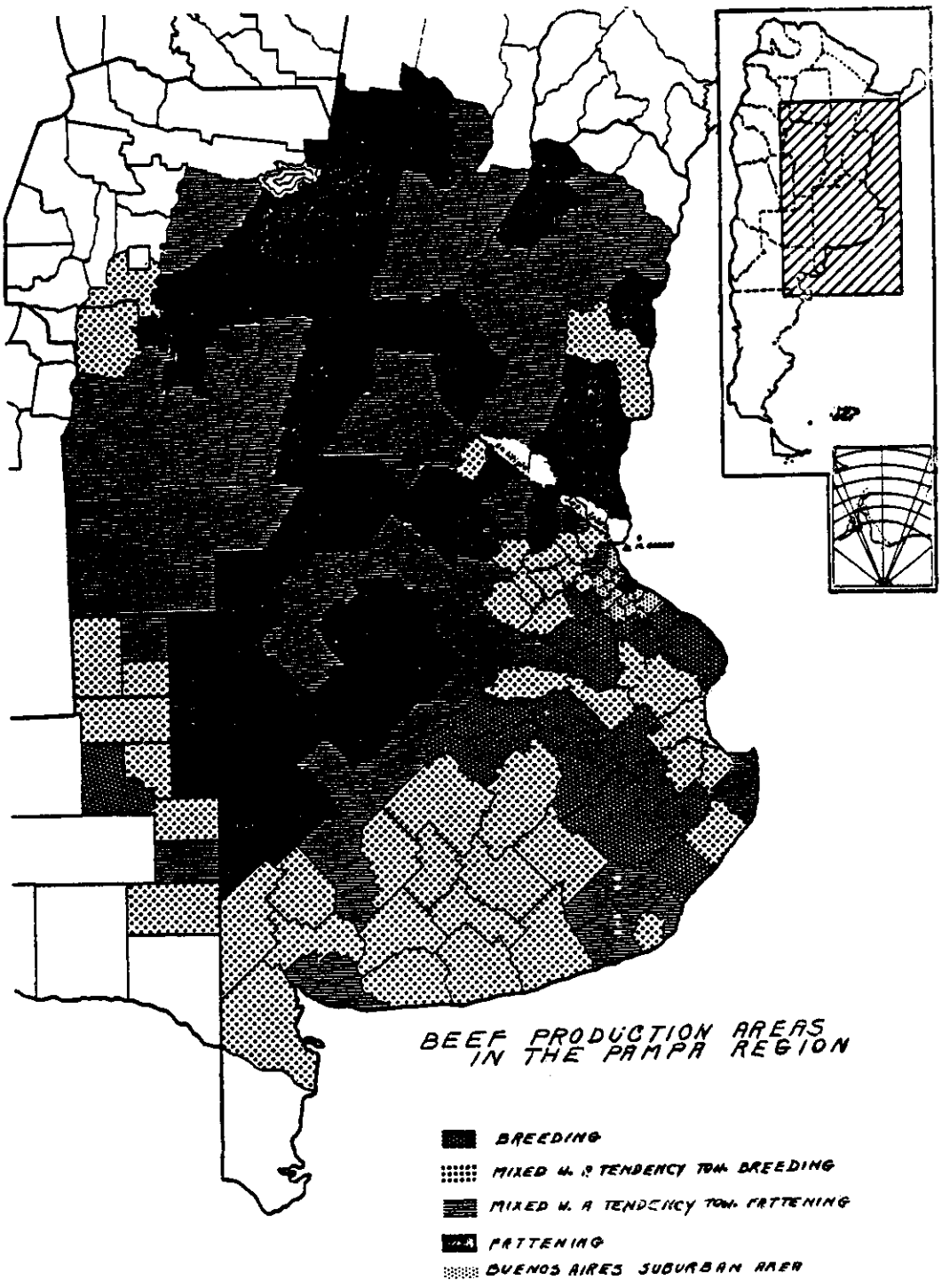
FIGURE 6

SOURCE OF CALVES SOLD AT LINIERS CATTLE MARKET
During 1982



Source: Junta Nacional de Carnes, Argentina, 1982.

FIGURE 7



Source: J. G. Dixon, PhD. Thesis, M.S.U., 1969.

Liniers market. On the year 1982, 73.8 percent of the calves sold in Liniers came from this province[5].

In the Buenos Aires province, the major breeding area is the "Pampa Deprimida Bonaerence" with an extension of 7.7 million hectares (15.4 million acres). This region is characterized by soils with poor drainage which restrict successful cash crop production, extremely flat land and many waterways, ponds and marshes. Vegetation is mostly natural and lacking in quality. Natural pastures in a representative county of this region cover 80 percent of the area[6]. On the eastern side of the region, enterprises of more than 2,500 hectares (5,500 acres) of size cover 37 percent of the total area. From 1,000 to 2,500 hectares (2,200 to 5,550 acres) in size cover 37 percent, and from 25 to 1,000 hectares (55 to 2,200 acres) cover 38 percent. Fifty three percent of the operators are engaged in cattle breeding, 37 percent are employed in mixed activities and only 5 percent are employed in crop production[7].

Cattle breeders match the supply and demand for forage by fitting the maximum requirements of the animal with spring, summer and fall. This organization leaves weaning from March till May, just before winter in

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[5]Junta Nacional de Carnes, Sintesis Estadistica 1982.

[6] Bochetto, PhD. Thesis, Michigan State Univ., 1981, p.86.

[7]Ibid. p. 80

Argentina. Studies done in the area by J. Gimenez Dixon[8] show that more than two thirds of the calves were weaned from April to June.

Figure 8 represents both the breeding cattle demand and the supply of forage from natural pastures. It can be noticed that this organization leads to a better use of pastures without running into deficits of forage. As the weaning period is moved into the winter, costs are expected to rise because of hay prices or reduction in the number of heads in the herd, to prevent forage deficits. The maximum deficit occurs when the weaning period extends through winter and spring, and therefore calves produced during this season are expected to have a higher cost per unit of weight.

Sixty five percent of the calves are sold when they are weaned. The remainder are grazed at the same farm till they reach 530 to 600 pounds at 18 to 20 months of age. However, post weaning production depends heavily on climatic conditions since the producers will accomplish it when there is excess supply of forage for their breeding herd.

Usually bulls are separated from cows to set the calving period on a particular season. An average of one bull per each twenty cows is kept, and the number of years a bull is kept in the herd is from 4 to 6.

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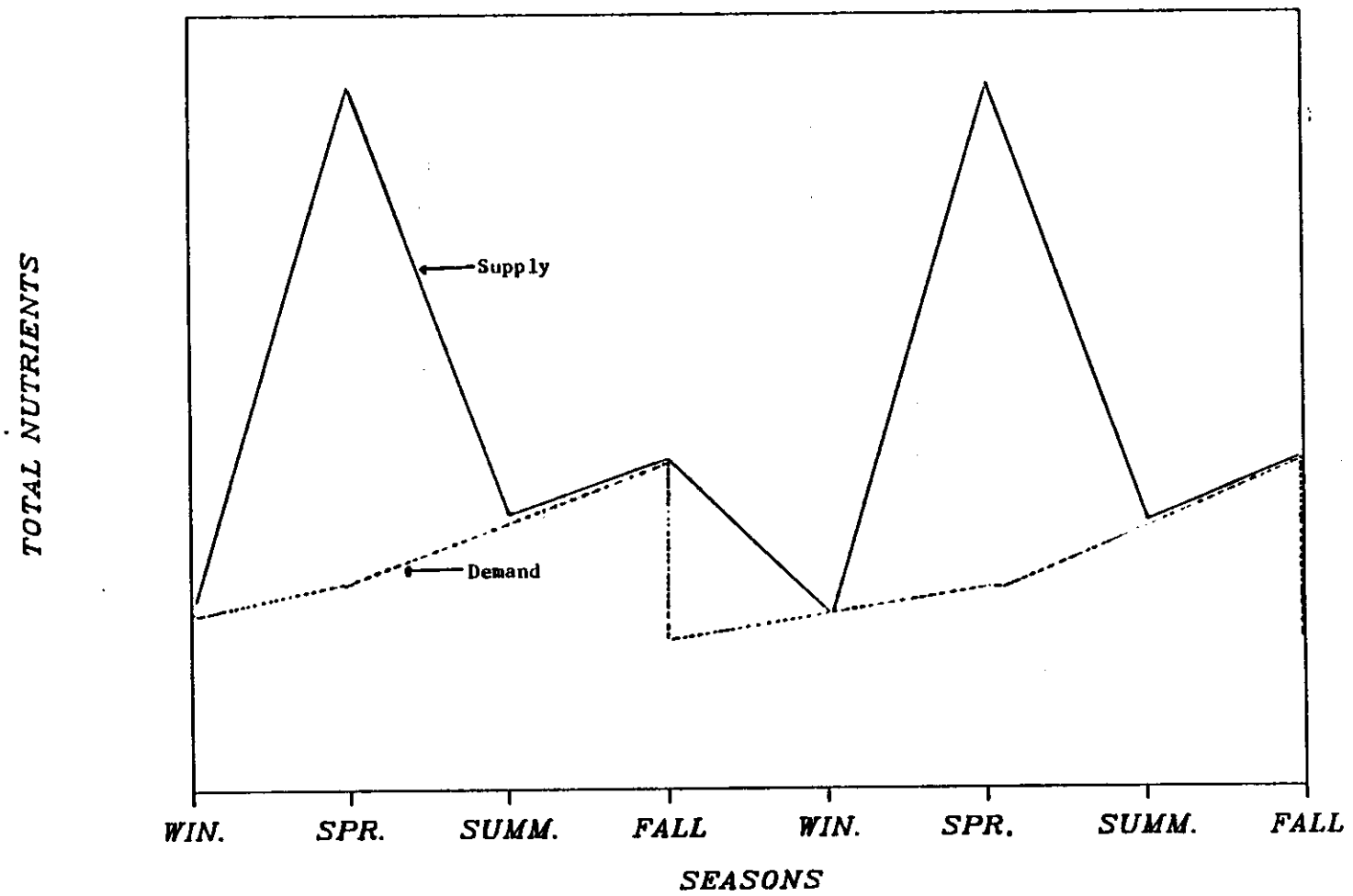
[8]J. Gimenez Dixon, Unpublished PhD. thesis, Michigan State Univ., 1969, p. 48

FIGURE 8

SUPPLY AND DEMAND FOR FORAGE

BREEDING CATTLE



The replacement heifers are usually raised on the farm, having their first calf at two or three years of age. An average cow is kept in the herd from 7 to 8 years[9].

Usually ranchers provide only management and supervision; hired labor performs all other functions. A ranch of 4,400 acres will have an average of four men employed, and an average number of animal units per year - round hired man of approximately 360 (Dixon).

The fattening process takes place in the west center area of Argentina (see fig. 7). Here, most of the forage is provided by a combination of permanent pastures and annual winter and summer forage. Almost 60 percent of this area is occupied by perennial pastures while 30 percent is occupied with annual crops[10].

The soils from this area are of higher quality than those of the breeding area, making possible successful cash crop operations and shorter rotations of land. For this reason the use of artificial pastures is very common, and the systems in general are more intensive than those in the breeding area.

Cattle feeders match supply and demand for forage by purchasing and selling animals according to the forage supply, and fitting the maximum weight of the animals with spring and summer. It seems logical to expect the cattle

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[9]Ibid. p. 48.

[10]M.Regúnaga, Magister Scienticiae Thesis, Castelar, 1970, p. 16

feeders to organize in this way to utilize more effectively their forage supply. The most common season to start the fattening of yearlings is winter and spring, buying the animals with a weight between 480 and 550 pounds and from 16 to 19 months of age. These same animals are sold 6 to 7 months later with an average weight of 970 lbs.[11].

Given that the best seasons with regards to meat conversion are spring and fall, and that the forage supply is also maximum at this time (especially spring), the animals finished during these seasons are expected to have lower costs of feeding. As in the breeding sector, the matching of high requirements from the animal with maximum supplies of forage leads to a minimization of the deficits of forage and hence a reduction in the costs of feeding. Therefore, following this rationale the steers finished in spring and fall would have lower costs than the ones finished in winter and summer.

2.2 TIME SERIES ANALYSIS AND SEASONAL PATTERNS

2.2.1 Components of Variation:

This analysis uses the classical time series model to study the seasonal component of the price of cattle. The classical model assumes there are four time series components of variation: Secular trend, Cyclical fluctuation, Seasonal fluctuation and Irregular fluctuation.

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[11]Ibid. p.16

Figure 9 shows a typical time series and its four components of variation. The secular trend is the long range movement in Yt over an extended period of time[12] and is represented by the line tt'. In the cattle market case the secular trend shows if prices or quantities of animals slaughtered are increasing or decreasing through the whole period considered. It gives the general trend of the dependent variable throughout the period 1957 - 1984.

The cyclical movement is characterized by wide swings - usually of a year or more - upward or downward from the secular trend (Lapin). This is represented by line cc' in figure 9. The Argentine cattle Cycles are well studied in the literature, lasting from six to eight years. The reasons for these cycles rests upon the fact that cattle are both the means to produce meat and the product itself. The only way to produce more calves in response to high prices is by increasing the number of females in the herd, and therefore farmers will tend to withhold their cattle from slaughter (specially females) when prices rise, pushing the prices even higher. The inverse situation occurs when prices drop. Farmers will sell more stock accentuating the drop in the price of meat.

The seasonal fluctuation is a generally recurring upward and downward pattern of movement in Yt usually on an

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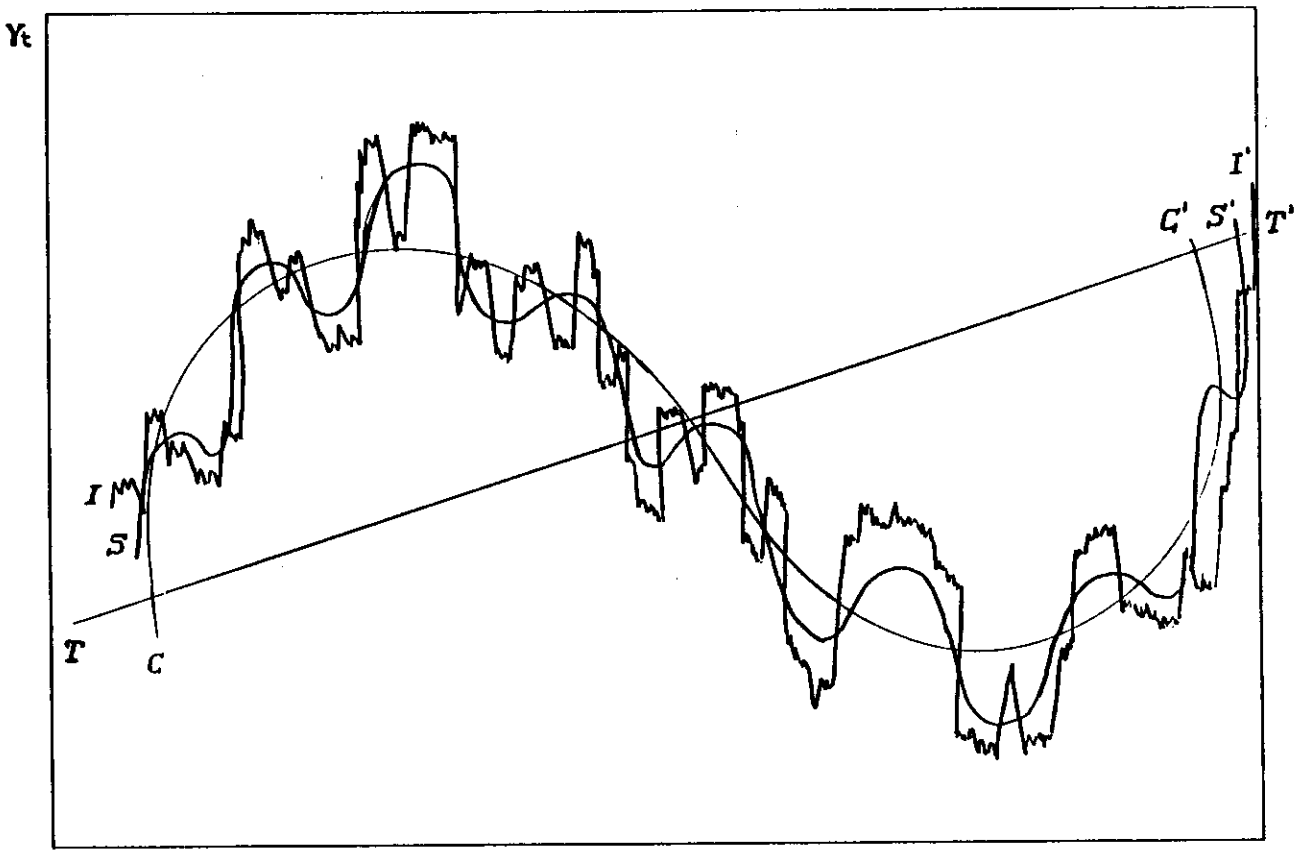
[12]L. Lapin, Statistics for Modern Business Decisions, 1978, Chapter 12.

FIGURE 9

TIME SERIES

COMPONENTS OF VARIATION



annual basis[13]. Seasonal fluctuations are represented by line ss' in figure 9. The graph shows that although Yt is pushed up through the whole time series by a secular trend, and swings up and down by a cycle(which in the case of Argentina is from 6 to 8 years), Yt also swings within each year in a more or less uniform way. This is the pattern that is analyzed in this study and whose causes, associated with certain events that occur every year, will be described in more detail later in this chapter.

The irregular variations are characterized by events that are completely unpredictable and sometimes are referred to as random factors. Such causes of variation are distinguished by their irregularity from the trend, cyclical and seasonal components which are collectively referred to as systematic variations. The irregular fluctuations are represented by line II' in figure 9. The Argentine cattle market shows a high variation due to this component. As it will be seen in chapter 3, prices and quantities of animals slaughtered per month differ greatly from the "typical" behavior, hence increasing the variance of the pattern.

2.2.2 Seasonal Variations:

Seasonal patterns are associated with things that take place every year (like the seasons), and affect the supply and/or the demand of a commodity. The reasons for seasonal

[13]Ibid. chap.12

variations in prices can be many and rely on external as well as internal factors in the market. However, all factors in a free market[14] act through only two market components: supply and demand. This means that any change in the price must come from a change either in the supply or demand and prices will not vary unless either of these two components is changed. This argument does not work inversely. A change in demand or supply does not necessarily result in a change in price because the movement of one can be offset by a movement in the other, leaving the equilibrium point at the original price level but at a different quantity of product marketed.

Figure 10 illustrates this point. When supply shifts up from s_1 to s_2 at the same time that demand shifts up from d_1 to d_2 the price level stays the same at p_1 but the quantity marketed increased from Q_1 to Q_2. The inverse situation happens when supply shifts back from s_1 to s_3 and demand shifts back also from d_1 to d_3.

Hence cyclical variations in the supply or demand do not necessarily result in cyclical prices because the change in one can be partially or fully offset by a change in the other.

Refreshments are a typical example of a commodity with a seasonal demand. It is expected that during the summer or hot season the demand for refreshments is going to increase

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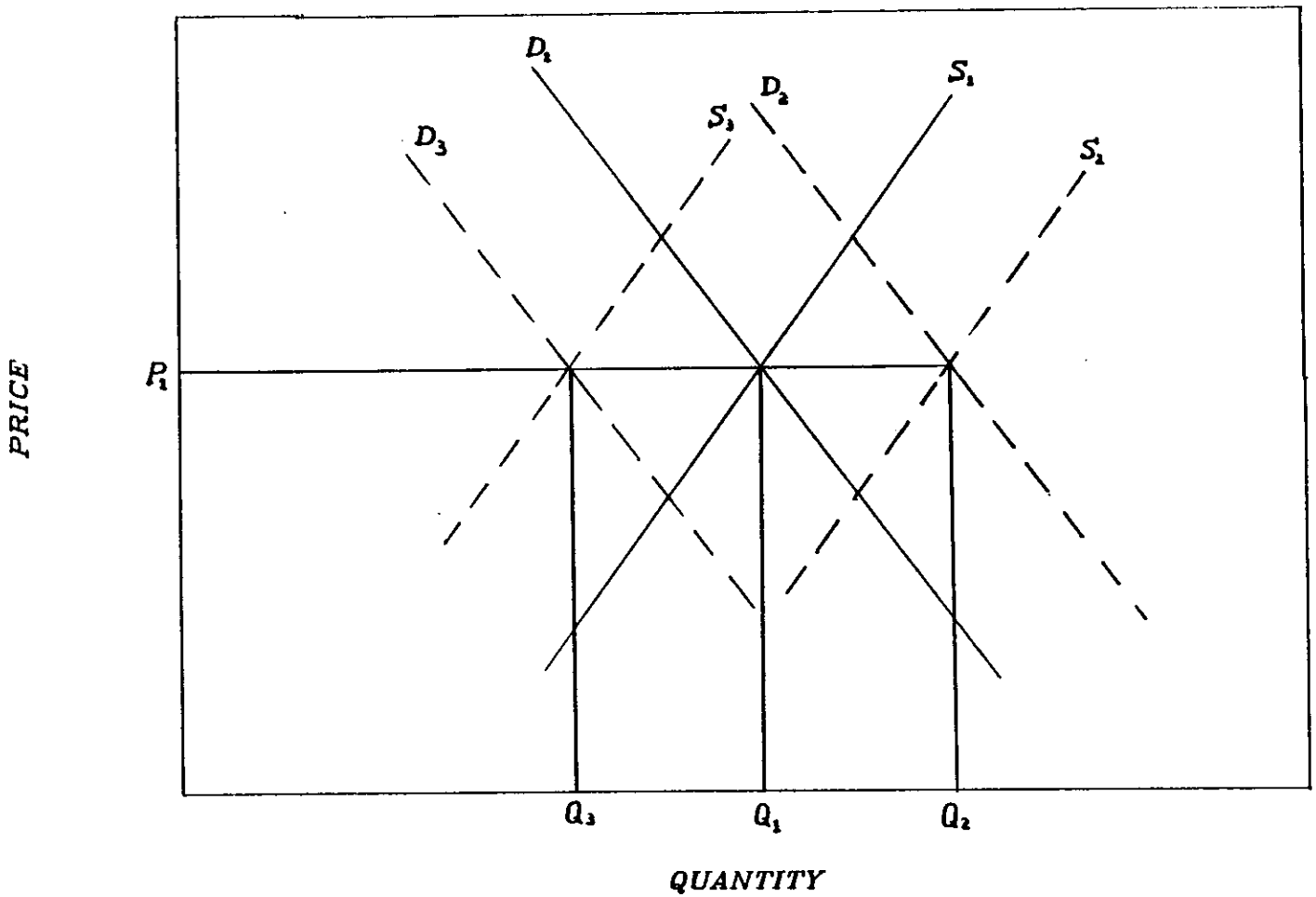
[14]The effects of price policy on prices is disscused later in point 3.1.4. in chapter 3.

FIGURE 10

SUPPLY AND DEMAND SHIFTS



because people will feel more thirsty. However, the price of refreshments may not rise if more refreshment stores are opened during the summer, increasing the supply of refreshments.

On the other hand, grains tend to follow a seasonal supply. There is usually one harvest period during the year when the grain is supplied and stored. During this time prices systematically tend to be low. As we go further from the harvest time, prices tend to increase up to the following harvest because the grain has to be stored for longer periods of time increasing the costs of the commodity.

It is important to note that the difference between the harvest price and the price at any other season should cover all costs incurred to provide the product at that time in order to encourage grain storage in the long run. This includes direct costs of warehouse space, fire insurance, interests on investments in facilities and inventory, and so forth. If there is storage, these costs should be covered by an increase in the price of the commodity; and since the process of harvest and storage is repeated in the same seasonal pattern through the years, prices will follow this pattern[15].

Higher costs incurred in producing a finished animal during winter due to the scarcity of forage and higher

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[15]W. Tomek & K.Robison, Agricultural Product Prices, 1981, p. 172.

requirements of energy from the animal, suggest that prices of finished cattle should follow a seasonal pattern the same as the grain example. Since meat is provided all - year - round, seasonal increases in the price of meat are expected to cover all the additional costs of finishing animals during winter. However, this is not a necessary condition, since the production of finished animals during winter may be offset by seasonal reductions in the prices of some inputs such as replacement cattle.

Studies made by the "Junta Nacional de Carnes[16]" show that there is a significant seasonal pattern in prices per kilogram of replacement cattle in a time series from 1950 to 1968 (see table 1). The difference between the price in the hot season (October through March) and the price in the cold season (April through September) is from 15 to 20 percent for small steers and calves.

No seasonal studies for replacement are made in this analysis due to lack of data. Replacement cattle are sold in local markets at a price per head, not per kilogram, making it difficult to obtain the information and rely on it. However the results of the "Junta Nacional de Carnes", if taken into consideration indicate that the cattle feeders might be rewarded by seasonal reductions in the costs of replacement cattle when selling finished animals in winter. If this is true, then the prices of finished cattle may not follow a pattern where prices increase when the

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[16]J.N.C., Unpublished information about auctions, 1970.

TABLE 1

PRICES OF REPLACEMENT CATTLE
AS A PERCENTAGE OF YEAR AVERAGE

	BIG STEERS	SMALL STEERS	CALVES
JANUARY	107.4	112.4	106.9
FEBRUARY	103.2	110.2	103.3
MARCH	103.5	105.3	98.2
APRIL	102.0	99.2	94.6
MAY	95.0	94.0	93.6
JUNE	95.0	94.0	93.6
JULY	95.6	88.4	93.1
AUGUST	94.2	89.3	92.7
SEPTEMBER	97.0	98.4	95.3
OCTOBER	96.4	92.4	95.1
NOVEMBER	98.8	100.3	109.3
DECEMBER	107.4	110.0	112.5

Source: Junta Nacional de Carnes, Unpublished information.

costs of production are higher. This point will be discussed further in chapter 3 where the results of this analysis are presented.

2.3 PRIOR AND RELATED WORK

Several authors have made contributions to help understand the organization and functioning of the Argentine beef cattle industry. Among them we can cite Carlos Díaz Alejandro[17], Rinaldo Colombé[18], William Otrera[19], Lucio Reca[20], Gustavo Nores[21], Raúl Iver[22] and Lowell Jarvis[23]. These studies although not recent, are

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[17]C. Díaz Alejandro, The Exchange Rate Devaluation in a Semi Industrialized Country: The Experience of Argentina, 1955-1961, M.I.T. Press, 1965.

[18]R. Colombé; Funciones de Oferta Agropecuaria de la Region Pampeana en el Periodo 1940-1960, Universidad de Cordoba, July, 1966.

[19]W. Otrera, An Econometric Model for Analyzing Argentine Beef Exports Potential, PhD. dissertation, Texas A & M Univ., 1966

[20]L. Reca, The Price and Production Duality within Argentine Agriculture, 1923-1965. PhD. dissertation, Univ. of Chicago, 1967.

[21]G. Nores, An Econometric Model of the Argentine Beef Cattle Economy, M.S. Thesis, Purdue Univ. 1969.
----------, Structure of the Argentine Beef Cattle Economy, a Short Run Model, 1930-1970, PhD. Thesis, Purdue Univ., 1972.

[22]P. Yver, Investment behavior and the Supply Response of the Cattle Industry in Argentina, PhD. Thesis, Univ. of Chicago, 1971.

[23]L. Jarvis, Cattle as Capital Goods and Ranchers as Portfolio Managers: An Application to the Argentine Cattle Sector, Jour. Pol. Ec., Vol. 82 #3, 1974.

still relevant as basic information which time has proved to be correct. The analysis of Nores, Iver and Jarvis will be briefly described here because of their power to explain the wide variation in cattle prices as well as several reasons for the organization of the beef cattle industry.

Nores presents an econometric model based on a theory of investment behavior of producers and on traditional demand theory. Four statistical models are specified as simultaneous equations in which quarterly slaughter volume and quantities consumed and exported react to and determine price. He recognizes the existence of seasonal patterns and the effects of them over slaughter response to price changes. In his own words:

> "The empirical evidence indicates that slaughter of different categories of animals are characterized by seasonal patterns reflecting the seasonality in births and pasture availability. Availability of pastures varies with the season and so does response to price changes."[24]

However Nores does not perform any further analysis to correct for the seasonal discrepancies of his model with the data.

Iver[25], in 1971 studies the investment behavior and the

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[24]G. Nores, p. xi.

[25]P. Yver, Investment behavior and the Supply Respose of the Cattle Industry in Argentina, PhD. Thesis, Univ. of Chicago, 1971.

supply response of the cattle industry, showing that the industry is highly responsive to changes in beef prices. He distinguishes between short and long run supply describing how the slope of this function changes when analyzed in different time horizons (see fig 11).

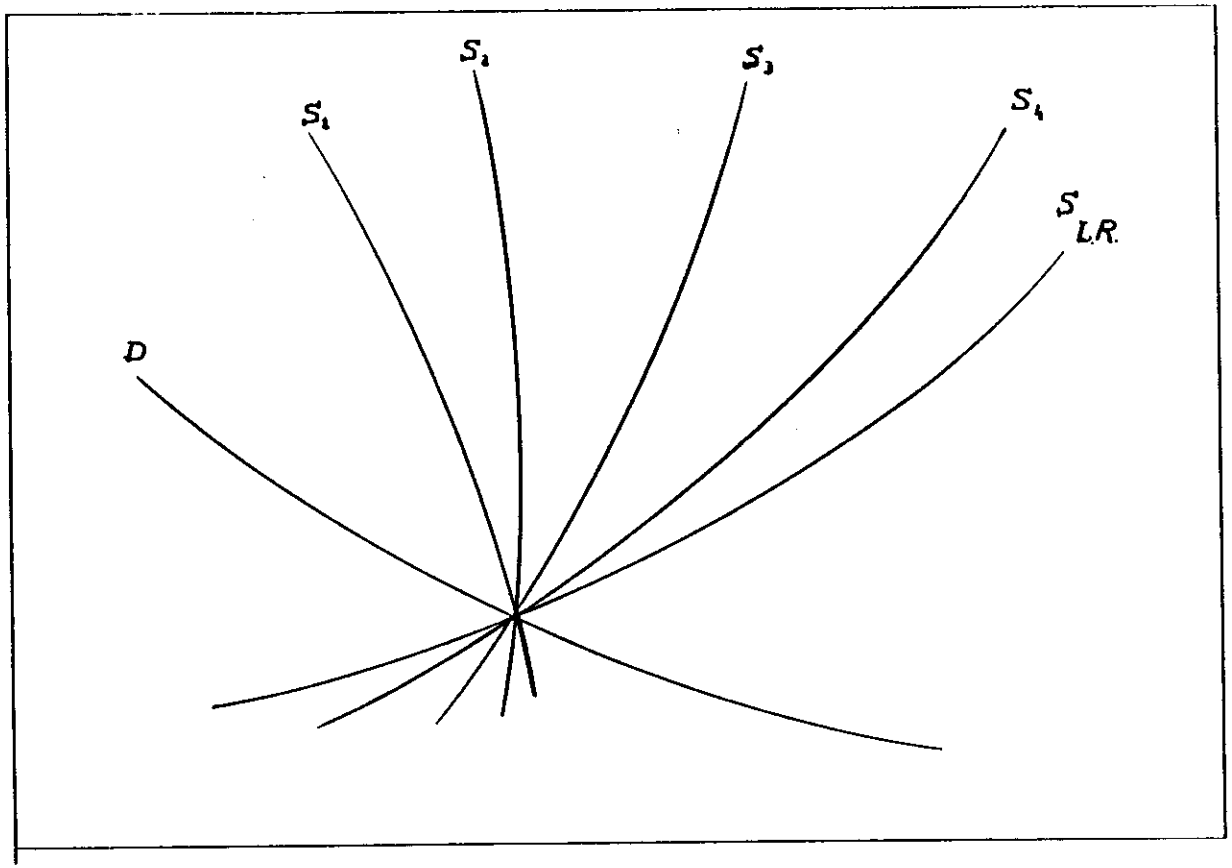
The shorter the time horizon, the more inelastic the supply becomes, reaching finally in the short run a negative slope. This is so because farmers compare the net present value of the animals with the price they can obtain in the market, selling the animal if the price at the market is higher. When prices rise, the net present value of cattle increases making it profitable to keep the animals up to more advanced ages and hence there is a temporary decrease in the supply of cattle for slaughter.

The price rise would affect different categories of animals unequally. The slaughter of animals with longer discounting horizons (like breeding stock) would be more sensitive to price variations because their net present value is more affected by price.

Yver's analysis provides a good explanation for the instability of cattle prices and the nature of the supply response to them, but it does not address the issue of seasonality, which might be an important variable affecting supply response. As will be described in chapter three, the supply of females has a well defined seasonal pattern with a peak during fall. Since females are more sensitive to price changes, an increase in the price of beef will have

FIGURE 11

SALES SUPPLY CURVES



Source: R. Yver, Unpublished PhD.Thesis, 1971

more impact on the supply if it takes place during fall because the proportion of females is greater at that time. Therefore an increase in the price of beef during fall is expected to result in a more negative supply response as compared to other seasons or this fall season compared to past.

Jarvis analyzes the cattle industry in a similar way as Yver does. He considers farmers as portfolio managers seeking the optimal combinations of different categories of animals to complement their non cattle assets. Cattle are considered to be capital goods which are held by producers as long as their capital value in production exceeds their slaughter value.

He assumes, the same as Yver, that the capital value of an animal is equal to the difference between the present value of the animal at slaughter minus the present value of all feed costs up to the time of slaughter. This is represented by the following equation for steers:

$$\Pi(0) = p(i,0).w(i,0).e^{-r0} - ci \int e^{-rt}\, dt$$

where: Π = present discounted profit of the fattening process.
p = price per pound which may be obtained from a beef consumer at age 0.
i = fixed bundle of inputs to the steers, independent of age.
0 = age of the steer.
w = weight of the steer.
r = interest rate.
ci= cost of the feed bundle.

The equation for cows is slightly different, having three terms reflecting respectively the calf stream, the

inputs required to maintain the animal and the present value of the beef available at the time of slaughter:

$$p = \frac{c(i,t)}{(1+r)^t} - ci\int e^{-rt}\,dt + p(i,0).w(i,0).e^{-r0}$$

These equations have several implications in the market as well as in the production organization at the farm level. Jarvis[26] lists the following:

> "A) A rise in the p increases the marginal value product of each category, increasing the optimal feed ration and the optimal slaughter age.
>
> B) A rise in the costs of inputs reduces both the daily input and the optimal slaughter age. Animals are fed not only less per day, but for a shorter period of time because they grow more slowly at any given age.
>
> C) A rise in r reduces the daily feed inputs because higher feed investments implies higher interest costs. The increase in r also reduces the optimal slaughter age, as it increases the interest forgone at every age."

This model can also be utilized to show that the magnitude of the slaughter response will differ for different types of animals. The net present value of female cattle will be more affected by a change in price due to the extra term representing the calf stream. This is what Yver called in his thesis a "longer discounting horizon".

Jarvis suggests as a rule of thumb based on his rationale that the slaughter elasticity decreases as the

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[26]L. Jarvis, Cattle as Capital Goods and Ranchers as Portfolio Managers: An Application to the Argentine Cattle Sector, Jour. Pol. Ec., Vol. 82 #3, 1974. p. 492 - 496.

animals grow older, and that the elasticity is greater for female than for male animals.

By combining Yver's and Jarvis' analysis together, we can conclude that female cattle have a more elastic supply for slaughter, and therefore it will have a more negative short run supply response because of the greater sensibility to price changes.

Jarvis provides a plausible explanation for the regional location of production activities in Argentina based on this model:

> "Producers with different feed costs will choose different parts of the production process. For example, breeding operations will usually take place in areas where the opportunity cost of feed is cheap, that is where the cost of maintaining a cow year round is less than the value of the calf at birth. Because all calves will have the same value at birth in a unified market, it will not be profitable to maintain breeding herds in high cost feed areas unless producers there are more efficient, that is, unless herds have higher calving rates and lower mortality rates than herds elsewhere."[27]

The regional location of the breeding stock described earlier fits this explanation very closely. The "Pampa Deprimida Bonaerence", the core of the breeding area, has low opportunity costs of feed because poor soils limit cash crop production and other intensive activities.

The econometric model proposed by Jarvis does not have any seasonal components since he works with annual data. The same as Yver, this model might be tuned more finely

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[27]Ibid. p. 505.

with the inclusion of variables which would handle seasonal variations because of the effects that these might have on the supply elasticities.

CHAPTER III

3.1.METHODOLOGY

3.1.1 General Procedure and Rationale

This study starts obtaining the seasonal patterns of the following variables:

Deflated prices per kilogram of :

1. Big steers
2. Small steers
3. Cows
4. Heifers
5. Calves
6. Average price of all categories

Heads slaughtered per month of:

7. Big steers
8. Small steers
9. Cows
10. Heifers
11. Calves
12. Sum of all Categories Considered

Average heads slaughtered per day of:

13. Big steers
14. Small steers
15. Cows
16. Heifers
17. Calves
18. Sum of all categories considered

Average kilograms slaughtered per day of :

19. Big steers
20. Small steers
21. Cows
22. Heifers
23. Calves
24. Sum of all categories considered

It follows comparing the seasonal patterns of deflated prices per kilogram between all the categories of animals (variable 1 to 5) through the use of both graphs and regression analysis. This provides an idea of how close prices of different categories are related together.

The same comparison is made among categories of animals for the seasonal patterns of average kilograms slaughtered per day (variables 19 to 24).

The results of the seasonal analysis done for all the categories on heads slaughtered per month and average heads slaughtered per day are shown (variables 7 to 18), pointing out the disadvantages of estimating slaughter in with these variables as compared to estimating it in terms of average kilograms slaughtered per day.

The general trend observed was that prices tend to move together not following changes in the seasonal increases in the cost of producing beef. According to the theory and analysis exposed in chapter 2, prices should increase in winter, when the costs of producing a finished animal are higher. However the analysis shows that there is a general trend on all prices to be lower at the end of fall and through the winter.

It was also observed that prices do not tend to follow the same relationship with the seasonal variations in the slaughter for every category. Cows, heifers and calves tend to have strong and negative correlation (low prices when the quantity slaughtered increases), while big and small steers

both have very low correlation coefficients and of different sign. This was unexpected because on the demand side, Argentine consumers do not have the possibility to discriminate directly between meat from different categories because the product is sold as fresh meat without any indication of its precedence[1]. On the supply side, producers have the same farm organization for animals that showed different signs (big and small steers). Therefore there is no immediate answer that would justify the different signs of the coefficients.

The next step was to look at the seasonal variation in the total kilograms slaughtered per day, that is the sum of all categories slaughtered per day. The seasonal pattern of the sum of all categories considered is elaborated adding up the expected kilograms slaughtered per day according to the seasonal index of each individual category. The product obtained is a graph which shows the proportions that each category typically takes in each month and the effects of them on the total slaughter. The correspondence between the seasonal pattern obtained through the direct use of the variable total slaughter in the analysis and the method just described is shown, testing for the reliability of the results.

The results obtained on the graph provided an explanation for the unexpected signs found on the relationship between price and quantity on the seasonal

---

[1]These assumptions are discussed later in this chapter.

patterns of prices. The seasonal supply of different categories offset each other resulting in a pattern of total seasonal supply that will differ from that of some individual categories. Those categories that are offset and therefore do not follow the same seasonal supply as the total slaughter are the ones with low correlation coefficients between price and quantity, and different sign (big and small steers). If we follow the same assumption proposed before, that consumers cannot discriminate directly between meat of different categories, we can also conclude that the meat from different categories will be close substitutes. One type of meat can be substituted by another without causing changes in the demand. Therefore prices will be more affected by the total quantity slaughtered rather than the quantity of an individual category.

The last step was to compare the strength of the relationship between prices of an individual category and total quantities slaughtered with prices and quantities of the same category. This is done through regression analysis by comparing the correlation coefficients between the pairs mentioned.

The results of the analysis are presented later in this chapter.

3.1.2 Systematic Procedure

The analysis followed a series of 6 steps which are described below:

Step 1:

Twenty eight years of monthly data was obtained about slaughter of five different categories of animals: big steers, small steers, heifers, cows and calves. For each one of the categories the data reported : prices, price indexes, number of heads slaughtered and average weight of the animals slaughtered. The series covered from January 1957 to December 1984.

Step 2:

The data was entered manually in a spreadsheet program (Lotus 1,2,3)[2] in a microcomputer. It totaled 6,720 cases, being the number of observations 336 for each variable in each category. The checking for errors was performed through visual inspection of graphs generated with each series of data entered.

Step 3:

Additional variables were computed from the original ones through the use of the spreadsheet capabilities. The following variables were created:

1. Deflated prices = Prices / price indexes
2. Average slaughter per day =
   slaughter per month / number of days in the month
3. Average Kg. slaughtered per day =

---

[2]Lotus 1,2,3 is a product of Lotus Development Co. wich combines spreadsheet and graphics capabilities.

(average slaughter per day) * (average weight of the animal)

4. Total Kg. slaughtered per day =
Sum of ((heads slaughtered per day) * (weight of the animal))

5. Total average deflated price =
Sum of ((deflated price per kg of a category) *
(Kg. slaughtered of that category / total Kg. slaughtered))

Step 4:

The data was transferred one variable at a time to another microcomputer program (mstat)[3] which performed all the mathematical procedures up to the calculation of the seasonal indexes.

Step 5:

The seasonal indexes obtained in step 4 were entered manually in the spreadsheet program (Lotus 1,2,3) and graphed with a plotter.

Step 6:

The results were transferred from the microcomputer to the Michigan State University's mainframe computer and used

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[3]Mstat is a program for microcomputers wich has statistical capabilities.

as data to run regressions with a statistical package (T.S.P.)[4].

3.1.3 Mathematical Procedure

As was mentioned in Chapter 2, this analysis uses the classical time series model which assumes four sources of variation: secular trend, cyclical fluctuation, seasonal fluctuation and irregular fluctuation. These four components if multiplied together will provide the value of the independent variable[5]. The equation takes the form:

$$Yt = Tt * Ct * St * It$$

Where:

Yt : Dependent variable

Tt : Secular trend

Ct : Cyclical fluctuation

St : Seasonal fluctuation

It : Irregular fluctuation

The following is an example of how the different components were calculated for deflated prices of cows (refer to table 2).

The secular trend is calculated running a regression of deflated prices on time. Table 2 shows that the value for the slope coefficient was .005, significantly different from

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[4]T.S.P. (time series processor) is a package designed to perform statistical analysis on time series.

[5]Lapin, Laurence; Statistics for Modern Decision Analysis, Javanovich Inc., 1978, Ch. 12.

TABLE 2

The first observation represents data from JAN, 1957.

REGRESSION RESULTS
FOR
DEFLATED PRICES OF COWS

NO OF OBS= 336	STD ERR OF EST= 3.088
MEAN OF Y= 10.988	STD DEV OF Y= 3.128
A IS EQUAL TO 10.077	T EQUALS 3.113
B IS EQUAL TO 0.005	STD ERR OF B= 0.002

DEFLATED PRICES OF COWS

OBSERV. NUMBER	ACTUAL DATA	TREND	MOVING AVERAGE	RATIO TO MOVING AVERAGE	CYCLICAL INDEX
1	5.65	10.08			
2	5.73	10.09			
3	6.10	10.09			
4	5.96	10.10			
5	6.40	10.10			
6	6.57	10.11			
7	6.22	10.12	5.88	105.71	58.13
8	5.69	10.12	5.91	96.28	58.40
9	5.96	10.13	5.93	100.54	58.58
10	5.82	10.13	5.95	97.77	58.78
11	5.28	10.14	5.97	88.50	58.88
12	5.06	10.14	5.95	84.93	58.70
13	5.94	10.15	5.96	99.67	58.70
14	6.16	10.15	6.08	101.30	59.87
. . . . .					
325	11.84	11.83	10.65	111.18	90.02
326	12.15	11.84	10.51	115.58	88.80
327	11.04	11.85	10.50	105.14	88.62
328	9.58	11.85	10.62	90.13	89.65
329	8.30	11.86	10.61	78.23	89.46
330	8.46	11.86	10.41	81.22	87.76
331	8.39	11.87			
332	10.00	11.87			
333	13.01	11.88			
334	11.99	11.88			
335	10.21	11.89			
336	8.75	11.89			

FIGURE 12

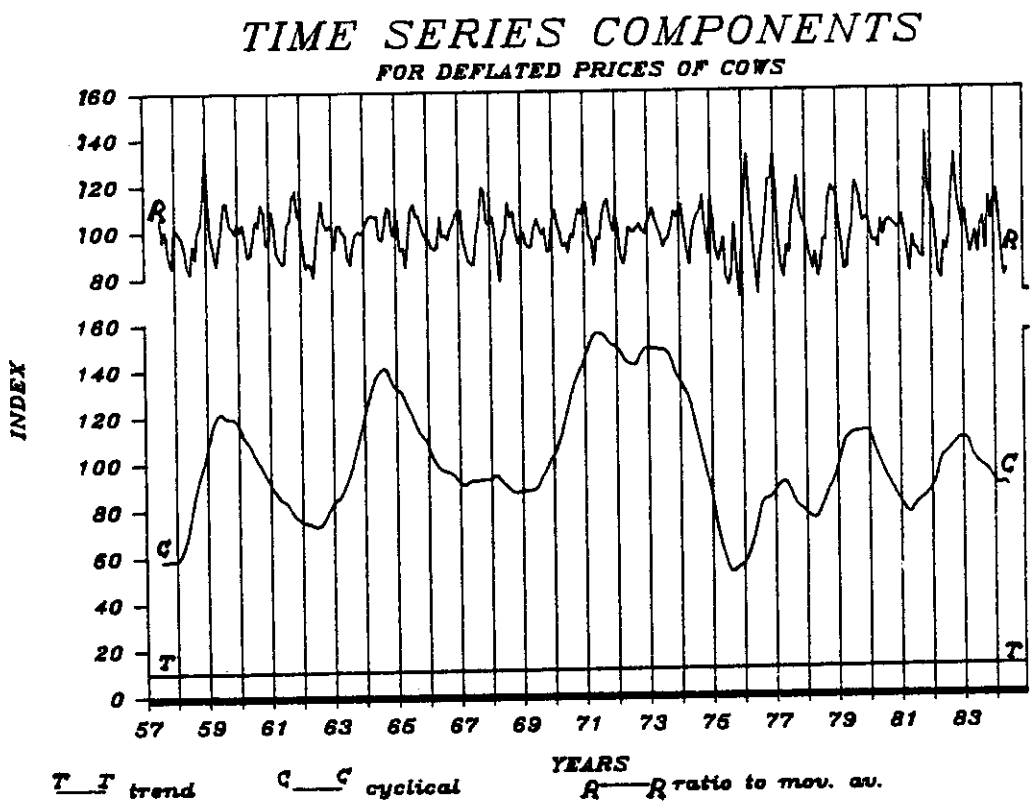
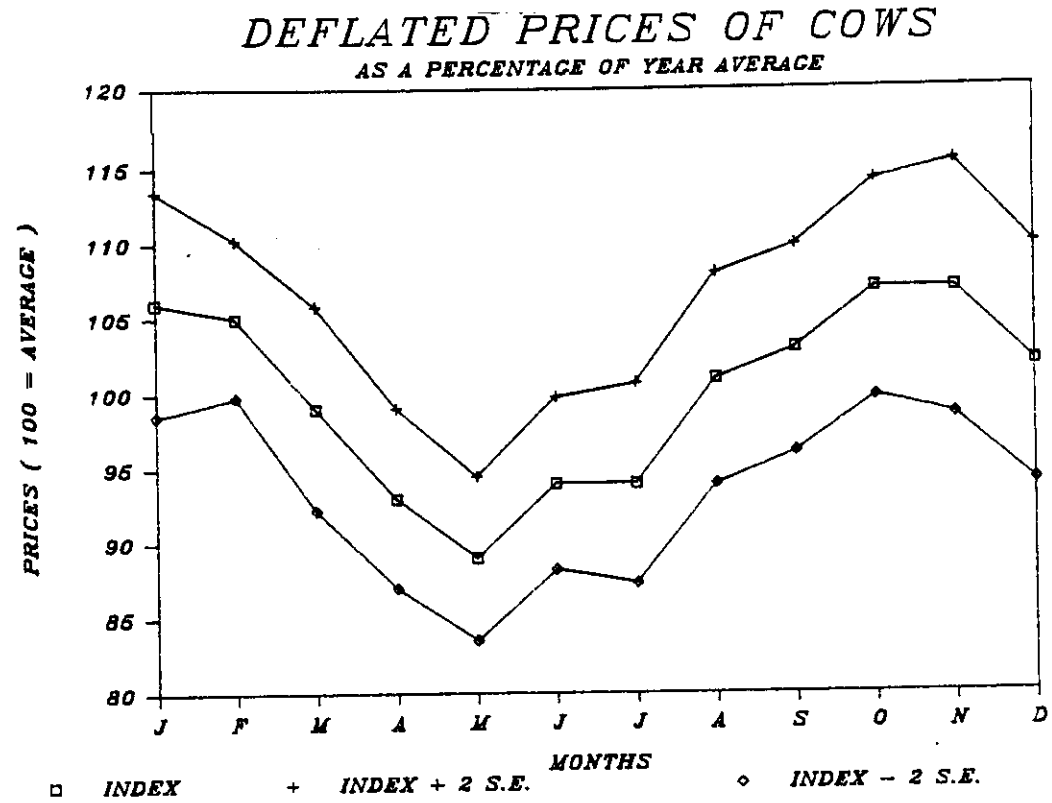


FIGURE 13



zero (t-value above 2). This shows that the deflated prices have been increasing at a ratio of $.005 per month since 1957. The expected values for this regression are shown in the column labeled "trend" and represent the secular component, this values are graphed in fig.12.

A centered moving average is calculated for each observation from the actual data. This moving average represents the level of prices for the whole year at which the observation is centered. It was calculated as:

C.M.A.(7) = (2 * (M2 + M3 + M4 + M5 + M6 + M7 + M8 + M9 + M10 + M11 + M12) + (M1 + M13)) / 24

Where :

C.M.A.(7) : Centered moving average of the seventh observation

M1...M13 : Value of the first month ... value of the thirteenth month.

Note that the first and last six values of the series are lost because there not enough months to complete a whole year.

The moving average will be used to calculate both the cyclical index and the seasonal index. The centered averaging for one year eliminates the seasonal component and is expected to eliminate the irregular component as well. Since the seasonal component lasts one year, its swings will average zero in a period of one year, therefore the one year moving average will not be affected by this component. The irregular component is also eliminated in the

process of averaging because, assuming that it is random, the period is long enough to expect the random fluctuation to average zero. Hence, the only sources of variation in the moving average are the secular and cyclical components[6].

Therefore, the moving average can be expressed as:

$$\text{Moving Average} = Tt * Ct$$

where: Tt = Secular trend

Ct = Cyclical fluctuation

As the secular trend has already been calculated through the regression, it can be eliminated from the moving average dividing it by the trend. Having eliminated all other components, the magnitude left represents the cyclical component. The results of this division expressed in percentages are listed in the column labeled "cyclical index" in table 2 and graphed in figure 12.

The deflated prices on the other hand, have all the four components of variation. Therefore, if the moving average has only two (cyclical and secular), the division by the last one would provide the seasonal and irregular components alone. This division expressed as percentages is shown in the column labeled "ratio to moving average" in table 2 and graphed in figure 12.

The ratio to moving average represents how much has the monthly price gone up or down as a percentage of the year average. For example, it can be noticed in figure 12 that

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[6]See Lapin Chapter 12 for a more detailed discussion.

the prices were very far away from the yearly average in the years 1975 - 1978. It can also be noticed that they follow a similar pattern through the years. This is the seasonal pattern that is being changed constantly by irregular fluctuations, but its effect can still be noticed by finding similarities in all the years.

Again, the averaging will eliminate the irregular component leaving only the seasonal component. Therefore, all the ratio to moving averages of the same month will be averaged through the whole time series, yielding as a result the seasonal index graphed in figure 13.

3.1.4 Data Source

The data about cattle used in this analysis was obtained by compiling statistical syntheses published by a well known government source called Junta Nacional de Carnes. Such synthesis is published yearly, reporting most of the parameters of the production, consumption and exports of the Argentine meat industry.

Numerous events as well as government interventions in the history of the cattle industry in Argentina may have altered the data in several ways. Some examples are: the development of black markets during periods of price control that might have affected the quantities and prices registered with the authorities. The same case might have happened with changes in the taxing system or in the tax

collection system. The price control imposed by the government might have not followed the seasonal pattern of a free market, adding more variance to the data. Changes in the terms of payments or interest rates may have distorted the real prices paid to producers. Inflation over than ten percent per month may have distorted both nominal and real average monthly prices. For these and many other reasons the data may not be measuring our parameters correctly. Since the isolated effect of each of these events is difficult to estimate, I have chosen a long period of time (28 years) to expect this effects to be compensated by each other and therefore, be more confident on the results obtained.

The isolated events that might have changed drastically any of the variables studied are not so relevant to the seasonal analysis as one might expect at first sight. For example, if a variable changes to a higher magnitude due to some external factor, this will be reported as a great increase in the difference between the moving average for that year and that particular month, but this difference is averaged with 28 other (28 years of data), and therefore the effect on the seasonal index is small. However, if the external factor acts systematically at a certain time in the year, this will severely affect the seasonal index.

The data with respect to price indexes was obtained from a government publication called Instituto Nacional de Estadistica y Censos and the index used to deflate the

prices was the retailer's index (in Spanish: indice mayorista nivel general).

3.2. RESULTS OF THE ANALYSIS

3.2.1. Seasonality of prices per Kilogram

The results of the seasonal analysis on prices for the five categories of cattle studied are shown in figures 14 trough 18 (the data that generated this graphs is in table 5 in the appendix).

These graphs show the seasonal indexes for each month in percentages. That is, they show how deflated prices of different categories differ with respect to the average price of the year, expressed in percentages. The average price is set to 100, so for example, when the index reads 104 for big steers in January, it means that the price is most likely to be 4 percent above the year average during that month.

The line labeled "index" represents the seasonal index for each month. Two more lines are given at both sides of the seasonal index. These lines provide an idea of how much prices have differed from the seasonal index in the past. As it was explained earlier, the seasonal index for a particular month is obtained averaging all ratio to moving averages for that month. To provide an idea of the variability behind this average twice the standard error is

FIGURE 14

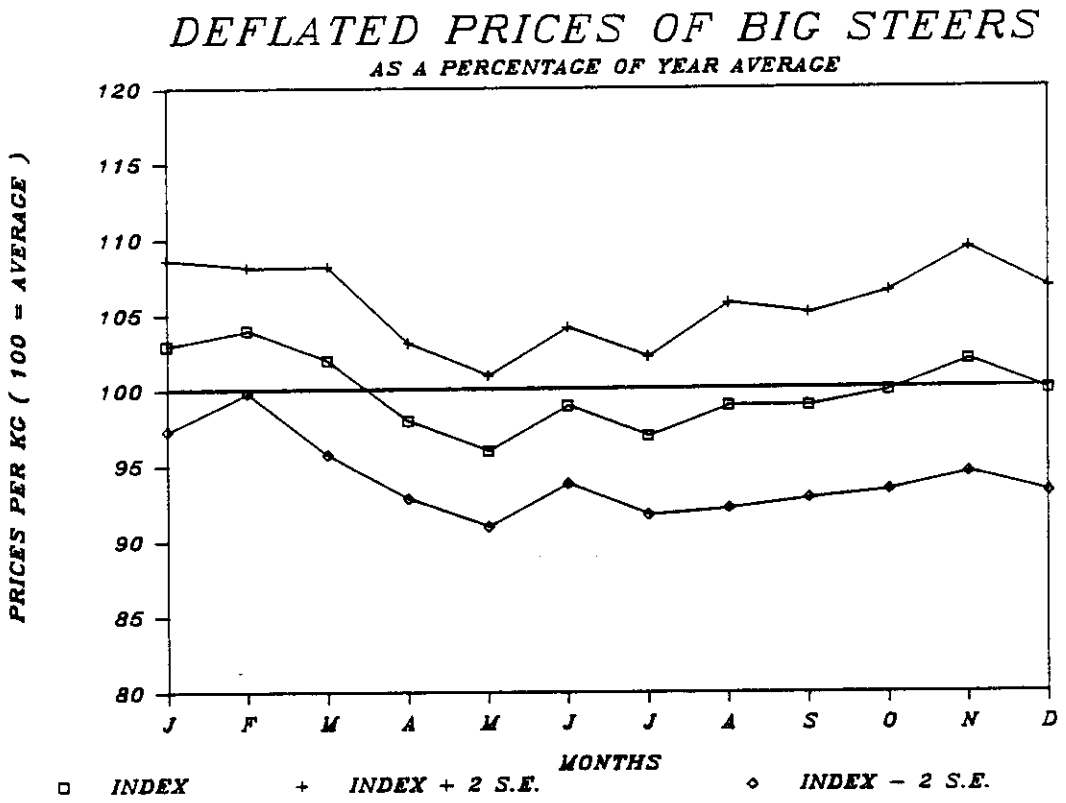


FIGURE 15

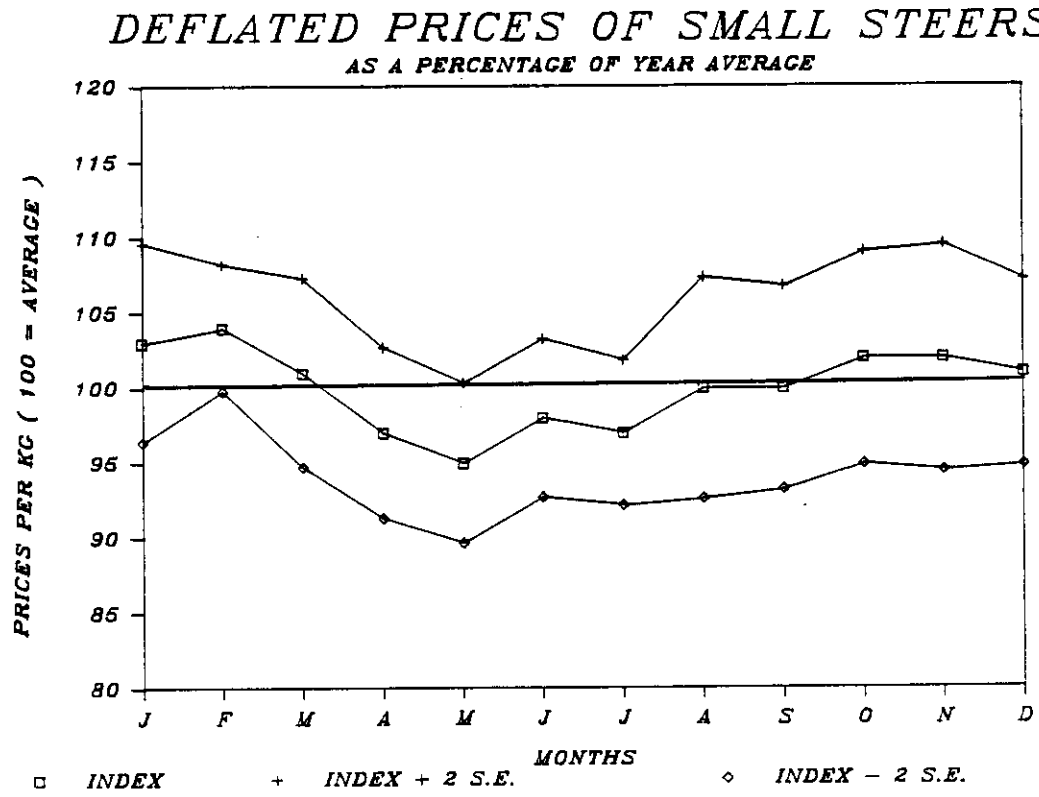


FIGURE 16

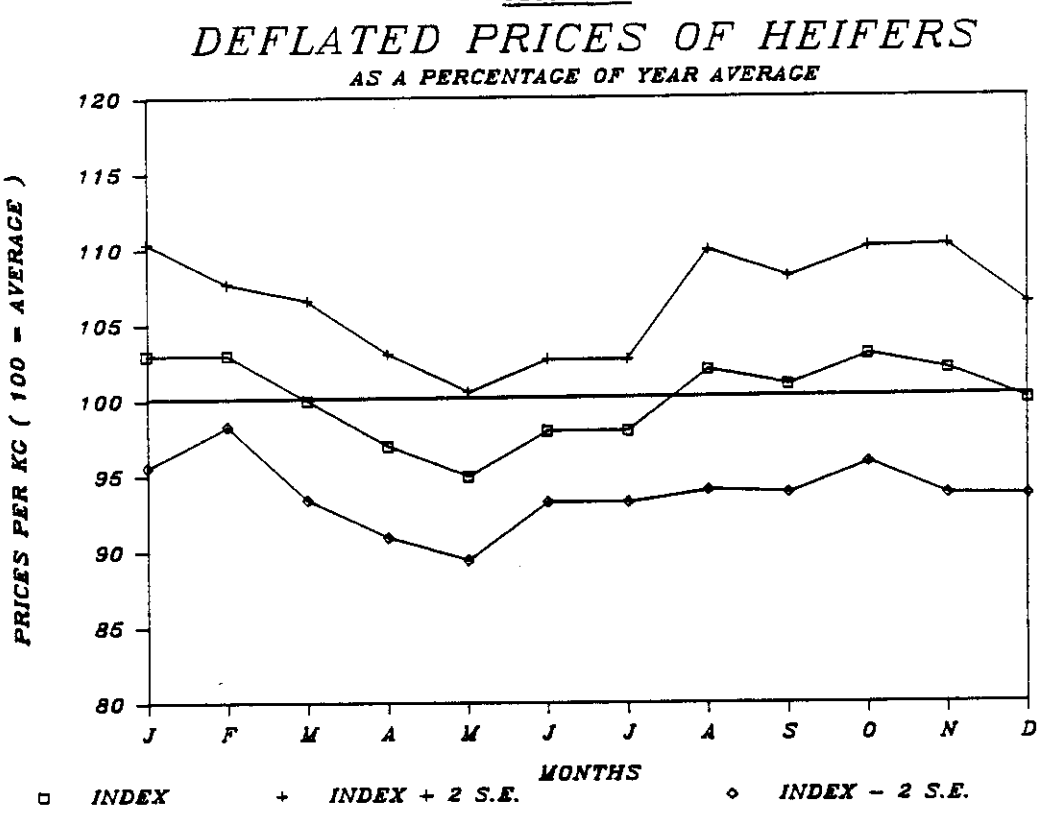


FIGURE 17

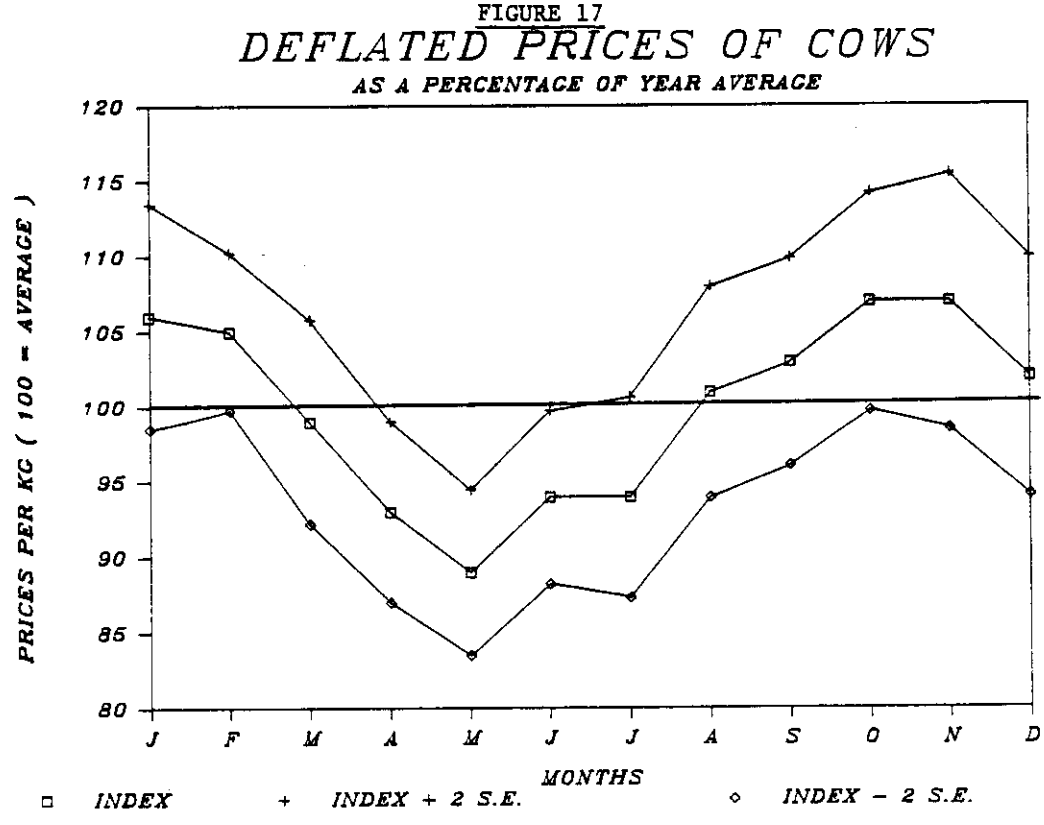
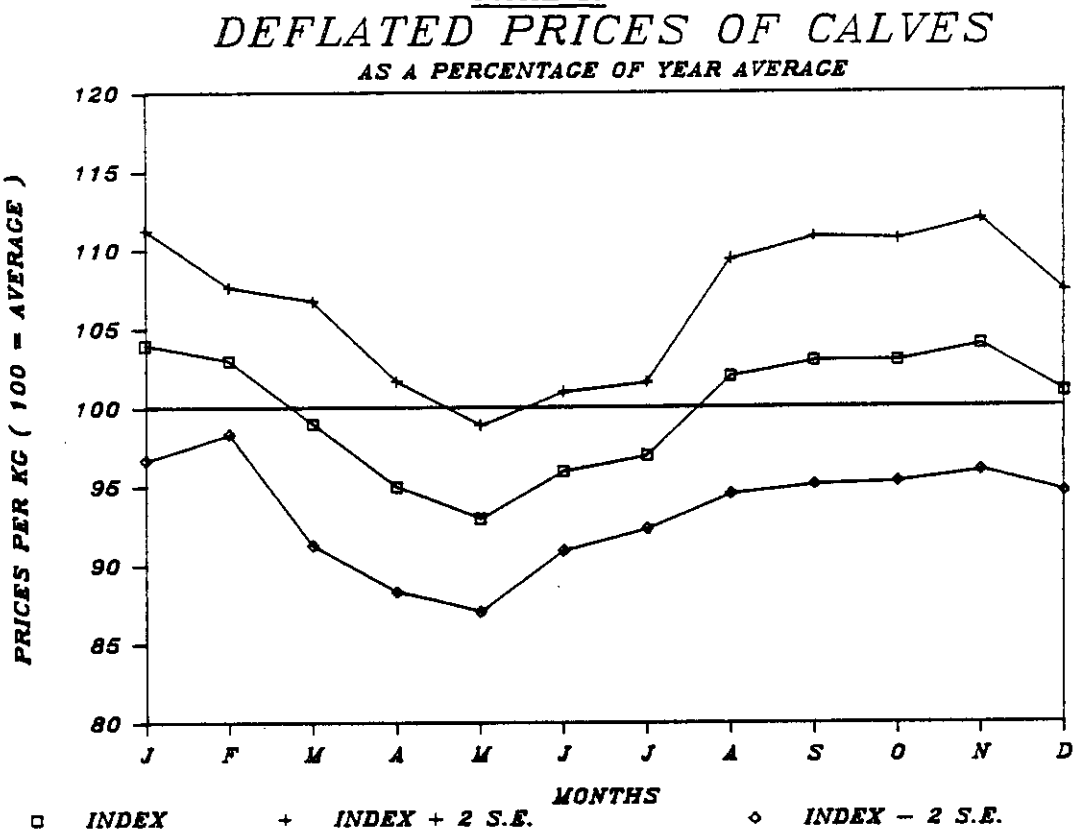


FIGURE 18


DEFLATED PRICES OF CALVES
AS A PERCENTAGE OF YEAR AVERAGE
PRICES PER KG (100 = AVERAGE)
120
115
110
105
100
95
90
85
80
J
F
M
A
M
J
J
A
S
O
N
D
MONTHS
INDEX
INDEX + 2 S.E.
INDEX − 2 S.E.

added and subtracted to the seasonal index and the results are plotted. Assuming the distribution is normal, the distance between both lines represents a 95 percent confidence interval for the seasonal index. This means, the interval has a 95 percent probability of containing the true index.

By comparing the categories we can notice that the seasonal patterns are relatively similar in shape while different in scale (graphs are shown using the same scale to facilitate comparisons). For all categories, prices tend to be below the year average (less than 100) from May to August, which is the end of fall and all winter, and above the average from September to February which is spring, summer and part of fall in Argentina.

The lowest price index is well defined and coincides with the month of May for all the categories. The highest price index is not so peaked as the lowest one and the months with the maximum price differ between categories.

We can also notice that in general for all categories, the period with lower price variation (narrower confidence intervals) is when prices are below the year average, that is during fall and winter in Argentina.

The only categories that show a confidence interval that does not contain the year average (goes completely above or below the year average) are small steers, cows and calves. All these cases show intervals only below the year average, as it can be expected due to a more peaked minimum

with a smaller standard error. A confidence interval below the year average means that there is a 95 percent probability that the true index can be below the year average for that month.

Cows have the highest amplitude of price indexes of all categories. It goes from 89 to 107 percent of the year average, that is 18 percent amplitude. These are followed by small steers and calves with 9 percent amplitude and heifers and big steers with 8 percent.

The results obtained from the analysis of deflated prices do not follow the rationale proposed by the theory explained in chapter 2. Prices do not increase in winter as it was expected due to higher production costs of finished animals during this season. In fact, prices tend to be lower during this time of the year for all categories.

The immediate question that arises is why would farmers produce finished animals in winter, when it is more costly, if they do not receive a higher price?

The answer might be because of the lower costs of replacement cattle during this time of the year, as it was suggested by the analysis done by the "Junta Nacional de Carnes[7]". Pastures have a certain amount of animals that they can feed. Farmers try to keep this capacity fully utilized to exploit pastures more effectively. This means that they will add animals to the field until there is no more unutilized grass and the animals have achieved the

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[7]See chapter 2 page 16

desired weight gain per day. Once the system is balanced, that is the supply of forage has matched the demand for forage at a certain level of weight gain, the selling of an animal must be offset by the purchase of replacement cattle. This will keep the pastures fully utilized all the time. Therefore, the moment at which the animals are sold is very important because it also implies the moment at which the replacement cattle are purchased. If the prices of replacement cattle are lower in winter, farmers who sell finished animals in this season can buy their replacement cattle cheaper than the ones who sell finished animals during spring. Hence, the production of finished animals in winter could be explained by lower prices of replacement cattle which would be offsetting higher feed costs.

3.2.2 Seasonality of Average Kilograms Slaughtered Per Day

The next set of graphs (fig 19 through 23) show the seasonal patterns of average kilograms slaughtered per day for the same categories as before. The graph construction is the same as explained earlier for deflated prices, and all 5 graphs are set to the same scale.

The seasonal patterns for slaughter differ very much between categories. The maximums for cows, heifers and calves are during fall while small steers have a maximum at the end of winter-beginning of spring, and big steers have a maximum during summer.

FIGURE 19

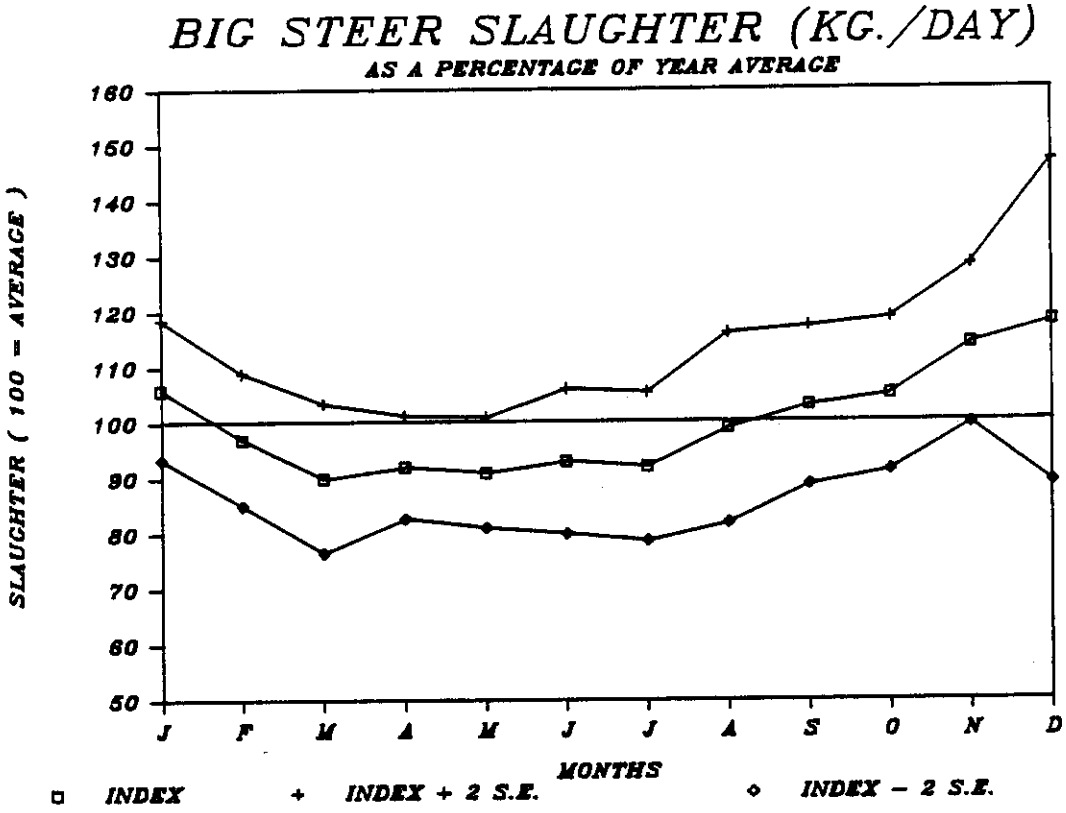


FIGURE 20

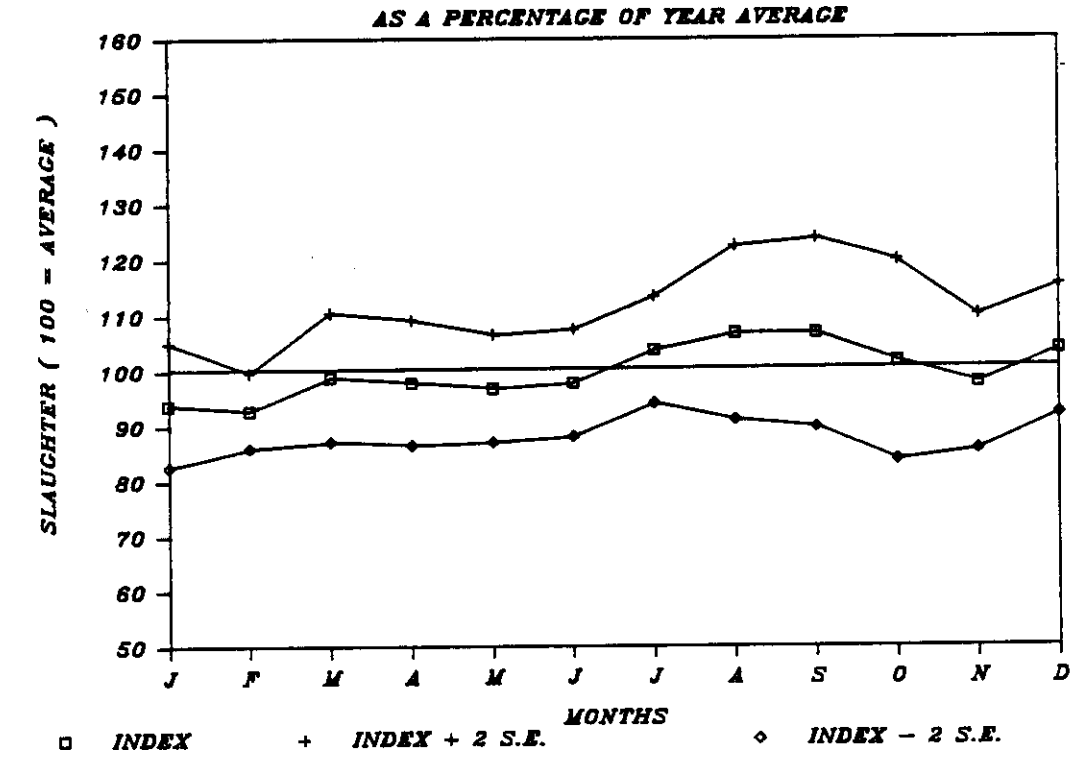


FIGURE 21

HEIFER SLAUGHTER (KG./DAY)

AS A PERCENTAGE OF YEAR AVERAGE

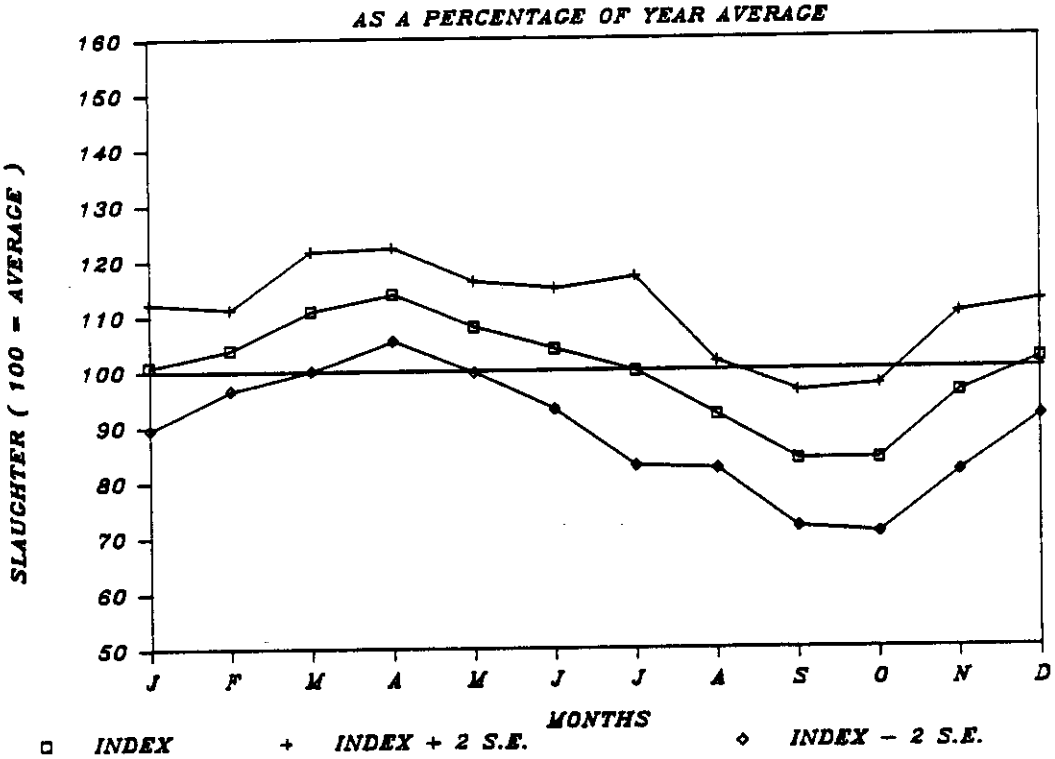


FIGURE 22

COW SLAUGHTER (KG./DAY)

AS A PERCENTAGE OF YEAR AVERAGE

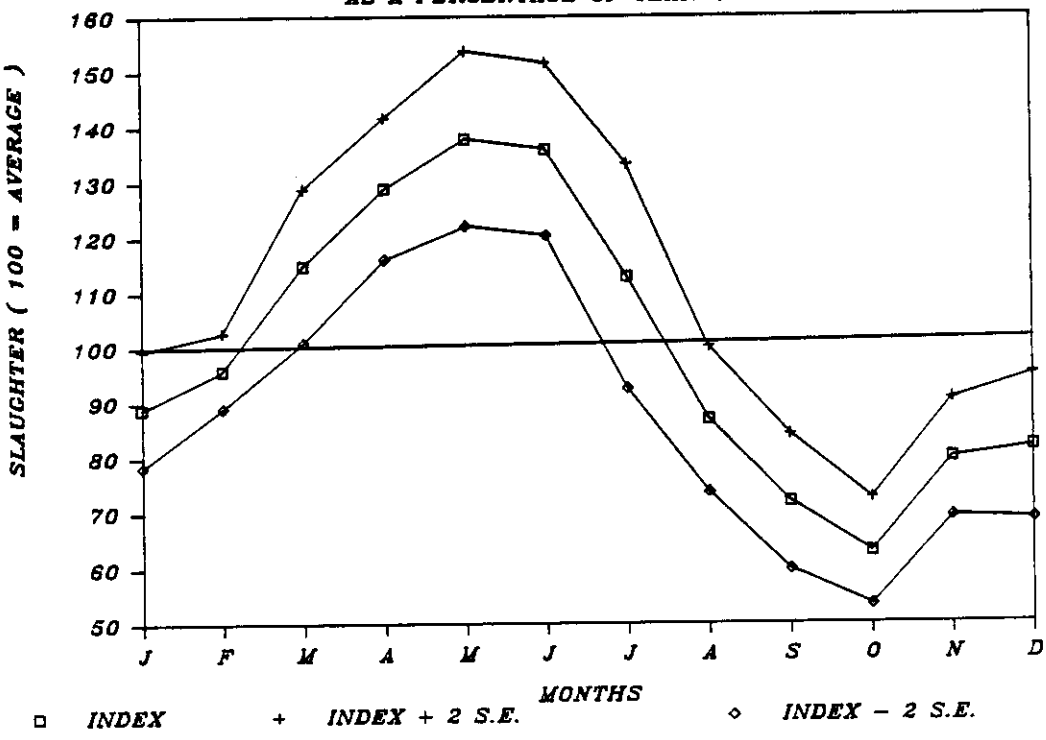
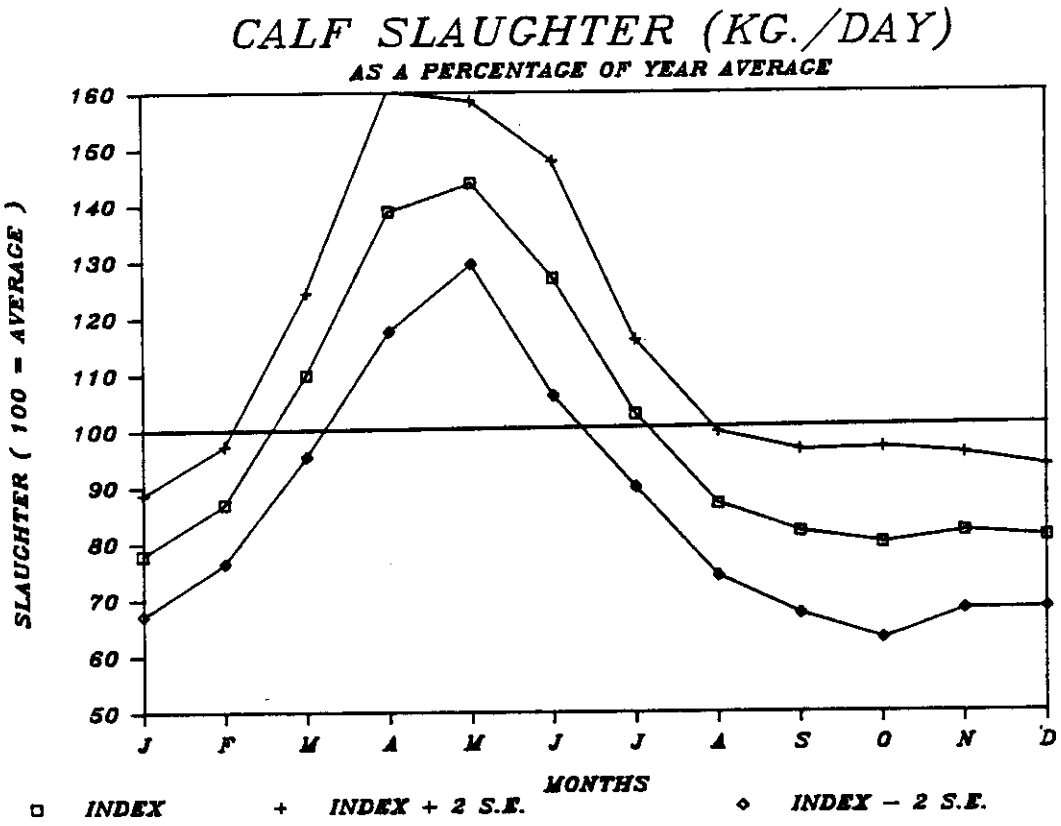


FIGURE 23


CALF SLAUGHTER (KG./DAY)
AS A PERCENTAGE OF YEAR AVERAGE
SLAUGHTER (100 = AVERAGE)
160
150
140
130
120
110
100
90
80
70
60
50
J
F
M
A
M
J
J
A
S
O
N
D
MONTHS
INDEX
INDEX + 2 S.E.
INDEX − 2 S.E.

The periods with low slaughter variation (small confidence intervals) also varies very much in the year between categories. For cows, small and big steers the variation tends to be lower during periods of slaughter below the year average, while for calves and heifers the situation is inverse, there is more variation in the months when slaughter is above the year average.

Only three categories have confidence intervals that do not contain the year average: cows, calves and heifers. In all three cases, the intervals are both above and below the year average implying a very well defined seasonal pattern through the year.

The same as in the seasonal pattern for prices, cows have the highest amplitude of all categories. It goes from 63 to 138 percent variation, that is a 75 percent total amplitude. Cows are followed by calves with 66 percent, heifers with 30, big steers with 27 and small steers with 14 percent.

It is logical to find well defined peaks during fall for cows, calves and heifers given that this is the time when cattle breeders usually wean the calves and liquidate the non pregnant cows and heifers in order to reduce the demand for forage during winter. As forage is a limitant during this time of the year, the breeding cows will have priority over other categories which will not yield the equivalent weight in meat to a calf. Therefore, old and non pregnant cows are liquidated first with weaned calves.

The seasonal patterns found for small and big steers follows a logical explanation related to the theory explained in chapter 2. Small steers are younger animals than big steers, and as it was explained before, higher quality diets are necessary to finish young animals. Therefore it is logical to expect more young animals finished at the beginning of spring, when the winter forage planted by cattle feeders has more quality (remember that cattle feeders make use of winter forage in their productive system). Also, it is logical to expect small steers to be finished earlier in the year than big steers since their higher conversion rate to meat will make them more efficient and faster to gain weight, being therefore the first ones to be ready for slaughter. In other words, it is logical to expect the supply of finished small steers to peak at the end of winter and beginning of spring because of the small volume and great quality of winter forage, and the supply of finished big animals to peak at the end of spring and summer because of big volumes and low quality of summer forage.

3.2.3 Relationship Between Seasonality of Deflated Prices and Average Kilograms Slaughtered Per Day

Comparing the two sets of graphs, deflated prices and average kilograms slaughtered per day, an unexpected behavior of the patterns can be noticed. While prices of different categories tend to follow the same pattern, the

slaughter patterns differ greatly between categories. This behavior is unexpected because it would imply that consumers (or producers) react differently to changes in prices according to the category of animal. That is, prices and quantities will be positively related for some categories and will be negative or independent for others.This is not likely to be true because:

From the demand side, it is difficult to discriminate directly between meat of different categories as it is sold without any information about its precedence. Consumers will more likely note the difference in taste and tenderness when it has been cooked. Retailers in turn, will carry a stock which is a mixture of different categories in order to keep their clientele from shifting to another retailer.

From the supply side, the production of both, finished big and small steers is mostly carried out by the same subsector (cattle feeders). However, as it will be described later, these two categories have different signs in the relationship between price and quantity indexes. There are no reasons for this difference given that the production organization is the same.

Regressions between the seasonal indexes of prices and quantities were run to give an idea of how close the relationship is between the seasonal patterns of prices and quantities for different categories. These results are shown in table 3. The table also shows the results of

TABLE 3

CORRELATION COEFFICIENTS

REGRESSION PRICE -VS- QUANTITY:

BIG STEERS	SMALL STEERS	HEIFERS	COWS	CALVES
.38	-.21	-.58	-.90	-.95

REGRESSION PRICE -VS- PRICE:

		PRICE PER KG.				
		BIG STEERS	SMALL STEERS	HEIFERS	COWS	CALVES
PRICE PER KG.	BIG STEERS	1	.93	.79	.78	.74
	SMALL STEERS		1	.98	.94	.90
	HEIFERS			1	.96	.97
	COWS				1	.98
	CALVES					1

FIGURE 24

BIG STEER SLAUGHTER INDEXES

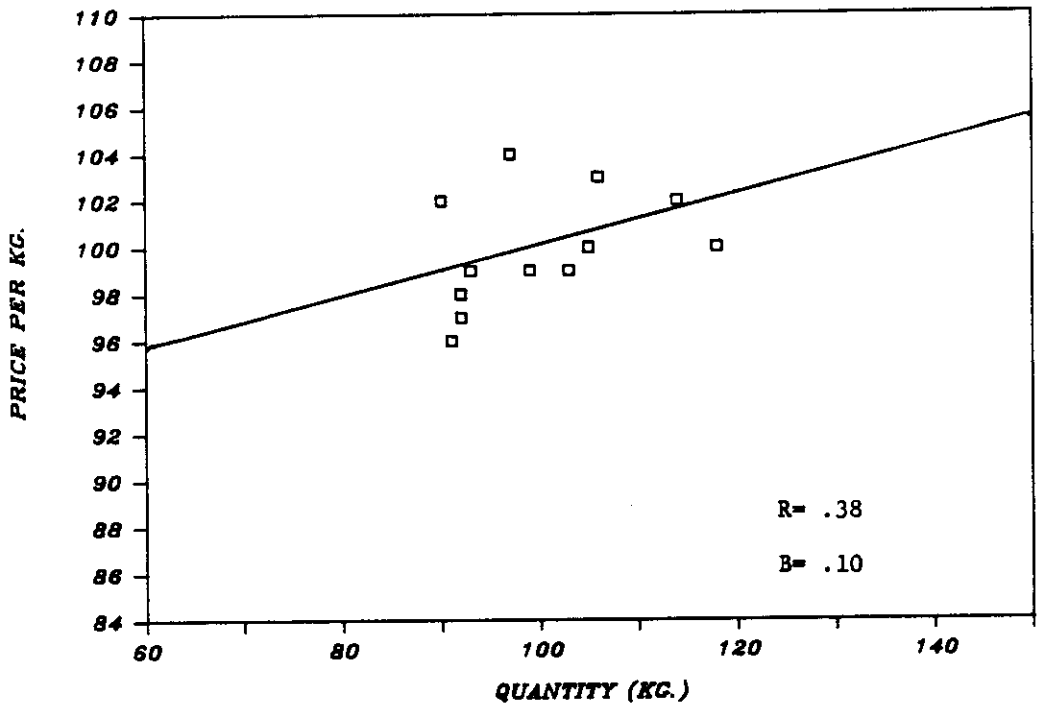


FIGURE 25

SMALL STEER SLAUGHTER INDEXES

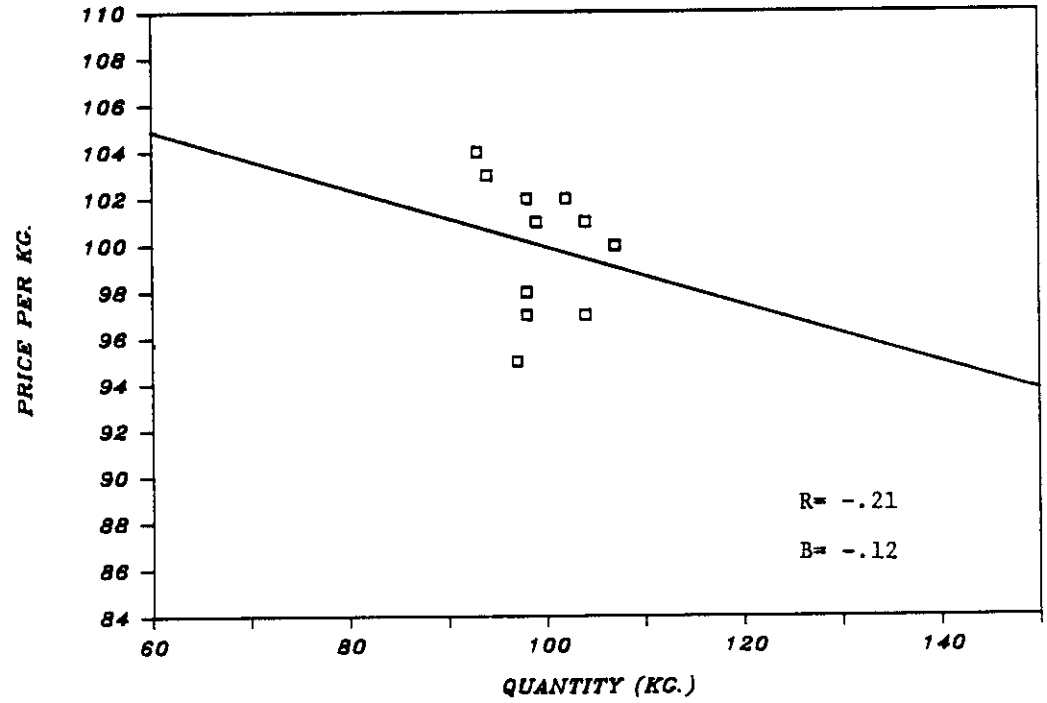


FIGURE 26

HEIFER SLAUGHTER INDEXES

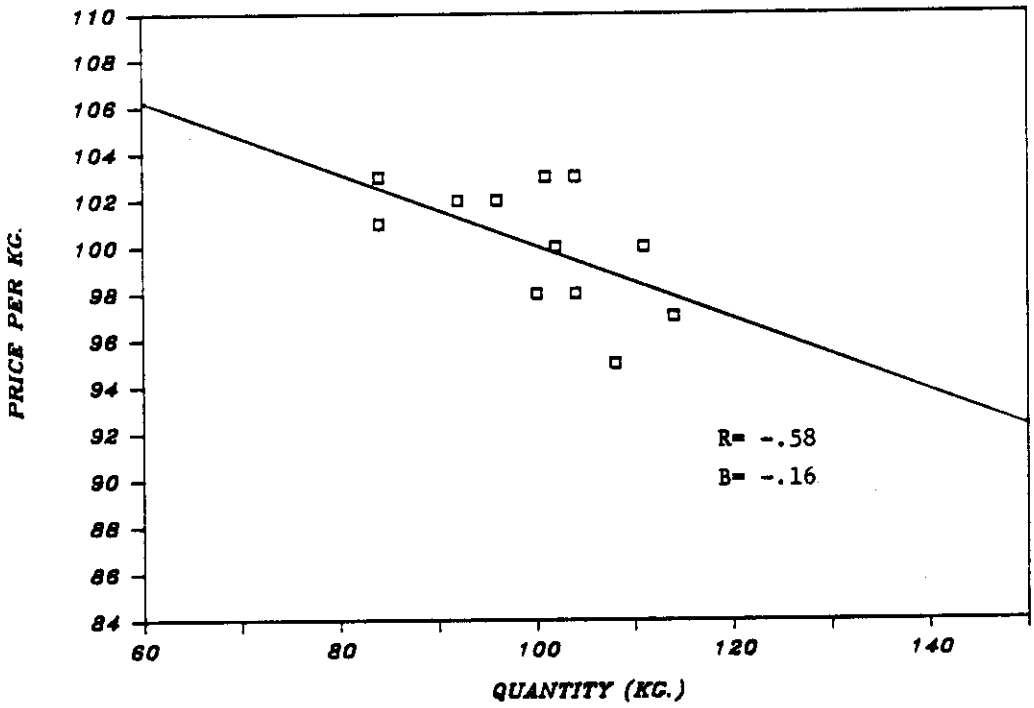


FIGURE 27

COW SLAUGHTER INDEXES

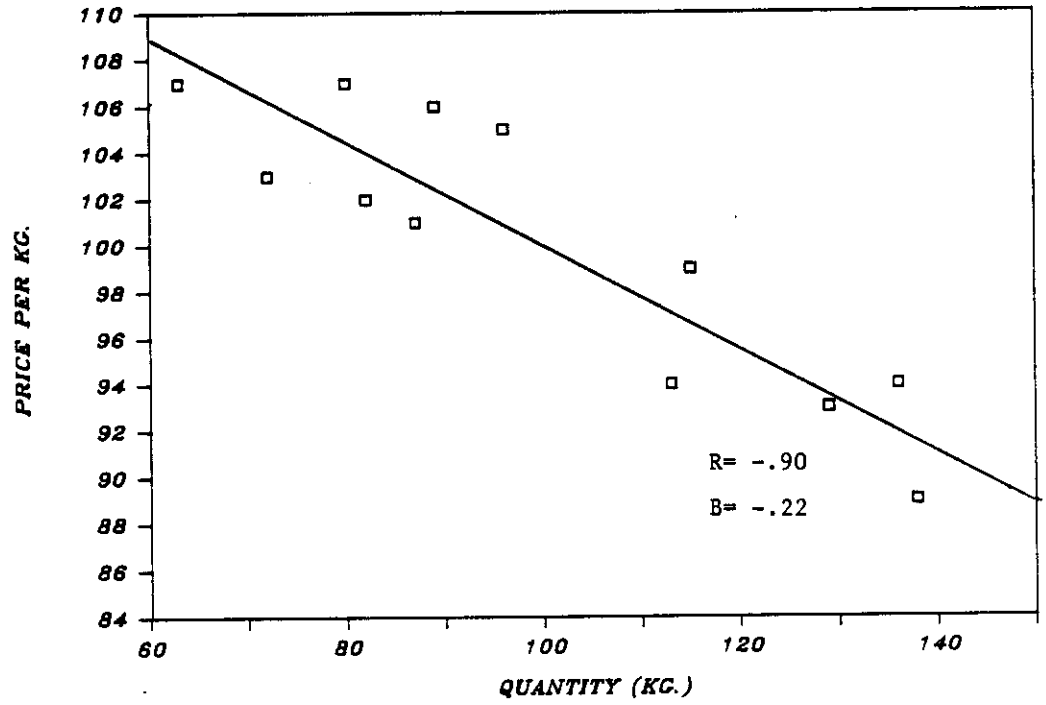
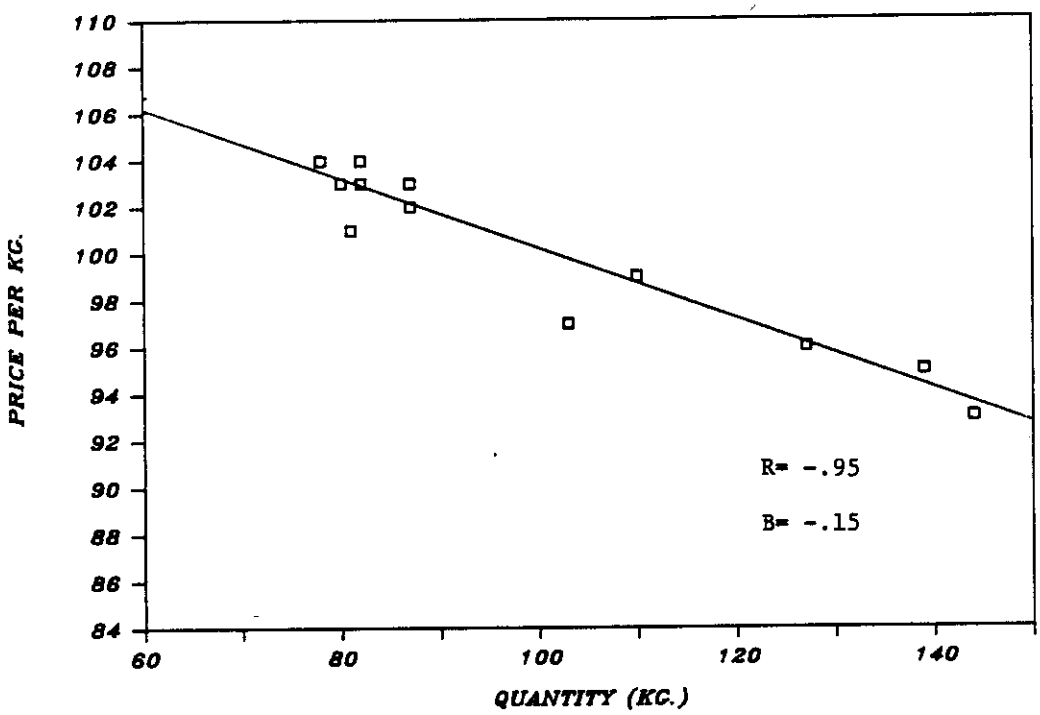


FIGURE 28

CALF SLAUGHTER INDEXES



regressions run between the seasonal indexes for all prices to provide an idea of how close prices move together.

The regression coefficients indicate a strong relationship between prices of all different categories, and in general, stronger than the relationship between prices and quantities for all the categories. See that the coefficients of the regressions between prices are closer to one and all of them have positive signs, indicating that when one price changes, the other one also changes on the same direction. This confirms the observations made about the graphs. Prices tend to behave similarly for all categories through the year, while not necessarily related with the quantities slaughtered at each time of the year.

The relationship between prices and quantities is graphed for each category in figures 24 to 28. These graphs show the values of both indexes in each month, reading indexes of quantities slaughtered on the x-axis and price indexes on the y-axis. It also shows the regression line obtained with those values and the corresponding regression coefficients.

See that the strongest relationship (highest correlation coefficient) is for calves, followed by cows and heifers, while lower regression coefficients are for big and small steers. Big steers present a positive sign which differs from all the other categories. This means that prices tend to be high at the same time of the year when quantities are high. This is the sign that was unexpected

because it differs from the others pointing out differences in consumers or producers reactions to price.

3.2.4 Seasonality of Other Variables and Criteria for Selection of Average Kilograms Slaughtered Per Day

The seasonal indexes of average slaughter per day were used in this analysis because of their advantages over other variables to estimate slaughter. The results of the seasonal analysis performed on heads slaughtered per month and average heads slaughtered per day are presented in tables 5 and 6 in the appendix.

The number of heads slaughtered per month has an evident bias as an estimate of slaughter for our seasonal analysis because of the different lengths of the months. If a month is shorter than the rest, like february, the number of heads slaughtered during that month will logically be less than others because there are not so many working days. As the heads slaughtered in february for example, are going to be systematically less than the rest of the months through all the period considered, it will bias the seasonal pattern towards a smaller number.

The effect produced by shorter months on seasonal patterns of slaughter are considered a bias because of the purpose to compare these patterns with the ones obtained on deflated prices. The pattern is reporting the fact that a short month like february will have less heads slaughtered, and this is correct. However, the process of price formation

takes place according to the supply and demand on a daily basis. If a month reports a smaller slaughter due to the effects of lesser days, this will not be caused by a smaller slaughter in every day and hence, it will not reflect the real daily situation.

To correct for this bias the number of heads slaughtered per month is divided by the number of days in that month. This results in average heads slaughtered per day. No further efforts were made to arrive to a more accurate variable that will estimate the average heads slaughtered per working day because of the complexities to determine them. Different factors like strikes, holidays and events like government coups or changes in the schedule of slaughter houses are abundant in the Argentine history, and not well recorded through 28 years.

The advantage of using average kilograms slaughtered per day over average heads slaughtered per day is that it refers to the same unit as the price does. The analysis was performed in prices per kilogram, not per head; therefore the last one was preferred. If heads slaughtered were to be compared with prices per kilogram it may lead to confusion because the weight of the animal may vary during the year, adding another source of variation not included in the analysis.

3.2.5 Seasonality of all Categories

The previous analysis provided the seasonal patterns of average kilograms slaughtered per day for each one of the categories. All these indexes by themselves give an idea of how slaughter varies as a percentage with respect to the year average, but since it is a percentage, it does not provide information about the absolute magnitude of the variation. Given that the average slaughter is different for all categories, neither it gives an idea of which variation between categories is greater in magnitude. For example, we wouldn't be able to tell if a 5 percent slaughter above the year average for cows (index = 105) is important with respect to total slaughter, and if it is greater than a 10 percent slaughter above the year average for calves because cows and calves have different year averages.

We can provide more information taking one step forward to the seasonal analysis. We can find the "typical" quantities slaughtered per day in each month by choosing a representative average slaughter for each category and multiplying it by the seasonal indexes . The average slaughter per day of each category for the whole period analyzed was chosen as representative[8]. The results obtained by this method are presented in figure 29.

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[8]The average is representative of the quantities slaughtered given that the trend component is very close to zero.

FIGURE 29

TOTAL AVERAGE SLAUGHTER PER DAY

ALL CATEGORIES EXCLUDING BULLS

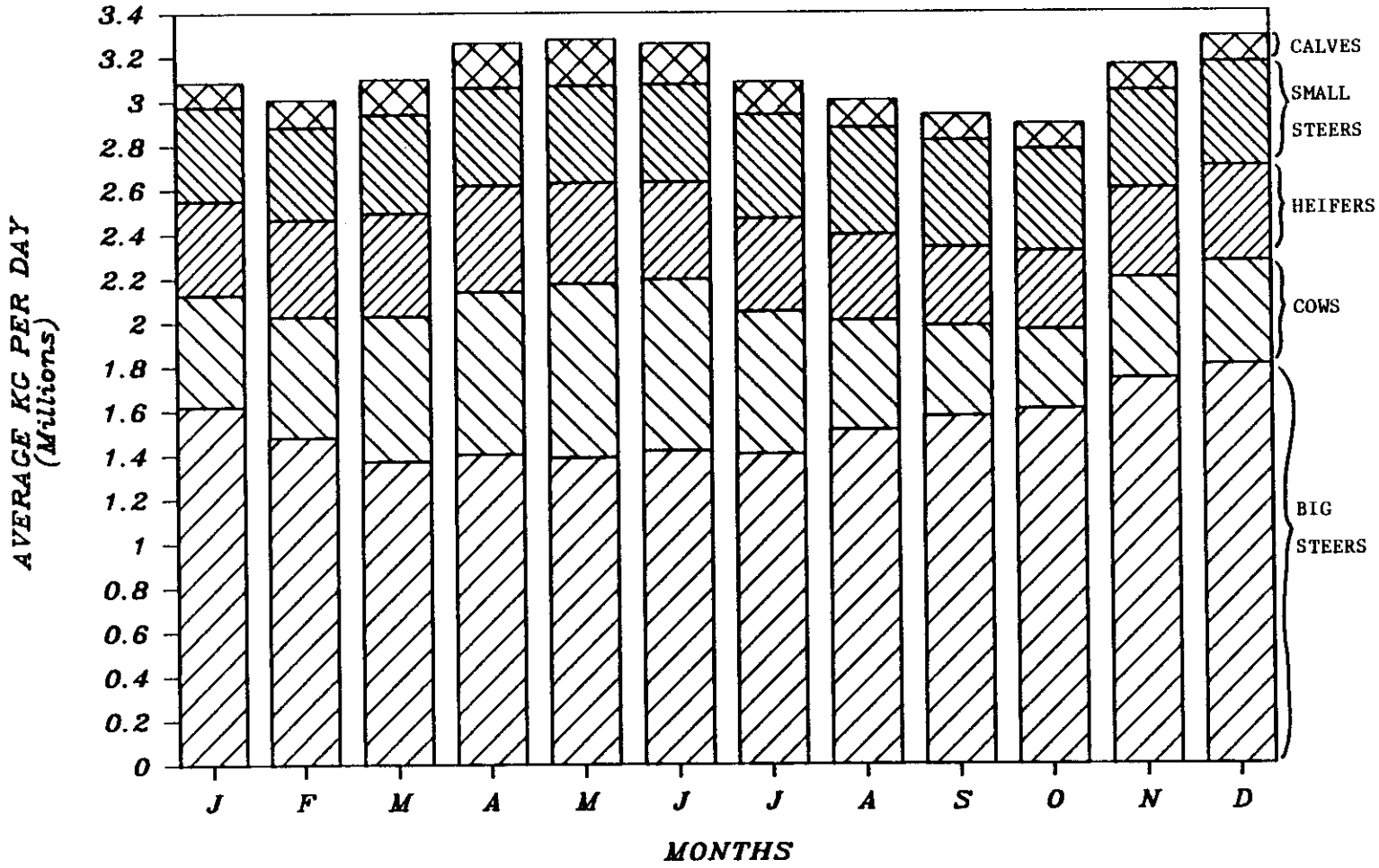

Figure 29 shows the "typical" average kilograms slaughtered per day stacked one category on top of the other. This type of graph shows at the same time the effect that each one has on the total kilograms slaughtered per day. Since the slaughter of each category is placed on top of the other, the sum of the slaughter of all categories is represented by the top of the bar. These values were compared with the results obtained through a seasonal analysis performed directly on the average kilograms slaughtered per day for all the categories considered. The error between both is sufficiently low (maximum 1.3 percent) to consider the procedure accurate enough for the analysis (results are in table 5 in the appendix). Note that bulls were excluded from the analysis because the slaughter of this category is too small to be relevant (bulls were 2.9 percent of the total slaughter in 1982[9]).

The graph shows that the total average slaughter per day increases typically in April, June and July (end of fall and winter) and also in November and December (summer). The category with the greatest proportion of animals in the market is big steers, which represents nearly 50 percent of the total slaughter. The next category in size is cows, which shows a great variability; followed by small steers, heifers and finally calves. The great amplitude found in the seasonal indexes of calves (66 percent) do not seem to be relevant to the total slaughter due to the small

[9]Junta Nacional de Carnes, Sintesis Estadistica, 1982.

number of heads slaughtered. Big steers, on the other hand, showed less amplitude in the seasonal pattern (27 percent), but the number of heads slaughtered is so big that this little variation causes great changes in the total slaughter.

The increase in winter slaughter is due to an increase in the cows, calves and heifers slaughtered, which is greater than the seasonal decrease for that time of the year in big and small steers. The increase in summer, in turn is caused mainly by a peak in the supply of big steers that offsets the seasonal minimum in the supply of cows, heifers and calves. In this way the seasonal patterns of different categories offset each other resulting in a pattern for total heads slaughtered which differs from that of each individual category.

Figure 29 helps to explain why there is so much difference between the relationship price-quantity for different categories.

As it was shown before, the seasonal patterns of prices are very similar for all categories while the seasonal patterns of slaughter for each category differ greatly. This could be explained following the same assumption used before, that meat of different categories are close substitutes.

If this assumption is true, then the prices paid for meat of each individual category would depend on the total slaughter, rather than on the slaughter of that category.

This is because if there is a small supply of one type of meat, manufacturers will shift to another category, instead of causing an increase in the price. In this way prices would depend on the total availability of meat in the market rather than in the slaughter of each individual category. Since the price patterns are all similar because they are influenced by total slaughter, and the slaughter patterns of each category are all different, it is logical to expect the relationship price - quantity to be quite different between categories.

Under this same assumption, it is also logical to find that the closer the slaughter pattern of a category is to the total slaughter pattern, the stronger the relationship is between prices and quantities (higher regression coefficients). This is the case for cows, calves and heifers, which registered the highest regression coefficients (see table 3).

Regressions between the seasonal indexes of prices and quantities were used to estimate the strength of the relationship between total slaughter and the price of meat for different categories. The results are shown in table 4.

The table shows that all the regression coefficients are of the same sign for the regressions run on price - vs - total slaughter. See that the unexpected sign of the coefficient corresponding to big steers has changed to a negative value (from .38 to -.28). This means that we do not have a different reaction of consumers (or producers) to

TABLE 4

CORRELATION COEFFICIENTS

REGRESSION PRICE -VS- QUANTITY:

	PRICE -VS-QUANTITY SLAUGHTERED OF EACH CATEGORY	PRICE -VS- TOTAL QUANTITY SLAUGHTERED
BIG STEERS	.38	-.28
SMALL STEERS	-.21	-.50
HEIFERS	-.58	-.71
COWS	-.90	-.62
CALVES	-.95	-.67

changes in the prices of meat according to the category of animal. The coefficients for small steers and heifers increased from -.21 to -.50 and from -.58 to -.71 respectively. This is consistent with our assumption. However, the coefficients for cows and calves have decreased form -.90 to -.62 and form -.95 to -.67 respectively.

The decrease in the coefficients of cows and calves is not surprising considering the magnitude of the seasonal peak in the supply. It is logical to assume that the categories will be close substitutes under certain limits, that is, butchers still have to keep a certain proportion of other categories and therefore cannot substitute one category entirely for another. The seasonal increase to 140 percent in calves and 135 percent in cows slaughtered and the results obtained in the regressions suggest that this limit might have been reached for these categories.

CHAPTER IV

4.1 INTRODUCTION:

My analysis does not provide all the answers about the functioning of the Argentine cattle market, and is not my intention to do so. My answers can be partial, one-sided and obsolete. I came to appreciate that the right question is usually more important than the right answer to the wrong question. I hope that this analysis raises the right questions to other investigators who will undertake the task of providing us with a better understanding of how the Argentine cattle market works.

4.2 LIMITATIONS OF THE ANALYSIS:

The limitations of the seasonal analysis emerge mainly from two sources: the assumptions taken in the analytical process and the reliability of the data. The main assumption taken in the analytical process was that the irregular component of the time series averaged zero. This assumes that there were as many irregular factors acting negatively on prices and quantities slaughtered as there were acting positively. This assumption was used twice, first when assuming that the moving average would have no irregular component because it averaged the irregular fluctuations

that ocurred in a year, and second when assuming that by averaging all ratios to moving averages of the same month we would eliminate the irregular component leaving only the seasonal one. It is obvious that if this assumption is not true the results of this analysis are going to be biased. However, the irregular component (often called the random walk of prices) has been widely studied in the literature and has lead many authors to assume that it is random[1]. If this is the case, then we can expect that prices and quantities will be equally balanced by the effect of external factors and therefore the averaging will eliminate efficiently the irregular component.

The limitations arising from the reliability of the data were discussed in chapter 3. I am aware of the biases that this data might contain and therefore I chose the longest time series I could get without major changes in the government data compilation system. The figures obtained were consistent among all categories studied, showing no illogical or unexplained behaviors of prices or quantities slaughtered. Graphs done with data for each category are shown in the appendix.

If the seasonal analysis is assumed to be correct, then other limitations arise from the logic and rationale followed in the whole analysis. These assumptions have been discussed as they were utilized in previous chapters.

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[1]See Tomek and Robinson, p.169, Lapin chap. 12.

The conclusions obtained from this work were drawn from studies done on a twenty eight year long time series. Therefore projections about the future seasonal patterns are based on the premise that the conditions which determined the magnitude of the variables studied will be similar to the ones in the future.

4.2 CONCLUSIONS AND RECOMMENDATIONS:

The first major conclusion that can be drawn from the analysis is that prices do not tend to follow the seasonal pattern which was expected according to the theory proposed in chapter two. Prices do not rise in winter, when production costs are higher. As it was discussed in chapter three, farmers can still be rewarded by the seasonal decrease in replacement cattle during this time of the year. Working experience of the author has shown that the seasonal decrease in the price of replacement cattle is in fact, widely known by Argentine farmers. This would explain why farmers still supply finished animals in winter.

However if this is true, then it implies that instead of the consumers, the producers of replacement cattle are paying the higher costs of winter production. Since prices do not raise during winter, consumers are not paying for a more expensive product. Cattle feeders also do not receive less revenue for producing in winter because they pay less

for replacement animals. Finally the producer of animals for replacement is the one who receives less for his product in winter. In this way, higher costs of production which are not paid by the consumer are transferred through the whole marketing chain up to the producer of replacement animals.

If this rationale is correct, then there should be a reason for the producers of replacement animals to supply their product in winter. This reason is apparently because they are minimizing loss rather than maximizing profit when producing these animals.

As we move backwards through the marketing chain, that is from the consumer to the cattle breeder, we find that the productive system loses flexibility. The cattle breeder has to keep a big proportion of fixed capital in order to produce calves. This fixed capital is mostly the breeding stock, which he has to maintain through the whole year. Studies made in a major breeding area showed that 65 to 70 percent of the total capital in several farms was fixed[2]. In addition to this, because the cow pregnancy takes more than nine months, the cattle breeder has to plan almost a year in advance what is going to be his production. The uncertainties with respect to the genetic material obtained as well as the quality of the future calf if the cow is pregnant make the option of buying stock according to the actual necessities, not attractive for a cattle breeder. The

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[2]R. Bochetto, PhD. Thesis, Michigan State University, 1981, p.90

genetic pool obtained in a farm is considered a valuable asset which most farmers do not want to loose, being common the use of heifers born in the farm as replacement for the old cows[3].

The rigidity of the productive structure of the livestock breeding sector was also observed by Bochetto[4]. He pointed out the extensive nature of cattle production and lack of investments in land saving innovations.

The cattle feeder, on the other hand does not have to keep any breeding stock to produce steers. Neither does he have to keep a constant genetic pool because the animals purchased on one year cannot affect the quality of the animals of any other year. This makes the cattle feeder more flexible with respect to the cattle breeder. He can buy and sell at different times of the year as long as he keeps his pastures fully utilized.

The breeding production system, as it was described in chapter two, has a cycle which weans the calves during fall to maximize the use of pastures. However, we also pointed out that according to studies done in the area, two thirds of the calves were weaned during this period[5]. The other third are born in periods that according to the theory are not so efficient, and obviously result from a mating period

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[3]J. Gimenez Dixon, Unpulished PhD. thesis, Michigan State University, 1969, p.48.

[4]R. Bochetto, PhD. Thesis, Michigan State University, 1981, p.90.

[5]See chapter 2 p.9.

that exceeds the three months, or that does not cover the summer. These mating periods are often the result of a lack of resources to keep the bulls separate from the cows, or of a high cost of shifting from an extensive system where six month or longer mating period are common, to an intensive one, where sanitary services and sophisticated management allows for a three month mating period.

When fall comes, the cattle breeders start selling their calves and old animals to lower the demand for forage during the coming winter[6]. At this point many of them will not eliminate the calf which was born late because it is too young for the market to get a fair price, and they would not sell both cow and calf because they do not want to lose the cow. Hence, the breeder will decide to leave it on the farm while he has enough grass, knowing that he will receive a low price, but minimizing the loss from a late born calf.

When winter comes, many of these calves have to be sold to decrease the demand for forage. These, and other animals that many cattle breeders have been keeping as long as there is enough forage are the replacement cattle that the cattle feeders will buy. Now cattle feeders are in a favorable position to bargain the price of the animals because they have a much more flexible schedule. Cattle breeders cannot keep their non-stock animals any longer and they have no option but to sell. This results in a lower price of animals

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[6]This produces the high peaks in the supply of calves, cows and heifers during fall, observed in the seasonal pattern. For more detail see chapter 3 p.19

sold by farmers with more rigid production systems, to the advantage of farmers who have their schedules more free, which are represented by cattle feeders.

Hence, the higher winter costs of producing meat are borne mostly by the breeding sector instead of the consumers. If the rationale proposed here is correct, this situation will more likely to continue as long as the breeding sector stays with insufficient resources for a more intensive production system. The shift to higher productivity levels through improved technology, better sanitary conditions and managerial education would bring more control to the farmer over the environment, preventing losses which they would eventually try to minimize.

The second important conclusion coming out of this analysis is that the seasonal patterns of slaughter are very well defined through the year, and differ substantially between categories. This conclusion is very relevant for future modeling and estimations of supply and demand response to changes in meat prices. The different seasonal patterns will result in different proportions of categories slaughtered according to the time of the year. The typical proportion that each category takes in a determined month can be easily obtained by dividing the expected slaughter values by the total expected slaughter in table 5 in the appendix. The revision of the literature exposed in chapter 2 described how categories differed in their supply elasticities. The total supply response therefore, can be

better estimated through the use of individual supply elasticities and these proportions.

A third conclusion is that prices of different categories tend to move together rather than to follow the seasonal patterns of their respective supply. This was shown by the regression coefficients, which reported higher values for regressions run between prices of different categories than for regressions run between prices and quantities for each individual category (see table 3 in chapter 3). This has implications for the effect that government policies have on the meat subsector. It suggests that policies which alter the price of an individual category will also alter the market as a whole. Moreover, we can improve the estimations coming out of this conclusion with the aid of the second conclusion (about the proportions slaughtered of each category). If we combine the effects that a change in price of a category has on the whole market with the expected proportion of it in the total slaughter, we can estimate more accurately the results coming out of policies that affect the price of a single category.

These results are consistent with the ones obtained by Regúnaga[7] in a time series from 1958 to 1968. He also obtained high correlation coefficients between prices of

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[7]Regunaga, Marcelo; Variaciones en los Precios de los Vacunos: Su Importancia en el Modelo de Decisión de la Empresa de Invernada, Magister Scientiae Thesis, 1970.

different categories of animals concluding that prices tend to move together.

The fourth conclusion is that the total slaughter tends to have a strong effect on prices of different categories, and explains better the price patterns than the slaughter of each individual category. When regressions were run between price and total quantities slaughtered, the regression coefficients were all of the same sign and had a significant increase for most of the categories. We must point out, however, that this conclusion arises from the assumption that meat of different categories are close substitutes, and that there are no special reasons to assume a different relationship between prices and quantities for different categories.

The fifth conclusion is concerned with the shape of the seasonal patterns of prices. In general terms, the shapes are similar for all the categories. The minimum price for all of them is registered in May. The maximum is not so peaked as the minimum, and varies according to the category within the seasons of spring and summer in Argentina. Cows, Heifers and Calves registered confidence intervals below the year average, which means that they have a high probability of prices below the year average during those months. The highest amplitude was registered by cows (18 percent), followed by small steers and calves (9 percent), heifers and big steers (8 percent). These patterns are useful to provide a better understanding of the argentine cattle

market, as it was shown through the analysis, as well as to aid in management decision making.

By knowing the expected prices at different times of the year, we can provide more accurate estimations of the profits received at different commercialization schedules. Moreover, we can estimate a 95 percent confidence interval for our revenue based on the two extremes, plus and minus two standard errors, which are presented in table 5 in the appendix and graphed in figures 14 through 18.

For example, if a farmer assumes the average price of the year is .30 dollars per kilogram of cow meat, and he wants to find out which is the expected revenue if he sells his cows in May, he should:

1. Look for the index of prices for cows in table 5 in the appendix.
2. Multiply the index for Cows in May (89 percent) times the average price of the year ($.30).

The result is $.267 per kilogram.

By looking at the graph generated with this data (figure 17) he can find which is the month that typically has the highest prices for cows. In this case it is November, but note also that the confidence interval is wider for November than it is for May, that is, the risk is higher in November because the price has tended to fluctuate more during this month over the past 28 years.

If he wanted to find out how confident he can be about the price he expects in May, he should do the following:

1. Look for the "+ 2SE " and "- 2SE" columns for the prices per kilogram for COWS in table 5 in the appendix.

2. Multiply the average price of the year ($.30) times both indexes (94.48 percent and 83.52 percent)

3. The answers are: $.281 and $.251

This means that he can expect to receive 95 out of 100 times, between $.281 and $.251 for his cow meat in May.

Similarly, the confidence interval for November is: $.346 and $.296.

APPENDIX

TABLE 5

PRICES PER KILOGRAM

	SMALL STEERS				BIG STEERS			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	103.00	17.50	109.61	96.39	103.00	15.00	108.67	97.33
F	104.00	11.10	108.20	99.80	104.00	11.00	108.16	99.84
M	101.00	16.60	107.27	94.73	102.00	16.50	108.24	95.76
A	97.00	15.10	102.71	91.29	98.00	13.60	103.14	92.86
M	95.00	14.10	100.33	89.67	96.00	13.20	100.99	91.01
J	98.00	14.00	103.29	92.71	99.00	13.70	104.18	93.82
J	97.00	12.80	101.84	92.16	97.00	13.80	102.22	91.78
A	100.00	19.50	107.37	92.63	99.00	17.90	105.77	92.23
S	100.00	17.90	106.77	93.23	99.00	16.20	105.12	92.88
O	102.00	18.70	109.07	94.93	100.00	17.40	106.58	93.42
N	102.00	19.90	109.52	94.48	102.00	19.70	109.45	94.55
D	101.00	16.30	107.16	94.84	100.00	17.90	106.77	93.23

	COWS				HEIFERS			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	106.00	19.80	113.48	98.52	103.00	19.60	110.41	95.59
F	105.00	13.80	110.22	99.78	103.00	12.40	107.69	98.31
M	99.00	18.00	105.80	92.20	100.00	17.40	106.58	93.42
A	93.00	15.90	99.01	86.99	97.00	16.00	103.05	90.95
M	89.00	14.50	94.48	83.52	95.00	14.70	100.56	89.44
J	94.00	15.30	99.78	88.22	98.00	12.50	102.72	93.28
J	94.00	17.70	100.69	87.31	98.00	12.50	102.72	93.28
A	101.00	18.60	108.03	93.97	102.00	21.00	109.94	94.06
S	103.00	18.20	109.88	96.12	101.00	18.90	108.14	93.86
O	107.00	19.10	114.22	99.78	103.00	18.80	110.11	95.89
N	107.00	22.40	115.47	98.53	102.00	21.80	110.24	93.76
D	102.00	20.90	109.90	94.10	100.00	16.70	106.31	93.69

	CALVES				TOTAL			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	104.00	19.30	111.29	96.71	104.00	16.60	110.27	97.73
F	103.00	12.30	107.65	98.35	104.00	11.00	108.16	99.84
M	99.00	20.40	106.71	91.29	100.00	16.80	106.35	93.65
A	95.00	17.60	101.65	88.35	96.00	15.00	101.67	90.33
M	93.00	15.60	98.90	87.10	93.00	14.40	98.44	87.56
J	96.00	13.30	101.03	90.97	96.00	13.60	101.14	90.86
J	97.00	12.30	101.65	92.35	96.00	13.70	101.18	90.82
A	102.00	19.70	109.45	94.55	101.00	18.20	107.88	94.12
S	103.00	20.80	110.86	95.14	101.00	16.90	107.39	94.61
O	103.00	20.30	110.67	95.33	104.00	18.20	110.88	97.12
N	104.00	21.10	111.98	96.02	104.00	20.00	111.56	96.44
D	101.00	16.80	107.35	94.65	102.00	17.00	108.43	95.57

TABLE 5 (CONT.)

AVERAGE KILOGRAMS SLAUGHTERED PER DAY

SMALL STEERS

	INDEX	SD	AVERAGE =450431.00 +2SE	-2SE	EXPECTED VALUE
J	94.00	29.80	105.26	82.74	423405.14
F	93.00	18.20	99.88	86.12	418900.83
M	99.00	30.90	110.68	87.32	445926.69
A	98.00	29.90	109.30	86.70	441422.38
M	97.00	25.70	106.71	87.29	436918.07
J	98.00	25.70	107.71	88.29	441422.38
J	104.00	25.50	113.64	94.36	468448.24
A	107.00	41.40	122.65	91.35	481961.17
S	107.00	45.00	124.01	89.99	481961.17
O	102.00	47.60	119.99	84.01	459439.62
N	98.00	32.20	110.17	85.83	441422.38
D	104.00	30.70	115.60	92.40	468448.24

BIG STEERS

	INDEX	SD	AVERAGE =1529055.00 +2SE	-2SE	EXPECTED VALUE
J	106.00	33.20	118.55	93.45	1620798.30
F	97.00	31.50	108.91	85.09	1483183.35
M	90.00	35.60	103.46	76.54	1376149.50
A	92.00	24.50	101.26	82.74	1406730.60
M	91.00	26.40	100.98	81.02	1391440.05
J	93.00	34.60	106.08	79.92	1422021.15
J	92.00	35.40	105.38	78.62	1406730.60
A	99.00	45.20	116.08	81.92	1513764.45
S	103.00	37.70	117.25	88.75	1574926.65
O	105.00	36.30	118.72	91.28	1605507.75
N	114.00	37.90	128.32	99.68	1743122.70
D	118.00	76.80	147.03	88.97	1804284.90

COWS

	INDEX	SD	AVERAGE =571643.00 +2SE	-2SE	EXPECTED VALUE
J	89.00	28.20	99.66	78.34	400883.59
F	96.00	18.20	102.88	89.12	432413.76
M	115.00	36.90	128.95	101.05	517995.65
A	129.00	33.90	141.81	116.19	581055.99
M	138.00	41.90	153.84	122.16	621594.78
J	136.00	41.20	151.57	120.43	612586.16
J	113.00	53.90	133.37	92.63	508987.03
A	87.00	35.10	100.27	73.73	391874.97
S	72.00	32.30	84.21	59.79	324310.32
O	63.00	25.40	72.60	53.40	283771.53
N	80.00	28.30	90.70	69.30	360344.80
D	82.00	35.00	95.23	68.77	369353.42
	82.00	35.00	95.23	68.77	369353.42

HEIFERS

	INDEX	SD	AVERAGE = 420649.00 +2SE	-2SE	EXPECTED VALUE
J	101.00	30.00	112.34	89.66	1544345.55
F	104.00	19.40	111.33	96.67	1590217.20
M	111.00	28.60	121.81	100.19	1697251.05
A	114.00	22.30	122.43	105.57	1743122.70
M	108.00	21.80	116.24	99.76	1651379.40
J	104.00	28.90	114.92	93.08	1590217.20
J	100.00	45.30	117.12	82.88	1529055.00
A	92.00	25.60	101.68	82.32	1406730.60
S	84.00	32.40	96.25	71.75	1284406.20
O	84.00	35.40	97.38	70.62	1284406.20
N	96.00	37.80	110.29	81.71	1467892.80
D	102.00	27.60	112.43	91.57	1559636.10
	102.00	27.60	112.43	91.57	1559636.10

TABLE 5 (CONT.)

AVERAGE KILOGRAMS SLAUGHTERED PER DAY (CONT.)

CALVES

AVERAGE = 145491.00

	INDEX	SD	+2SE	-2SE	EXPECTED VALUE
J	78.00	28.50	88.77	67.23	351336.18
F	87.00	27.70	97.47	76.53	391874.97
M	110.00	38.40	124.51	95.49	495474.10
A	139.00	56.40	160.32	117.68	626099.09
M	144.00	38.30	158.48	129.52	648620.64
J	127.00	55.00	147.79	106.21	572047.37
J	103.00	34.60	116.08	89.92	463943.93
A	87.00	33.90	99.81	74.19	391874.97
S	82.00	38.50	96.55	67.45	369353.42
O	80.00	44.90	96.97	63.03	360344.80
N	82.00	36.50	95.80	68.20	369353.42
D	81.00	33.30	93.59	68.41	364849.11

ALL CATEGORIES OBTAINED THROUGH SEASONAL ANALYSIS

AVERAGE =3117270.00

ALL CATEGORIES OBTAINED THROUGH SUM OF ALL EXPECTED VALUES

	INDEX	SD	+2SE	-2SE	EXPECTED VALUE	SUM	PERCENTAGE ERROR
J	99.00	25.20	108.52	89.48	3086097.30	3091304.	-0.17
F	98.00	18.00	104.80	91.20	3054924.60	3014913.	1.31
M	99.00	27.00	109.21	88.79	3086097.30	3106426.	-0.66
A	105.00	15.60	110.99	99.10	3273133.50	3267344.	0.18
M	105.00	20.10	112.60	97.40	3273133.50	3281033.	-0.24
J	105.00	24.60	114.30	95.70	3273133.50	3263126.	0.31
J	99.00	28.10	109.62	88.38	3086097.30	3091640.	-0.18
A	96.00	33.10	108.51	83.49	2992579.20	3006629.	-0.47
S	94.00	32.20	106.17	81.83	2930233.80	2941118.	-0.37
O	93.00	28.50	103.77	82.23	2899061.10	2894820.	0.15
N	101.00	26.90	111.17	90.83	3148442.70	3164985.	-0.53
D	105.00	46.70	122.65	87.35	3273133.50	3288390.	.00

TABLE 6

HEADS SLAUGHTERED PER MONTH

	SMALL STEERS				BIG STEERS			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	96	30.6	107.57	84.43	107	32.9	119.44	94.56
F	86	17.0	92.43	79.57	90	28.6	100.81	79.19
M	101	31.5	112.91	89.09	92	36.3	105.72	78.28
A	98	29.6	109.19	86.81	91	24.1	100.11	81.89
M	100	26.7	110.09	89.91	92	26.7	102.09	81.91
J	97	25.0	106.45	87.55	92	33.7	104.74	79.26
J	105	25.3	114.56	95.44	94	35.4	107.38	80.62
A	108	40.7	123.38	92.62	101	45.9	118.35	83.65
S	105	43.6	121.48	88.52	101	37.1	115.02	86.98
O	104	47.7	122.03	85.97	107	37.0	120.98	93.02
N	96	31.0	107.72	84.28	112	36.5	125.80	98.20
D	105	31.6	116.94	93.06	121	76.9	150.07	91.93

	COWS				HEIFERS			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	89	29.3	100.07	77.93	104	29.9	115.30	92.70
F	88	17.9	94.77	81.23	97	16.9	103.39	90.61
M	115	36.7	128.87	101.13	113	28.9	123.92	102.08
A	127	33.2	139.55	114.45	112	21.3	120.05	103.95
M	141	42.7	157.14	124.86	110	20.7	117.82	102.18
J	135	41.7	150.76	119.24	101	27.5	111.39	90.61
J	122	34.3	134.96	109.04	105	23.3	113.81	96.19
A	91	36.1	104.64	77.36	92	25.8	101.75	82.25
S	72	32.0	84.09	59.91	82	31.7	93.98	70.02
O	63	23.8	72.00	54.00	85	36.0	98.61	71.39
N	77	25.8	86.75	67.25	94	37.0	107.98	80.02
D	80	34.3	92.96	67.04	105	28.7	115.85	94.15

	CALVES				ALL CATEGORIES CONSIDERED			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	79	29.8	90.26	67.74	100	24.6	109.30	90.70
F	82	24.7	91.34	72.66	90	15.1	95.71	84.29
M	114	40.5	129.31	98.69	103	26.8	113.13	92.87
A	139	56.6	160.39	117.61	106	15.9	112.01	99.99
M	149	38.5	163.55	134.45	110	20.1	117.60	102.40
J	128	55.1	148.83	107.17	105	23.1	113.73	96.27
J	106	35.1	119.27	92.73	103	24.6	112.30	93.70
A	88	33.2	100.55	75.45	97	31.9	109.06	84.94
S	79	36.6	92.83	65.17	91	31.1	102.75	79.25
O	79	43.7	95.52	62.48	93	28.5	103.77	82.23
N	78	34.1	90.89	65.11	98	25.4	107.60	88.40
D	80	32.0	92.09	67.91	105	42.5	121.06	88.94

TABLE 6 (CONT.)

AVERAGE HEADS SLAUGHTERED PER DAY

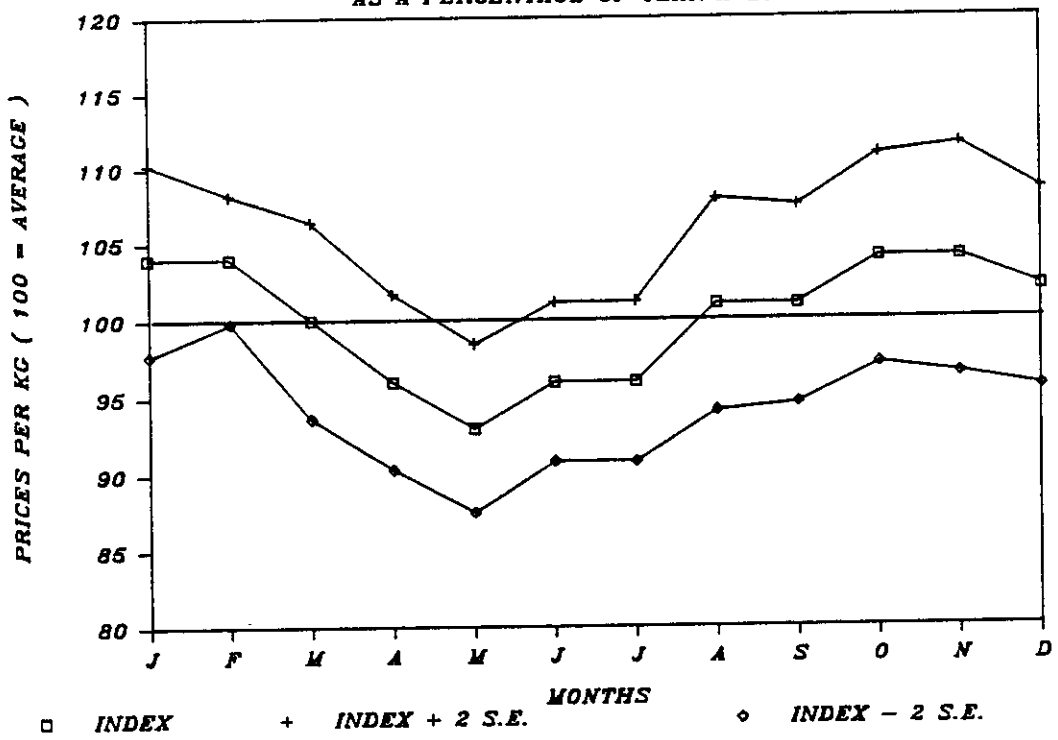
	SMALL STEERS				BIG STEERS			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	94.00	30.10	105.38	82.62	105.00	16.16	111.11	98.89
F	93.00	17.60	99.65	86.35	97.00	15.46	102.84	91.16
M	100.00	30.90	111.68	88.32	90.00	17.73	96.70	83.30
A	99.00	30.10	110.38	87.62	92.00	12.18	96.60	87.40
M	98.00	26.60	108.05	87.95	91.00	13.03	95.92	86.08
J	98.00	25.30	107.56	88.44	93.00	17.08	99.46	86.54
J	103.00	24.90	112.41	93.59	92.00	17.47	98.60	85.40
A	106.00	40.10	121.16	90.84	99.00	22.61	107.55	90.45
S	106.00	44.30	122.74	89.26	103.00	18.84	110.12	95.88
O	102.00	46.90	119.73	84.27	105.00	18.18	111.87	98.13
N	98.00	31.50	109.91	86.09	114.00	18.56	121.02	106.98
D	103.00	31.20	114.79	91.21	118.00	37.86	132.31	103.69

	COWS				HEIFERS			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	87.00	28.80	97.89	76.11	102.00	29.30	113.07	90.93
F	95.00	19.90	102.52	87.48	105.00	18.30	111.92	98.08
M	113.00	36.00	126.61	99.39	111.00	28.40	121.73	100.27
A	129.00	33.60	141.70	116.30	114.00	21.60	122.16	105.84
M	138.00	41.80	153.80	122.20	108.00	20.20	115.63	100.37
J	137.00	42.10	152.91	121.09	102.00	27.70	112.47	91.53
J	120.00	33.70	132.74	107.26	103.00	22.90	111.66	94.34
A	89.00	35.40	102.38	75.62	91.00	25.40	100.60	81.40
S	73.00	32.40	85.25	60.75	83.00	32.20	95.17	70.83
O	62.00	23.40	70.84	53.16	83.00	35.40	96.38	69.62
N	78.00	26.20	87.90	68.10	95.00	37.60	109.21	80.79
D	79.00	33.70	91.74	66.26	103.00	28.30	113.70	92.30

	CALVES				ALL CATEGORIES CONSIDERED			
	INDEX	SD	+2SE	-2SE	INDEX	SD	+2SE	-2SE
J	78.00	29.30	89.07	66.93	98	24.2	107.15	88.85
F	88.00	27.30	98.32	77.68	97	16.5	103.24	90.76
M	111.00	39.70	126.01	95.99	101	26.2	110.90	91.10
A	141.00	57.40	162.70	119.30	108	16.1	114.09	101.91
M	146.00	37.90	160.32	131.68	108	19.6	115.41	100.59
J	129.00	55.80	150.09	107.91	107	23.3	115.81	98.19
J	104.00	34.50	117.04	90.96	101	24.3	110.18	91.82
A	86.00	32.70	98.36	73.64	96	31.4	107.87	84.13
S	80.00	37.20	94.06	65.94	93	31.5	104.91	81.09
O	77.00	42.90	93.21	60.79	91	28.1	101.62	80.38
N	79.00	34.60	92.08	65.92	99	25.9	108.79	89.21
D	79.00	31.50	90.91	67.09	103	41.8	118.80	87.20

TOTAL AVERAGE PRICES

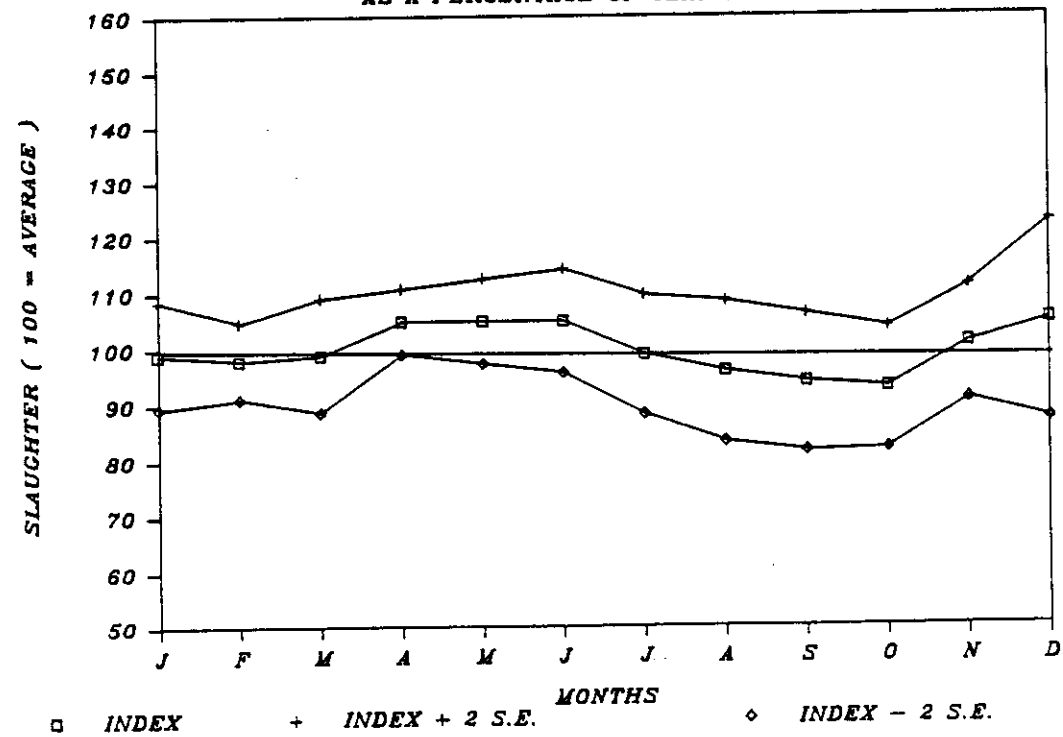
AS A PERCENTAGE OF YEAR AVERAGE



□ INDEX + INDEX + 2 S.E. ◇ INDEX − 2 S.E.

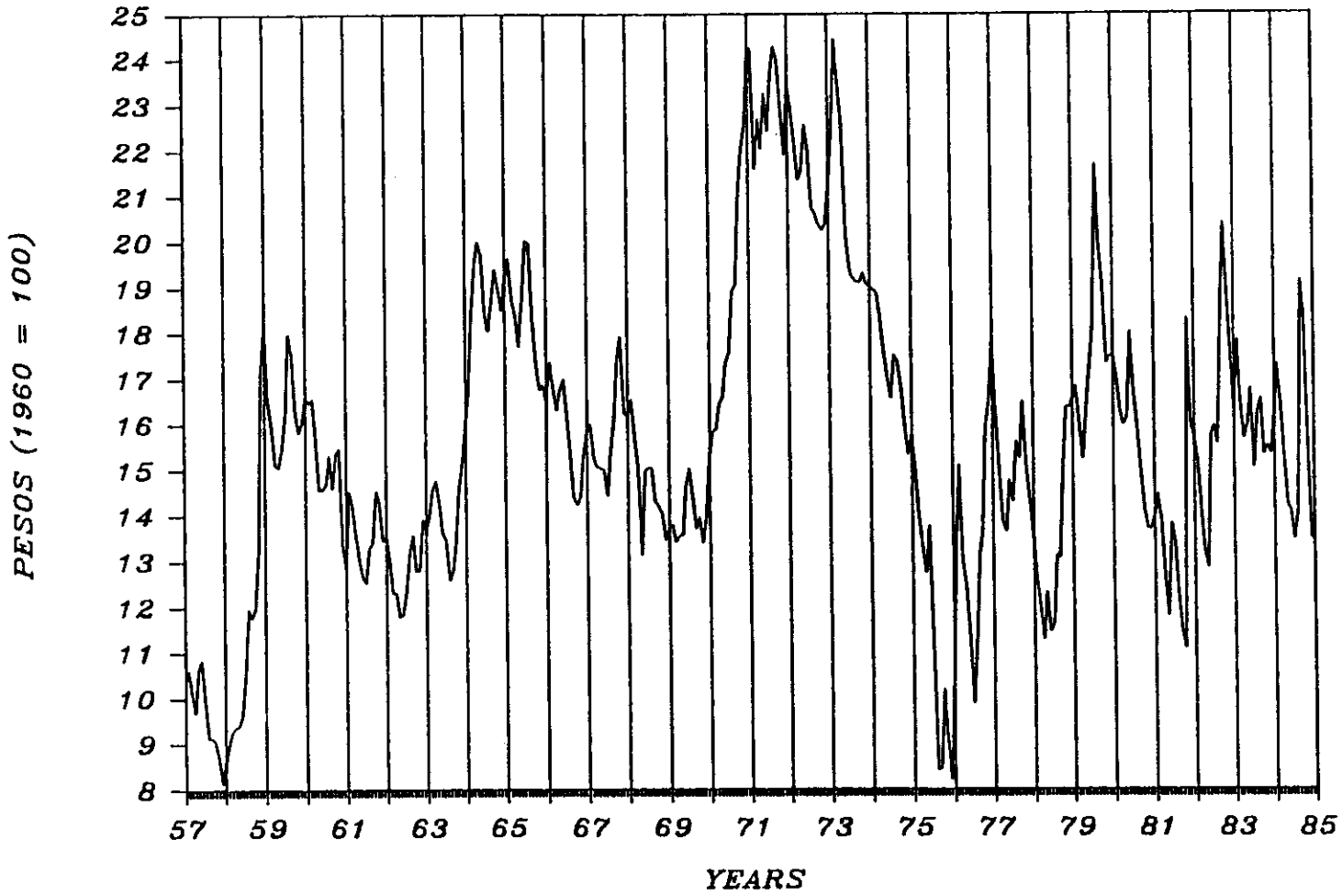
TOTAL SLAUGHTER (KG./DAY)

AS A PERCENTAGE OF YEAR AVERAGE

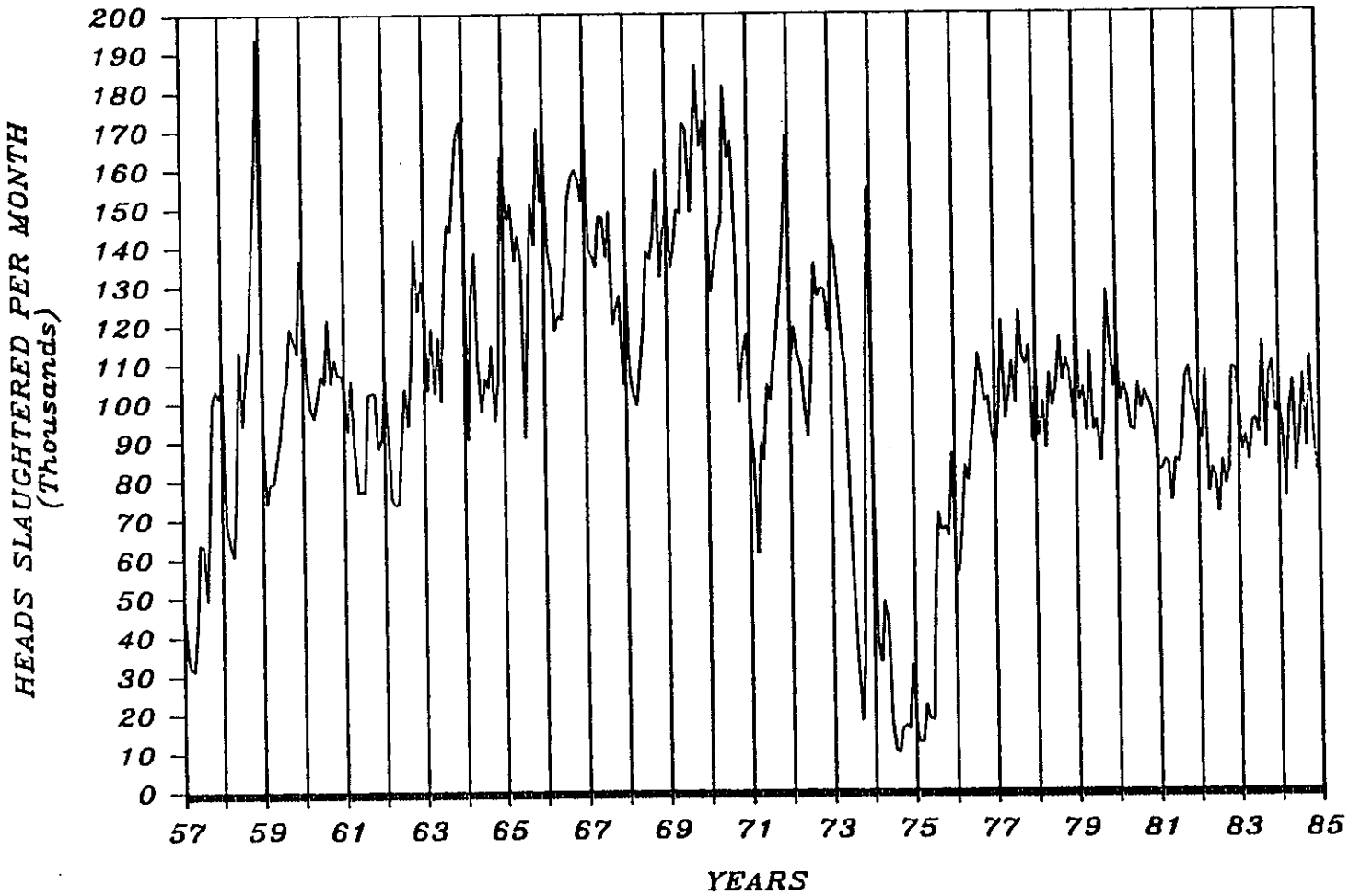


□ INDEX + INDEX + 2 S.E. ◇ INDEX − 2 S.E.

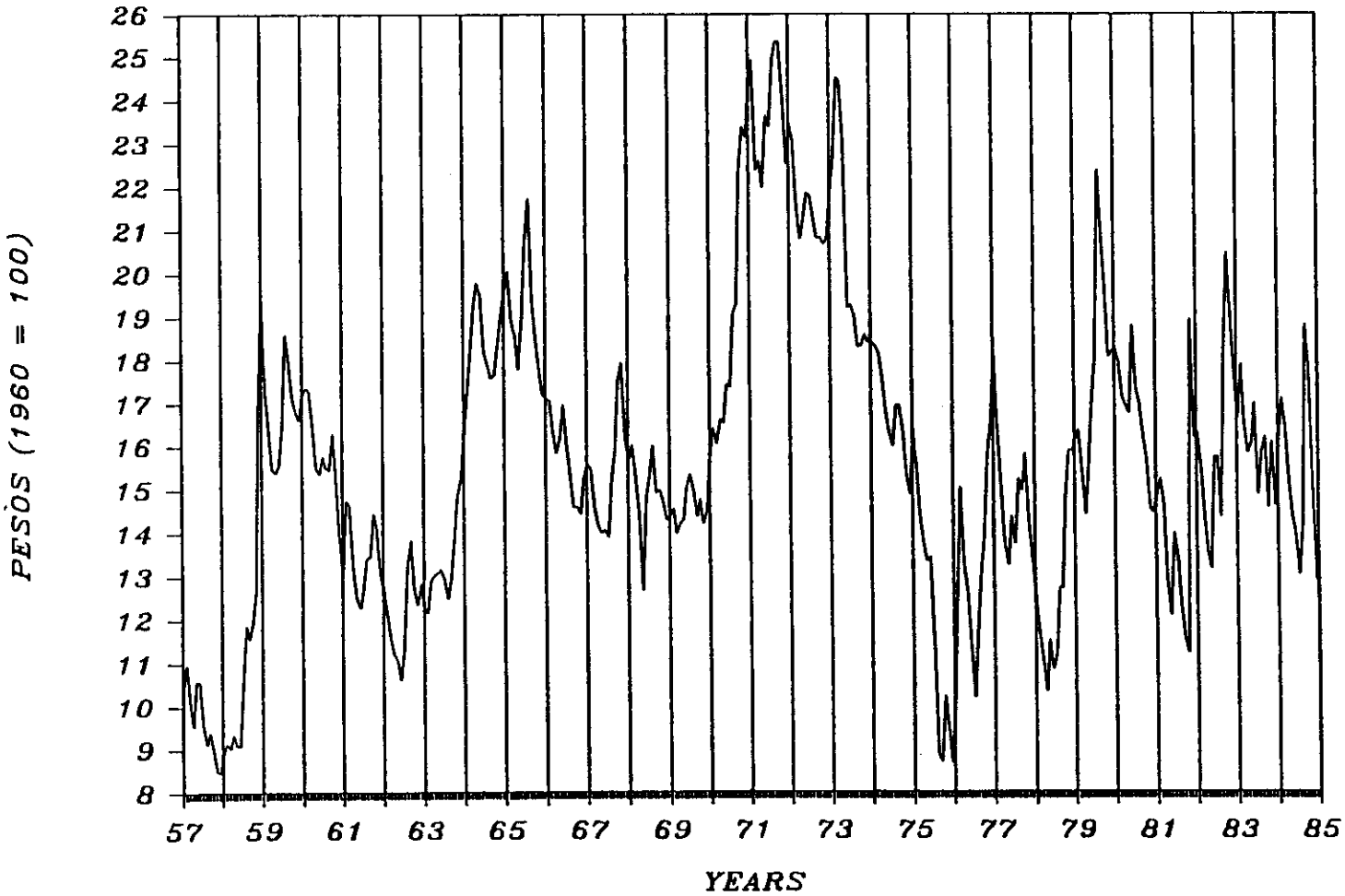
DEFLATED PRICES OF BIG STEERS



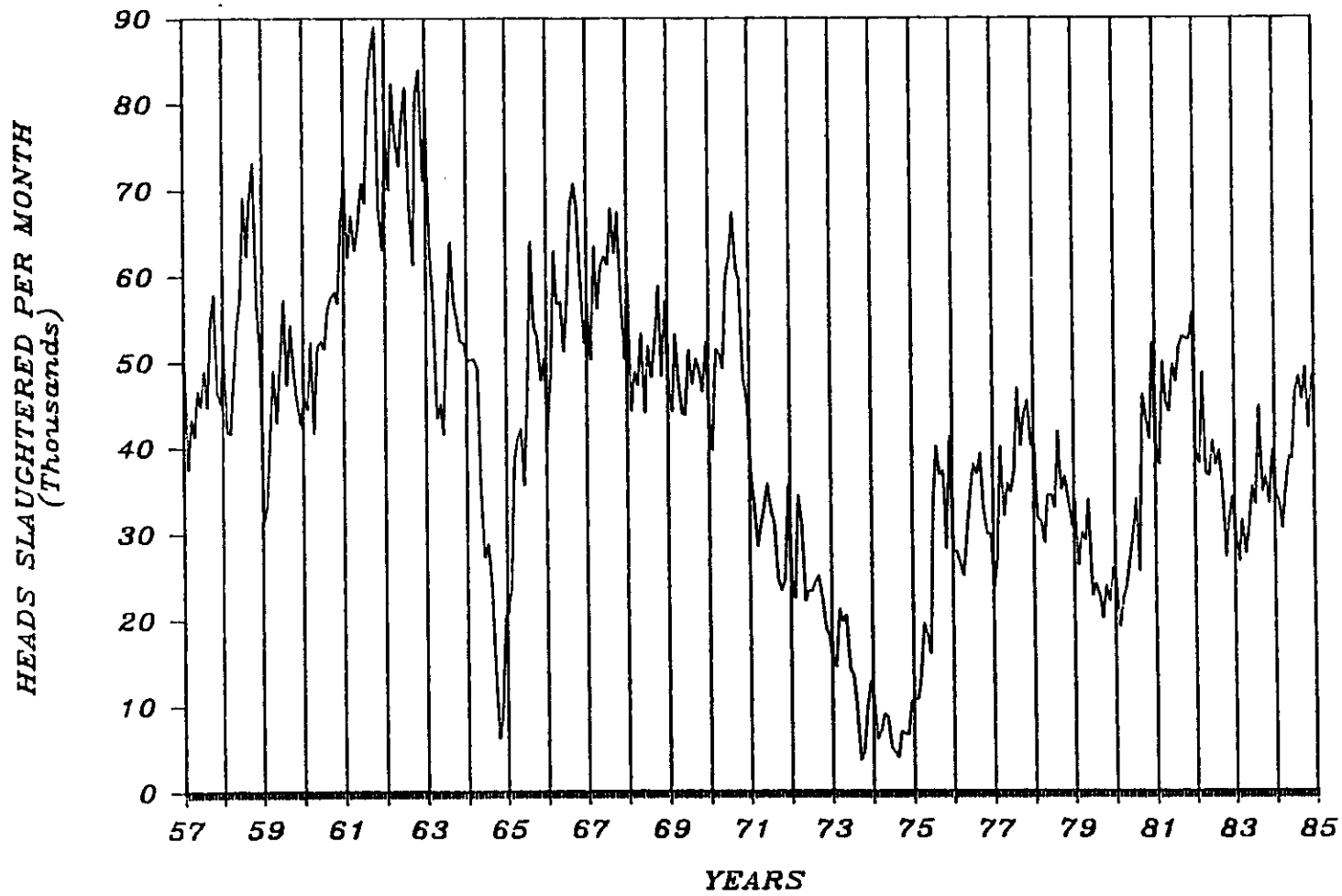
SLAUGHTER OF BIG STEERS



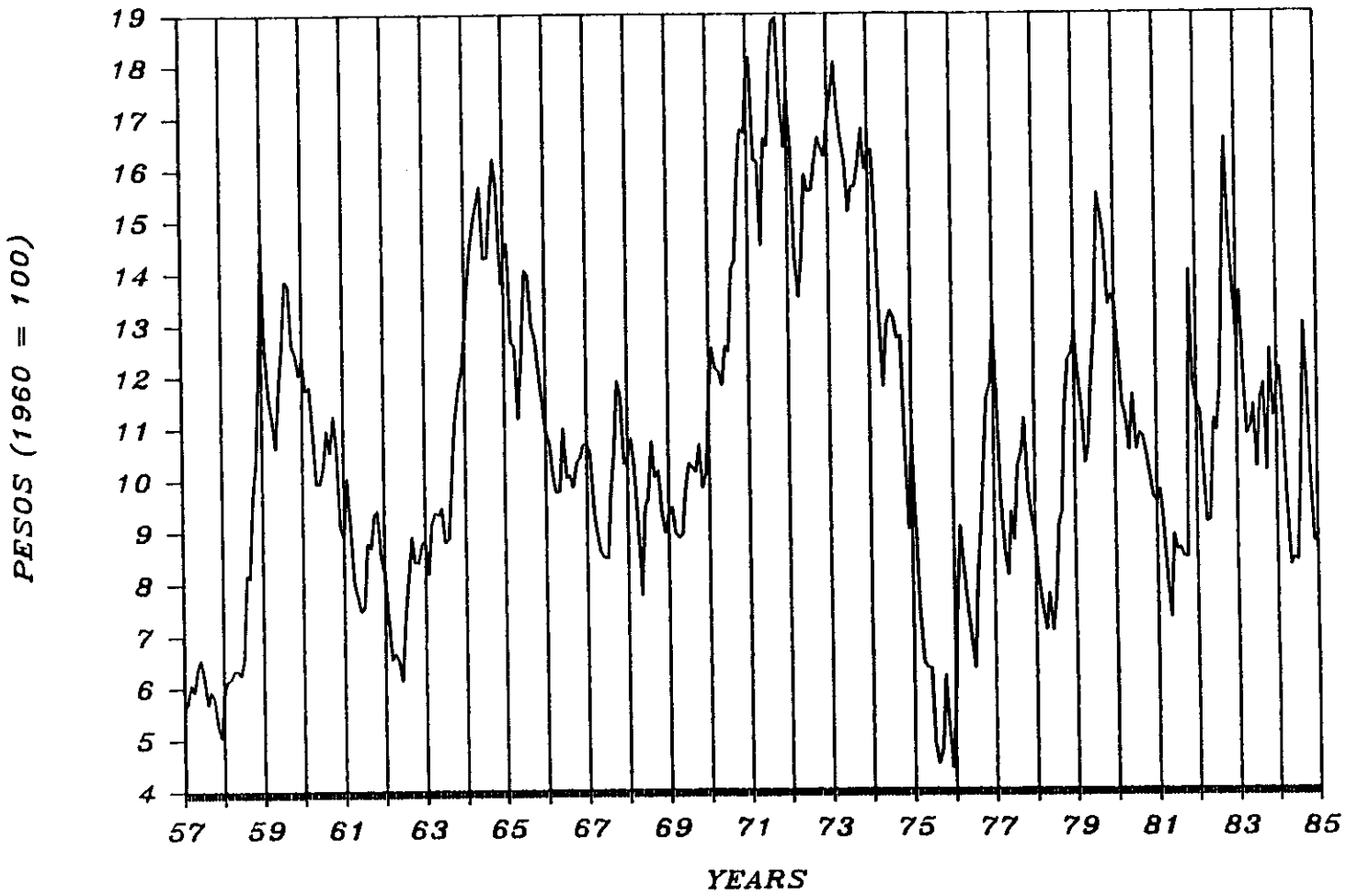
DEFLATED PRICES OF SMALL STEERS



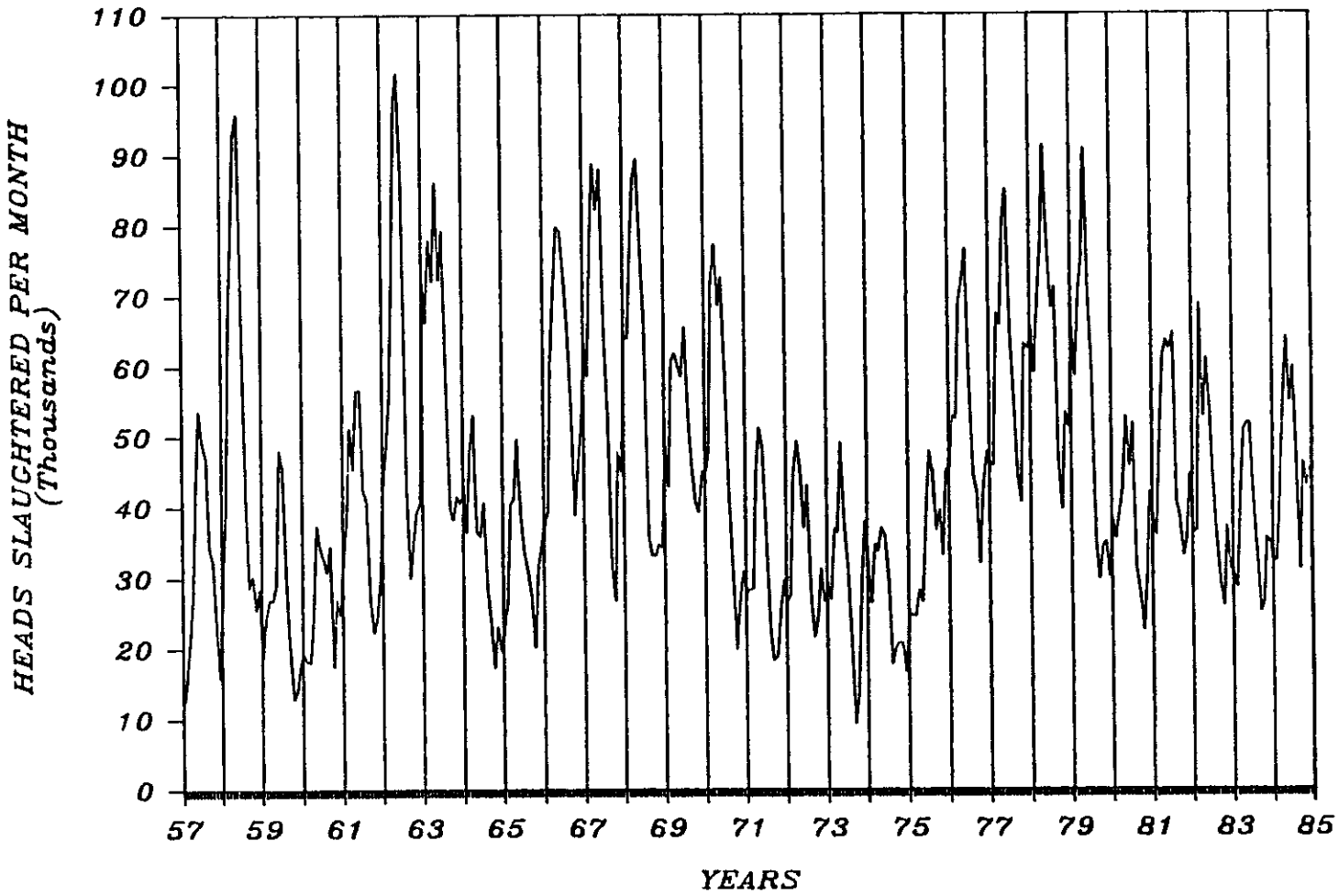
SLAUGHTER OF SMALL STEERS



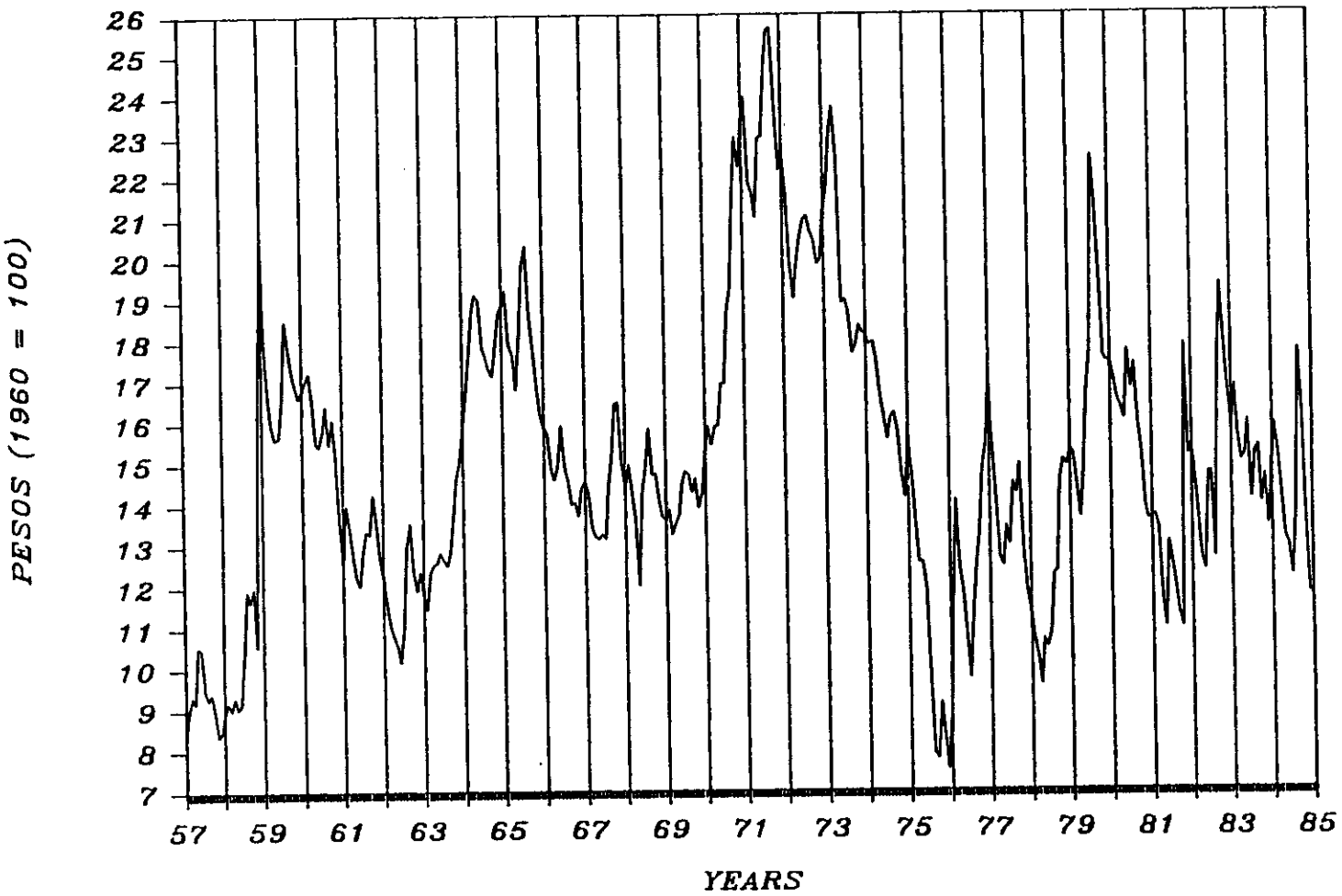
DEFLATED PRICES OF COWS



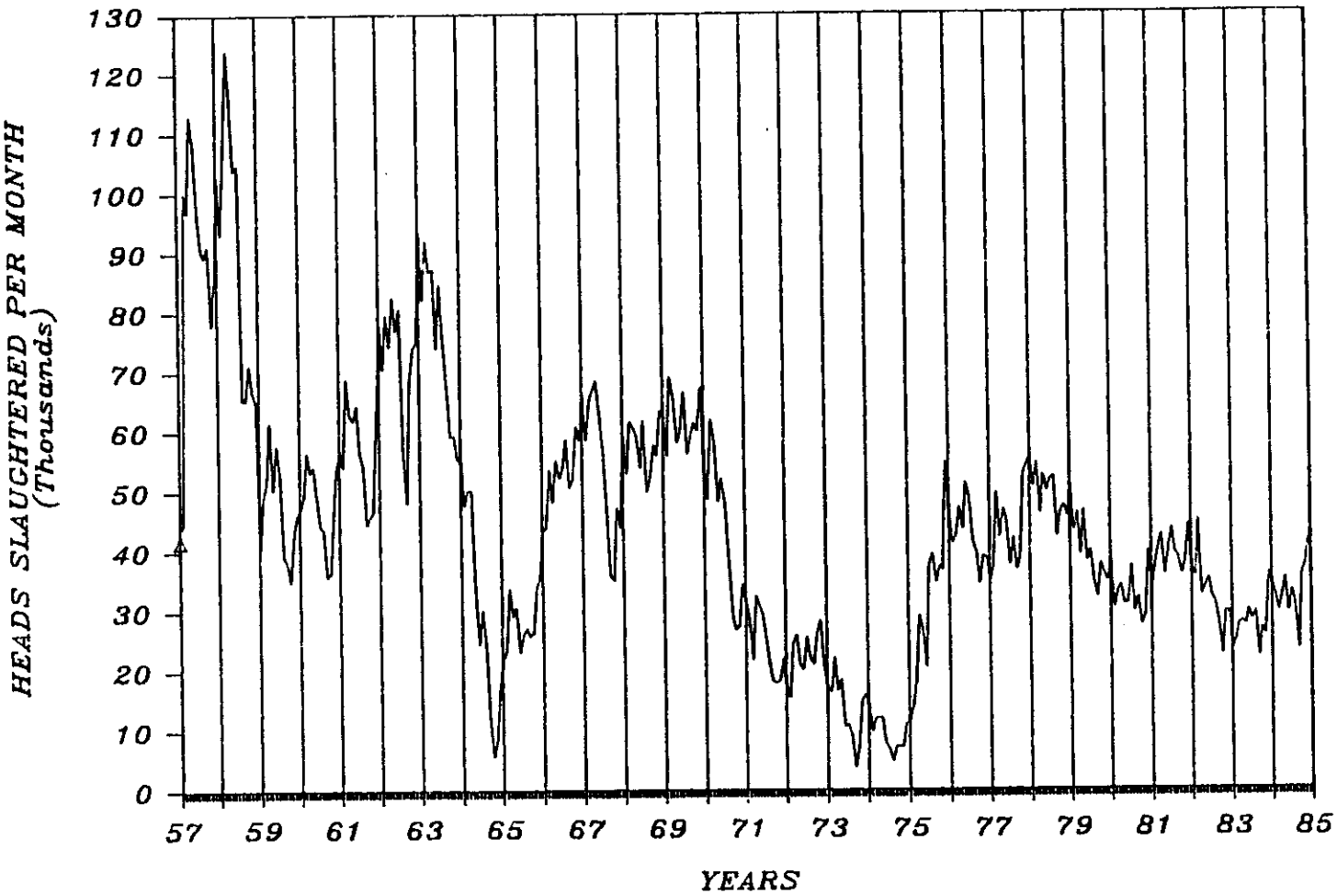
SLAUGHTER OF COWS



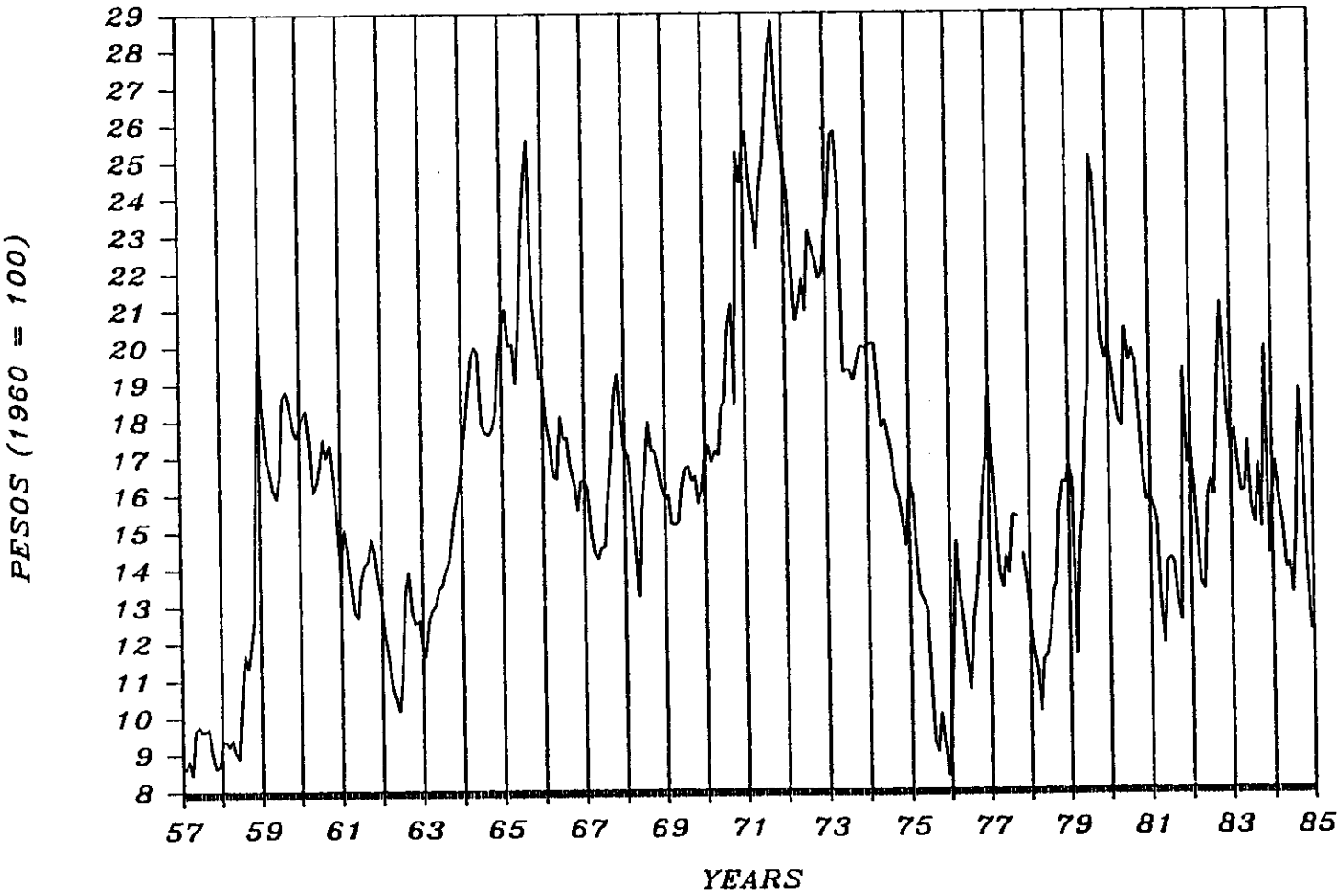
DEFLATED PRICES OF HEIFERS



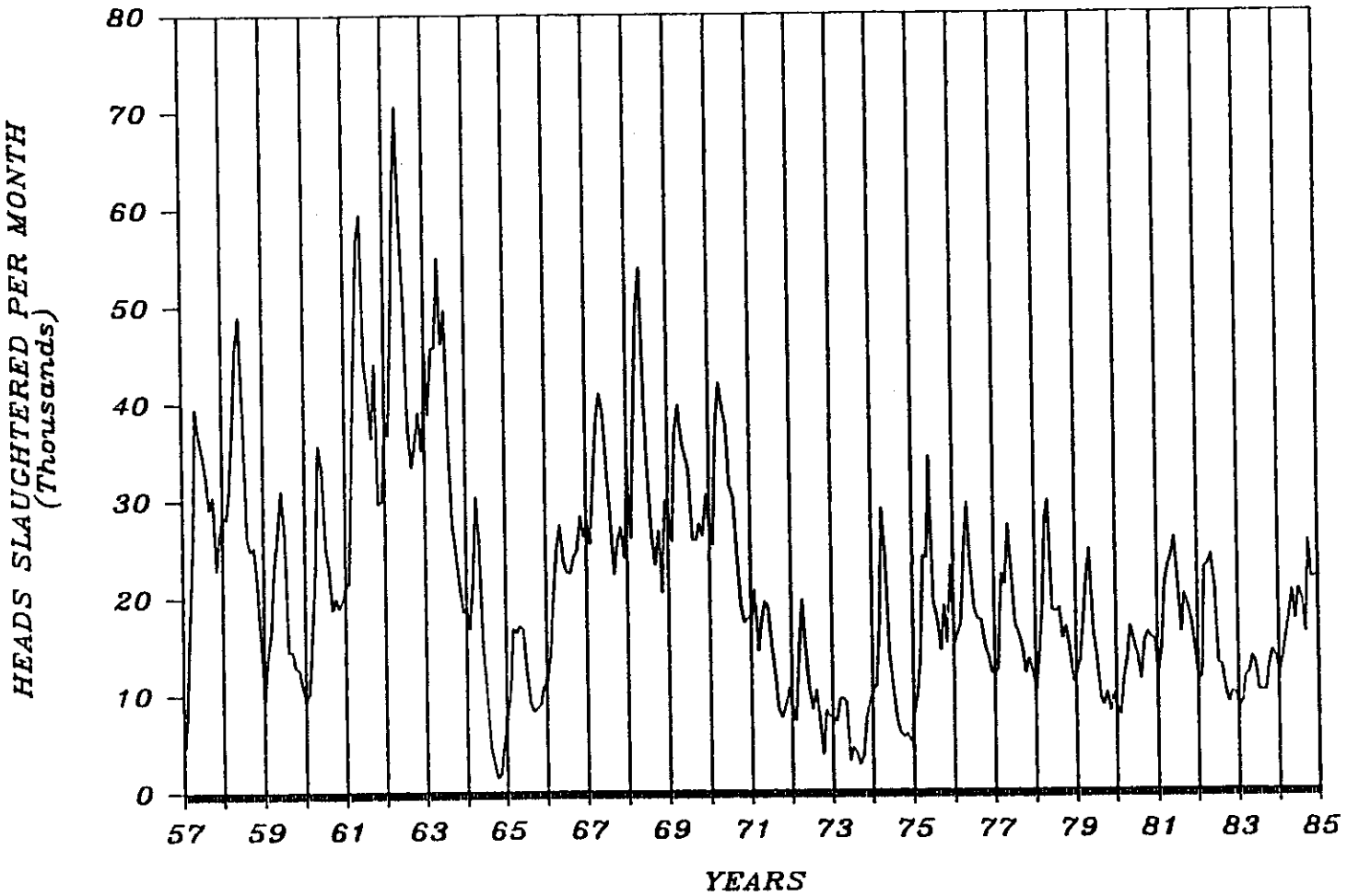
SLAUGHTER OF HEIFERS



DEFLATED PRICES OF CALVES



SLAUGHTER OF CALVES



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