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Of course ideas on their own are not enough. The quality and sheer reality of these Proceedings must be credited to the 15 authors who have, in my opinion, applied themselves to the task with great enthusiasm and come up with a very valuable collection of papers.

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Ian F. Whan,
Editor

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SOME ECONOMIC ISSUES RELATING TO MEAT PROCESSING IN AUSTRALIA*

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INTRODUCTION

The meat industry is a large and vital component of Australian agriculture, with the value of cattle, sheep, pigs and poultry slaughtered amounting to about \$5 billion, or 40 per cent of the total gross value of livestock production in 1987-88 (Australian Bureau of Agricultural and Resource Economics 1988). From a broad perspective, exports of meat and live animals for slaughter in 1987-88 accounted for an estimated 18 per cent (\$2.5 billion) of the total value of Australian exports of rural origin. Most of these exports were beef and veal (almost \$2 billion), lamb and mutton (over \$300 million) and live sheep for slaughter (around \$35 million). Exports of pig and poultry meat amounted to \$33 million.

Meat processing, which in this paper is taken to include slaughtering, boning and freezing, is an integral part of the task of converting livestock on farms to meat for domestic and overseas consumers. In 1987, there were 86 abattoirs licensed to export meat and a further 157 abattoirs licensed only for the domestic market (Table 1). In addition there were around 300 smaller 'slaughterhouses' servicing the needs of local communities mainly in non-urban areas. Typically, the largest operations are those licensed for export. There are state and local government owned 'service' abattoirs in all mainland states.

Table 1: Slaughtering facilities in Australia: 1987

State	Licensed abattoirs		Local slaughter	Government abattoirs (a)
	Export	Domestic		
NS.W. and ACT	19	11	36	5
Victoria	13	78	20	2
Queensland	29	10	115	4
South Aust.	8	9	78	1
Western Aust.	8	39	10	1
Tasmania	5	4	40	0
Northern Terr.	4	6	na	0
Total	86	157	299	11

(a) Also included in the figures for export and domestic licensed abattoirs. na Not available.

Sources: Various abattoir licensing authorities and their annual reports.

The continued viability of Australia's meat and livestock industry depends on its ability to remain competitive on both the world and domestic markets. An important factor affecting competitiveness is the efficiency with which livestock are transformed to final product for the end-user - whether that be a domestic consumer or an overseas importer. Since the meat processing industry plays a key role in this transformation, the costs of processing have attracted considerable attention from beef and sheep meat producer groups. Processing accounts for an estimated 13 per cent of the costs incurred between the farm gate and domestic consumer and for 45 per cent of the costs from farm gate to export destination (PA Management Consultants 1986). The focus of producers on meat processing also reflects the

fact that the market forces affecting meat demand and supply are such that any major or sustained movements in processing costs tend to be reflected mainly in the prices received by livestock producers. For example, Corra and Johns (1983) demonstrated that about 80 per cent of any increase in cattle slaughter levies is borne by producers (in the form of lower auction prices for beef) and about 20 per cent is borne by consumers. It should be noted, however, that the ability of processors to pass such costs on is constrained, in the short term at least, by variations in the supply and demand for livestock. For instance, when the supply-demand situation is tight, processors may elect to absorb some increase in costs in order to maintain throughput.

New technology and its rate of adoption has been an issue of particular interest to producer groups and industry leaders in the 1980s. Walker (1981) suggested that there was a great deal of scope for using and developing new technology to assist in cutting processing costs, and that meat processors were looking increasingly at this area of potential efficiency gains. However, certain characteristics of the industry, such as the great diversity of stock which have to be handled in the slaughter chain, may hinder the rate of adoption of new technology.

Given the widespread interest in processing costs, the objective in this paper is to examine, from an economic perspective, various aspects of the meat and livestock industry likely to affect the cost structure of the processing sector. In view of the overwhelming importance of the red meat (that is, beef, lamb and mutton) industries in Australia's livestock export trade, and the fact that irregularities in supply and demand for cattle and sheep pose particular economic problems for abattoirs, the discussion will not embrace issues relating to the processing of pigs and chickens.

The first step in looking at some of the economic issues relating to meat processing involves outlining several of the important structural features of the industry and providing estimates of processing costs. The role of such factors as plant ownership, industry regulation and labour arrangements as they affect economic efficiency in meat processing are then considered. At the end of the paper, some conclusions are presented. Since many of the developed market economies of the world have systems for slaughtering and processing livestock which are similar in some respects to Australia's, these conclusions may also be relevant for other countries.

ECONOMIC STRUCTURE OF THE MEAT PROCESSING INDUSTRY

An understanding of some of the economic characteristics of the meat processing industry provides a basis for examining the functions and behaviour of its various components. This makes it easier both to identify those elements of the industry's structure which are likely to influence economic efficiency, and to also gain some insights for possible future changes.

The Role of Processing in Marketing

The processing component of the meat marketing system plays a role in transmitting economic information between buyers and sellers at different levels in the market. In an efficient market, such information is largely contained in the 'price

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signals' that reflect the demand and supply for different meats of various qualities. These price signals are passed between end-users (meat consumers) and raw material suppliers (livestock producers).

In the Australian context, livestock producers have a range of options available for marketing their animals, with some of these involving the slaughter of stock before sale. However, in most regions of the country it is more common for ownership of livestock to be transferred to a processor, or wholesaler or retailer, prior to slaughter. In southern Australia, stock are typically sold at auction in municipal saleyards or by negotiation with buyers on the farm. By way of contrast, in northern Australia it is more common for stock (especially cattle) to be sold direct to abattoirs on the basis of prospective buyers' price schedules for different weights and grades of animal.

Livestock supply and demand

The environment within which Australian abattoirs must operate is characterised by substantial intra-seasonal variations in the supply of cattle and sheep for slaughter due to fluctuations in the availability of feed from pastures. In addition, dependence on often highly variable export markets means that there are considerable inter-seasonal fluctuations in the supply of stock to processors as producers increase or decrease herds and flocks in response to changing overseas demand. The extent of inter-seasonal supply fluctuations, other than due to drought, is affected by the ability of farmers to respond to changes in the relative profitability of raising livestock for meat compared with other enterprises such as wool production and cropping. The degree to which farmers can substitute between enterprises varies between regions and is very limited in most of the beef grazing areas of northern Australia.

It was the large variations in inter-seasonal turnoff of stock which brought into focus the issue of slaughtering capacity utilisation in the early 1980s. At the time, reduced throughput in abattoirs (due to lower livestock numbers) was linked to an observed declining profitability in the meat processing industry. The New South Wales Meat Industry Authority (1985), for example, argued that 'under utilisation of existing capacity is the greatest single cost factor in the meat processing industry' (p.10). Such sentiments were often used to justify state government regulatory policies designed to restrict slaughtering capacity.

From an economist's perspective, however, underutilisation of capacity is not necessarily a sign of inefficiency. In fact, it is largely to be expected as an inevitable consequence of the type of economic environment in which the industry operates. Substantial inter- and intra-seasonal fluctuations in livestock output and prices in Australia mean that abattoirs processing cattle and sheep are never likely to maintain throughput at their theoretical maximum capacity.

The Importance of Changes in Processing Costs

Changes in processing costs may affect the prices received by livestock producers, or the prices paid by meat consumers, or both. The extent to which processors are able to pass cost changes forward or back depends on the sensitivity of consumer demand for meat to changes in its price, the sensitivity of livestock supplies to prices received, and the degree of competition between processors.

In general terms, the more sensitive demand is to price changes, the smaller is the degree to which consumers are affected by variations in processing costs. An important feature of the demand for meat in Australia is the relatively price sensitive nature of the domestic and export markets. For example, demand for beef on the domestic market has been estimated to change by 0.98 per cent, in the opposite direction, for each 1 per cent change in retail price. The demand for Australian beef in the US market has been estimated to decline by 1.7 per cent for each 1 per cent increase in the Australian saleyard price of beef

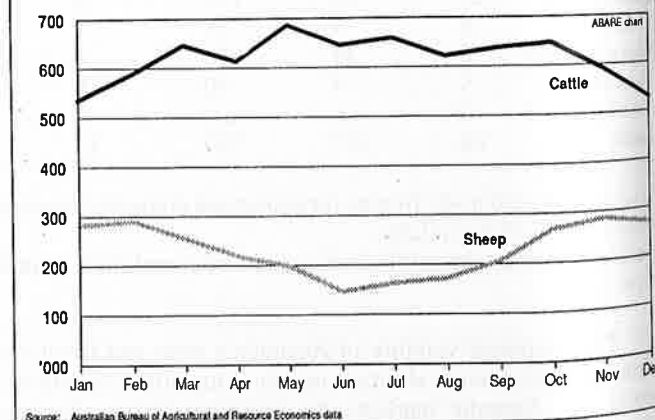
(Dewbre, Shaw, Corra and Harris 1985).

While livestock demand changes rapidly when prices change, livestock supply adjustment is constrained in the short run by biological and climatic factors. In the year following an increase in saleyard prices for cattle, the supply of beef actually declines, while in the medium term (say after five years) supply is estimated to increase by only 0.34 per cent (Dewbre, Shaw, Corra and Harris 1985). The negative short term response reflects the fact that, in order to produce a sustained increase in output, producers have to initially withhold breeding stock from slaughter.

Because the demand for meat (and, hence, livestock) is relatively more sensitive to price changes than supply, changes in processing costs tend (in the longer run) to be borne largely by producers. A change in processing costs results in a change in the marketing margin, which is the difference between the retail price of meat and the price of the livestock from which such meat is derived. Changes in marketing margins appear as shifts in the livestock demand and meat supply relationship (Tomek and Robinson 1981). For example, if processing costs (and therefore marketing margins) increase, there will be less livestock demanded and less meat supplied at each price level. Increases in processing costs will be felt through higher retail meat prices and lower livestock prices, with the effect likely to be greater at the farm level than at the retail level.

While the pasture based production systems used by Australia's beef and sheep industries mean that livestock can be turned off at relatively low cost, such systems can impose additional costs in the processing area. For example, the substantial intra-seasonal variability in supply of stock for slaughter (illustrated in Figure 1) makes it difficult to use the capital investment (in plant and facilities) at what might otherwise be regarded as economically optimal levels throughout the year. Furthermore, marked variations in the size and weights of animals slaughtered pose particular problems with the design and economic operation of processing plants and their associated equipment, compared with that encountered with pigs and poultry, or with grain fed cattle in, say, North America.

Figure 1: Slaughter seasonality
Average monthly cattle equivalents slaughtered, 1972-88



The Cost Structure of Meat Processing

In addressing the issue of industry costs, questions relating to their measurement and the concepts of accounting versus economic costs need to be clarified. With respect to measurement, the break-up between fixed (overhead) and variable (direct) costs, often must be quite arbitrary. While it may be easy to determine which category (fixed or variable) some costs fit into, for others the determination has to be based on assumptions that may not be entirely appropriate. Although the distinction between variable and fixed costs is important in an accounting sense, it is critical in economic terms.

The economic importance of distinguishing between fixed and variable costs stems from the 'sunk cost' nature of much of the investment in abattoir buildings and equipment. In the short

the critical determinant of whether a firm should continue to operate is whether or not they can cover the variable costs (such as labour, power, repairs and maintenance) incurred. As long as earnings are greater than the variable cost of operation, it is economically feasible for a firm to continue operating even if it does not cover all its fixed costs. In the longer term, however, if the firm cannot recover the total (fixed plus variable) cost of operation it must eventually go out of business.

Information on the cost structure of the meat processing industry is limited. This, in part, reflects the differing approaches to accounting in various firms and a possible reluctance on the part of some to make commercially sensitive data available to those undertaking surveys. Nevertheless, a report by PA Management Consultants (1986) indicates that labour is the principal factor in the estimated 13 per cent of costs from the farm to domestic retail level and 45 per cent of costs from farm to export destination that are attributable to processing. Labour costs accounted for about 46 per cent of the \$643 million estimated cost of slaughtering, boning and freezing in 1984-85. Other significant components included materials (15 per cent), taxes and levies (12 per cent), administration (9 per cent), interest (6 per cent) and energy (4 per cent).

As part of its study of the abattoir and meat processing industry, the Industries Assistance Commission (1983) provided some cost information from a survey it undertook of abattoir costs. The main purpose of the survey was to investigate the relationship between processing costs and changes in capacity utilisation. The results are summarised in Table 2.

Export abattoirs were found to have greater unit costs, especially fixed costs, than establishments licensed for the local market. This was attributed to the higher standard of facilities necessary for export production. The lower fixed costs for the publicly owned abattoirs in the survey were attributed to significantly lower depreciation figures for public abattoirs, perhaps due to their relatively greater age and type of construction. The Commission also suggested that cost accounting techniques for public abattoirs may be different from private abattoirs leading to a different valuation of their fixed costs. The measurement problems encountered by the Commission serve to illustrate the difficulties involved in obtaining an accurate picture of the cost structure of the meat processing industry.

Despite the measurement difficulties, the Industries Assistance Commission was able to conclude that short run per head costs could be decreased by \$5.50 (in 1981-82 dollar terms) if average capacity utilisation increased from 57 per cent to 100 per cent. While seasonality of supply means that such a rate of capacity utilisation is no more than a theoretical concept for the grazing based livestock industries, it does show that there are gains from increased utilisation of plant. In practice, as capacity utilisation will always be well short of 100 per cent, and given the magnitude of the cost changes shown in Table 2, the gains from higher throughput are unlikely to be very large in either absolute or percentage terms. The Commission indicated that an accepted rule of thumb in the industry was that 60 per cent capacity utilisation is necessary to cover costs.

A substantial diversity of abattoir costs was also revealed in the Commission's work. The 'all abattoirs average total cost' estimates had standard deviations of 44 per cent for the actual and 38 per cent for the maximum capacity. This can be interpreted as indicating that there is likely to be scope for significant cost savings through improvements to work practices and through the introduction of new processing techniques that increase meat yield, as well as through increases in capacity utilisation through such things as changes in livestock purchasing strategies, vertical integration and greater use of shift work.

The Industries Assistance Commission's cost survey also found that larger abattoirs have lower processing costs. In 1981-82, large establishments (maximum annual capacity in excess of 200 000 cattle equivalents) had approximately 25 per cent lower average processing costs than small establishments (less than 100 000 cattle equivalents). This supports the popular view that the meat processing industry is characterised by economies of size. The existence of such economies has implications for the market power of processing firms and also for the efficient allocation of resources within the sector.

In New Zealand, a major study by the consultants Pappas, Carter, Evans and Koop (1985) estimated potential savings of between NZ\$100 million and NZ\$200 million associated with a reduction in available slaughtering and processing capacity of between 35 and 40 per cent. It was argued that by closing plants and amalgamating firms, capacity utilisation in the industry would be raised and the average unit costs of processing animals

Table 2: Average costs and average capacity utilisation of abattoirs in Australia per cattle equivalent: 1981-82

Type of establishment	Average fixed cost (a)		Average variable cost (b)		Average total cost		Average capacity utilised (d)
	Actual output	Maximum capacity (c)	Actual output	Maximum capacity (c)	Actual output	Maximum capacity (c)	
	\$	\$	\$	\$	\$	\$	%
By ownership							
Private	8	5	27	25	35	29	59
Public	4	3	26	23	30	25	50
By type of operation							
Export	8	5	27	25	35	30	59
Local	2	1	26	23	28	24	50
All abattoirs	7	4	27	25	34	29	57

(a) Includes depreciation, rent and lease payments, rates and administration expenses. (b) Includes labour, fuel, electricity, water, government charges and repairs and maintenance. (c) Maximum capacity is defined as the maximum daily potential throughput based on normal product mix, plant layout and taking account of over-tally if appropriate) multiplied by the average number of working days in the year. In the case of seasonal works, the number of working days is based on the length of the normal killing season. (d) Participants in the survey were asked to provide the actual number of livestock slaughtered and the estimated number which would have been slaughtered at maximum capacity.

Source: Industries Assistance Commission (1983).

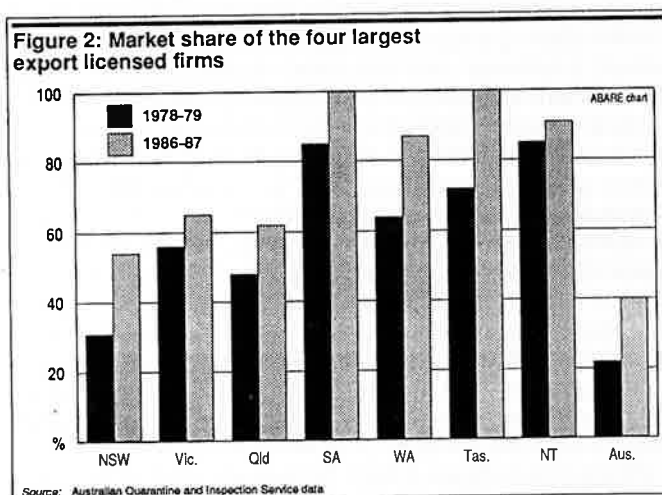
would decline. While the estimates of potential savings in New Zealand seem large compared with those made by the Industries Assistance Commission for Australia, the difference probably stems mainly from the less competitive market for processing services that existed in New Zealand prior to about the mid-1980s.

OWNERSHIP OF MEAT PROCESSING CAPACITY

With the decline in profitability in the processing industry since the late 1970s, there has been substantial rationalisation of ownership in the sector. This rationalisation has mostly been in the form of take-overs or mergers of operations in which actual ownership remains separate. The resulting concentration in the industry has been a matter of some debate, as has the role of government owned abattoirs and their possible effects on overall economic efficiency in the processing sector.

Concentration of ownership

Recent trends towards greater concentration in ownership of abattoirs have attracted considerable attention from livestock producers. The degree of concentration in the ownership of Australia's export abattoirs is illustrated in Figure 2. The percentage of livestock slaughtered in export licensed works by the four largest meat processing firms increased from around 22 per cent in 1978-79 to about 40 per cent in 1986-87.



Increased concentration is of particular concern in Queensland where a consortium of four major processors (called Australian Meat Holdings), who were formerly competitors, now controls 37 per cent of the state's overall slaughtering capacity and 60 per cent in the north (Kingston and Whan 1988). The obvious potential disadvantage of such increases in concentration of ownership is the possibility that abattoir owners will develop market power sufficient to enable them to manipulate and depress prices received by producers. In early 1988, the Trade Practices Commission challenged the consortium's acquisition of a competitor company with abattoirs in the region. The case was argued in the Federal Court under legislation designed to prevent any one firm gaining market dominance.

On the issue of market dominance, unless there are artificial barriers to entry, the extent to which processors may be able to depress prices in a region will be constrained by the ability of livestock producers and buyers to transport stock to alternative abattoirs. Thus, prices should not vary between regions by more than the costs of transport which, because of the competitiveness of road transport and technological gains such as larger road haulage units and improved roads, have been declining in real (net of inflation) terms. A finding by the Federal Court (Wilcox 1988) that cattle price differentials between north Queensland and the central and southern regions of the state were greater than the cost of freighting stock between them appears to have been critical to the determination of the Trade Practices Commission's

case. The judgment handed down by the Federal Court in mid-July 1988 required the consortium to divest itself of two abattoirs in north Queensland because the merger resulted in the firm being able to dominate the market in the region.

While the Queensland case appears to have been decided on the basis of market dominance and its possible adverse affect on producers, greater concentration of ownership may also bring economic benefits. Such benefits are likely to stem from better utilisation of capacity, more specialisation in management, increased opportunities for vertical integration, greater scope for innovation and the development and adoption of new technology, and 'brand name' marketing.

Where a number of works are brought under the control of a single firm or entity, it might be possible to make better use of existing facilities. This is especially true in Queensland where the availability of stock for slaughter is highly seasonal. With merged operations, there is likely to be more scope to assemble available supplies of livestock in a way that will allow some (presumably lower cost) plants to be better utilised whilst closing others belonging to the group.

Greater specialisation in management could benefit the industry insofar as merged firms are likely to be able to draw on a larger pool of management expertise or be in a stronger financial position to recruit such expertise from outside the organisation. In either case, managers with strengths in particular areas will be better able to concentrate on those areas rather than being spread thinly across a number of management tasks. Beyond a certain optimal business size, however, unit management costs could begin to rise due to the increasing complexity of the overall management operation.

Larger operators are generally likely to be in a better position to vertically integrate into livestock production and the marketing of meat. By being able to better manage the flow of stock to abattoirs and by engaging in downstream marketing activities, such operators may be able to reduce some of the risks associated with the processing business. Persistent financial losses incurred by public abattoirs have been partly attributed to their inability to follow the lead of private operators and offset any losses from slaughtering by undertaking complementary activities (Livestock and Meat Authority of Queensland 1986, 1987).

Bigger firms may be better equipped to implement new cost-saving technology, the benefits of which would be shared by livestock producers. Important advantages for larger firms when it comes to adopting new technology include access to capital, greater scope for achieving higher levels of throughput (capacity utilisation) by rationalising the number of plants in operation, stronger ability to deal with labour relations issues, and a larger pool of talent to manage research and development. On the labour relations front, it may be possible for unions to extract concessions from smaller processing works in one locality and then to play off one firm against another to gain further benefits for their members. Concentration might make this practice more difficult.

Large firms could have more chance of success than small firms in attempting to gain brand name recognition for their products. A major advantage of brand names is that they readily provide consumers with confidence in the quality of the product purchased and no firm will lightly sacrifice a reputation that has required a substantial investment to achieve. When introducing brand name products, large firms have major advantages in gaining consumer recognition through word of mouth communication, private information services, and advertising. These advantages make it possible for them to establish and maintain quality assurances (and therefore reputations) much more quickly than small firms (Nelson 1970).

There may, however, be some difficulties with the successful establishment of brand names in the marketing of red meat. The heterogeneous nature of livestock raised on pasture means that a firm is likely to have considerable difficulty in ensuring uniformity of product despite recent improvements (such as AUS-MEAT) to grading systems. Even with grain fed animals, the ability of one

firm to capture any price premiums on the basis of superior and reliable quality could be limited if other firms can use the same technology to produce a similar product.

Government Abattoirs

Most government abattoirs were established many years ago as service works to ensure that livestock producers and individual butchers and wholesalers had adequate and hygienic facilities available for slaughtering stock. However, government involvement in the ownership and management of abattoirs may have significant implications for economic efficiency in the processing sector. This is, in part, due to the fact that government organisations often have non-commercial objectives imposed upon them. A major one among these is the requirement, often at the behest of producers, to provide a particular service at equal cost to all users regardless of location or time, and to stand ready and able to serve all customers on demand. This non-commercial objective was identified by Spriggs, Geldard, Gerardi and Treadwell (1987) as a source of inefficiency in the grains industry, and it would appear to apply also to government abattoirs, given the service nature of their operations. The fulfilment of non-commercial objectives can often mean running a more costly facility than would be the case for a private company not subject to such constraints.

Because of their service nature, public abattoirs have only limited control over their daily utilisation of slaughtering and processing capacity. This factor is likely to be particularly important in areas where there are substantial seasonal variations in livestock supplies or where the publicly owned facility is a major local employer and there are few alternative avenues for employment when the demand for abattoir labour is low.

Another feature of government owned abattoirs is that revenues often must be earned entirely from slaughtering and related by-products operations. This is in contrast to private abattoirs, which trade in both livestock and meat and therefore have more opportunity for successful production planning and for off-setting any losses from slaughtering with profits from meat trading (Livestock and Meat Authority of Queensland 1986). Public abattoirs are also not able to vertically integrate. This precludes them from ensuring a stable supply of livestock through the ownership of properties and from deriving income from meat distribution activities (Livestock and Meat Authority of Queensland 1986). Nevertheless, some government abattoirs have improved profitability by leasing out unused or underutilised parts of their facilities, such as boning rooms and cold storages, to private operators.

Differences in the capital structure of government and privately owned abattoirs can affect how each type of enterprise conducts its operations. Because of the need to obtain capital injections from state annual budgets and the difficulties this entails at times, government owned enterprises often have a higher debt to equity ratio than comparable private sector firms. This does not mean, however, that the availability of funds from retained earnings, which can be re-invested in plant improvement, will be less than with private institutions. Since private firms are under pressure to provide a return on shareholders funds, they are unlikely to experience any competitive advantage over government owned abattoirs on the basis of their usually lower debt to equity status.

Impediments to profitable operation, such as those outlined above, have sometimes resulted in attempts to protect public abattoirs from competition. For example, in Queensland, public abattoirs were for many years protected from full competition by a system of franchises which restricted the supply of meat within areas serviced by public facilities (Livestock and Meat Authority of Queensland 1987). These restrictions were removed in late 1985.

The fact that public abattoirs often do not operate profitably does not necessarily indicate economic inefficiency. If non-commercial objectives are the source of financial losses, and

fulfilment of these objectives is deemed worthwhile to society, then society should be willing to finance the resulting shortfall. However, most of the functions that government abattoirs were set up originally to perform are probably now amply supplied by the market. For example, the Australian meat hygiene control system is now highly developed and not dependent on the existence of public abattoirs. Furthermore, as the number of private abattoirs and local slaughterhouses has grown substantially since most publicly owned plants were established, it seems most unlikely that Australia's domestic and export markets could not be serviced adequately if the few remaining government works ceased to operate or were sold. Where maintenance of service facilities for small retailers is deemed to be a matter of high public priority, the sale of government abattoirs to private entrepreneurs could be made conditional on the service facility being maintained.

On a related point, if efficient private abattoirs are driven out of business due to protection and subsidisation of government abattoirs, there could be a net welfare loss to society. This is because many of the economic losses incurred by public abattoirs may not be due entirely to their non-commercial obligations. While public abattoirs may perform well in providing service kill facilities, for example, financial losses due to internal inefficiency could arise as a result of management having to respond to different economic incentives to those faced by managers of non-government operations. The ability of publicly owned firms to continue to operate in such circumstances may tend to be greater when losses are subsidised.

INDUSTRY REGULATION

The Australian meat processing industry is characterised by a large amount of regulation. While many of these regulations are in the form of hygiene standards designed to protect public health, there are others which affect the structure of the industry by restricting the size and location of abattoirs.

The Role of Regulation

There has been considerable debate in the economic literature regarding the role of regulation in society and how regulations evolve. In a review of the literature dealing with regulation in agriculture, Piggott (1980) identified two main theories. These are the 'public interest theory' and the 'capture theory'. According to the former, the regulatory body will act in the public interest to correct distortions in the use of resources which can sometimes occur when market forces are left to operate freely. The capture theory, on the other hand, postulates that 'regulation is supplied in response to the demands of interest groups struggling among themselves to maximise the incomes of their members' (Posner 1974, p.335).

Both the public interest theory and the capture theory are relevant to regulation in the meat processing industry. For example, as previously explained, one of the main reasons government-owned service slaughtering facilities were originally introduced was to correct a perceived failure of the market to provide the standard of hygiene demanded by the public. However, despite the fact that the Australian meat quality control system has advanced to the stage where the initial justification for government abattoirs (public health) is probably no longer relevant, efforts to close them have usually met with difficulties. This is often because private interest groups, such as employees and local users of the service, have lobbied against abattoir closures, just as the 'capture theory' of regulation predicts that they would. The vocal opposition of labour unions and some wholesalers and retailers to the recent closure of the loss making Homebush public abattoir in New South Wales provides an example of this theory in practice.

Barriers to Entry into Meat Processing

The entry of new firms into the industry is affected by both market related and artificial barriers. Market barriers can arise

from pricing practices of existing firms and from the nature of the investment required. Economies of size mean that large abattoirs, by virtue of their lower average cost structure, are often able to be more price competitive than smaller operators. However, given that there are few non-market impediments to the raising of investment capital, and that economies of size do exist over a certain range of output, it would make sense for potential new entrants to invest in the most economically optimal capacity, be it large or small.

A more important natural barrier to entry is likely to be the high level of such costs incurred by firms entering the industry. Firms contemplating moving into the meat processing business could be deterred by the knowledge that much of the needed investment is unlikely to be salvageable should the business not be successful. Furthermore, existing firms, having already made an investment in the industry, and thus faced with a certain amount of fixed (or overhead) costs, can act to discourage potential entrants by cutting processing charges or raising bid prices for stock. Provided such firms can cover the variable (or direct) costs of operation, it is economically feasible to keep operating, even if they are unable to earn sufficient to meet the total (fixed plus variable) costs incurred.

Artificial barriers to new entrants into meat processing either exist, or have existed, in a number of states as a result of policies introduced by meat industry authorities. The ability to introduce policies that restrict entry comes from the legislated powers of the authorities to grant licences to operate. In addition, the legislation in New South Wales, Victoria, Queensland and Western Australia actually specifies that the licensing authorities shall monitor slaughtering capacity and location in relation to the overall requirements of the state.

Since the administrative restriction of slaughter capacity has implications for such things as the adoption of new technology, industry costs and livestock pricing, the authorities in these four states have considerable power to control industry development. In New South Wales, the Meat Industry Authority granted its last general licence in 1977, and the policy is to grant new licences only in special circumstances such as when an export market is threatened or where new technology will be implemented. The policy of the Victorian Abattoir and Meat Inspection Authority from August 1982 until September 1985 was to grant no new licences, while now licences are only granted if existing regional facilities are considered inadequate. The Queensland Livestock and Meat Authority operated a policy of nil expansion of slaughtering capacity from early 1981 to mid-1987. In Western Australia, the Meat Industry Authority's policy of nil abattoir expansion was removed in February 1987 and each licence application is now considered on its merits.

While the legislative environment in the rest of Australia is somewhat less interventionist with respect to abattoirs, substantial regulatory powers do exist. In Tasmania and the Northern Territory, licences to increase slaughtering capacity are issued by government departments, but their powers to restrict capacity have never been exercised. In South Australia, the Meat Hygiene Authority issues licences purely on the basis of compliance with construction and equipment standards designed to ensure satisfactory meat hygiene. Capacity restricting policies have never been introduced and state slaughtering capacity is not recorded.

The Economics of Capacity Regulation

Various arguments have been used to justify capacity restrictions as being in the public interest, including the adequacy or excess of existing facilities and the possibility of destructive competition developing. However, a key motivation for restricting slaughtering capacity may well be the protection of existing works from competition because of possible benefits to some of the interest groups who make up the membership of the licensing authorities.

In New South Wales, Queensland, Victoria and Western Australia, the licensing authorities are made up of a majority of members who are representatives of livestock producers, meat processors, government abattoirs, and employees in the meat processing industry. It is possible that those associated with the management of private and public abattoirs will prefer as little competition as possible, and that their employees will want to maintain the viability of existing works. Livestock producers who support capacity restrictions probably do so out of concern that the licensing of additional capacity will lower overall capacity utilisation in the industry and therefore result in higher average processing costs which would be passed back to them. However, it can be argued that additional capacity would mean increased competition for stock as processors attempt to maintain throughput. This may result in higher livestock prices and would hasten the elimination of less efficient abattoir operators from the market.

Various economic analyses have also suggested that capacity restrictions are not in the interests of the industry, or the public. For example, the Industries Assistance Commission (1983) was unable to identify any special characteristics of meat processing to justify government intervention by way of capacity licensing aimed at maintaining profitability. In their view, meat processing is no different from any other industry where firms may invest (or disinvest) on the basis of their own assessment of future prospects and the risk involved. The Commission concluded that although licensing of meat processors may be desirable to protect public health, extension of this control to the industry's capacity to produce meat is undesirable. In their view, 'such an approach may impose costs on the community by closing one potential avenue for adjustment through the prevention of relatively more efficient new firms from entering the industry or relatively more efficient existing firms from expanding. In the extreme, it could ossify the industry's existing structure and reduce innovation and technological development in the industry' (p. 61). PA Management Consultants (1986) also concluded that market forces offer the best prospect for any capacity rationalisation in the industry.

Restriction of competition allows existing firms in the industry to exercise market power and extract economic rents from livestock producers and domestic meat consumers. Economic rent is the extra payment for resources above what these resources would earn in any alternative use. The opportunity to extract economic rents can be created by government regulations, including regulations preventing the entry of new firms into an industry. Because these rents are valuable (in this case, the value of a licence being determined by the market power associated with being the provider of a service for which supply is restricted), firms favoured by the regulations have an incentive to lobby governments to defend existing arrangements. Such behaviour wastes resources and imposes a cost on the industry that would not occur in the absence of capacity restrictions.

The extent to which meat processors can extract economic rents from livestock producers is limited by the competition they face from other processors seeking to obtain livestock for their own plants. The intensity of this competition will reflect the overall supply and demand for stock in the marketplace. Typically, in an efficient market, the differences in livestock prices between regions should be no more than the cost of transport to alternative markets. Thus, a processor's ability to reduce bid prices for stock is limited by the cost of transporting stock to an alternative plant.

Another aspect of capacity regulation is that constraints may provide incentives for an increase in concentration of ownership. According to Kingston and Whan (1988), the formation of a consortium of four major processors in Queensland could be attributable to the restrictive licensing policy which operated from early 1981 to mid-1987. The protection from external competition (from new entrants) afforded to existing processors by the licensing policy might have given the necessary impetus

the formation of the consortium to take advantage of size economies and the potential to exercise greater market power. There are a number of other economically less desirable aspects of administered capacity constraints. These include the incentive for existing firms to overestimate capacity and therefore underestimate capacity utilisation so as to encourage regulators to exclude new entrants. Reduced competition may also provide opportunity for labour, as well as management, to appropriate some of the resulting 'excess' economic benefits from processors. Constraints on slaughtering capacity also work to impede the rate at which new technology is introduced into the industry (Coffey 1987). The argument in this latter instance is that competition between those already in the industry is reduced and it is consequently economically feasible to keep old plant in operation longer than would otherwise be the case in a freely functioning market. Of course, this could be offset by the continued incentive for private firms to increase profits by adopting new technology, raising prices and thereby capturing a larger share of the market. Another potential benefit from removing capacity restrictions is that new firms may have greater opportunities to import new technology into the industry. This is because new firms are generally not constrained by existing plant and equipment, and to some extent can be in a better position to negotiate new labour arrangements specific to the plant. Updating the technology at existing meat processing plants has tended to prove difficult and costly. For example, the recently closed public abattoir at Murrumbidgee in New South Wales continued to operate at a loss, largely as a result of the high interest payments on the large debt incurred when the facility was substantially updated in the 1970s. As the geographic distribution of livestock tends to change over time, restrictions on processing capacity also need to be viewed in the broader context of abattoir location. While the last general meat processing licence in New South Wales was granted in 1977, it is unlikely that the economically optimal number and location of abattoirs in the state would have remained unchanged over the intervening period. In Queensland, the removal of franchise restrictions and the re-introduction of non-containerised shipping from northern ports are factors which are likely to have implications for the location of slaughter facilities (Coffey 1987). Brown and Gorman (1986) estimated potential gains in Queensland, from improved plant location and size, of at least \$4.4 million a year. Other factors likely to affect the optimal location of abattoirs include the growth in (cattle) feedlotting in some regions, improvements in road transport and the charging policies of state governments.

LABOUR ARRANGEMENTS

The processing industry is characterised by a highly unionised labour force which has generally been in a position to restrict the entry of new labour in order to maintain or raise incomes. The labour environment is also affected by the fact that there are considerable seasonal variations in employment, especially in northern Australia, and by the generally unpleasant operating conditions on slaughter chains and in boning rooms when compared with other forms of employment. The importance of labour component, as noted in the section on cost structures, and the limited possibilities for substitution between labour and capital, help explain the apparently strong bargaining powers of meat industry unions and the high degree of industrial unrest that has beset the industry in the past. However, as previously mentioned, the trend towards a more concentrated industry might be expected to abate union power in the future. For many decades, payment for labour in slaughterhouses and abattoirs has been based on a tally, which is the number of carcasses a slaughterman could reasonably be expected to slaughter and dress in the course of a day's work. The tally system was originally introduced to ensure, from the employer's point of view, that all employees did a reasonable day's work that did not require them to work too quickly or carelessly. From the

employee's point of view, the tally ensured that the tasks required each day, in what is a physically demanding occupation, were not excessive (Prices Justification Tribunal 1978).

The sequential nature of the slaughtering and processing tasks associated with moving from solo killing to the chain system of slaughtering and dressing carcasses means that the tally (or a similar) system of labour arrangement is more or less essential. At the same time the introduction of assembly-line techniques into abattoirs has meant that the tally system has become much more complicated as the interdependencies between workers at various stages in the process has grown. Although only 20 per cent of meat processing industry employees are now employed on a tally basis, these employees perform the key functions of slaughtering, boning and slicing. Therefore, the workload of employees on tally affects the workload of employees further up the chain such as packers, by-product employees and technical staff (Industries Assistance Commission 1983).

Controversy over the tally system has dominated debates about labour arrangements in the meat processing industry, and the efficiency implications of the tally system were addressed by the Industries Assistance Commission (1983). A perception of some industry groups is that the tally system lacks flexibility and impedes the adoption of new equipment or work practices aimed at raising productivity in abattoirs (Bowtell 1984). While the need to negotiate new tally rates is certainly a hurdle to be cleared when introducing new technology or new operating procedures, the fact that tallies have risen over the years, and that they can vary between and within states, shows that they are not immutable. For example, with the introduction of downward hide pullers in Australia in the mid-1970s, tallies were increased by 12 per cent for employees covered by federal awards and by 8 per cent for those working under the New South Wales award (Industries Assistance Commission 1983, p.16).

Difficulties with respect to labour relations may also contribute in less obvious ways to a slow rate of uptake of cost-saving technologies already available. For example, firms which have previously experienced industrial disputes when attempting unilaterally to introduce new technology may be less willing to do so in the future. This may especially be the case if such firms have observed competitors benefiting from an increased demand for their services during the dispute. It is for this reason that abattoir owners could have a preference for some forms of new technology to be introduced on an industry-wide, rather than firm-specific basis.

The increased concentration of processing ownership in recent times could well prove to be a counter to some of the bargaining power of the unions and result in greater flexibility in working arrangements. The Commonwealth Conciliation and Arbitration Commission, whose role is to arbitrate disputes between labour and management, has probably affected the rate of increase in labour productivity over the years. For example, decisions that enable labour to appropriate what in the view of employers may be a disproportionate share of the benefits of introducing new technology would serve to reduce the incentive to introduce new equipment in abattoirs. Of course, decisions that result in employees gaining an increased share of operating returns may result in the opposite, with employers being encouraged to substitute more rather than less capital for labour.

When considering whether the tally system should perhaps be modified or replaced, it is useful to examine some of the possible alternatives. For instance, a return to a system based merely on hours worked, could see a reduction in productivity in the industry as workers' remuneration would be geared more towards time spent on the job than towards minimising the time taken to complete a particular task. An alternative could be one where abattoir employees receive a basic hourly rate of pay (an incentive to work longer hours) combined with a payment relating to the number of animals processed or meat produced (an incentive to work faster).

While the latter system, if well designed, would provide an incentive to improve productivity, it may not be unambiguously superior to what currently exists. In fact, if abattoir operators and their employees are largely satisfied with the tally system as it now operates, and given that the market for processing services is competitive and that tallies are to some extent negotiable in individual plants, there may be little justification for changing the system.

CONCLUSIONS

An economically efficient meat processing sector is in the best interests of Australia's livestock industries and of the national economy. In order to remain competitive domestically and internationally the meat processing industry must respond to changes in the available technology, the quantity and type of livestock supplied, relative processing and transport costs, and changes in the demand for meat.

In general terms, the procedure by which livestock is converted to meat in Australia is relatively efficient. Nevertheless, in order to remain competitive in domestic and world markets, efforts to enhance economic efficiency need to continue in a whole range of areas. Based on the discussion in this paper, it appears that major areas likely to affect economic efficiency in the industry include concentration of privately owned firms, government ownership of abattoirs, regulation of slaughter capacity, and labour arrangements.

While producers have been concerned that greater concentration of ownership will lead to reduced competition and lower livestock prices, it is not unambiguously clear that they will be worse off. In fact, it is possible that producers may benefit as a result of the lower processing costs and improved product quality (through price premiums) and better marketing capabilities which could result from such changes. To be properly evaluated, the whole issue needs to be looked at more closely in a benefit-cost framework. Within this context, a reduction in government constraints on the entry of new firms should help ensure that more of the benefits from scale economies are likely to be reflected in returns to livestock producers.

The original justification for government abattoirs seems no longer to apply. Thus, the question of whether such operations should be closed down or privatised is worth examining. Where such operations are less economically efficient than competing private ones or there appears to be little justification for their continuance from a public benefit viewpoint, a case can be made for them to cease operating.

From the discussion of capacity restrictions, it can be seen that they have the potential to impede the efficient operation of the meat processing industry in a number of ways. They protect inefficient processors and slow structural adjustment in the industry when there are advances in technology, changes in demand, or a change in the pattern of livestock supply. Artificial barriers to entry tend to create market power and associated economic rents. At the same time they tend to transfer income from consumers and producers to processors, and lead to activities aimed at maximising these transfers rather than at improving the returns from processing itself. All of these impose unnecessary costs on the industry and society in general.

Procedures for settling disputes between meat workers and processors probably could be usefully re-examined. Of importance is the requirement for greater flexibility in determining mutually agreeable working arrangements on a plant specific basis in an environment where efficiency can be enhanced and labour and other factors of production are paid a competitive return.

Changes to some aspects of the broad regulatory environment in which the processing industry operates have considerable potential for enhancing economic efficiency. The power to restrict processing capacity, for example, could be removed from the legislation governing the operation of state meat industry authorities. This would ensure that those states that currently do

not enforce capacity restraints cannot easily re-impose them in the event of some future economic downturn in the industry.

On a final note, the extent to which particular changes might benefit the industry will be difficult, if not impossible, to accurately quantify in advance. Nevertheless, an inability to quantify the potential benefits should not be a justification for lack of action. The principal economic objective in all such situations should be to put in place policies that will create the right environment for greater efficiency and improved benefits for all involved in the livestock industry.

REFERENCES

- Australian Bureau of Agricultural and Resource Economics (1988). 'Statistics', *Quarterly Review of the Rural Economy* 10(2), 184-203.
- Bowtell, K. (1984). 'The meat processing industry. Australian Meat Exporters Federal Council paper presented at the BAE Regional Beef Review and Outlook Conference, Albury, 31 August.
- Brown, C.G. and Drynan, R.G. (1986). 'On some aspects of organisational efficiency in the Queensland cattle slaughtering industry', *Review of Marketing and Agricultural Economics* 54(2), 11-29.
- Coffey, S.G. (1988) Submission by the Cattlemen's Union of Australia to the Livestock and Meat Authority of Queensland on Licensing Restrictions on Meatworks, 22 July 1987, Rockhampton, Queensland.
- Corra, G. and Johns, M. (1983). 'The slaughter levy: a theoretical and simulation study'. Bureau of Agricultural Economics paper presented at the 27th Annual Conference of the Australian Agricultural Economics Society, Brisbane, 8-10 February.
- Dewbre, J., Shaw, I., Corra, G. and Harris, D. (1985). EMABA: Econometric Model of Australian Broadacre Agriculture. AGPS, Canberra.
- Industries Assistance Commission (1983). The Abattoir and Meat Processing Industry. IAC Report No. 313, Australian Government Publishing Service, Canberra.
- Kingston, O. and Whan, I. (1988). 'Recent developments in Queensland's cattle slaughtering industry', *Queensland Agricultural Journal*, 14(3), 143-46.
- Livestock and Meat Authority of Queensland (1986). Annual Report, Brisbane.
- Livestock and Meat Authority of Queensland (1987). Annual Report, Brisbane.
- Nelson, P. (1970). 'Information and consumer behaviour', *Journal of Political Economy* 78(2), 311-29.
- New South Wales Meat Industry Authority (1985). Annual Report for the Year Ended 30 June. 1985 Sydney.
- PA Management Consultants (1986). 'The cost of converting livestock to meat', Report commissioned by the Australian Meat and Livestock Industry Policy Council, Sydney.
- Pappas, Carter, Evans and Koop (1985). 'Cost competitiveness in export meat processing', Report commissioned by the Meat Industry Council of New Zealand, Wellington.
- Piggott, R.R. (1980). 'A review of some literature on regulating agricultural markets'. University of New England paper presented at the Political Economy of Free and Managed Markets for Agricultural Products Conference, Centre of Independent Studies, University of Sydney, 27-28 November.
- Posner, R.A. (1974). 'Theories of economic regulation', *Bell Journal of Economics and Management Science* 5(2), 335-358.
- Prices Justification Tribunal (1978). Beef Marketing and Processing: An Examination of the Charges and Margins Applying at all Stages of Beef Marketing and Processing in Australia. Australian Government Publishing Service, Canberra.

Briggs, J., Geldard, J., Gerardi, W. and Treadwell, R. (1987). Institutional Arrangements in the Wheat Distribution System. ABARE Occasional Paper 99, Australian Government Publishing Service, Canberra.

meek, William G. and Robinson, Kenneth L. (1981). Agricultural Product Prices, 2nd edition, Cornell University Press, Ithaca.

Walker, D. (1981). 'The place of processing technology'. CSIRO paper presented at 'Meat '81': Meat Trades Exhibition and Fair, Brisbane, 16 October.

Wilcox, J. (1988). Trade Practices Commission v. Australian Meat Holdings Pty Ltd. NSW G.92 of 1988, Sydney, 15 July.

